High Voltage Live Work Procedures – Transmission Insulated Stick
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For the current version of this document, see:
- Depot Pack (see Depot Pack Instructions (DM# 9001578))
- the Western Power intranet site, busbar http://busbar/work-practices.html
- Enterprise Connect (DM# 12900876)

### Note

Any updates to this document will be communicated to the Network Total Workforce (NTW) and the electronic version updated on Depot Pack, the Western Power website and busbar.

This document has been prepared by Work Practice Development & Training.

work.practice.development@westernpower.com.au
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Introduction

These procedures have been developed to provide qualified and authorised high voltage (HV) live workers with standardised methods of HV live work. The procedures include the roles and responsibilities expected of HV live workers to create and maintain a safe working environment that meets state and national legislation, standards and work practices. All relevant staff must be issued with these procedures and follow them at all times.

There are three sets of HV live work procedures:

- High Voltage Live Work Procedures – Distribution Insulated Stick
- High Voltage Live Work Procedures – Glove and Barrier
- High Voltage Live Work Procedures – Transmission Insulated Stick (under development)

The following Australian Standards are the primary references for these procedures:

- AS 5804.1-2010 High-voltage live working – General
- AS 5804.2-2010 High-voltage live working – Glove and barrier work
- AS 5804.3-2010 High-voltage live working – Stick work

Hierarchy of documentation

Government legislation and regulations set the requirements for company-level policy. Within Western Power, documentation is governed by the hierarchy shown in Figure 1, below. If there is ever a difference between documentation, the higher level documentation always overrides documentation at a lower level. For example:


Figure 1: Western Power’s Safety, Health and Environment Management System Document Framework

Keeping these procedures up to date

These procedures are regularly reviewed, updated and developed to meet legislative changes, newly developed techniques and technological advancements in equipment and network design for accessing and working on the Western Power network.

The following groups meet regularly to discuss HV live work, and oversee all major changes to the procedures:

- Senior Management High Voltage Live Line Work Committee
- High Voltage Live Line Work Group
- Local High Voltage Live Line Work Groups
Feedback
The Work Practice Development team strives for continual improvement of systems, procedures, processes and instructions. We value feedback and encourage suggestions and recommendations for changes, alterations or inclusions.

Feedback must be submitted to a formal leader for review, who can then forward it on to:
- the Work Practice Development team at work.practice.development@westernpower.com.au
- a representative of a High Voltage Live Line Work groups

Version control
- It is the user's responsibility to update and maintain hard copies for their own use.
- It is the formal leader's responsibility to ensure that employees are using the current version.

Note
Use the electronic version, wherever possible, to ensure that the most up to date version is being used. Access the electronic version from Depot Pack, the Western Power website and busbar.

Depot Pack
These procedures are available on Depot Pack on the Operational page.
Depot Pack is an electronic resource designed to be used by workers in the field where a data connection may not be available. It does not require a network or internet connection to be used (although one is required to update the Depot Pack files).
Depot Pack is available to the entire Network Total Workforce and is in use by all Western Power staff and many of our contractors.
Depot Pack is:
- the one stop shop for all Western Power work practice information
- easier to use and more reliable than printed paper documents. It's regularly updated, so you know the information is current, unlike a printed document that may have changed since your copy was printed.
- a controlled source of information, which is crucial when it comes to safe and efficient procedures

For information on installing and updating Depot Pack, see Depot Pack Instructions.

Western Power website
These procedures are available on the Western Power website on the Network contractors page:

busbar
These procedures are available on busbar (Western Power's intranet) on the Work Practice Development page:
http://busbar/work-practices.html

References
- AS 5804.1-2010 High-voltage live working – General
- AS 5804.2-2010 High-voltage live working – Glove and barrier work
- AS 5804.3-2010 High-voltage live working – Stick work
- Depot Pack Instructions (DM# 9001578)
- Electrical System Safety Rules (ESSR) (DM# 9199327)
- High Voltage Live Work Manual (DM# 6127457)
- High Voltage Live Work Procedures – Distribution Insulated Stick (DM# 12733098)
- High Voltage Live Work Procedures – Transmission Insulated Stick (DM# 12900876)
User guidelines

Figures
Many procedures include a supporting photograph or drawing. These are provided for illustration purposes only. Insulating barriers have often been removed for clarity. The positioning of HV live work equipment in a particular figure does not imply that it is accurate for all construction types.

Resources
The Resources section in each procedure is not a complete list of the resources required to perform that procedure. Instead, it lists:

- only the additional equipment or plant to what a glove and barrier HV live work team would normally have on hand
- the specific personnel numbers required to perform that procedure, and their basic roles

Box outlines
Box outlines are used to indicate a break in the procedure. Where this occurs, the task in the box outline must be completed before continuing. In the example below, a new pole must be installed before proceeding to step 3.

Example
1. Untie the middle conductor and move to the conductor trap on the inside of the auxiliary arm.
2. Double shroud the last outside conductor, shroud the conductor and move away with the EWP bucket.
3. Confirm that all safety requirements, conductor loads, equipment checks and permits have been checked or are in place.

Terminology
There are a few terms used in the procedures that are common to HV live work. We do not define them every time we use them, but have included them here to ensure there is no confusion over their meaning.

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### Acronyms and definitions

<table>
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<tr>
<th>Acronym</th>
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<tr>
<td>SWL</td>
<td>Safe working load, also known as working load limit (WLL)</td>
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<td>TDO</td>
<td>Temporary drop-out</td>
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<tr>
<td>Tensioning device</td>
<td>A device used to tension overhead conductors, e.g. strap hoist, pulley block rope tackle.</td>
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Safety

Principles of transmission HV live work
HV live work enables authorised HV line workers to safely perform construction and maintenance on HV energised or de-energised mains and apparatus using approved procedures.

Transmission insulated stick method
The authorised HV live worker uses tools and equipment mounted on HV live work sticks to maintain the MADs from energised components at the worksite.

Note
All HV live work must be carried out in accordance with:

- Electrical Systems Safety Rules (ESSR)
- High Voltage Live Work Manual
- the procedures relevant to the method being used, as provided in:
  - High Voltage Live Work Procedures – Distribution Insulated Stick
  - High Voltage Live Work Procedures – Glove and Barrier
  - High Voltage Live Work Procedures – Transmission Insulated Stick

If any doubt arises regarding a procedure, seek clarification before proceeding.

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1. General safety requirements
2. Safety observer
3. Combining procedures
4. Resource requirements
5. Personal protective equipment
6. External clothing, jewellery and hair
7. Tools and equipment
8. Weather conditions
9. Rescue and emergencies
10. Control of conductors
11. Conductor loads
12. Approach distances for HV live work
13. Debriefing
14. Making and breaking connections
15. OHEW
16. Insulated stick requirements
   - Work practices
   - Clearance markers
   - Electrical rating of insulating stick
Safety requirements

1. General safety requirements

The following is a summary of section 2 (Safe working principles) in *High Voltage Live Work Manual*.

- All members of the public must be kept clear of all worksites while HV live work is in progress.
- All work and worksites must be inspected by an authorised person prior to work taking place.
- The integrity of the structure, adjacent structures and conductors must be visually checked before work takes place.
- Other work must not be carried out simultaneously on a pole while HV live work is being undertaken.
- HV live work PPE, tools and equipment, including the insulated EWP, must all be within the current test date.
- Always clean and inspect all PPE, tools, equipment and EWP before use.
- The correct permitting for the task must be in place, and received by the RIC before HV live work commences.
- Onsite hazards must be identified, risks assessed and control measures put in place and reviewed according to the hazard and risk control assessment in the risk assessment document.
- Vehicle GADs must be maintained.
- A safety observer and onsite person in charge must be in place before HV live work commences.
- Before commencement of HV live work, conductor weights and loading changes applied to structures must be assessed or calculated.
- Before commencement of HV live work, the following must be assessed (if required):
  - electrical loading on conductors
  - conductor temperature
- A drop zone must be established.
- MADs must be maintained.
- All work must be performed from a 132kV insulated EWP.
- All work must be completed in accordance with the relevant transmission live work procedures.
- Only one electrical potential can be worked on at one time.
- Where two teams are working on one structure a minimum of 2000 mm must be maintained between the insulated EWP’s.
- The minimum number of authorised personnel must be onsite at all times when the work is under commencement.
- Only web strap tensioning devices may be used for HV live work.
- Conversation between HV live workers must be limited to the necessary remarks concerning the work, to maximise focus and concentration on the task at hand.
- All HV live workers performing a procedure must be totally focused on the activity being performed.
- Where conductors are being moved, their movement is to be closely observed throughout the adjacent spans. This is to ensure that no clearances are breached.

2. Safety observer

When acting as a safety observer for HV live work the following must be met:

- give undivided attention to those performing the work
only focus on one work activity at a time
not undertake any other tasks that may distract their focus on the work that is being performed

3. Combining procedures
- It may be a requirement to combine various procedures to allow specific tasks to be completed.
- When HV live work is to be accomplished through a combination of procedures, 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 work procedures is required, all work must stop and a suitable procedure 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. Resource requirements
- The minimum resource requirements for HV live workers are provided within each procedure. The result of an onsite risk assessment may indicate that additional HV live workers are required.

5. Personal protective equipment
- The following is a summary of work practice 2.10 (Personal protective equipment (PPE) requirements) in High Voltage Live Work Manual.
- PPE must be:
  - worn before leaving the ground or the EWP boom leaves rest
  - worn continuously while work is carried out.
- The intent is to ensure that HV live workers are wearing PPE when:
  - approaching and entering the work area
  - work is being carried out in the work area
  - leaving the work area.

6. External clothing, jewellery and hair
- External clothing must be made of fire proofed cotton or other approved material in work practice 3.1 (Clothing and personal protective equipment requirements) in Work Practice Manual.
- Always ensure that full body cover is maintained.
- All personal metallic objects, e.g. wrist watches, bracelets, jewellery, medallions, rings, pencils, pens, must be removed.
- Hair may be a conducting medium and as such, its length may become an electrical hazard as well as posing dangers of entrapment in moving parts of tools and live work equipment. It must be securely fixed and confined close to the head to control these risks.

7. Tools and equipment
- The following is a summary of section 6 (Tools and equipment) in High Voltage Live Work Manual.
- All work on HV live equipment must be carried out from a 132kV insulated EWP.
  - Tools, equipment and materials must be kept in the appropriate bags or tool trays and not laid on structures or cross-arms.
b. All approved, non-insulated lifting equipment must be inspected for damage prior to each use and rated to lift the calculated load. When not in use the equipment should be stored correctly and not exposed to the elements on the back of vehicles.

8. Weather conditions
The following is a summary of work practice 2.7 (Managing risks associated with weather conditions) in High Voltage Live Work Manual.

- Always be vigilant of weather changes. Work must not be started or continued when lightning is visible or thunder audible at the work location. If the weather changes after the work has commenced, the job must be left in a safe condition and personnel must descend to the ground.
- In wet weather conditions, the risk assessment must be reviewed to determine if it is safe to carry on with the work.
- High temperatures and humidity must be taken into consideration and suitable precautions must be taken to avoid HV live worker fatigue.
- Work must not start or commence in excessive winds.

9. Rescue and emergencies
The following is a summary of work practice 2.13 (Rescue and emergencies) in High Voltage Live Work Manual.

a. Hazards that may be found at an HV live work site are:
   i. step and touch potential
   ii. energised vehicles, poles and structures
   iii. energised or potentially energised fallen mains and equipment
   iv. fire
   v. shattered glass or porcelain
   vi. ruptured hydraulic lines
   vii. unsafe overhead hazards e.g. damaged mains with potential for failure, loose overhead materials
   viii. other live circuits in the vicinity.

b. Actions required in the event of an incident during HV live work are listed below:
   i. Ensure your safety and that of others on site including the public.
   ii. Attend to the needs of any casualties, if they can be approached without compromising your own and others safety.
   iii. Administer first aid, as required.
   v. Contact Emergency Services, if required.
   vi. Report the incident to your supervisor as soon as reasonably possible.
   vii. Treat every part of the network as energised until it is proven to be de-energised, earthed and short circuited.
   viii. The site must be preserved and not disturbed unless there are immediate safety concerns or you are authorised by Western Power.

10. Control of conductors
The following is a summary of work practice 7.0 (Conductors and insulators) in the High Voltage Live Work Manual.

- Conductors must be positively controlled when being displaced.
- Conductors must be secured before any binder or conductor clamp is removed.
• Covered conductors may be free-floated after giving due consideration to ground clearances, conductor spacing, wind, adjacent circuits, trees, etc. Covered conductors may be pulled out of the work area using ropes and spiral link sticks.
• Care must be exercised when removing ties, jumpers and helical fittings. All clearances both to the body and equipment must be maintained.

11. Conductor loads

The following is a summary of section 7 (Conductor loadings) in *High Voltage Live Work Manual*.

a. Where possible, conductor load should be calculated on the pre-work site visit. This will ensure that the correct method is selected and appropriate equipment is taken to the site.

b. Onsite conductor load calculations must be performed before work commences to confirm the pre-work site visit calculations or determine the conductor load on site.

12. Approach distances for HV live work

The following is a summary of work practice 10.0 (Transmission insulated stick method) in *High Voltage Live Work Manual*.

**MADs**

a. HV live workers must not to allow any part of their body, anything they wear or any conductive apparatus they are carrying closer to live apparatus than the MAD for that voltage. The MAD must always be maintained.

b. When there is doubt about a MAD, do one of the following:
   • measure the distance with an insulated stick
   • visually estimate the MAD, then increase the estimated distance

c. MAD distances must be marked on insulating sticks with consideration for the activity and equipment that is being used.

13. Debriefing

Once all work is complete the team must conduct a debriefing, this will include:

• Sign off permits and complete risk assessment
• Notifying NOC that the live work is complete
• Address any issues that may have occurred completing the task

14. Making and breaking connections

No live phase connection is allowed to be made or broken when carrying out transmission live work.

15. OHEW

When working on an OHEW wire the HV live worker must wear class 4 rated insulated gloves and outers.

16. Insulated stick requirements

The minimum requirements for stick work are that:

• Live work sticks must have insulation suitable for the work site environment to safely allow work on energised apparatus. They shall maintain rated insulation between the live electrical apparatus and the live worker and other sources of electrical potential; and
• Live work sticks shall have a structural capacity to adequately manipulate or support the electrical apparatus that they are attached to.
Work practices

Insulated fibreglass sticks are used to manipulate, support or take conductor tension providing electrical insulation between live electrical apparatus, the live worker and other sources of electrical potential difference.

Live work stick generally fall into two categories:
- hand sticks used by the live worker to manipulate or operate electrical apparatus; and
- strain link sticks used to displace energised conductors.

Clearance markers

Hand guards must be installed on hand sticks to define the insulated section of the stick and to define the separation from the hand held section.

Hand guards shall be secured to the live work stick to prevent their movement during work.

Clearance markers should be installed on all other insulating sticks at the insulation distance appropriate to the minimum approach distance (MAD) for the voltage being worked on and the task being performed where practical. (e.g.: conductor lifting sticks).

Electrical rating of insulating sticks

The insulation rating of a stick is determined by the length of its effective insulation.

The stick only achieves this rating when the stick surface is clean, completely free from moisture, in good condition and hydrophobic.
TIS-01  Insulator testing and inspection

Purpose
This procedure describes how to test insulators prior to starting work on 66kV and 132kV systems.

Parameters
- All testing must be carried out from a 132kV insulated EWP.
- MADs must be maintained at all times whilst testing.
- The minimum number of sound insulators required for HV live work: 3 for 66kV and 4 for 132kV.

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Onsite job setup

Calculate load handling capacity
- Determine loads exerted on the HV live work equipment when performing the task.
- The calculations are used to ensure that:
  - the SWL of the equipment, crane and EWP is not exceeded
  - increases in conductor tension (when moving/relocating conductors with the HV live equipment) do not place undue strain on adjacent ties or terminations
Site setup
- EWPs should, where possible, be positioned so that all work areas can be:
  - accessed safely
  - reached from the one site setup.
- EWPs and plant must always maintain the required MAD from conductors and other live apparatus.
- A drop zone must be established and agreed to by the HV live work team.

Clean and inspect equipment
- Clean, wipe down and inspect all equipment that is to be used.
- Items that are subject to periodic testing (e.g. insulated sticks) must be checked to ensure that they are:
  - within test date
  - rated for the voltage to be worked on.

Inspect structure
- Carry out a visual inspection of the following prior to commencing the task:
  - the structure, lines and equipment to be worked on
  - adjacent structures.

Procedure
Remember to follow all safety requirements as listed in:
- Safety
- section 2 (Safety) in High Voltage Live Work Manual

Testing porcelain disc insulators
1. Confirm that all safety requirements, equipment checks, switching programs and permits have been checked and are in place.
2. Confirm that the tester is correctly set up and the read out display is working.
3. Using an insulated stick, place the probes across the disc dielectric closest to the conductor (disc 1). The red probe should be to the line side as shown in Figure 2 below
4. Ensure good contact between the probes and the metal fittings of the insulators.
5. Wait for the reading to steady.
6. Communicate the disc number and the measured voltage to the HV live worker recording the data.
   Repeat steps 4 to 6 for all discs in the string.
7. After testing all of the discs in the string, determine whether there are enough healthy disc insulators to continue with the task. This will be determined by an insulator having a lower voltage across it when tested and a higher voltage across the other insulators in the string. See Table 3 in work practice 7.9 (HV insulators) in the HV Live Work Manual.

Note
The above procedure can be used where glass insulators are subjected to high pollution.
Visual inspection of glass disc and porcelain insulators

As glass disc insulators usually shatter when damaged, it is easy to identify when they have failed. The surface of a glass insulator becomes opaque and burnt when a flashover occurs. Porcelain insulator should be checked for chips, cracks and puncture holes. Also look for signs of flashover where the porcelain surface has burnt and melted. When inspecting both types of insulator check for wear on the ball end and clevis end of the insulator, where they are prone to corrosion.

Visual inspection of polymeric and composite insulators

Check for:
- rusting on the metal end, near the insulated seal
- damage to the sheath
- dull powdery sheds
- excessive pollution
- electrical arcing to the surface
- tracking and surface discharge.
Visual inspection of porcelain post insulators

Check for:
- large chips
- hair line cracks
- puncture holes
- flashover.

Audible inspection

An audible inspection must be carried out on all types of insulators. Where the noise is unusually loud, all HV live line work must stop and an alternative method used to carry out the task.

For further information on HV insulators see work practice 7.9 (HV insulators) in the HV Live Work Manual.

References

- High Voltage Live Work Manual:
  - section 2 (Safe work principles)
  - work practice 7.9 (HV insulators)
- High Voltage Live Work Procedures – Transmission Insulated Stick, Safety
**TIS-02 Insulator and conductor disconnection/reconnection**

**Purpose**

This procedure describes how to disconnect conductors on transmission 66kV and 132kV systems.

![Suspension insulator](image)

**Figure 1: Suspension insulator**

**Parameters**

- The conductor must be secure in the conductor gate or roller before starting to disconnect/reconnect the conductor from/to the insulator.
- Insulators must be inspected and, where required, tested before work commences. Follow ‘TIS-01 Insulator testing and inspection’.
- All HV live work must be carried out from a 132kV insulated EWP.
- MADs must be maintained at all times.

**Resources**

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<td>• 1 safety observer</td>
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### Onsite job setup

#### Calculate load handling capacity
- Determine loads exerted on the HV live work equipment when performing the task.
- The calculations are used to ensure that:
  - the SWL of the equipment, crane and EWP is not exceeded
  - increases in conductor tension (when moving/relocating conductors with the HV live equipment) do not place undue strain on adjacent ties or terminations.

#### Site setup
- EWPs should, where possible, be positioned so that all work areas can be:
  - accessed safely
  - reached from the one site setup.
- EWPs and plant must always maintain the required MAD from conductors and other live apparatus.
- A drop zone must be established and agreed to by the HV live work team.

#### Clean and inspect equipment
- Clean, wipe down and inspect all equipment that is to be used.
- Items that are subject to periodic testing (e.g. insulated sticks) must be checked to ensure that they are:
  - within test date
  - rated for the voltage to be worked on.

#### Inspect structure
- Carry out a visual inspection of the following prior to commencing the task:
  - the structure, lines and equipment to be worked on
  - adjacent structures.

### Procedure

Remember to follow all safety requirements as listed in:
- Safety
- section 2 (Safety) in *High Voltage Live Work Manual*

#### Suspension insulator disconnection
Suspension insulators are connected to the conductor clamp via a clevis with a W-pin, clevis bolt and split pin or clevis bolt with nut and split pin. When the conductor is secure in the conductor gate or roller the W-pin, split pins and bolt can be removed. This allows for the clevis bolt to be removed once the tension on the insulator has been removed.

1. Confirm that all safety requirements, conductor mechanical loads, equipment checks and permits have been checked and are in place.
2. Position the crane hook, link sticks and conductor gate or roller above the conductor.
3. Secure the conductor in the conductor gate or roller.
4. Remove the W-pin from the clevis or remove the split pin and nut.
5. Raise the conductor so that the clevis and insulators become slack.
6. Disconnect the clevis from the insulators or remove the clevis bolt.
7. Displace the conductor away from the insulators to provide a safe work area to carry out the task.

**Suspension insulator reconnection**
1. Move conductor back into position.
2. Attach the conductor clamp and reinstate the clevis and W-pin or clevis pin bolt and split pin to the insulators.
3. Lower the conductor so that the tension is applied to the insulator.
4. Detach the conductor from the conductor gate or roller and remove lifting device.
5. Clean, wipe down and stow away all equipment.

**Post insulator disconnection**
1. Confirm that all safety requirements, conductor mechanical loads, equipment checks and permits have been checked and are in place.
2. Position the crane hook, link sticks and conductor gate or roller above the conductor.
3. Secure the conductor in the conductor gate or roller.
4. Loosen the bolts on the conductor clamp so that the armour grip support (AGS) is disconnected.
5. Displace the conductor away from the insulators to provide a safe work area to carry out the task.

**Post insulator reconnection**
1. Move conductor back into position.
2. Tighten the bolts on the conductor clamp so that the AGS is secured.
3. Detach the conductor from the conductor gate or roller and remove lifting device.
4. Clean, wipe down and stow away all equipment.

**Horizontal insulator disconnection**
1. Confirm that all safety requirements, conductor mechanical loads, equipment checks and permits have been checked and are in place.
2. Position the crane hook, link sticks and conductor gate or roller above the conductor.
3. Secure the conductor in the conductor gate or roller.
4. Loosen the bolts that hold the trunnion in place so that the trunnion plate is disconnected.
5. Displace the conductor away from the insulators to provide a safe work area to carry out the task.

**Horizontal insulator reconnection**
1. Move conductor back into position.
2. Secure the trunnion clamp by tightening the bolts on the conductor clamp.
3. Detach the conductor from the conductor gate or roller and remove lifting device.
4. Clean, wipe down and stow away all equipment.
References

- High Voltage Live Work Manual
  - section 2 (Safe work principles)
  - work practice 7.9 (HV insulators)

- High Voltage Live Work Procedures – Transmission Insulated Stick
  - Safety
  - TIS-01 Insulator testing and inspection
**TIS-03  3-pole construction (cricket wicket) pole change**

**Purpose**
This procedure describes how to displace a single conductor to maintain and replace pole and pole top hardware on 66 kV and 132 kV 3-pole construction (cricket wicket) pole configurations.

![Figure 1: Pole being removed](image)

**Parameters**

**Before work commences**
- A risk assessment must be completed.
- A visual inspection of conductors, poles and pole top hardware must be completed in both adjacent spans.
- All permits for the task must have been checked and received by the RIC.
- The roles of safety observer and dogger must be established.
- All mobile plant involved in the pole change must be earthed as outlined in work practice 4.0 (Mobile plant and related equipment for HV live work) in the *High Voltage Live Work Manual*.
- Measure the sag in the adjacent spans and record the shortest sag on the risk assessment.
- All live work must be carried out from a 132kV insulated EWP.

**During the task**
- No MADs must be breached to other phases or circuits. For more on this, see work practice 1.0 (Introduction to HV live work) in the *High Voltage Live Work Manual*.
- Inspect the post insulators for any signs of damage. Follow 'TIS-01 Insulator testing and inspection'.
- The conductor must not be lifted higher than twice the length of the shortest sag.

**Resources**

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<thead>
<tr>
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<td>Web slings</td>
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<td>varies</td>
<td>Rated D-shackles</td>
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### High Voltage Live Work Procedures – Transmission Insulated Stick

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<td></td>
</tr>
<tr>
<td>1</td>
<td>EWP insulated to 132kV</td>
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</tr>
<tr>
<td>2</td>
<td>Mobile cranes</td>
</tr>
<tr>
<td></td>
<td>• Crane 1 to displace the conductors</td>
</tr>
<tr>
<td></td>
<td>• Crane 2 to hold the old pole when it is removed and to install the new pole</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Personnel</td>
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<tr>
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<td>• HV live workers:</td>
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<td></td>
<td>• 2 in the EWP</td>
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<tr>
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<td>• 1 safety observer</td>
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<td>• 1 ground worker</td>
</tr>
<tr>
<td>2</td>
<td>Crane operators</td>
</tr>
<tr>
<td>1</td>
<td>Dogger</td>
</tr>
</tbody>
</table>

#### Onsite job setup

**Calculate load handling capacity**
- Determine loads exerted on the HV live work equipment when performing the task.
- The calculations are used to ensure that:
  - the SWL of the equipment, crane and EWP is not exceeded
  - increases in conductor tension (when moving/relocating conductors with the HV live equipment) do not place undue strain on adjacent ties or terminations.

**Site setup**
- EWPs should, where possible, be positioned so that all work areas can be:
  - accessed safely
  - reached from the one site setup
- EWPs and plant must always maintain the required MAD from conductors and other live apparatus.
- A drop zone must be established and agreed to by the HV live work team.

**Clean and inspect equipment**
- Clean, wipe down and inspect all equipment that is to be used.
- Items that are subject to periodic testing (e.g. insulated sticks) must be checked to ensure that they are:
  - within test date
  - rated for the voltage to be worked on.

**Inspect structure**
- Carry out a visual inspection of the following prior to commencing the task:
  - the structure, lines and equipment to be worked on
  - adjacent structures.
Procedure

Remember to follow all safety requirements as listed in:
- Safety
- section 2 (Safety) in *High Voltage Live Work Manual*

1. Displace conductors
   a. Confirm that all safety requirements, equipment checks, switching programs and permits have been checked and are in place.
   b. Position the crane boom so that the hook insulating spiral link sticks are over the near outside conductor.
   c. Lower the spiral link sticks and secure the conductor.
   d. Disconnect the conductor from the insulator. Follow TIS-02 ‘Insulator and conductor disconnection/reconnection’.
   e. Vertically raise the conductor until the desired clearance is achieved to safely remove and replace the pole or change pole top hardware.
   f. Carry out desired task.

![Figure 2: Typical site layout](image)

2. Replace conductors
   a. Confirm that all safety requirements, equipment checks, switching programs and permits have been checked and are in place.
   b. Ensure that pole is firmly in place, if changed or pole top hardware is secure and in place.
   c. Lower the lifting insulated spiral link sticks until the conductor is in place and secure.
   d. Release the conductor from the gate and move the insulated sticks away.

The above procedure can be repeated to replace middle and opposite outer poles or hardware, so long as the crane size is of a suitable size to maintain the MADs.

If the crane cannot maintain the MADs for the opposite outer pole, the crane will have to be repositioned.

Once work is completed all tools and equipment must be removed, cleaned and stowed away.
References

- High Voltage Live Work Manual:
  o work practice 1.0 (Introduction to HV live work)
  o section 2 (Safe work principles)
  o work practice 2.0 (Safety observer for HV live work)
  o work practice 4.0 (Mobile plant and related equipment for HV live work)

- High Voltage Live Work Procedures – Transmission Insulated Stick
  o Safety
  o TIS-01 Insulator testing and inspection
  o TIS-02 Insulator and conductor disconnection/reconnection
TIS-04 Displacing conductors using crane and lifting beam

Purpose
This procedure gives detailed instruction on displacing conductors on fir tree and main arm – buck arm configurations to maintain and replace pole and pole top hardware on 66kV and 132kV systems.

Parameters

Before work commences
- A risk assessment must be completed.
- A visual inspection of conductors, poles and pole top hardware must be completed in both adjacent spans.
- All permits for the task must have been checked and received by the RIC.
- Determine the loads that will be exerted on the HV live line equipment, lifting equipment and crane to ensure the SWL/WLL will not be exceeded when performing the task.
- The roles of safety observer and dogger must be established.
- All mobile plant involved in the pole change must be earthed as outlined in work practice 4.0 (Mobile plant and related equipment for HV live work) in the High Voltage Live Work Manual.
- If insulated rope will be used on the 132kV line then it must be tested with an approved field tester.
- Work must not commence in poor weather conditions.
- All live work must be carried out from a 132kV insulated EWP.
- MADs must be maintained at all times.

During the task:
- MADs must not be breached to other phases or circuits. For more on this, see work practice 1.0 (Introduction to HV live work) in the High Voltage Live Work Manual.
- MADs must not be breached for uninsulated plant and loads. For more on this, see work practice 4.0 (Mobile plant and related equipment for HV live work) in the High Voltage Live Work Manual.
- Inspect the insulators for any sign of damage. Follow ‘TIS-01 Insulator testing and inspection’.
- For the disconnect and reconnect of conductors and insulators, see ‘TIS-02 Insulator and conductor disconnection/reconnection’.
- When a rope is attached at ground level a suitably rated anchor point must be used.
- Class 4 rated insulated gloves must be worn at all times when disconnecting and reconnection the overhead earth wire (OHEW).
High Voltage Live Work Procedures – Transmission Insulated Stick

Conductor loads

This procedure uses a crane with lifting beam and tackle to raise and control the conductors while maintenance is being performed. The load handling capacity of the rig is determined by the capacity of the tackles, ropes and the crane doing the lifting (in its working position).

To ensure that all work is within limits of the lifting equipment, the SWL/WLL of the tackles, ropes and the crane must be noted on the risk assessment.

Note

The range of the conductor loadings for the site is calculated in the office/depot using the TLS software. The range data is then taken by the work crew to the site and verified using the laser angle determination tool.

The lowest SWL/WLL rating of any individual part of the lifting rig is the maximum lifting capacity of the entire rig.

Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Item</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Lifting beam – maximum SWL/WLL is 6.6 tonnes when beam is spread to 3.58 m.</td>
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<tr>
<td>2</td>
<td>220kV insulators – to provide additional insulation between the lifting beam and crane. Lifting devices that are positioned at an angle must have an extra de-rating applied. Supports that are positioned at a 60 degree angle must be de-rated. The formula for de-rating is: SWL/WLL @ 60° = WLL (of one leg) x 1.73</td>
</tr>
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<td>Equalising yoke</td>
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<tr>
<td>3</td>
<td>3 x 2 rope block and tackles</td>
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<tr>
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<td>Pulley blocks (change of direction blocks)</td>
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<tr>
<td>8</td>
<td>Insulated link sticks</td>
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<td>4+</td>
<td>Ropes</td>
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<td></td>
<td>2 x live work ropes (minimum 25m with 18mm diameter)</td>
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<tr>
<td></td>
<td>2 x live work rope (minimum 20m with 18mm diameter)</td>
</tr>
<tr>
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<td>2</td>
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<td>1</td>
<td>Rope tester</td>
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<td>Laser angle determination tool</td>
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<tr>
<td>1</td>
<td>Insulator tester</td>
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<td>1</td>
<td>Bonding lead for OHEW to down earth</td>
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<td>Pair of class 4 insulated gloves</td>
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<td><strong>EWP</strong></td>
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<tr>
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<td>EWP bonding mat with bonding lead</td>
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High Voltage Live Work Procedures – Transmission Insulated Stick

<table>
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<th>Item</th>
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<td></td>
<td>Mobile cranes</td>
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<tr>
<td>1+</td>
<td>• Crane 1 to displace the conductors.</td>
</tr>
<tr>
<td></td>
<td>• Crane 2 (if required) to hold the old pole when it is removed and to install the new pole or to assist with hardware replacement.</td>
</tr>
<tr>
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<td>Personnel</td>
</tr>
<tr>
<td>4</td>
<td>Transmission HV live workers:</td>
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<tr>
<td></td>
<td>• 2 in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 safety observer</td>
</tr>
<tr>
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<tr>
<td>1+</td>
<td>Crane operators</td>
</tr>
<tr>
<td>1</td>
<td>Dogger</td>
</tr>
</tbody>
</table>

**Note**
- The insulated rope will not be required so long as the link stick used on the top phase double side is of sufficient length so that it will bridge the distance between phases with an overhang to still maintain the MADs. The insulated rope can then be replaced with a live work rope.
- Where the construction does not have an OHEW equipment numbers will be reduced, as required.

**Onsite job setup**

**Calculate load handling capacity**
- Determine loads exerted on the HV live work equipment when performing the task.
- The calculations are used to ensure that:
  - the SWL of the equipment, crane and EWP is not exceeded
  - increases in conductor tension (when moving/relocating conductors with the HV live equipment) do not place undue strain on adjacent ties or terminations.

**Site setup**
- EWPs should, where possible, be positioned so that all work areas can be:
  - accessed safely
  - reached from the one site setup.
- EWPs and plant must always maintain the required MAD from conductors and other live apparatus.
- A drop zone must be established and agreed to by the HV live work team.

**Clean and inspect equipment**
- Clean, wipe down and inspect all equipment that is to be used.
- Items that are subject to periodic testing (e.g. insulated sticks) must be checked to ensure that they are:
  - within test date
  - rated for the voltage to be worked on.

**Inspect structure**
- Carry out a visual inspection of the following prior to commencing the task:
  - the structure, lines and equipment to be worked on
  - adjacent structures.
Procedure

Remember to follow all safety requirements as listed in:
• Safety
• section 2 (Safety) in High Voltage Live Work Manual

This procedure uses a lifting beam that is attached to the crane hook via two 220kV insulators to provide a second level of insulation for the crane.

Attached to the lifting beam are three rope and tackle blocks that are used to raise and lower the conductors, using link sticks for insulation. Two pulley blocks are attached to the beam to suspend the two fall ropes from two ropes and tackle blocks away from the live conductors and a levelling rope is also attached to the beam to assist with keeping the beam level.

Link sticks, live work rope (side pull ropes) and ratchet pullers are used to displace the conductors sideways achieving the MADS require to carry out the task.

Where an OHEW is attached to the pole construction a sling is attached to the lifting beam just off centre with a link stick and ratchet puller to displace the OHEW.

1. Crane 1 can position either side of the line, preference is given to the single phase side but site conditions will determine the best position.
2. All vehicle positioning dimensions are approximate.
Test insulators

If porcelain dish or polluted glass insulators are used on the construction being worked on then the insulators must be tested. Follow ‘TIS-01 Insulator testing and inspection’.

1. Lifting beam setup
   a. To fit the lifting beam to the crane hook, attach two 220kV insulators to each end of the lifting beam, and then attach the insulators to the crane via an equalising yoke.
   b. Place two 3 x 2 rope block and tackle at end 1 of the lifting beam; this will be to lift the double phase side of the line.

![Figure 3: End 1 block and tackle setup](image1)

   c. On end 2 of the lifting beam place:
      - one block and tackle that will lift the single phase side conductor
      - two pulley blocks and place the fall ropes from the two rope and tackle blocks from end one double phase side
      - the beam levelling rope.

![Figure 4: End 2 block and tackle, pulley block and beam levelling rope](image2)
Figure 5: Lifting beam setup

**Note**

The tackle ropes attached to the lifting beam can be used to assist in its positioning while it is being manoeuvred.

If the pole construction has an OHEW, secure a sling with a link stick and ratchet puller to the lifting beam (offset of centre) to raise the OHEW.

A 22kV insulator can be used in place of the link stick but a SWL/WLL de-rating will apply (SWL/WLL = routine test load / (2 x 9.81).

Once all of the required lifting equipment has been attached, the lifting beam can be positioned in place centrally over the pole construction.

When positioning the beam into place the levelling rope can be used to keep the lifting beam horizontal. A ratchet puller can be used to assist with keeping the beam horizontal. All other fall ropes must be controlled so that they do not breach the MADs.

The lifting beam should be positioned approximately 2m above the pole. When in position the crane must be shut down.

The crane, crane boom and lifting wire must maintain the required MADs at all time.
2. **Displace bottom phase conductor double side**
   a. Attach two link sticks together so that the length of the combined link sticks covers the phase to phase gap between the bottom and top conductor and also give sufficient insulation above the top conductor, and place between a rope block and tackle and the bottom phase conductor double side.
   b. Attach the fall rope from the rope block and tackle to a suitably rated anchor point.
   c. Attach a 25m live work rope to a link stick and secure on the conductor.
   d. Attach the bottom of the 25m rope to a suitably rated anchor point via a ratchet puller.
   e. Take up tension on the side pull rope to ensure that the conductor, when disconnected, cannot swing towards the structure.
   f. Take up the conductor load with the rope block and tackle until the insulator is loose and disconnect the insulator.
   g. Tie off the rope block and tackle to a suitably rated anchor point.
   h. Using the side pull rope with ratchet puller displace the conductor away from the structure until sufficient MAD is achieved.

3. **Displace single phase side**
   a. Attach a link stick between the rope block and tackle and the bottom phase conductor single side.
   b. Attach the fall rope from the rope block and tackle to a suitably rated anchor point.
   c. Attach a 25m live work rope to a link stick and secure on the conductor.
d. Attach the bottom of the 25 m rope to a suitably rated anchor point via a ratchet puller.

e. Take up tension on the side pull rope to ensure that the conductor, when disconnected, cannot swing towards the structure.

f. Take up the conductor load with the rope block and tackle until the insulator is loose and disconnect the insulator.

g. Tie off the rope block and tackle to a suitably rated anchor point.

h. Using the side pull rope with ratchet puller displace the conductor away from the structure until sufficient MAD is achieved.

4. **Displace top phase conductor double side**

a. Attach a link stick between the rope block and tackle and the top phase conductor double side.

b. Attach the fall rope from the rope block and tackle to a suitably rated anchor point.

c. Attach a 25m live work rope to a link stick and secure on the conductor. This link stick must be of sufficient length so that it will cover the phase-to-phase gap between the bottom and top conductor and also give sufficient insulation below the bottom conductor.

d. Attach the bottom of the 25m rope to a suitably rated anchor point via a ratchet puller.

e. Take up tension on the side pull rope to ensure that the conductor, when disconnected, cannot swing towards the structure.

f. Take up the conductor load with the rope block and tackle until the insulator is loose and disconnect the insulator.

g. Tie off the rope block and tackle to a suitably rated anchor point.

h. Using the side pull rope with ratchet puller displace the conductor away from the structure until sufficient MAD is achieved.

![Figure 6: Displacing the conductors](image-url)
5. **Disconnecting the OHEW**

When disconnecting the OHEW a bonding mat has to be placed in the EWP and connected to the OHEW to create an equipotential zone when contacting the OHEW.

**Important**

| Class 4 rated insulated gloves must be worn at all times when disconnecting and reconnecting the OHEW. |

a. Connect the bonding mat in the EWP to OHEW.
b. Attach the link stick and ratchet puller to the OHEW and secure.
c. Wearing class 4 insulated gloves connect a bonding lead from the pole down earth to the OHEW.
d. Disconnect the OHEW from the pole down earth and suspension clamp and remove the bonding lead (remove from the OHEW first, then from the down earth).
e. Using the ratchet puller raise the OHEW just clear of the pole head.
f. Disconnect the EWP bonding mat from the OHEW.
g. Raise the OHEW clear of the pole head.

![Figure 7: Disconnection of the OHEW](image)

Commence maintenance of pole top hardware or complete pole replacement.

6. **Reconnecting the OHEW**

a. Wearing class 4 insulated gloves connect the EWP bonding mat to the OHEW.
b. Using the ratchet puller lower the OHEW near to the pole suspension clamp.
c. Connect a bonding lead between pole down earth and OHEW.
d. Clamp the OHEW in the suspension clamp and reconnect to the down earth.
e. Remove the OHEW from the ratchet puller and link stick.
f. Remove the bonding lead.
g. Disconnect the EWP bonding mat from the OHEW.
7. Replace top phase conductor double side
   a. Slacken both side pull rope and rope block and tackle and allow the conductor to be repositioned to the insulator.
   b. Connect the conductor to the insulator.
   c. Release and raise the rope block and tackle.
   d. Remove the side pull rope and link stick.

8. Replace conductor single side
   a. Slacken both side pull rope and rope block and tackle and allow the conductor to be repositioned to the insulator.
   b. Connect the conductor to the insulator.
   c. Release and raise the rope block and tackle.
   d. Remove the side pull rope and link stick.

9. Replace top phase conductor double side
   a. Slacken both side pull rope and rope block and tackle and allow the conductor to be repositioned to the insulator.
   b. Connect the conductor to the insulator.
   c. Release and raise the rope block and tackle.
   d. Remove the side pull rope and link stick.

10. Remove lifting beam
    - Remove lifting beam away from all live conductors.
    - Dismantle lifting beam set up.
    - Clean and store all equipment.

References
- High Voltage Live Work Manual:
  - work practice 1.0 (Introduction to HV live work)
  - work practice 2.0 (Safety observer for HV live work)
  - work practice 4.0 (Mobile plant and related equipment for HV live work)
- High Voltage Live Work Procedures – Transmission Insulated Stick:
  - Safety
  - TIS-01 Insulator testing and inspection
  - TIS-02 Insulator and conductor disconnection/reconnection
TIS-05  Wire tong support pole saddle method

Purpose

This procedure gives detailed instruction on displacing conductors using the wire tong pole saddle support method to maintain and replace pole top hardware on transmission 66kV and 132kV systems.

Parameters

Before work commences:

- A risk assessment must be completed.
- A visual inspection of conductors, poles and pole top hardware must be completed in both adjacent spans.
- All permits for the task must have been checked and received by the RIC.
- Determine the loads that will be exerted on the HV live line equipment and lifting equipment to ensure the SWL/WLL will not be exceeded when performing the task.
- The roles of safety observer must be established.
- All mobile plant involved in the pole maintenance must be earthed as per outlined in work practice 4.0 (Mobile plant and related equipment for HV live work) in the High Voltage Live Work Manual.

During the task:

- No MADs must be breached to other phases or circuits. Follow work practice 1.0 (Introduction to HV live work) in the High Voltage Live Work Manual.
- Inspect the post insulators for any sign of damage. Follow ‘TIS-01 insulator testing and inspection’.
- Maximum outer conductor lift is 450kg per phase.
- Maximum line deviation allowed on the line is 5°.
- Do not lower the conductor below the wire tong saddle height.
- Displace the lower conductor first, middle second and top third and then reverse for replacing.
- All work must performed from a 132kV insulated EWP.
- Link sticks must be of a suitable length for the voltage being worked on.
Conductor loads

This procedure uses a wire tong, strap hoist and ropes to displace and control the conductors whilst maintenance is performed. To ensure that all work is within limits of the lifting equipment, the SWL/WLL of the wire tong, ropes, strap hoist and wire tong saddles and snubbing bracket must be noted on the risk assessment.

Note

The range of the conductor loadings for the site is calculated in the office/depot using the TLS software. The range data is then taken by the work crew to the site and verified. The lowest SWL/WLL rating of any individual part of the lifting rig is the maximum lifting capacity of the entire rig.

Resources

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<th>Item</th>
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<td>3</td>
<td>18mm tag lines</td>
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<tr>
<td>3</td>
<td>63mm wire tong saddles</td>
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<td>3</td>
<td>Strap hoist</td>
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<td>1 tonne slings</td>
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Personnel

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<tr>
<td></td>
<td>• 1 safety observer</td>
</tr>
<tr>
<td></td>
<td>• 1 ground worker</td>
</tr>
</tbody>
</table>

Note

Where the task requires additional plant, a risk assessment must be carried out to determine the extra personnel required.

Onsite job setup

Calculate load handling capacity

- Determine loads exerted on the HV live work equipment when performing the task.
- The calculations are used to ensure that:
  - the SWL of the equipment, crane and EWP is not exceeded
  - increases in conductor tension (when moving/relocating conductors with the HV live equipment) do not place undue strain on adjacent ties or terminations.
Site setup

- EWPs should, where possible, be positioned so that all work areas can be:
  - accessed safely
  - reached from the one site setup.
- EWPs and plant must always maintain the required MAD from conductors and other live apparatus.
- A drop zone must be established and agreed to by the HV live work team.

Clean and inspect equipment

- Clean, wipe down and inspect all equipment that is to be used.
- Items that are subject to periodic testing (e.g. insulated sticks) must be checked to ensure that they are:
  - within test date
  - rated for the voltage to be worked on.

Inspect structure

- Carry out a visual inspection of the following prior to commencing the task:
  - the structure, lines and equipment to be worked on
  - adjacent structures.

Procedure

Remember to follow all safety requirements as listed in:

- Safety
- section 2 (Safety) in High Voltage Live Work Manual

1. Test insulators

   If porcelain dish or polluted glass insulators are used on the construction to be worked on the insulators must be tested. Follow 'TIS-01 Insulator testing and inspection'.

2. Displace lower conductor

   a. Confirm that all safety requirements, conductor loads, equipment checks and permits have been checked or are in place.
   b. Attach a 63mm wire tong saddle to the working side of the pole, approximately 2000mm below the conductor, on the opposite quarter to conductor.
   c. Attach the 63mm wire tong to the conductor and secure in the wire tong saddle.
   d. Attach a strap hoist between the wire tong saddle and the butt ring on the bottom of 63mm wire tong.
   e. Attach a snubbing bracket to the pole 1000mm from ground level
   f. Attach a 1 tonne sling and snatch block to the pole 1000mm to 2000mm above the height of the conductor.
   g. Attach a tag line and link stick to the conductor, pass through the snatch block and secure to the snubbing bracket at ground level.

   h. Apply tension to the conductor via the 63mm wire tong and tag line, so that the insulators become slack.
   i. Clamp the 63mm wire tong in the wire tong saddle.

   Note

   A tensioning device can be used at ground level to lower or raise the conductors if the weight of the conductor is excessive to raise or lower by hand.
j. Disconnect the conductor from the insulator. Follow ‘TIS-02 Insulator and conductor
disconnection/reconnection’.
k. Loosen the tension on the tag line from ground level so that a safe work area is achieved.
l. Secure the tag line to the snubbing bracket at ground level.

3. **Displace middle and top conductors**

   The process for displacing the middle and top phase conductors is the same as the lower conductor

![Diagram wire tong support saddle setup](image)

**Figure 2: Diagram wire tong support saddle setup**

4. **Replace top conductor**
   
a. Confirm that all safety requirements, conductor loads, equipment checks and permits have been
   checked or are in place.
b. Take up tension on the tag line at ground level to raise the conductor up to the insulator.
c. Attach the conductor to the insulator; adjustment of the strap hoist on the 63mm wire tong may be
   required.
d. Release the tension on the conductor from the ground snubbing bracket and the strap hoist on the
   63mm wire tong.
e. Remove link stick and tag line from the conductor.
f. Remove the 1 tonne sling and snatch block from the pole.
g. Remove the strap hoist from the wire tong bracket and butt ring.
h. Remove the 63mm wire tong from the wire tong saddle and conductor.
i. Remove wire tong saddle.
j. Clean and stow away all equipment.
5. Replace middle and bottom conductor

The process for replacing the middle and bottom phase conductors is the same as the top conductor.

References

- High Voltage Live Work Manual, section 2 (Safe work principles)
- High Voltage Live Work Procedures – Transmission Insulated Stick:
  - Safety
  - TIS-01 Insulator testing and inspection
  - TIS-02 Insulator and conductor disconnection/reconnection
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