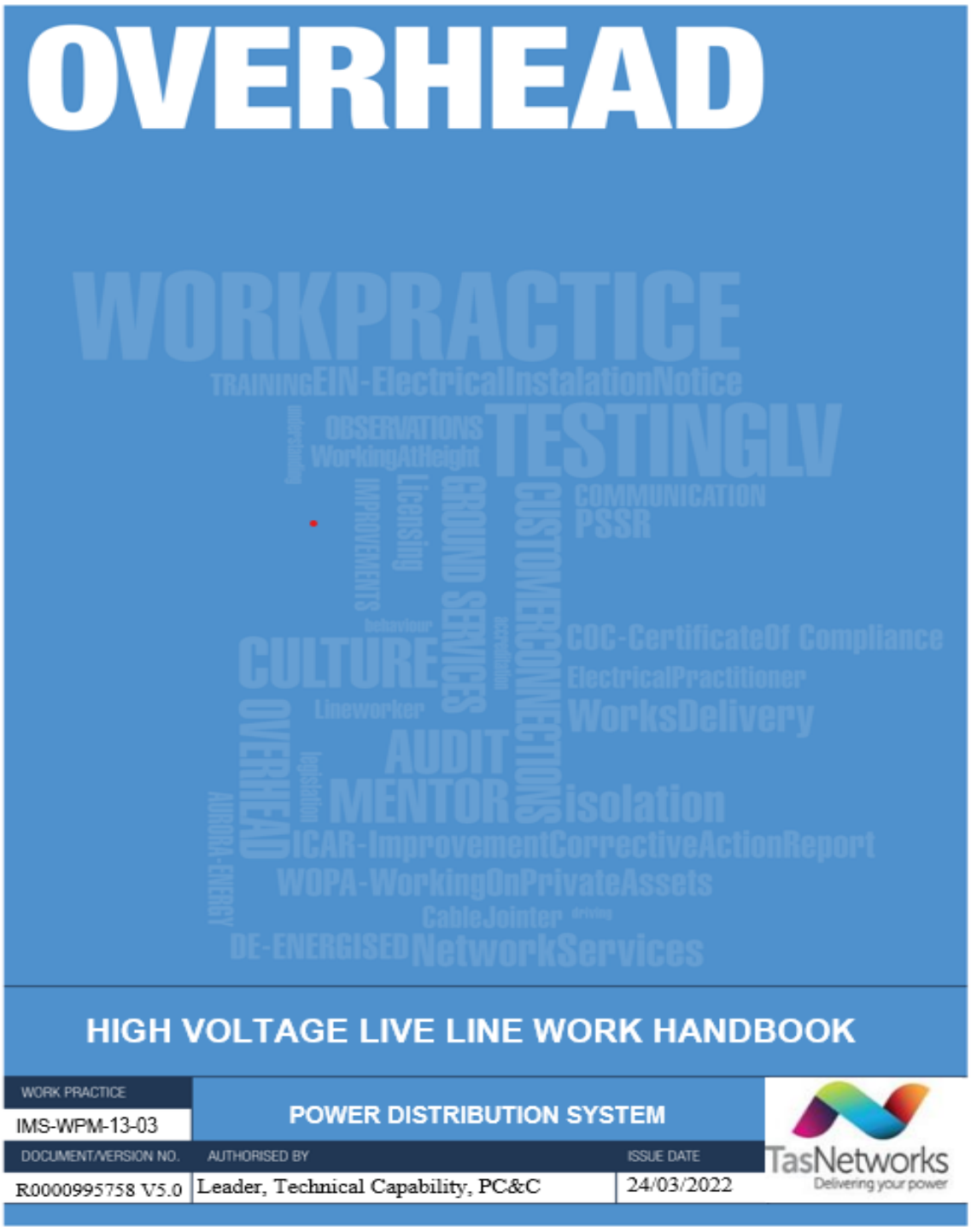

OVERHEAD
WORKPRACTICE
TRAININGEIN-ElectricalInstalationNotice
OBSERVATIONS
WorkingAtHeight
TESTINGLV
Licensing
IMPROVEMENTS
GROUND SERVICES
CUSTOMERCONNECTIONS
COMMUNICATION
PSSR
CULTURE
COC-CertificateOf Compliance
ElectricalPractitioner
Lineworker
WorksDelivery
AUDIT
MENTOR
isolation
OVERHEAD
ICAR-ImprovementCorrectiveActionReport
WOPA-WorkingOnPrivateAssets
CableJointer
DE-ENERGISED
NetworkServices
HIGH VOLTAGE LIVE LINE WORK HANDBOOK
WORK PRACTICE
IMS-WPM-13-03
POWER DISTRIBUTION SYSTEM
DOCUMENT/VERSION NO.
AUTHORISED BY
ISSUE DATE
R0000995758 V5.0
Leader, Technical Capability, PC&C
24/03/2022
TasNetworks
Delivering your power

1.0 INTRODUCTION

The forerunner to this HV Live Work Manual was introduced in 1995 when Benchmark Power from Queensland was contracted by the then Hydro-Electric Commission to prepare a Document suitable for training personnel in Glove and Barrier Live Work procedures. Associated with this training was a shortened version of the Live Work Stick Method, the reason was so that both these Live Work methods could be utilised together as and when the need dictated.

This HV Live Work Manual reflects the current changes embraced in the Electricity Supply Industry as well as Australian standards and codes of practice. This Manual is open to continued review in order to stay abreast of current trends.

Strict compliance with the requirements of this Manual is necessary to ensure:

- The safety of employees, Contractors and the general public.
- Continuity of supply.
- Security of TasNetworks assets.

The words **"shall"** and **"must"** are intended to refer to MANDATORY requirements.
The word **"should"** is used in a discretionary or advisory sense.

1•1 PURPOSE

The purpose of this Manual is to specify the safe working requirements and minimum standards for carrying out Live Work on energised high voltage electrical apparatus within Tasmania.
The high voltage Live Work covered in this Manual is restricted to a maximum of 33,000 volts AC and generally assets owned by TasNetworks Pty Ltd.

Under no circumstance shall the safety of Employees be compromised.

1•2 ALTERATIONS AND ADDITIONS

Doc. No. And Version	Page Or Section No.	Section Number and Description	Approved	Date Modified
		HYDRO ELECTRIC COMMISSION CHANGES		
Unknown	1.14	Air Break Switch maintenance with three (3) persons restricted to handle adjustment, lubricating and tightening of components only.	H.E.C.	14/10/1996
Unknown	2.29	Testing of gloves and sleeves added to routine testing "Table".	H.E.C.	14/10/1996
Unknown	3.8	The appointment of a designated Safety Observer clarified during the Team briefing.	H.E.C.	14/10/1996
Unknown	3.10	Requirements for the removal of condemned poles or otherwise from the work area clarified.	H.E.C.	14/10/1996
Unknown	3.15-3.17	Restriction on particular rigs being used for angle pole top arrangements included.	H.E.C.	14/10/1996
Unknown	3.78-3.80	Procedure for energising/de-energising underground cable reviewed.	H.E.C.	14/10/1996
Unknown	3.112	Procedure for installation of an Air Break Switch reviewed.	H.E.C.	14/10/1996
Unknown	3.3.2	Procedure for installing Glove and Barrier Auxiliary cross arm modified.	H.E.C.	23/2/1999
		AURORA ENERGY CHANGES		
CS#169380 V2.b	All	Reviewed modified and updated entire Handbook.	Mgr. Standards & Compliance	March, 2004
CS#169380 V2.b	5-4/5.4.1	Modified Wording about "Audits" & included reference to "Internal Audit Form" (Benchmark recommendation).	" "	" "
CS#169380 V2.b	5-5/5.4.2	Included info about retention of competency & qualification for Team Leaders, etc. not performing regular Live Line work (Live Line Panel)	" "	" "
CS#169380 V2.b	7-1/ 7.1	Relocated "Safety Rules" from section 11.5.4 & restructured sentences (Benchmark).	" "	" "
CS#169380 V2.b	7-1/ 7.1	Changed reference to Distribution Operating Authority and "setting "Feeder protection for Live Line work. (Network request & changes to PSl&AP's document).	" "	" "
CS#169380 V2.b	7-2/ 7.1	Included additional info re, rigging & relocating conductors by hand, EWP & Crane (Benchmark & Live Line Panel).	" "	" "
CS#169380 V2.b	7-4/ 7.3	Modified Table lo clarify approach distances (Benchmark).	" "	" "
CS#169380 V2.b	7-6/ 7.5	Modified & removed unwanted information (Benchmark).	" "	" "
CS#169380 V2.b	8-2 / 8.3	Modified reference to Distribution Operating Authority and "setting" Feeder protection for Live Line work (Network request & changes to PSl&AP's document).	" "	" "

Doc. No. And Version	Page Or Section No.	Section Number and Description	Approved	Date Modified
CS#169380 V2.b	8-3 / 8.3	Modified wording re, tripping of Feeder (Benchmark).	Mgr. Standards & Compliance	March, 2004
CS#169380 V2.b	9-1 / 9.2.1	Changed reference to Table & page number (Benchmark).	" "	" "
CS#169380 V2.b	9-3 / 9.2.3	Removed unwanted info re, General Work Clothing (Benchmark).	" "	" "
CS#169380 V2.b	9-16 / 9.3.8	Included reference to G&B hand application (Live Line Panel).	" "	" "
CS#169380 V2.b	9-16 / 9.3.8	Included additional Table on current rating (Benchmark).	" "	" "
CS#169380 V2.b	9-18 / 9.3.10.1.2	Clarified requirement for "earthing" of EWP's.	" "	" "
CS#169380 V2.b	9-19 / 9.3.10.1.2	Relocated sentence re, EWP's found in Section 7.3 and increased voltage in following "note" to 33 kV. (Live Line Panel).	" "	" "
CS#169380 V2.b	9-19 / 9.3.10.2	Removed unwanted information re, ladders (Benchmark).	" "	" "
CS#169380 V2.b	9-27 / 9.4.3.3.2	Changed wording in first sentence (Benchmark).	" "	" "
CS#169380 V2.b	9-28 / 9.5	Included "footnote" about Item T400-l 940 (Benchmark).	" "	" "
CS#169380 V2.b	10-1 / 10.1	Changed "formula" for calculation of Down Force (Network).	" "	" "
CS#169380 V2.b	10-3 / 10.1	Removed last sentence from section 10.1 (Network)	" "	" "
CS#169380 V2.b	10-5 /10.2	Inserted - (70 kg per wire holder) Load Diagram 10-1 (LIL Panel).	" "	" "
CS#169380 V2.b	10-10 to 10-13/ 10.3	Replaced first Table for Intermediate poles -level ground, with "four" new modified tables. (Network).	" "	" "
CS#169380 V2.b	10-14 to 10-23 /10.3	Removed colour coding from Tables on these pages. (Network).	" "	" "
CS#169380 V2.b	11-3 / 11.3	Inserted reference to "t\VO levels of insulation for steel / composite structures" (Std's & Compliance).	" "	" "
CS#169380 V2.b	11-4 / 11.5.1.1	Modified Table to clarify meaning & inserted new sentence at bottom of page (2"' dot point) (Std's & Compliance).	" "	" "
CS#169380 V2.b	11-6 /11.5.4	Relocated "safety rules" to section 7.1 & changed "title" (Benchmark)	" "	" "
CS#169380 V2.b	ll-24 to l l-27 / 11.7.2	Rewrote & restructured this whole section to better reflect the requirements & to align with Appendix 13.3 (Live Line Panel).	" "	" "

Doc. No. And Version	Page Or Section No.	Section Number and Description	Approved	Date Modified
CS#169380 V2.b	13-7 to 13-18/13.3	Rewrote entire document to clarify requirements and "differences" for Live line workers & Distribution Line Workers and to enable the erection of all types of poles in various locations. (Live Line Panel).	" "	" "
CS#169380 V2.b	13-21 / 13.5	Inserted Tables about "Minimum Approach Distances for Live Line Work". (Std's & Compliance).	" "	" "
CS#169380 V2.b	13-23 /13.6	Inserted copy of the Live Line Internal Audit Form. (live Line Panel).	Mgr. Standards & Compliance	March, 2004
CS#169380 V2.b	13-24 / 13.7	Inserted process for, "Employee Emergency Rescue - Live Line HV Work". (Live Line Panel)	" "	" "
CS#169380 V2.b	13-23 / 13.6	Inserted copy of the Live Line Internal Audit Form. (live Line Panel).	" "	" "
CS#169380 V2.b	13-24 / 13.7	Inserted process for, "Employee Emergency Rescue - Live Line HV Work". (Live Line Panel)	" "	" "
CS#169380 V2.b	13-23 / 13.6	Modified & expanded the Live Line Audit Form. (Live Line Panel)	" "	March, 2005
CS#169380 V2.b	13-28 / 13.8	Inserted information, "Testing Lightning Arrestors - Live Line Installation". (Live Line Panel).	" "	" "
CS#169380 V2.b	13-29 / 13.9	Inserted information, "Testing Current Flow in Conductor Loops". (Live Line Panel).	" "	" "
CS#169380 V2.b	11-47 to 55 11.7.3.1 to 3	Inserted reference to testing "loops" for presence of current flow prior to disconnecting. (Live Line Panel).	" "	April, 2005
CS#169380 V2.b	1 I -66 to 69 11.7.3.7	Inserted new procedure -Energise I De-energise a Recloser or Load Break Switch / Sectionaliser. (Live Line Panel).	" "	" "
CS#169380 V2.b	11-70 to 72 11.7.3.8	Modified instructions to address use of temporary EDO unit, parking bushes & connection of Voltage Transformer. (Live Line Panel)	" "	" "
CS#169380 V2.b	11-2 to 103 All Sect. 11	General word smithing & minor corrections. (Std's & Compliance).	" "	" "
CS#169380 V2.b	Contents List	Updated to reflect changes in Section 11 and 13. (Std's & Comp!).	" "	" "
CS#169380 V2.b	9-13 / 9.3.4	Inserted photo and information about the fall restraint I anchor tool.	" "	May, 2005
CS#169380 V2.b	9-17 / 9.3.8	Included extra information about the temporary EDO unit.	" "	" "

Doc. No. And Version	Page Or Sect. No.	Section Number and Description	Approved	Date Modified
CS#169380 V2.b	Contents List	Updated to reflect changes in Section 9 and 13. (Std's & Compliance).	" "	" "
CS#169380 V2.b	13-29 I 3 (B)	Included reference to maximum of "15" amps in loop, size of permanently attached flexible lead & Maxinum size of fuse element.	" "	" "
CS#169380 V2.b	12-30	Included additional information about Ferroresonance.	" "	" "
CS#169380 V2.b	11-2/11.2	Included exceptions where work may be done on 7/.064 copper.	" "	May, 2006
CS#169380 V2.b	11-24 / 11.7.2	Changed size of rope from 16 to 18 mm & added reason for use.	" "	" "
CS#169380 V2.b	11-93 & 94 /11.7.3.18	Include new point 7 referring to conducting a "touch test". Changed points 7, 8 & 9 to 8, 9 & 10.	" "	" "
CS#169380 V2.b	11-95 to 97 / 11.7.3.19	Included notes about using temp EDO units & Metering Technician. Included Pre-Commissioning Checks & Wiring Diagram.	" "	May, 2006
CS#169380 V2.b	11/ 7.3.15	Updated to cover edo replacement and to cover issues arising from a history of mechanical failure in the insulator section.	" "	May, 2007
CS#169380 V2.b	3.0, 5.2.3, 5.3.2 ,5.4.1 , 7.1, 8.1, 8.3, 9.3.8, 9.4, 11.7.4.3, ll.7. 4.4	Multiple changes to manual + reformatting for quality reasons	" "	Feb 2008
CS#169380 V2.b	11.7.l.1	Extension stick diagram added as example	" "	Mar 2009
CS#169380 V2.b	9.3.2.6	Extension stick added to conductor support equipment Vegetation section added	" "	" "
CS#169380 V2.b	All	Converted to PDF copy and placed on TasNetworks Work Practice Web Site as interim measure until full update done.	Grp Leader HSE & TC	16-03-2016
R0000995758 V2.0	All	Whole manual reviewed by G. Spriggs, R. Cruse, G. Shearing. Updates shown in greyed background colour. Added in Section 3 Electrical & Work Compliance. Updated Section 2.0 Scope & Application Siemens Temporary isolation switch added in.	Grp Leader HSE & TC	09-04-2018
R0000995758 V3.0	All	Minor alterations shown in greyed background colour as approved by Live Line Panel.	Leader, Technical Capability	01-08-2019
R0000995758 V4.0	All	**Refer List of Changes Made**	LL Panel	06/07/2021
R0000995758 V5.0	All	**Refer List Of Changes Made**	LL Panel	24/03/2022

2.0 SCOPE AND APPLICATION

This Manual has been compiled as a training resource and standard work procedure document for TasNetworks personnel and contractors. It assists field, supervisory and technical support staff involved with Live Work maintenance procedures on high voltage Distribution lines and associated electrical apparatus up to and including 33,000 volts (33kV).

The procedures described within the Manual have been designed and developed for the performance of work on all types of pole and cross arm structures (steel, timber, concrete and synthetic) utilising insulated Stick and Glove and Barrier methods.

It is the responsibility of personnel involved in Live Work maintenance to be fully conversant with all aspects of this live work Manual and any subsequent amendments.

Reference to Line Worker, unless specifically noted, shall refer to a Certified HV Live Worker.

2•1 EXCLUSIONS

1. Standard Distribution line work when supply is isolated and earthed.

2. Distribution live LV work.

3. Any other type of overhead work not covered under Live Work in this manual.

NOTE: Where any non-live overhead distribution work is performed, as above under 1. to 3. it shall comply in accordance with the safety and work method requirements in the **Line Workers Reference Handbook**.

4. Transmission work.

This work on supply infrastructure with voltages above 33Kv is covered in the **Transmission Manual**.

2•2 APPLICATION

The information contained within this Manual applies to all TasNetworks employees and Contractors authorised to perform live Glove and Barrier, Stick or combination of Glove and Barrier and Stick work on energised High Voltage (11kV – 33kV) Electrical Distribution Networks in Tasmania.

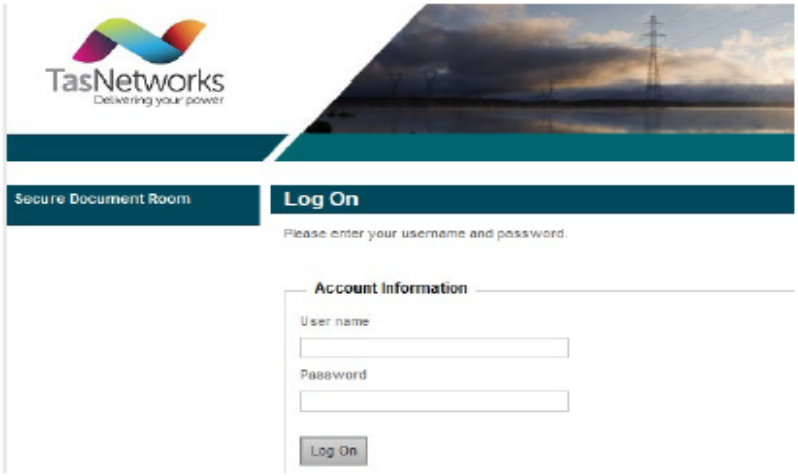
2•3 DOCUMENT CONTROL

The production and issue of this handbook is for electronic PDF format only and, there is no formal control over issue and maintenance of hard copies.

TasNetworks will endeavour to inform users of this handbook of any revisions and updates but, notwithstanding that, it is the responsibility of users to ensure they have the latest updated electronic version via:-

1. For TasNetworks employees – accessing documents via the **Internal Work Practice Web Site** on the **ZONE intranet** or the ODI App on field tough pads.

2. For Service Providers – accessing the **External Work Practice Web Site** on the Internet. **Note**: This requires the Service Provider to contact TasNetworks for approval to obtain a Username and Password to gain access into the external web site.



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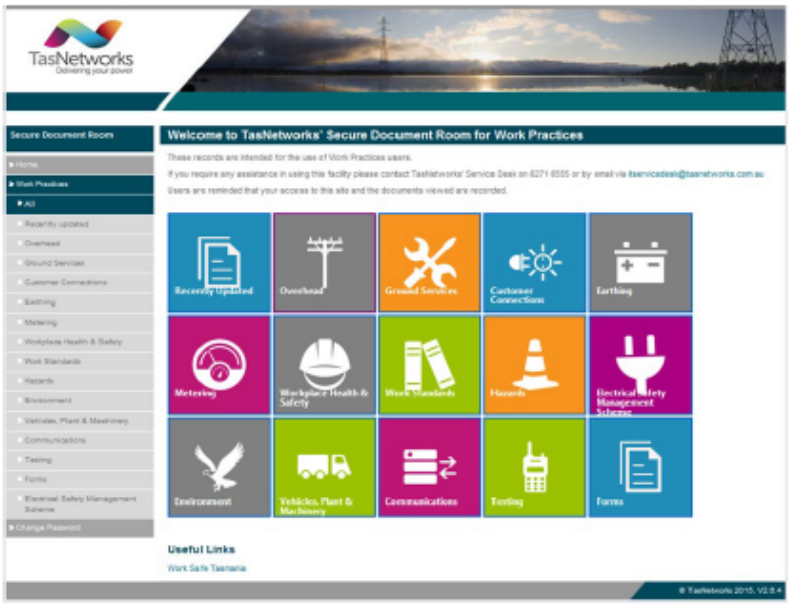

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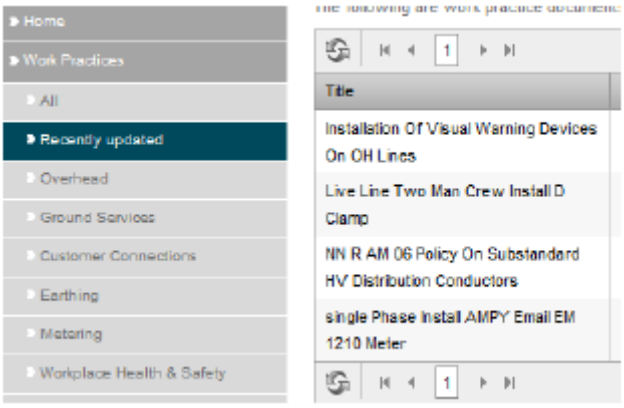

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Version control of the handbook is via the following process:-

1. Where a major change to the handbook is made where formal approval is required, the issue date will change and, the version number will change to the next whole number e.g. old version was Version 2.0 and will now change to Version 3.0 with a new issue date and so on with each major change madeand;

2. Details of major changes made will be recorded in Section **1.2 Alterations And Additions To Handbook**. Details of minor editorial changes that do not require a major version change will be recorded here as well.

3. Associated documents that are hyper-linked from this handbook will have their own document version control process. The only exception is when opening up technical support documents (e.g. parts description from a supplier) that TasNetworks has no control over.

2•4 DISCLAIMER

The material contained within this publication has been developed for the use and guidance of Electrical Practitioners and other personnel working on or in close proximity to Tasmanian Power Distribution Supply assets.

No person should act on the basis of any matter contained in this publication without first considering, and if necessary, taking appropriate professional advice upon his / her own particular circumstances.

TasNetworks Pty Ltd disclaims all and any liability to any person or company, whether a purchaser of this publication or not, in respect of anything and of the consequences of anything done, or omitted to be done, by any such person, or persons, in respect wholly or in part to the information contained within this publication.

2•5 COPYRIGHT

2•6 QUALIFICATIONS, AUTHORISATION & TRAINING

2•6.1 GENERAL REQUIREMENTS

Outside the requirements contained in this manual for live line work, all other electrical and work compliance requirements for line work shall comply with the Line Workers Reference Handbook and in particular, **Section 5.0 Electrical And Work Compliance**.

No person shall undertake Live Work on the distribution power system assets in Tasmania - unless appropriately certified and then authorised and registered by TasNetworks to do so.

HV Live Workers will have their authorisation and registration revoked if they are proven to be UNSAFE to themselves or fellow HV Live Workers.

2•6.2 RECOGNITION OF INTERSTATE QUALIFICATIONS

Persons from Interstate or outside Australia must apply to the Tasmanian Dept. Of Justice, Electrical Licensing Section, to have their electrical practitioners license checked and endorsed and;

Must provide this evidence to TasNetworks, Training School at Mornington, Hobart for confirmation and be checked and approved to perform live line work.

There may be a requirement for the person(s) involved to attend specific training to cover off any additional requirements and accreditations required by TasNetworks to be permitted to work within the Tasmanian Power Distribution System and perform live line work.

2•6.3 SELECTION OF PERSONNEL

2•6•3•1 SELECTION PROCESS

A formalised selection process is used to choose appropriate personnel who are capable of meeting the specified criteria prior to selection as a trainee HV Live Worker.

The specified criteria shall be:

1. A proven safety record.

2. A minimum of two (2) years' experience as an Electrical Practitioner Line Worker or Electrical Practitioner Electrician but also qualified as a Line Worker.

3. Demonstrated competency in a broad range of line work.

4. A Nationally Certified High Risk Work License to operate plant/machinery within close proximity to Power Distribution infrastructure (live or de-energised).

5. Able to give and receive precise and clear instructions.

6. A demonstrated degree of responsibility, conformance with standards and procedures, and the ability to concentrate on critical tasks.

7. A demonstrated ability to work as part of a "team" with a willingness to participate in the planning of each job.

8. Medically and physically, fit with NO disabilities that might have a detrimental impact on the work team. Things such as, skeletal or cardiovascular problems, hearing or sight impairment or seizures of any kind.

9. Not under the influence of any substance that could impair judgment.

2•6•3•2 TEAM SIZE

A Live Work crew shall generally consist of at least **three (3)** authorised HV Live Workers and sometimes **four (4)** depending upon the task(s) to be performed.

The **benefit** of having **four (4)** authorised HV Live Workers in a crew is to ensure the continued viability of the team during periods of short-term absence of individual members.

2•6•3•3 REDUCTION IN TEAM SIZE

A Live Work team may be reduced from four (4) to three (3) HV Live Workers for specific tasks provided an on-site risk assessment has been conducted to ensure the job can be done safely by a team of three (3) HV Live Workers.

The three HV Live Workers must be competent in the methods and techniques to be used. The risk assessment shall include provision for two (2) HV Live Workers to operate out of an Elevating Work Platform and at least one (1) HV Live Worker - competent in the same methods and techniques - to be positioned on the ground at all times. This person shall act as the Safety Observer.

The Safety Observer may perform some minor work on-site (e.g., operate an Air Break Switch "handle", tie off a rope, etc.) but only after the two live workers working at the pole top have positioned themselves outside the "contact area".

When a Live Work team is reduced to three (3) HV Live Workers - the "team" may be assisted by a person who holds a recognised Qualification as a Distribution Line Worker or Electrical Fitter / Mechanic and who has the appropriate line work experience. This person must be acceptable to the Live Work team. [This person shall be known as the "assistant"].

One HV Live Worker and the "assistant" shall remain on the ground at all times. *The "assistant" shall only perform the duties of ground worker and shall NOT under any condition perform the function of safety observer.*

2•6•3•4 SINGLE PERSON TASKS (TWO (2) HV LIVE WORKERS)

A Live Work team may be reduced to two (2) HV Live Workers for specific tasks provided an on-site risk assessment has been conducted to ensure the job can be done safely by a team of two (2) HV Live Workers.

The two (2) HV Live Workers must be competent in the methods and techniques to be used. The risk assessment shall include provision for one HV Live Worker to operate out of an Elevating Work Platform and at least one HV Live Worker competent in the same methods and techniques to be positioned on the ground at all times. This person shall act as the Safety Observer.

The tasks that may be performed by this team of two (2) HV Live Workers are limited to the following list:

- Installation and removal of fault detection and recording equipment.
- Installation and removal of insulating barriers.
- Installation and removal of vibration protection.
- Installation and removal of bird covers.

- Work practice **Installation And Removal Of "D" Stirrups**.
- Installation and removal of spreader ropes.
- Retire over the top of an existing tie only (preform ties not allowed).
- Tighten hardware.
- Cross arm inspection.
- Installation of earthing bolts on the bottom of an EDO. Note: the EDO must be open with fuse carrier removed before this task can be done as a one man task.
- Removal of leads from de-energised side of Siemen switches.

If the Safety Observer has to temporarily relinquish this "role" they may hand over the responsibility to another HV Live Worker who must adopt the role of Safety Observer and cease any other work in which they were engaged.

2•6.4 MEDICAL / PHYSICAL EXAMINATION

Prior to the selection of any person, for training as a HV Live Worker, each applicant is required to be medically examined by a qualified Occupational Health Practitioner. This is to ensure the "individual" can physically meet the requirements to carry out the work and has no medical condition that could affect the safety of the individual or the work team. *[Once the person is qualified, this examination must be performed annually].*

The Examination shall include an emphasis on their medical history during the past five (5) years in connection with:

- Any physical disabilities.
- Medical investigations as a result of surgery.
- Hospitalisation or accidents.
- Any long-term medication requirements.
- Any genetically inherited medical condition that could affect the safety of the worker or the work team.
- An assessment of current general physical condition, relative to the work requirements, taking into account:
- Normal physical and muscular-skeletal functions.
- Cardiovascular and respiratory systems.
- The functions of the senses necessary to carry out Live Work.

Reference to **Appendix 11.2–Requirements for Medical / Physical Examination** that indicates the areas an individual is to be examined).

2•6.5 TRAINING AND CERTIFICATION

2•6•5•1 GENERAL

It is the responsibility of Line Managers, Team Leaders and employees of TasNetworks and Service Providers to ensure minimum accreditations and authorisations required to perform live line work are attained and are current through training and refresher training in accordance with:-

The general requirements of this Handbook.

Any specific additional training required as detailed in associated linked Work Practices and Work Practice Procedures in this handbook.

- Any specific training detailed in the **ASP Work Practice/Technical Specification For Overhead Work** for Service Providers.

- A significant amount of lead time is required where TasNetworks provides training. Therefore, Service Providers must book in training for employees as early as possible in consultation with the TasNetworks Training Centre.

- **Note**: All details of qualifications and completed training and refresher training must be recorded and stamped in the ESI passport and this must be available on site to be produced as evidence if an audit is conducted.

2•6•5•2 INITIAL TRAINING

Initial training shall be structured so as to provide each "trainee" with the necessary theoretical knowledge, practical skills and competencies relevant to both Live Work "Stick" or Live Work "Glove and Barrier" methods.

HV Live Work training courses are competency based with supervised leaning. Assessment time frames may vary due to a range of factors such as competency levels and course participant numbers. The anticipated minimum time frame of the formal training component for a nominal group of 4 trainees:

- 6 weeks for Glove & Barrier to 33KV

- 8 weeks for Glove & Barrier and Stick to 33kv

This training shall include the proper care of all tools and equipment, and the practicing of the required techniques on "dead" lines followed by their application on energised lines.

Training courses shall comply with the relevant national training standards. Training providers and Assessors shall be RTO's whose scope of registration accredits them to deliver the training.

Every HV Live Worker undergoing Live Work Stick / Glove and Barrier training shall be monitored during the training program to ensure their suitability for this type of work.

After successful completion of the formal HV Live Work training, trainees must complete a work experience component (Workbook based) under the supervision mentor/s.

On completion of the work experience component a final capstone assessment will be conducted by an RTO (at least 70% practical) including analysis of evidence collected in the Workbook.

The training course combined with the work experience component including the final capstone assessment shall be completed in not less than 3 months and not exceeding 12 months. If the capstone is not completed within the specified time frame, the participant shall cease live work until a competency reassessment is completed and a suitable training program is implemented. The relevant certificate is issued after successful completion of the capstone assessment.

On satisfactory completion of this training - the Registered Training Provider (RTO) will issue a "Statement Of Attainment", duly numbered and recorded.

The Live Work Manager in conjunction with the Training Manager will determine the training needs based on the details recorded for each individual.

Refresher training may be performed on-the-job provided it is performed under the direct and immediate supervision of the Live Work Manager or a qualified Live Work Instructor authorised by TasNetworks.

2•6•5•3 MAINTENANCE OF COMPETENCY

To ensure ongoing maintenance of competency and Live Line re-authorisation:

1) TasNetworks, or a Training Service Provider working on behalf of TasNetworks, will monitor the performance of every individual Live Worker via field audits (inspections).

2) Each individual HV Live Worker shall undertake selective refresher training within each calendar year.

Note: If, due to any delay, the refresher training and re-authorisation cannot be completed as due for that calendar year:

(a) The refresher training and re-authorisation will be rolled over to be completed in the following calendar year in addition to;

(b) The original scheduled refresher training and re-authorisation for that calendar year resulting in two refresher training and re-authorisations in the same calendar year, and both must be successfully completed for the person involved to be authorised to continue to perform live line work.

The refresher training and re-authorisation shall be conducted on:

- At least one of the following - installing/removing temporary HV links, Siemens switches or Temporary air break switches.

- At least one of the following - installing/repairing/replacing air break switches.

- At least two of the following:
  - o Pole erection/change over/removal through HV Conductors/ mid span, intermediate.
  - o Strain pole, double pin, dead end pole.
  - o Pole change over utilising crane (crane lift).

- Other tasks to be considered:
  - o Installing/replacing pole mounted switchgear.
  - o Installing/replacing connecting bridges/bonding connections.
  - o Energise/de-energise cable.
  - o Installation/replacement of EDOs/Links
  - o Pin/Disc insulator replacement
  - o Cross arm replacement.
  - o Work procedures or other matters related to deficiencies found during field audits.

3) Pole Hole Borer Erector Unit Operators are required to spend a minimum of ten (15) working days in the field every year erecting poles through live High Voltage Conductors to maintain competency skill level.

4) Retention of Live Work competency and Qualification for Live Work, by personnel such as Team Leaders (and others) not regularly performing Live Work, shall comply with all of the following requirements:

(a) Spend a week as part of a live work crew, in the first six months of the year then;

(b) Spend another week in a live work crew to complete their live line re-authorisation/refresher for that year to;

(c) Complete total of two weeks over a twelve months period in a calendar year.

(d) Have satisfactorily completed the required Live Work field competency assessment.

(e) Have satisfactorily completed the required medical assessment.

Where an individual (or team) fails to adequately demonstrate the required level of competency - that individual and / or team shall be immediately programmed to undertake further training and assessment until such time as they can demonstrate competence.

Note: The re-training program will be determined by the Live Work Manager in consultation with the RTO and the HV Live Worker.

HV Live Workers who are not deemed competent shall be restricted to ground duties until they complete re-training and are deemed competent to recommence normal Live Work duties.

2•7 AUSTRALIAN STANDARDS AND CONSTRUCTION STANDARDS

Persons performing work on Power System Supply infrastructure must ensure design, construction and quality of work complies with requirements of the following main documents:

1. This handbook, for live work practice requirements.

2. AS5804.1 Part 1 General
3. AS5804.2 Part 2 Glove And Barrier Work
4. AS5804.3 Part 3 Stick Work

5. TasNetworks:
   - Overhead Design Construction Manual
   - High Voltage ABC Conductor Manual
   - Low Voltage ABC Conductor Manual
   - Maintenance Manual
   - Road Lighting Manual

6. AS/NZS 7000 Overhead Line Design Standard.

7. **AS/NZS 3000 Wiring Rules and associated Standards** (for work performed on privately owned LV supply infrastructure assets).

8. **AS 2067 High Voltage Installations Exceeding 1 KV** (for work performed on privately owned HV supply infrastructure assets).

2•8 SERVICE & INSTALLATION RULES

TasNetworks **Service And Installation Rules** contains all the following requirements that Service Providers, Authorised Metering Installers (AMIs), Designers, Consultants and the like must comply with in regard to the following:

1. Connecting to the Power Distribution System.
2. Covers the low voltage electricity supply.
3. Servicing arrangements.
4. Metering.

2•9 ENVIRONMENTAL

2•9.1 GENERAL REQUIREMENTS

Comply with TasNetworks **Environmental Handbook.**

Associated work practices can be found in the **Environmental Section** on the internal or external Work Practice Web site.

2•9.2 VEGETATION MANAGEMENT

Only Authorised Service Providers are permitted to carry out full scale vegetation management near overhead power lines and, shall comply with the follow work practice and ENA Guideline.

Work Practice/Technical Specification Vegetation Management

ENA Guidelines For Safe Vegetation Management Near Live OH Powerlines

2•10 ACCESS TO PERFORM WORK

2•10.1 N.E.C.F. REQUIREMENTS

The **National Electricity Customer Framework (NECF)** is a Federal Government body set up to administer a set of new energy regulations that protects the interests of customers connected to the Power Distribution System.

As TasNetworks has signed up with NECF, TasNetworks must comply with a number of **NECF obligations** on customer connection notifications and;

If obligations have been breached TasNetworks can be sanctioned and/or fined.

Therefore, it is very important that all persons working for or on behalf of TasNetworks make sure they understand and comply with the NECF obligations and make sure these are not breached.

2•10.2 PROCESS FOR CUSTOMER NOTIFICATION

The general process to follow regardless if the customer or TasNetworks initiates the work is via the **Customer Connections Process**.

Where work has been initiated by TasNetworks and this requires the electricity supply to be disconnected, unless it is a safety issue or an emergency (e.g. power outage caused by a storm), the NECF obligations for customer notification must be complied with (e.g. sufficient advance notification given to customers on life support) via:

Issue of a **Customer Interruption Acceptance Form.**

2•10.3 RIGHTS TO ENTER PRIVATE PROPERTY

In accordance with section 58 of the ESI Act 1995, persons are required to have an Electricity Officer ID card to enable lawful entry onto private property to perform electricity supply/customer connections work.

2•10•3•1 TASNETWORKS EMPLOYEES

Persons performing work that requires access onto private property *shall* be issued with an Electricity Officer Card via the following process:

1) Fill out an **Application Form** to apply for a card.

2) Email the filled out Application Form via **EO.Cards@tasnetworks.com.au** for processing.

After processing is completed the applicant will be issued with an **"Instrument Of Appointment"** in writing and *must* comply with the conditions imposed in regard to powers of entry granted to access private property to carry out work and;

An Electricity Officer ID card will be issued, and *must* be carried at all times to be produced if access onto private property if challenged by the customer.

2•10•3•2 SERVICE PROVIDER EMPLOYEES

Service Provider employees are also required to have an Employee ID card when accessing private property when working for or on behalf of TasNetworks.

Contact TasNetworks, Training Centre to obtain an ID card and, you will need to supply, a good electronic picture i.e. head shot of each employee from the shoulders up, their employee number and, details of the work they will be doing.

2•10.4 PUBLIC ACCESS & CLEARANCES TO SUPPLY INFRASTRUCTURE

Unless authorised otherwise by TasNetworks, public access and clearances to energised power supply infrastructure shall be in accordance with the following:

- **Guidelines When Working Near TasNetworks Assets**

The above guideline contain requirements for customers to contact TasNetworks and provide sufficient notice when needing access to work near energised power supply infrastructure.

- **A Guide For The Public Working Safely Near Overhead Power Lines**.

- The relevant sections in the **PSSR** for clearance (i.e. SADs) for private vehicles and plant.

2•10.5 WORK ON COUNCIL OWNED INFRASTRUCTURE

For public safety, TasNetworks employees and Service Providers must comply with the following guideline to ensure Council owned infrastructure, such as footpaths, is restored and reinstated to a proper standard to avoid creating a public hazard (e.g. a trip hazard if hole not properly back filled after pole removal).

- **Guideline For Working On Council Owned Infrastructure.**

2•10.6 ACCESS NEAR UG SERVICES

Where overhead infrastructure, such as power poles, will be installed near existing underground services, such as where gas pipes are likely to be buried nearby, the DIAL BEFORE YOU DIG 1100 process must be used before any excavation can occur and;
It may be necessary to engage a TasNetworks or Private underground **Cable Locations Officer** to locate, in accordance with work practice **Locate Underground Services** and warn of, underground cables and other services within the vicinity of the work zone to avoid when excavating.

When it is okay to excavate, if an underground cable or other service is close by, careful hand digging (also known as pot holing) must be used to carefully locate where the cable or other underground services are before proceeding with major excavation e.g. using a pole hole borer erector unit.

2•10.7 TRAFFIC MANAGEMENT

In general, employees and Service Providers shall comply with the Australian Traffic Standard AS 1742.3.

Employees must have "Implement Traffic Plan" accreditation to be able to implement a Traffic Management Plan (TMP).

Where ever possible employees shall implement the non-complex TMPs provided by TasNetworks, by selecting an appropriate TMP from the **Traffic Mgt. Selection Matrix.**

A Traffic Mgt. Contractor should only be called in where a complex TMP is required e.g. at a major intersection, round about or, on a built up section of a highway.

2•10.8 RESPONSIBILITY

A Traffic Mgt. Contractor should only be called in where a complex TMP is required e.g. at a major intersection, round about or, on a built up section of a highway.

2•11 AUDITING

2•11.1 CONSEQUENCES OF NON COMPLIANCE

For Service Providers if a non-compliance is found from the outcomes of a work site audit it will be managed under either or both of the following:-

1) The Authorised Service Provider Scheme and may result in:-

The person involved being stood down from being permitted to continue working on site (may be immediate if enforced by the Field Auditor for a major non-compliance) until the problem is rectified and;

If the non-compliance found is severe enough (e.g. a major safety breach), it may result in all the Service Provider work force being stood down until the issue is rectified to the satisfaction of TasNetworks Pty Ltd.

2) Breach of Contract Conditions - handled by TasNetworks, Contracts Section.

For TasNetworks employees, non-compliance will be dealt with in accordance with relevant TasNetworks policies and procedures and, if the non-compliance is severe enough, disciplinary action may apply.

2•11.2 AUDIT PROCESS

The performance and competency of a Live Work team shall be regularly audited by conducting field inspections. These field inspections (audits) shall be conducted by a person that is:

- Authorised and experienced in the procedures / tasks being audited and has a comprehensive understanding of live work.
- Independent of the work party.

Ongoing auditing is necessary to ensure:

- Ongoing safety and compliance with established work procedures.
- The level of competence of individuals and teams is maintained.

An auditing program should be co-ordinated by the Live Work Manager and conducted by suitably qualified personnel.

Audits shall be formally documented, kept on file for analysis and be conducted in a uniform and proper manner.

Audits will be:

- **Conducted Randomly** – by personnel who are appropriately accredited.
- **Conducted at regular programmed intervals** - by "internal" Live Work Team Leaders or other selected personnel. (There is an internal "LIVE WORK ON SITE AUDIT" form provided for this purpose. Refer Section 11.4 for sample).
- **Conducted Annually** – by selected personnel competent in all the latest Live Work procedures and representing an approved Registered Training Organisation (RTO's).

The “random” and “programmed” audits will focus on compliance issues - ensuring each Live Work team is complying with ALL safety and procedural requirements.

The “annual” audit will focus on the level of competence - of each Live Work team and individual member.

The respective audits shall address procedural and safety issues such as:

- Compliance with approved work procedures.
- Teamwork.
- Job planning.
- Assessment of work site risks and control of hazards.
- Observance of minimum approach distances.
- Identification and avoidance of all second points of contact within the work area.
- On-the-job communication.
- Attention to detail.

Failure to meet the audit “standard” - will result in authorisation for the specific task(s) being withdrawn until competence at the required standard can be achieved and demonstrated.

3.0 CONCEPTS

3•1 GLOVE AND BARRIER

The Live Work "Glove and 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 / or phase-to phase contact.

This is achieved by:

- Wearing appropriately rated and tested insulating gloves and sleeves.
- Always working from an approved insulated elevating work platform (EWP), or pole mounted insulating platform, and never directly from a ladder, pole or structure;
- Working at only one potential at a time from a single platform; and
- Providing additional protection for the HV Live Worker by using insulating barriers. All sources of potential difference that are within reach shall be covered with insulating barriers with exception to the item being worked on.

Additional protection for the HV Live Worker is provided by fitting an insulating basket liner in the EWP and by temporarily disabling the automatic reclosing equipment connected to the circuit / feeder control apparatus. (This is done by arranging with the Distribution Operating Authority for the appropriate Feeder protection to be identified and "SET" in accordance with the requirements for "Live Work").

Line Workers carrying out Glove & Barrier work in the "contact area" shall wear insulating gloves and sleeves and these shall not be removed until the Line Worker is outside the "contact area".

3•2 STICK METHOD

The Live Work "Stick" method is based on the principle that the HV Live Worker always maintains a Minimum Approach Distance (MAD) from any energised high-voltage line or apparatus while performing work using tools and equipment fitted to insulating Live Work Sticks.

Additional protection can be provided by the HV Live Worker using insulating barriers where applicable, fitting an insulated liner in an EWP bucket and by temporarily disabling the automatic reclosing equipment connected to the circuit / feeder control apparatus. *(This is done by arranging with the*

Distribution Operating Authority for the appropriate Feeder protection to be identified and "SET" in accordance with the requirements for "Live Work").

Access to the work can be from:

1. A pole or structure (conductive structures not allowed).

2. An approved work platform or ladder attached to a pole or structure.

3. The basket of an Elevating Work Platform (EWP).

3•3 COMBINATION OF GLOVE & BARRIER WITH STICK METHOD

Live Work can be accomplished through a combination of Glove & Barrier and Stick method. However, this type of work shall be limited to situations where the safety margins are not reduced by introducing Live Work Sticks into the contact area.

Clear transition points and communication between work members and the Safety Observer shall exist when moving between Glove & Barrier and Stick methods.

Any Live Worker changing from Glove & Barrier method to Stick method shall move outside the contact area, remove their Gloves & Sleeves and, gain acknowledgement from the safety observer of the change of work method.

Line Workers changing from the Stick to Glove & Barrier method - shall put on insulating gloves and sleeves BEFORE re-entering the contact area.

The following combinations are **NOT permitted**:

1. One Line Worker performing Stick work and one Line Worker performing Glove & Barrier work from the same insulated EWP.

2. One Line Worker performing Stick work from a pole or structure and another Line Worker performing Glove & Barrier work from an insulated platform on the same pole or structure.

Supplementary to the above, given that some tasks naturally require a combination of Stick and Glove & Barrier equipment, Live Work methods to accomplish a task shall be determined prior to commencement and should not be changed to a different method during the task unless no alternative exists.

In general tasks should be started and completed using the same methodology.

3•4 COMBINATION HV LIVE WORK AND ACCESS AUTHORITY WORK

Live Work and work under Access Authority shall only be conducted on the same structure provided that:

The two work methods are not undertaken simultaneously

1. Clear transition points exist between the HV Live Work and the Access Authority work. This transition process shall be communicated to all of the work party.

2. HV Live Work personnel who are required to work aloft and/or other persons likely to infringe the 'contact area' via a conductive medium (e.g. Proline operator or person pushing a pole into the pole hole) who have signed onto the Access Authority shall;

3. Sign off the Access Authority prior to ascending to perform HV Live Work or operating the Proline to stand a pole. For the Access Authority to remain current (open), the recipient in charge must remain signed onto the permit and must remain on the ground.

4. All conductors that have been moved or displaced are secured.

5. HV Live Work Minimum Approach Distances are established and maintained using HV Live Work techniques and/or equipment between the live circuit and the Access Authority area.

6. Where live high voltage line work is undertaken on a circuit above or below a circuit under access authority, an isolation must be established on that circuit between the work parties performing the access authority work and the live high voltage line work.

   This can be achieved by installing temporary HV links/Flying shackles or the breaking of loops at a shackle pole. **This then becomes the isolation point for the Access Authority** - which is NOT in the same span where the HV live work is taking place.

   NOTE - This is to ensure the access authority work area cannot be energised inadvertently by the live high voltage line work being performed.

4.0 DEFINITIONS

Accident

A personal injury accident while at work where an employee has attended medical treatment and as a result of their injury have lost at least a part of or a complete workday.

Apparatus

Conductors, cables and associated hardware and pole mounted plant which is energised or is able to be energised.

Approved

Approved by a person or body authorised by TasNetworks.

Approved Work Procedure

A documented procedure which meets the requirements of this guide and which has been approved for use by TasNetworks.

Authorised

Shall be in writing, or by means of an approved procedure from TasNetworks.

Brush Contact

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

Certified

Means a Line Worker who has satisfactorily completed all training and been assessed as competent in relevant Live Work Methods and who has been issued with the appropriate Certificate and registered with TasNetworks.

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.

Competent

Means having the training, skills, knowledge and attributes a person needs to complete a task.

Contact Area

The area within one (1) metre of the nearest energised high voltage conductor or component whilst carrying out Glove and Barrier work.

Dead

Apparatus which is isolated 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 Live Work equipment connected to live apparatus could become uncontrolled (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 network system.

High Risk Work License

Means a license to use or operate an Elevating Work Platform (EWP) with a boom length greater than 11 metres and issued by a Certifying Authority.

High Voltage

Voltages exceeding 1000 volts.

Incident (Near Miss)

Is an incident that could have resulted in property loss or damage.

Incident

Is an incident that did result in property loss or damage.

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, cross arm cover, termination cover or as a cover for similar equipment.

Insulating Gloves and Sleeves

Insulating gloves and sleeves specifically designed, approved and tested to a rated voltage and worn with approved leather protector gloves.

Insulating Pole Platform

A platform of insulating material specifically designed, approved and tested for use with the Live Work Glove and Barrier method.

Insulating Rope

Insulating rope is specially designed, manufactured, tested and maintained so as to have very high insulating qualities. It can intentionally be placed across phase to phase or phase to earth air gaps. [This is not used in Tasmania for Live Work in the Distribution Environment].

Live (or alive or energised)

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.

HV Live Worker

A certified person who has demonstrated competency in performing live high voltage work and who is authorised to undertake this work.

Live Work Equipment

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

Live Work Glove and Barrier Method

A method of performing Live Work on circuits up to and including 33 000 volts. The HV Live Worker is fully insulated from earth and phase(s) using approved insulating gloves and sleeves, insulating platform and / or insulated elevating work platform and insulating barriers.

Live Work Manager

Person, authorised by TasNetworks, to oversee Live Work activities as part of the Live Work Panel.

Live Work Panel

Consists of a number of technical and management representatives, which monitors and approves changes to Live Work procedures and activities.

Live Work Suppression

A confirmation issued from the network's System Controller to verify to a Live Work party the control measures are in place on the circuit to be worked on and to authorise work. Details of suppression are recorded on the worksite "hazard ID" form.
The method of issue and cancellation (transfer) may be by:

- Verbal exchange.
- Hard copy format.
- Electronic means.

Live Work Rope

Standard commercial grade synthetic (polypropylene) rope, which is not intentionally placed across phase to phase or phase to earth air gaps, but which is known to have good insulating properties. [**Note**. *Live Work rope is not Insulating Rope*].

Live Work Rope should be used in series with an insulating stick or composite insulator to provide known insulating properties.

Live Work Stick (also called 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 Work Stick Method

A method of performing Live Work using tools and equipment attached to Live Work sticks with the HV Live Worker maintaining the minimum safe approach distance 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.

Mentor

A Mentor is a person appointed in the workplace that is qualified with;

• Current HV Live Work Certification / Qualification.
• A minimum of two (2) years HV Live Work experience.

The Mentor is not the assessor but a person who assists the trainee develop their on-job skills and knowledge.

Minimum Approach Distance (MAD)

The minimum air gap that shall be maintained between a Line Worker and any other component at different potential during Live Work, in order to prevent flashover and provide for worker safety.

Minimum Tool Insulation Distance *(also called effective length)*

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 Live Work sticks consist of sections joined with metal couplings, the insulation distance shall be the total of each of the lengths of insulating material which have not been bridged out by the metal couplings.

Rated Voltage

The manufacturer's recommended maximum voltage that shall be applied to specified equipment.

R.T.O.

Registered Training Organisation.

Safety Observer

An appropriately trained and competent employee assigned the duty of observing the work activity and warning against approach to live electrical apparatus.

Safe Working Load (SWL)

The maximum load (in kilograms [kgs]) which shall be applied to the specified equipment, apparatus or hardware.

Secondary Point of Contact

All electrical apparatus or earth structures operating at different potentials to the primary point of contact under the glove & barrier method.

Step Potential

The voltage between the feet of a person standing near an energised grounded object e.g. pole, structure, energised crane or EWP. The step voltage is equal to the difference in voltage between two points (both feet). A person could be at risk of electric shock during a HV Live Work incident simply be standing near to the grounding point, EWP or pole.

Substandard Conductor

As per Policy NN R AM 06 HV Distribution Conductors:

Conductors that are used for HV power lines are defined as substandard if they have an ultimate breaking strength of less than 5kN or are a galvanised single strand steel conductor of less than 4 mm in diameter.

Conductors that are classed as substandard are:

- No. 8 gauge steel.
- 7/.044 copper.
- 7/.048 copper.
- 7/.064 copper.

Note: Live work is prohibited where substandard conductors are encountered at the work site.

Suspect Conductors

Conductors that are used for HV power lines are defined as suspect if as new conductors they would have had a strength greater than the minimum limits for substandard conductors but may have deteriorated due to corrosion to be similar to substandard conductors.

Conductors that are classed as suspect are:

- 7/093 Aluminium.
- 7/.080 Copper.
- All other GI Steel conductors that are not 8 gauge size.

Note: Suspect conductors must be inspected up to two spans either side of the work location to risk assess if it is safe to perform work under live conditions or not.

Tested

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

Test Voltage

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

Touch Potential

The voltage between an energised object and the feet of a person in contact with the object e.g. a person contacting an energised vehicle, plant or pole.

Work Area

The area within normal body reach of the HV Live Worker's working position.

5•0 DEVELOPMENT OF NEW PROCEDURES

Work procedures shall be developed and documented for every Live Work activity where the level of risk and the level of complexity are such that a written procedure is required.

Each work procedure shall:

• Clearly identify and state the work objective or desired outcome.

• List specialist equipment required.

• Contain information necessary for accessing the network system.

• Become an integral part of the existing Live Work Manual.

New work procedures shall be implemented by:

• Trialling the procedure in a “dead” line situation (to ensure it can be carried out safely and reliably).

• Submitting the procedure for approval by TasNetworks Live Work Panel.

• Including the new procedure in TasNetworks Live Work Manual as a standard work procedure.

• Including the new procedure in the current re-authorisation/refresher training program.

• Including the update in the Line Worker’s Skills Record System.

• Documenting the intended procedure.

6.0 SAFETY REQUIREMENTS

6•1 SAFE WORK PRINCIPLES

These safe work principles are common to all Live Work regardless of whether it is Stick, Glove and Barrier or a combination of both.

A work site risk assessment – involving all team members – shall be conducted on- site prior to the commencement of any Live Work.

Persons working in association with live work crews shall have an understanding of the live work techniques and be instructed in the live work to be done.

Plant operators shall be directed by a nominated member of the live work team at all times.

Work on steel / composite material structures – (steel lattice poles, tubular steel, spun concrete, stobie poles etc.) require additional safety precautions because of the earthed state of the structure at the pole top. [Refer to Section 10.3, "Work on Steel / Composite Structures" for further information].

If decay, rust or fatigue has weakened a structure - it shall be reinforced or adequately supported before Live Work can commence on the structure.

When conductors are being "moved" – their movement shall be closely monitored throughout the adjacent spans as per:

- The integrity of at least one (1) span either side of the proposed work site (structure) for horizontal.
- For vertical type construction (Double circuit) two (2) spans either side of the structure being worked on shall be observed. This is particularly important on "vertical" type construction as conductors can clash together in adjacent spans. Additional observers may be required to monitor these spans.
- Where possible the hardware (Crossarms) on the adjacent poles may need to be tightened.

The Minimum Separation Distances between conductors shall be observed (See Tables in Section 6.6.2.1 MINIMUM APPROACH DISTANCES).

Location of all under-crossings, over-crossings, roads and other obstacles in the work vicinity - shall be identified and ALL relevant "clearances" verified.

The conductor loadings must be taken into account to ensure the most appropriate work method is used - refer Section 9.0 Conductor Loading.

The Live Work team(s) shall at all times observe the safety rules relevant to the method being applied.

Ensure all sources of potential difference within the "ELECTRICAL DROP ZONE" are covered.

These safety rules shall in no way compromise the requirements of TasNetworks, "Power System Safety Rules" (formerly Electrical Safety Code and Power System Isolation and Access Procedures).

Metallic objects such as: neck chains, earrings, rings, watches, bracelets and other body jewellery shall not be worn while carrying out Live Work. *[This is to reduce the severity of personal injury in the advent of a high voltage arc or flashover].* Only approved neck warmers and beanies are to be worn whilst working aloft.

The Live Work team(s) shall determine whether a particular work task can be performed. Work shall cease if a potential hazard is identified during Live Work and appropriate action shall be taken to ensure the safety of all personnel.

No other work shall be carried out on the same structure or adjacent structures at the same time as Live Work is performed on the structure – unless it is part of a programmed and coordinated Live Work project. Furthermore, no work shall be carried out on the same overhead line that may cause inadvertent movement of the conductors on the structure on which the Live Work team is working.

The automatic reclosing equipment that controls the "Feeder" on which Live Work is to be carried out shall be SET for the duration of the task in accordance with standard operating procedures for Live Work.

Permission shall be obtained from the Distribution Operating Authority prior to the commencement of any Live Work on the distribution network. Each Live Work team shall notify the Distribution Operating Authority before commencing work, after completing the work and when moving to another work location on the same Feeder.

Note: No work shall be undertaken on live SWER lines.

Note: No live work shall be undertaken to remove arcing horns.

If a job is temporarily suspended because of rain or other hazardous condition, all insulated Live Work tools / equipment left on the job shall be wiped with a silicone cloth (attached to a universal stick, where required) prior to resuming work.

Electrical conditions such as **Step and Touch Potential** could exist on / about a structure, on which Live Work is to be performed, and thereby create a hazardous situation. If this situation is suspected / or known then appropriate actions should be taken, such as:

• Conducting a **test for stray voltage** before touching or climbing the structure.

- Performing the work from an insulated EWP.

- Covering the existing insulation with approved insulating barriers.

- Performing the work at a distance using Live Work sticks rather than Glove and Barrier.

- Prior to making /breaking loops or cutting conductors the work party shall stop and assess that the controls put in place are adequate and then;

- **CAUTION:** Prior to opening any loops, confirm it is safe to do so, by doing a tong test (as per Section 10.7.25 Testing Current Flow In Conductor Loops) to check presence of current flow or not and from the readings obtained;

- The work party shall stop and confirm with the Safety Observer it is okay to continue.

6•2 RIGGING AND RELOCATING CONDUCTORS

When relocating conductors – it must be remembered that any transfer of conductors from their existing position - should be done in accordance with the following requirements:

1. Weight of conductor in the order of **20kg Per conductor/per person** – may be transferred by hand (*Provided that the SWL of the bucket is not exceeded and the risk assessment deems the task safe)*. It should be noted that accepted manual handling techniques should be employed and that the risk of manual handling incidents increases exponentially at loads above 20kg/person.

2. Weight of conductor **below 70kg Per conductor** – can be relocated by using an auxiliary rig. (*Conductors may be relocated using an insulated EWP fitted with an approved "lifting device" [Gin Pole] in accordance with the lifting capacity of the EWP*).

3. Weight of conductor above **70kg Per conductor** – should be relocated by using a lever lift device (or combination of lifting devices).

4. A suitable crane fitted with an approved insulated lifting device may be used to lift conductors, where it is safe to do so.

5. The Minimum Separation Distance between conductors shall be maintained at all times.

6. The conductor being "moved" shall be kept **under control** at all times. Clearances shall be closely monitored.

7. When working with live conductors from within an EWP bucket, each conductor must:

- Have a level of insulation applied (line hose).
- Not be carried on the EWP basket.
- Be held by hands.
- Only be placed on EWP basket when the EWP is stationary.

Note. See Section 9.0 of this Manual for information relating to "conductor loading" and Reference Tables, which will assist with determining conductor weights over various span lengths for stipulated conductor types and sizes.

6•3 GLOVE & BARRIER SPECIFIC WORK PRINCIPLES

These Glove and Barrier work principles supplement other common work principles and are distinct from them in that they only apply to Glove and Barrier work.

Insulating gloves and sleeves shall be visually inspected inside and out and "air tested" prior to use and when they become suspect.

Insulating gloves and sleeves shall be worn at all times whilst working within the "contact" area.

Prior to entering the "contact area" the work crew shall communicate with the safety observer showing they have fitted their gloves and sleeves.

Insulating gloves shall not be worn "inside out" or without approved protective outer gloves.

Protective outer gloves shall not be used for any purpose other than with the insulating gloves.

Insulating barriers shall be applied to all conductive components within the immediate work area, which are or could be expected to be at different potential to the conductor / apparatus being worked on.

6•4 STICK SPECIFIC WORK PRINCIPLES

Before use, live work sticks shall be:

- Checked to confirm they are within the test period.
- Thoroughly inspected for damage or deformity.
- Wiped clean to remove all contaminates.
- Treated with an approved moisture inhibiting product.

6•5 SAFETY OBSERVER

During all Live Work – one member of the Live Work Team shall be appointed as the designated Safety Observer.

The person nominated as the Safety Observer shall always be a Certified HV Live worker.

The Safety Observer's role is to alert the work team to any potentially unsafe actions or lack of compliance with approved procedures during Live Work tasks.

The Safety Observer shall:

- Be AUTHORISED to carry out the particular work being observed.
- Be positively identified to each member of the Live Work team.
- Be positioned in a suitable position to always be able to OBSERVE the work being performed.
- Be AWARE of how the work will progress and what changes need to be made.
- Have the authority to temporarily SUSPEND the work at any time.
- Maintain effective and immediate COMMUNICATION with the work team at all times.
- NOT perform any other task whilst performing the role of Safety Observer.
- Temporarily SUSPEND all work in the event of having to leave the site or change position significantly.
- Be visually identifiable as the Safety Observer by ensuring a RED safety observer vest is worn.

The Safety Observer's role may be rotated between members of the work team to reduce fatigue or to share the workload among team members. However, when this occurs, it shall be done in such a way that Live Work is temporarily suspended and all team members are made aware of the change.

The Safety Observer will generally be positioned on the ground unless another position better provides a clearer, safer and broader view of the work.

Note:

- Under no circumstances, shall any person - other than an authorised HV Live worker - act in the role of a Safety Observer for Live Work activities.

- When two (2) Live Work Crews are working up a structure at the same time but on opposite sides of the structure – two (2) Safety Observers shall be appointed with one (1) Safety Observer to observe only one work crew each.

6•6 MINIMUM APPROACH DISTANCES

6.6.1 GLOVE AND BARRIER WORK

There is no Minimum Approach Distance that applies to Glove and Barrier work. HV Live Workers can "contact" live high voltage conductors with the gloved hands up to and including 33kV – so long as there is no second point of contact.

HV Live Workers must maintain an air gap (refer Tables below) between any uninsulated part of their body and all energised electrical apparatus.

Note.

Flexible or rigid insulating covers (barriers) are installed to provide protection against "brush" contact with energised equipment or equipment at a different potential.

All conductors within reach, except the one to be worked on, shall be covered with insulating barriers.

6.6.2 STICK WORK

It is normal industry practice to determine the Live Work Minimum Approach Distance (MAD) as the "distance" required to prevent flashover from worst-case voltage transients on the system, plus an additional allowance for inadvertent movement.

6•6•2•1 MINIMUM APPROACH DISTANCES

1. **HV Live Worker - Minimum Approach Distance.**

Line Voltage	Stick Work	Glove & Barrier Work
11 kV.	350 mm	50mm from body
22 kV.	400 mm	100mm from body
33 kV.	450 mm	150mm from body

Note. A Safety Observer is required & "contact" is only with approve insulation e.g. insulation gloves.
Note. "body" means any part of a person not adequately protected by insulating material against the voltage listed in the Table.

2. **Conductor Movement – Minimum Separation Distance (Phase to Phase)**

Line Voltage	Stick Work	Glove & Barrier Work
11 kV.	400 mm	400 mm
22 kV.	500 mm	500 mm
33 kV.	550 mm	550 mm

Note. A Safety Observer is required.

3. **Crane – Minimum Approach Distance**.

Line Voltage	Uninsulated Conductors	Covered Insulated Conductor
Low Voltage.	300mm	100mm
11 kV.	1.0 metres	400mm
22 kV.	1.0 metres	400mm
33 kV.	1.0 metres	450mm

Note. A Safety Observer is required for Special Limits of Approach (Authorisation to work at reduced distances).

4. **Insulated Elevating Work Platform – Minimum Approach Distance**.

Line Voltage	Uninsulated Section	Insulated Section
Low Voltage.	300mm	Contact allowable
11 kV.	1.0 metre / 400mm*	400mm / Contact*
22 kV.	1.0 metre / 400mm*	400mm / Contact*
33 kV.	1.0 metre / 450mm*	450mm / Contact*

Note. *EWP Boom to covered conductor/s.

5. **Wood & Titan Pole Erection – Minimum Separation of Pole and Conductor**.

Line Voltage	No Insulation	One Level of Insulation	Two Levels of Insulation
Low Voltage.	As required	As required	Contact
11 kV.	700 mm	150 mm	Contact
22 kV.	1.0 metre	250 mm	Contact
33 kV.	1.0 metre	250 mm	Contact

Note. Safety Observer is required.

6. **Conductive Pole Erection – Minimum Separation of Pole and Conductor.**

Line Voltage	Two Levels of Insulation Fitted to Pole, Conductors or both
Low Voltage.	Contact with approved insulated covers
11 kV.	150 mm
22 kV.	250 mm
33 kV.	250 mm

Note. A Safety Observer is required.

If the minimum separation distance of 150mm (11kV) and 250mm (22kV) respectively between the pole and conductors cannot be maintained after the pole is erected the conductors shall be attached to the new pole.

6•6•2•2 INSULATED ELEVATING WORK PLATFORM

When positioning an insulated Elevating Work Platform (EWP) between circuits a minimum clearance of **250 mm** (to ensure the standard 300mm SAD to LV is not breached) shall be maintained between the basket of the EWP and the lower circuit. (This includes; aerial earths, catenary cables, low voltage conductors and other conductive components). If the minimum clearance of **250mm** cannot be maintained at all times then HV covers shall be fitted.

If insulating barriers rated for the higher voltage are fitted to the lower circuit then contact can be made with the barriers, provided they are not moved or dislodged in any way.

When more than one (1) insulated EWP is being used a distance of two (2) metres must be maintained between EWPs, unless they are working on the same phase.

When two (2) EWP's are being used, two (2) phases may be worked simultaneously provided a distance of two (2) metres is maintained between the booms and baskets of the EWP's while the Live Work is in progress. (*Two (2) Safety Observers are required for this activity*).

See also Section 8.3.10.1.2, Procedural Limitations.

Special Notes:

- If it is considered at any time, prior to or during a task, that the relevant distances cannot be maintained – the task shall not be performed live.

- When performing Live Work glove and barrier work from the bucket of an insulated EWP the work shall be restricted to one (1) phase at a time.

6•6•2•3 INSULATED POLE PLATFORM

When using an approved insulated pole platform between circuits – adequate insulating barriers (rated for the higher voltage) shall be fitted to the lower circuit to ensure a minimum clearance of 250 mm is maintained to ensure the standard 300mm SAD to live LV is not breached.

Insulated pole platforms shall have provision for a safety harness anchorage point that will sustain a restrained fall arrest of 6kN.

6•7 MINIMUM NUMBER OF SOUND INSULATORS

During live work, the minimum number of electrically sound and functioning disc insulators shall provide adequate insulation to ensure the safety of the HV Live Workers.

The following insulator conditions shall be regarded as unsound:

- Physical Damage to greater than one third of the outer radius.
- Flashover
- Electrical Distress
- Bridging by conductive components
- Significant Pollution
- Surface Moisture

Table 7.2

Minimum Number of Sound Disc Insulators

Nominal Line Voltage (kV)	Minimum Number of Electrically sound insulators as defined above
11	1
22	1
33	2

Live work shall not be performed where the minimum number of sound discs are not available unless there is a specific approved work practice for that situation and assessment has been carried out.

6•8 PROTECTIVE CLOTHING

When Live Work activities are being performed, personnel shall wear approved protective items in accordance with TasNetworks, **Personal Protective Equipment Procedure**. The following covers the key requirements for live line work:

1) Arc resistant clothing shall be worn at all times, that covers the body from neck to wrist and to ankles, fits well and does not incorporate metal fasteners.

2) Head and eye protection to reduce the risk of injury from flashover (and debris).

3) Safety footwear with non-slip rubber soles.

4) Insulated Gloves and Sleeves (for Glove & Barrier work).

5) Metallic objects such as: neck chains, earrings, rings, watches and bracelets shall not be worn while performing Live Work.

6) Only approved neck warmers and beanies are to be worn whilst working aloft.

7) Long hair shall be securely fixed or confined close to the head.

8) Mobile phones or Pagers shall not be carried by HV Live Workers while they are performing Live Work at the pole top - as they may cause a distraction and reduce concentration.

9) Safety helmets generally have a life span of at least three (3) years from the time of issue and therefore helmets in regular use shall be replaced after this period of time. (The user should examine the helmet regularly and discard if any damage is evident).

10) The free end of body belts, pole straps and ropes shall be restrained from swinging around - to prevent bridging out components at different potential.

11) Consideration should be given to wearing underclothing (singlet, tee shirt, etc) of fire resistant material such as "cotton" beneath work clothes to reduce severity of injury in the event of fire. Synthetic type materials will melt and stick to skin.

12) Only dry clean PPE clothing and EWP lanyards or other attachments shall be used whilst performing live work.

6•9 ELECTRIC AND MAGNETIC FIELDS

Electric and Magnetic Fields (EMFs) are found everywhere there is electricity and TasNetworks will endeavour to keep employees informed with up to date information about possible effects of exposure to electric and magnetic fields.

6•10 ACCIDENT / INCIDENT REPORTING

For the purposes of this instruction – an accident / incident can be defined as any of the following events:

- An electric shock or other serious injury received by a team member.
- A flashover at, or close to, the work site.
- Complete or partial breakdown of any insulating tool or equipment (irrespective of whether flashover occurred).
- The electrical or mechanical failure of any Live Work tool which did, or could have the potential to cause an accident / incident.
- A near miss relevant to any of the above.

In accordance with the Incident Management Procedure the "One (1) Hour Rule" applies whereby all accidents/incidents must be escalated to your immediate Leader within 1 hour.

- The Team Leader / Line Manager shall ensure that:
- Injured persons or those at risk have been rescued.
- The immediate first aid and medical needs of any injured person and the safety of other persons at the work site have been attended to.
- Any emergency switching requirements have been attended to.
- The restoration of any power outage (resulting from the accident / incident) has been attended to.
- Investigation, reporting requirements and the implementation of appropriate remedial measures has been put in place.
- All relevant persons / parties who are required to be notified - have been so notified.

To assist with accurate assessment of all the contributing factors leading to an accident / incident – **DO NOT MOVE** the plant and equipment at the work site except to aid or assist an injured person or where it may pose an ongoing risk to personnel or property.

Note:

A near miss shall be treated with the same level of significance as an incident / accident and investigated in much the same way.

6•11 MOBILE EARTHING REQUIREMENTS

In general, earthing shall comply with the **ENA Guideline For Earthing Of Mobile Plant**.

Mobile plant such as EWP's, Cranes, PERUs or Task Trucks used in conjunction with HV Live Work shall be electrically connected to earth via a conductor from the chassis to a permanent earth or temporary driven earth electrode of 20mm diameter driven to a depth of 500mm as per the ENA Guideline For Earthing Mobile Plant. The lowering of an earth chain is not an adequate means of earthing when undertaking HV Live Work.

For safety, as per the **ENA Guideline For Earthing Of Mobile Plant**, the earth stake and the earthed mobile plant should be barriered off for a distance of 1 metre minimum. **Note**: If the mobile plant cannot be effectively earthed, it still must be barriered off to ensure employees and the public are kept clear of the working area touch and step potential zone.

Mobile plant should be parked at least 2 metres apart to reduce different potential issues. The separated mobile plant shall be separately earthed.

Where the mobile plant items are parked closer together than 2 metres they shall be bonded together to a common earth system / electrode.

Where earthing of plant and equipment is not practicable (e.g. concrete/bitumen area) then the plant shall be barricaded to 2 metres to prevent access to manage the step & touch potential hazard.

Conductive poles being lifted in proximity with live HV conductors shall be bonded to the lifting plant prior to lifting or unless safety analysis indicates otherwise, and a documented process is available to ensure that the work can be performed safely.

No contact shall be made with earthing (bonding) conductor or EWPs or PERUs or any other vehicle engaged in HV Live Work while the work crew are within the contact area or is in any way in contact with live conductors.

This also applies when the Proline/Peru is used to hold/support a pole during a live pole changeover.

Access may be made when the live work crew is out of the contact area.

All personnel and members of the public shall be kept clear of the worksite where reasonably practicable while Live Work is in progress.

Mobile plant items that have control levers or remote controls that may be operated whilst standing on the ground shall not be used unless one of the following options is applied:

• Precautions shall be taken to protect the Operator from hazardous step and touch potentials; or

• Operator is positioned on the vehicle; or

• Operator is at least 6 metres from the vehicle and/or earth electrode.

7•0 WORK SITE REQUIREMENTS

7•1 RISK ASSESSMENT

After arriving on the job site and before commencing any work – an on-site Live Work team review shall be carried out to identify hazards and the associated management requirements and to determine the most appropriate work method.

The Live Work On-Site Risk Assessment shall be conducted and documented using either the hard copy or the electronic **Live Line JRA** stored on the WP Web Site and the ODI and shall include detailed "inspections" and consideration of:

• Communication to all involved on the MADs to be used and any factors that may affect the MADs and how these will be mitigated.

• Any obvious or potential hazards and their associated risks. (*This could also include stock, traffic and pedestrian movement*).

• The integrity of the structure on which work is to be performed.

• The competence of the individual/team to undertake the specific task i.e. seldom used tasks, which involve lever lifts and associated stick work etc.

- The integrity of at least one (1) span either side of the proposed work site (structure) *for horizontal and two (2) spans for vertical type construction. This is particularly important on "vertical" type construction as conductors can clash together in adjacent spans*.

- The integrity of all conductors and fittings in these two adjacent spans.

- The integrity of the adjacent structures.

- The integrity of all insulators in the immediate work area.

- Clearances to potential mid span hazards (*e.g where conductors will be moved during the work*).

- Conductor loadings.

- Site conditions.

- Environmental issues.

- Existing and potential weather conditions.

- Risks associated with task and determination of crew size.

- Feeder Protection Suppression Requirements and Arrangements

- Condition of all Live Work tools & equipment.

- Communication required on relevant safe approach distance as per MADs - safe approach distance to be part of JRA.

When condemned poles are identified either side of the worksite they shall be securely supported (i.e. Proline or Vehicle Mounted Crane) for the duration of the task, taking the following options for securing poles into consideration:

- **WP Replacing Condemned Poles.**
- Section 12.2.2.1 **Securing Of Poles Prior To Work** in the LWRHB.

NOTE: LIVE WORK LIFTING EQUIPMENT SHALL NOT BE ATTACHED/RIGGED TO A CONDEMNED POLE.

As part of the risk assessment process – a work site briefing shall be conducted **with all personnel on site**.

This "briefing" shall address:

- WHY the work is to be done.
- WHAT is to be done?.
- HOW it is to be done.
- WHO will do exactly WHAT?.

This "briefing" shall discuss all aspects that could influence the safety and progress of the work as well as identifying second points of contact.

For example, is the condemned pole a 365 day pole or an urgent 7 day pole because it is in a bad condition and needs replacing as soon as possible?.

Also, are pole top forces (e.g. conductors at angle to pole) a consideration that could affect how best to temporarily support the pole?.

Note:

Public safety shall also be considered and all members of the public shall be kept clear of the work site while Live Work is in progress. This may mean that the work site may have to be barricaded and / or signed, in order to prevent any access onto the site.

7•2 WEATHER CONDITIONS

Live Work shall only be carried out in suitable weather conditions and when there is adequate "light".

Weather conditions could be unsuitable because of:

- An electrical storm in the vicinity (or within 20km of the work site).
- Significant rain (beyond intermittent spotting), mist, fog, snow or sleet.
- Excessive wind velocity (such that work can't be continued in safety).
- Excessive humidity or heat.
- Inadequate light (to see clearly).
- Bush fires, or a high fire danger day or a total fire ban day, where the **Bush Fire Season Total Fire Ban Response WP** must be followed.

In this regard avoid driving large vehicles onto properties where hot exhausts could easily ignite undergrowth and cause a fire.

This particularly applies to vehicles with diesel exhausts that have a "particulate" burner that could automatically operate without warning creating extra heat to burn off diesel residue build up in the exhaust to reduce the level of smoke expelled.

Note:

If Live Work is in progress and weather conditions deteriorate to a point where it could become unsafe work shall not proceed and the Live Work team shall remain clear of the electrical circuit.

In the event of work being temporarily suspended because of rain or other hazardous conditions – then before resumption of work - all the insulated tools / equipment left on "conductors" at the job site shall be wiped down with a silicone cloth (attached to a universal stick where necessary).

Where reduced insulating conditions could occur it may be necessary to replace all insulating barriers / sticks with clean dry ones in order to prevent the possibility of STEP and TOUCH "potential" prevailing on / around the structure.

7•3 LIGHT CONDITIONS

Adequate light must be available to perform HV Live Work tasks to ensure:

- Workers are able to see what they are doing.
- The safety observer is able to see what the workers aloft are doing.
- All other items within the work area that pose a risk are visible.

7•4 FEEDER ACCESS (AUTHORITY TO WORK)

Managing the Distribution Network in Tasmania is the responsibility of TasNetworks and approval must be obtained from TasNetworks Distribution Operating Authority for work to be carried out on Distribution lines / apparatus.

Prior to any Live Work commencing at any work site – the Live Work Team shall contact the Distribution Operating Authority and receive from them "Confirmation of feeder suppression" on the nominated Feeder(s). The suppression only remains in force for the duration of the work and is canceled when the work is completed.

The Issue / Cancellation of Live Work suppression may be by one of the following methods:

- Verbal Exchange (Assurance via TMR, mobile phone or in person).

- Hard Copy (Printed form).

• Electronic Means (Email, FAX, etc).

Details of suppression are recorded on the worksite "hazard ID" (JRA) form, and must include who gave the feeder suppression from Operations Section and the time given.

The issue of a Live Work Suppression - shall ensure that all appropriate Feeder protection facilities are identified and "SET" in accordance with the requirements for Live Work.

In the event of a Feeder tripping, during Live Work, the Feeder shall not be re- energised without first having direct communication with the respective Live Work party (or parties).

Immediately after the Live Work is completed and the Suppression is canceled the Feeder protection devices shall be "RE-SET" to normal operation.

Note:

The Verbal Exchange of "authorisation" shall be done in such a way as to ensure that contact with the Distribution Operating Authority can be maintained through out the operation.

7•5 COMMUNICATION

Each Live Work team shall establish a reliable on-site two-way communications link with the Distribution Operating Authority.

This link should be continuous and regularly checked during the course of the work to ensure it is functioning correctly.

Every member of the Live Work team shall also ensure they create and maintain an open and effective communication link with each other to ensure the safety of
the team.

8.0 EQUIPMENT

8•1 EQUIPMENT GENERAL

It is essential that only tools and equipment specifically designed, tested and approved for Live Work be used to perform this type of work on energised high voltage lines.

Appropriate care and maintenance of these tools and equipment is essential for "safe" Live Work.

All Live Work tools and equipment shall be inspected and maintained in accordance with manufacturer's recommendations and relevant Standards referred to in this Document.

Section 9.4 deals with the cleaning and maintenance of equipment.

8•2 PERSONAL PROTECTIVE EQUIPMENT

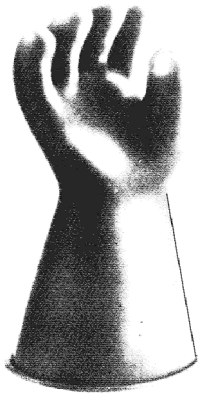
The equipment illustrated in this section is the most commonly used when performing Live Work on voltages up to and including 33 kV. Additional or alternative equipment may be used provided it is designed and tested to comply with the relevant standards and gains approval from TasNetworks.

8.2.1 INSULATING GLOVES AND SLEEVES

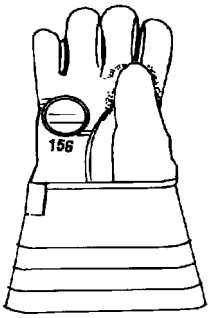
Insulating gloves and sleeves are manufactured from flexible insulating material (Type 1 rubber) and are available in all four classes (as per Table in Section 11.3). These gloves and sleeves are two coloured (e.g. inside red, outside yellow), which facilitates damage detection and determining if the correct side is facing out.

8•2•1•1 INSULATING GLOVES

These are available with the gloved hand curved and in a range of hand sizes and cuff lengths. (Cotton gloves may be worn under the insulating gloves to absorb excess perspiration).



8•2•1•2 GLOVE PROTECTORS



These are worn over the insulating glove to provide mechanical protection and to keep it free of contaminants.

8•2•1•3 INSULATING SLEEVES

These are available curved at the elbow.

The curves greatly reduce Line Worker fatigue.

8•2•1•4 SLEEVE HARNESS

This is secured to each insulating sleeve with two threaded buttons. They are slipped over the HV Live Workers head and rest on their shoulders.

Note: Insulating gloves and sleeves are specifically designed, approved and tested to rated voltage and are worn with approved protector gloves.

Note: The sleeve straps shown opposite are a new alternative option to use to secure the sleeve harness.

8.2.2 SAFETY HELMETS

Safety helmets generally have a life span of at least three (3) years from the time of issue and therefore helmets in regular use shall be replaced after this period of time. (The user should examine the helmet regularly and replace it if any damage is evident).

No helmet should be re-issued unless it has been thoroughly cleaned and inspected. Generally when re-issuing a helmet to a different person, a new harness should be fitted.

Should any components of the helmet deteriorate more rapidly in service than the recommended interval, they should be replaced. (Harnesses may need replacement after two (2) years from the date of issue).

Note:
For helmets used infrequently, stored away from sunlight, dirt and extremes of variation in temperature, the above guidelines may be varied.

Conversely, helmets exposed to abnormally high levels of wear and tear may need component, or complete replacement at shorter periods than the time intervals shown above. The user should examine the helmet regularly, and discard if any damage is evident.

8.2.3 GENERAL WORK CLOTHING

Suitable approved arc flash protective work clothing, as per TasNetworks **PPE Procedure**, shall be worn during Live Work.

Protective work clothing shall consist of adequate covering of the body from neck to wrists and ankles. It should fit well and not incorporate any metal fasteners.

Safety footwear with non-slip soles shall also be worn.

8•3 OTHER EQUIPMENT

8.3.1 INSULATING BARRIERS

Insulating barriers (or covers) are items of insulating material specifically designed, approved and tested for use as:

- Line covers.
- Insulator covers.
- Dropout covers.
- Cross arm covers.
- Deadens covers.

These “covers” are used to prevent HV Live Workers making accidental contact with apparatus at a different potential.

Insulating barriers are manufactured from either “rigid” or “flexible” material.

8•3•1•1 RIGID BARRIERS

Rigid barriers are manufactured from either high impact acrylo-nitrile butadiene styrene (ABS) plastic or high-density polyethylene and are available in a wide variety of configurations. The various categories are detailed in Table 3 - 1 Below.

Category	Phase to Phase Voltage
1	25.0 kV
2	34.5 kV
3	46.0 kV

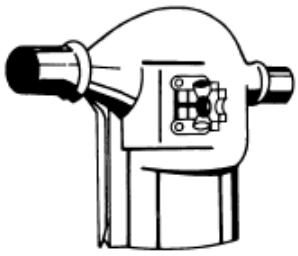
Table 3 - 1 Rigid Barriers

8•3•1•1•1 CONDUCTOR COVER – CAT. 1.

This is 1.5 metres in length and is designed to insulate the conductor. It is available with or without a grip-all adaptor and is designed to interlock with insulator covers and other conductor covers of similar type.

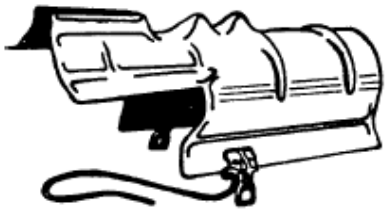
8•3•1•1•2 INSULATOR COVER – CAT. 1.

This is designed to cover pin and post insulators and can be interlocked with conductor covers. This cover is available in two heights: (150 mm or 225 mm) and with or without a grip-all adaptor fitted.

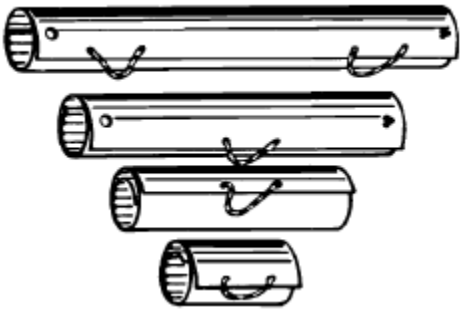


8•3•1•1•3 CROSS ARM COVER

This is designed to fit over a cross arm and slotted so as to slide around an insulator pin (below the insulator). This provides protection against tie wire contacting a steel cross arm when tying in or untying conductors.



8•3•1•1•4 POLE COVERS



These are designed to insulate a section of pole and are available in either 225 mm or 300 mm diameter with a range in length from 0.6 metre to 1.8 metres.

8•3•1•2 FLEXIBLE BARRIERS

Flexible barriers are manufactured from a flexible insulating material and are available in the classes detailed in Table 3 - 2 Below.

Class	Rated Voltage (Phase to Phase)	Working Voltage (Phase to Phase)
1	10 kV	5 kV
2	20 kV	15 kV
3	30 kV	25 kV
4	40 kV	35 kV

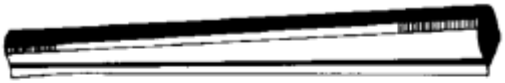
Table 3 - 2 Flexible Barriers

Rated Voltage is the phase-to-phase voltage at which the equipment is tested.

Working Voltage is the phase-to-phase voltage on which the equipment may be used.

8•3•1•2•1 LINE HOSE COVERS

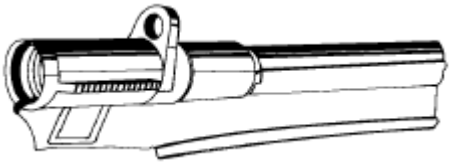
Straight line conventional in Classes 2 and 3. These covers completely enclose the conductor and can be joined together with the use of a separate insulated joiner.



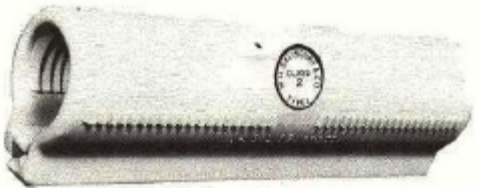
Straight line conventional with connector ends in Classes 2 and 3.

Extended lip type in Class 4.

Extended lip type with connector end in Class 4.

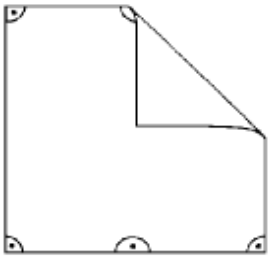


Designed to join together non-connector end line hoses. (Classes 2 and 3).

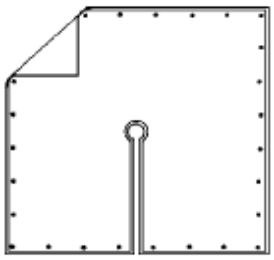


8•3•1•2•2 INSULATING BLANKETS

Insulating Blanket - Eyelet style.
These are flat, generally square in shape and fitted with reinforced eyelets, which are used to secure them. (They are available in Classes 2 and 4).

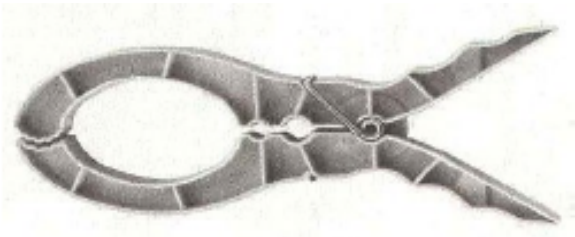


Insulating Blanket - Slotted style.
Identical to the eyelet style, except for a slot running from one side to the center of the blanket.
This slot is to improve and simplify application to various electrical apparatus. (They are available in Classes 2 and 4).



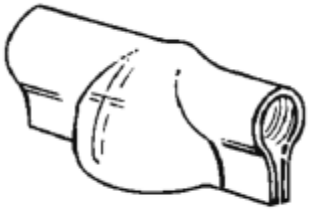
8•3•1•2•3 BLANKET PIN (PEG)

These are used to secure insulating blankets in position. (They are available in 240 mm and 340 mm sizes).



8•3•1•2•4 INSULATOR COVER

Designed in various configurations to suit pin and post insulators and are compatible for interlocking with flexible hoses.



8.3.2 CONDUCTOR SUPPORT EQUIPMENT

8•3•2•1 RATCHET HOISTS

Suitable for either Live Work Stick method or Glove and Barrier method use. Strap hoists are fitted with rings on all latches hooks and control levers to facilitate ease of positioning and operation.
The operation of the hoist is via the insulated handle. Strap hoists shall only be used in conjunction with an insulating link stick.

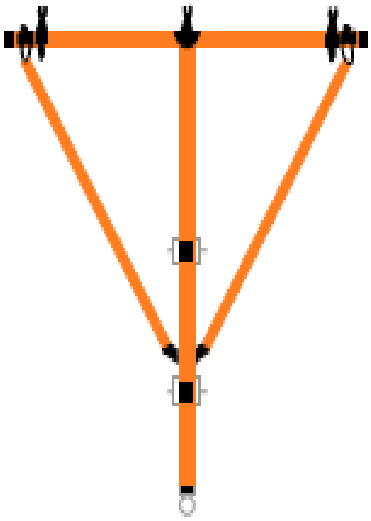
SWL = 750 / 1500 kg.

8•3•2•2 AUXILIARY ARM

The Glove and Barrier Auxiliary Arm is used to support the conductors to facilitate the replacement of insulators, poles or cross arm's. Two 63 mm wire tong saddles are used to mount the auxiliary arm mast to the pole.

There is a range of wire holders available for use with the auxiliary arm. These include the types identified on the next page:

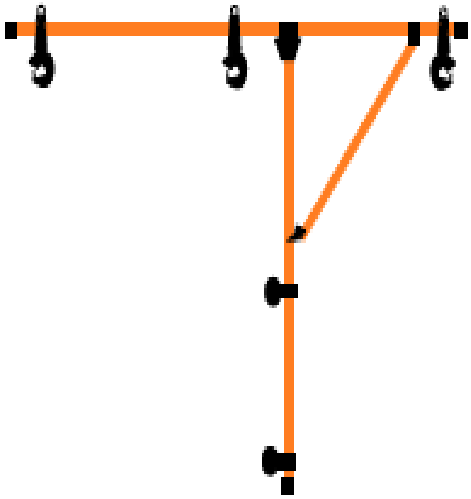
The cross arm / wire holder assembly – Double Braced SWL = 210 kg. (Total)
-- Single Braced SWL = 70 kg. (Total)



Double Braced

(Balanced Load)

Each wire holder **SWL** = 70 kg



Single Braced

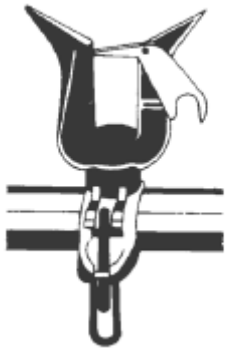
(Unbalanced Load)

Each wire holder **SWL** = 23 kg.

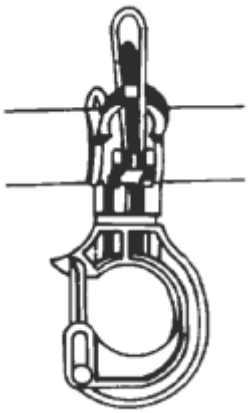
8•3•2•3 WIRE HOLDERS

8•3•2•3•1 FORK TYPE WIRE HOLDER

This is fitted in the upright position on the auxiliary arm **SWL**= 70 kg.

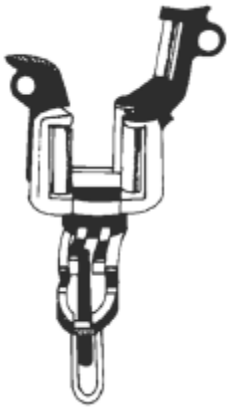


8•3•2•3•2 TYPE WIRE HOLDER



This is fitted in the suspended position on the auxiliary arm.
SWL = 70 kg.

8•3•2•3•3 ROLLER WIRE HOLDER

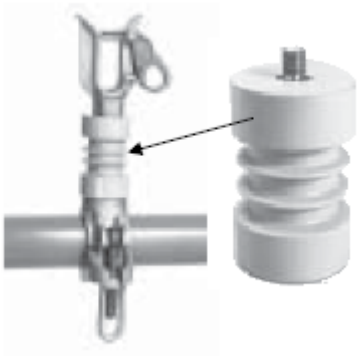


This is fitted in the upright position on the auxiliary arm and allows for conductor movement. (It is fitted with rollers).

SWL = 90 kg.

8•3•2•4 CONDUCTOR SUPPORTS

8•3•2•4•1 EPOXY INSULATOR



These are fitted on the "arm" in the upright position and used to insulate the wire holder from the alloy bangle attached to the auxiliary cross arm.

They shall be used with the wire holder at all times. They can also be used in other situations as well.
SWL = 70 kg.

8•3•2•4•2 POLE MOUNTED TEMPORARY CONDUCTOR SUPPORT

Used to temporarily support conductors during maintenance and is attached to the pole via a chair tightener or ratchet strap.

Single (760 mm). **SWL** = 90 kg. Double (1220 mm). **SWL** = 140 kg.

8•3•2•4•3 SPIRAL LINK STICK

This is used to insulate strap hoists or ropes from anchor points on poles.
A.B. Chance: **SWL** = 1500 kg. Hastings: **SWL** = 900kg.

8•3•2•4•4 EXTENSION STICK

Used on intermediate poles, of less than 15 degrees of line angle, to raise the outside conductors to allow greater access to center conductor or to relocate the center conductor for pole erection.

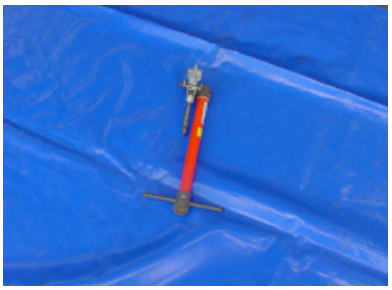
SWL= 40kg with 700mm stick/post

8•3•2•4•5 V-ARM SUPPORT

Used on intermediate poles. Attached to pole to support conductors for the replacement of cross arms and insulators.

SWL=70kg per wire holder (max 80kg per side)

8•3•2•4•6 TEMPORARY PARKING BAR (HANGER



Used to support the end of temporary bypass jumpers.

8.3.3 INSULATING STICKS AND ATTACHMENTS

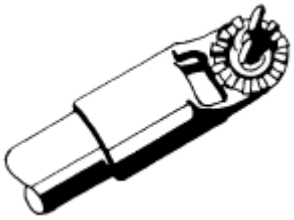
8•3•3•1 UNIVERSAL STICKS

These are designed for use as handles for the attachment of a variety of tools and equipment used for Live Work.

They vary from 0.75 metres to 3.0 metres in length with a diameter of 32 mm. They are normally provided with a spline anchorage on either end.

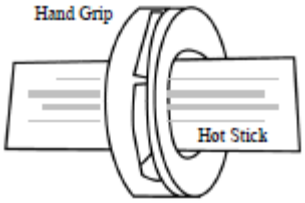
8•3•3•2 SPLINE ANCHORAGE

Enables tools to be set at various angles up to 90°. A universal adaptor may be added between the stick and the tool to obtain the desired angle.



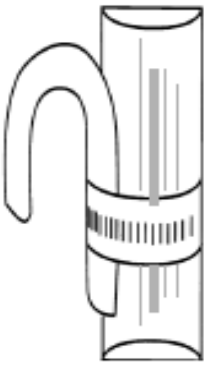
8•3•3•3 HAND GUARDS

Used to indicate the minimum length of insulation required between a HV Live Workers hands and the live metal ends on a universal stick.



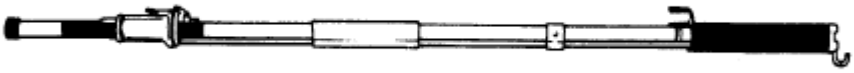
8•3•3•4 TOOL HANGER

May be attached to a universal stick to enable it to be suspended from an appropriate hanging position.



8•3•3•5 GRIP-ALL CLAMP STICK

Primarily designed for installing and removing Live Work clamps and rigid insulating covers. (These are sometimes referred to as Shotgun Sticks).



The operating mechanism incorporates a sliding hand grip that opens the hook to grasp a clamp “eye screw” and retract it into the tool head.

A thumb latch must be depressed to release the locked hand grip to open the hook.

8•3•3•6 WIRE HOLDING STICK

Fits wire sizes = 4 mm – 38 mm Dia.

May be used on or around live conductors for forming, bending and positioning loops and for holding of conductors during splicing operations. The head of this tool can be locked in three (3) different positions.

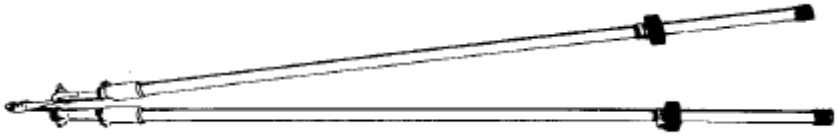
8•3•3•7 CONDUCTOR CUTTERS - RATCHET TYPE

Fitted with a cutter head, which is designed to cut aluminium, copper and single steel strand ACSR. The cutter head assembly is replaceable / interchangeable.

(It is often used in conjunction with the Wire Holding tool shown above).

8•3•3•8 WIRE CUTTERS - LIGHT DUTY

Side cutters fitted to insulating handles and are used for cutting tie wire or small gauge single wire.



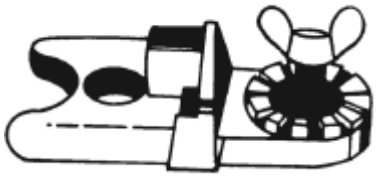
8•3•3•9 PLIERS

Are fitted to insulating handles and are used for all typical applications where pliers are required.
.

8•3•3•10 TOOLS FOR ATTACHMENT TO UNIVERSAL STICKS

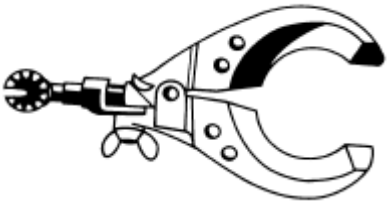
8•3•3•10•1 ADAPTOR SPLINE COUPLING

Designed to fit the grip-all clamp stick and allows for attachment of universal tools.



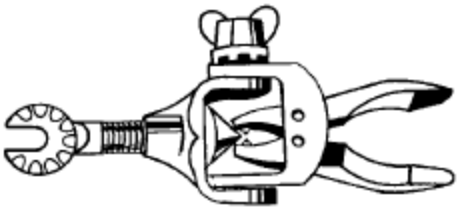
8•3•3•10•2 ADJUSTABLE INSULATOR FORK

Used for holding insulators steady when handling security clips and clevis pins. The fork is equipped with fibre jaws with a chamfer on one side and is designed to grasp disc insulators between the porcelain and the metal cap. Jaws adjust from 76 – 114 mm.



8•3•3•10•3 ALL-ANGLE PLIERS

Designed to grasp from any angle and are opened and closed by rotating the spline screw. The pliers are generally used as a holding device for loose hardware.



8•3•3•10•4 APPLICATOR RING

Used for the installation and removal of spiral vibration dampers, retaining rods, armour rods and helical terminations.

8•3•3•10•5 CLEVIS PIN HOLDER – SHORT

Used for removing or replacing bolts and clevis pins. It has a slot and adjustable leaf spring, enabling it to hold bolts or pins up to 16mm diameter.

8•3•3•10•6 CLEVIS PIN HOLDER – LONG

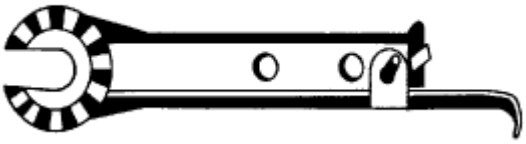
Used for replacing bolts and clevis pins in semi-recessed areas where tool clearances are restricted.

8•3•3•10•7 SNAP OUT SPLIT PIN REMOVER

The principal tool used to release hump back split pins or remove standard split pins.
It comprises a hook for engaging the pin eye and a compression spring in the shank which, when released by a quick jerk on the stick, produces a hammer like action which will release the split pin.

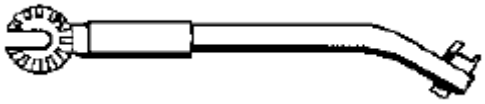
8•3•3•10•8 SPLIT PIN TOOL - ALL PURPOSE

Can be used for removing and replacing split pins.
The tool comprises a hook for engaging the pin eye and a compression spring in the shank which, when released by a quick jerk on the stick, produces a hammer like action which releases the pin. (Suitable for use on clevis pins and ball socket insulators).



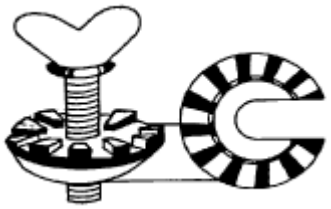
8•3•3•10•9 SPLIT PIN / COTTER PIN HOLDER

Used to install split pins or cotter pins. Will hold the pin firmly, yet readily releases once engagement is made.



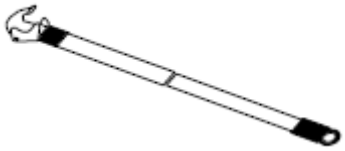
8•3•3•10•10 UNIVERSAL ADAPTOR

May be installed between a universal stick and any tool attachment to enable almost any angle of approach to be achieved.
(Useful for working in close positions).



8•3•3•10•11 WIRE TONG STICKS - 38 MM AND 63 MM

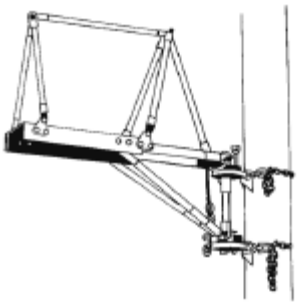
These are attached to wire tong saddles / lever lifts and are used for holding and moving live conductors. Each wire tong is fitted with jaws and a butt swivel ring. (These are used in conjunction with other support equipment to create temp. rig).

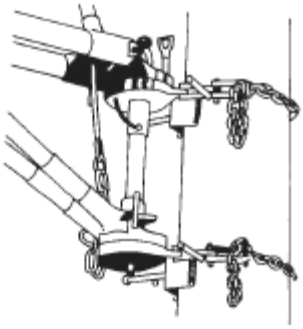


8.3.4 INSULATING POLE PLATFORM

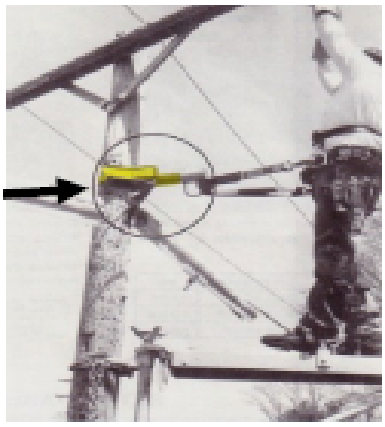
The insulating pole platform has an insulating section between the pole attachment bracket and the work platform is subjected to dielectric tests in accordance with ASTM: F711 or its equivalent. The insulating pole platform has a non-slip surface and there should be provision for a 6 kN anchorage point.

Maximum Load Rating = 225 kg.





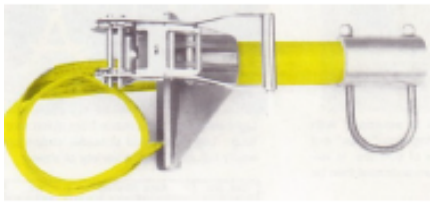
Platform Railing Provides an insulated horizontal rail, mounted 600 mm above the platform tread surface. This is used as the attachment point for the safety harness or body belt lanyard. (Pole strap).



Fall Restraint / Anchor

Note. Whenever a Line Worker is working from the pole platform a "fall restraint / anchor tool", similar to that shown at right, MUST be attached to the pole above the platform for attachment of the HV Live Workers safety lanyard.

The "anchor tool" should be fastened to the pole at a height comparable to the Live Workers waist above the floor of the platform. See diagram at right.



The **Pivot Attachment** attaches to the pole via a chain tightener and provides 180° rotation.

The "lanyard" of the safety belt / harness shall be attached to this fall restraint / anchor tool in a manner that prevents the Line Worker from falling from the platform should they lose balance.

8.3.5 POLYPROPYLENE ROPE

Only synthetic rope with electrical properties, which comply with the requirements of ANSI/IEEE 516, and mechanical properties not inferior to polypropylene rope manufactured to AS 4142.2 shall be used for Live Work.

All ropes used for Live Work shall be used within their Safe Working Load (SWL) for the tension or mass to be supported.

For a more accurate determination of the SWL of a specific rope - a rope specification table (as supplied by rope manufacturers) can be consulted.

The rope presently in use by Tasmanian Live Work personnel is known as "Polypropylene Blue." The table below shows the respective weight per unit length, the breaking strain and SWL of the two (2) sizes shown.

Size of Rope	12 mm Diameter	16 mm Diameter
Weight per coil	17.3 kg.	30.5 kg.
Length per coil	250 metres	250 metres
Weight per metre	0.07 kg.	0.1 kg.
Breaking Strain	1870 kg.	3050 kg.
Safe Working Load	288 kg. (New Rope)	512 kg. (New Rope)
Safe Working Load	192 kg. (Used Rope)	341 kg. (Used Rope)

Under no circumstance should a fibre rope be loaded in excess of its Safe Working Load (SWL). The minimum "breaking load" should never be considered as being the Safe Working Load.

The Safe Working Load (**SWL**) of natural / synthetic fibre ropes can generally be calculated as follows:

SWL of <u>New</u> Natural Fibre Ropes. Formula. SWL (in kg) = (Diameter. in mm)^2

SWL of <u>New</u> Polypropylene Ropes. Formula. SWL (in kg) = (Diameter in mm)^2 X 2

SWL of <u>Previously Used</u> Natural and Synthetic Fibre Ropes.
Formula. SWL (used rope) = SWL (new rope) X 2/3

When it is necessary to attach ropes to live conductors, insulating link stick(s) or insulator(s) shall be fitted between the rope end(s) and the conductor.

Ropes used in Live Work may be used in the following configurations:

• **Side / Spreader Rope.** A rope (preferred size 16 mm) 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.

Note:

• Ropes shall only be connected to a live conductor via an insulating link stick.

• Only approved fibre ropes shall be used and the correct type and size of rope must be selected to perform the job safely. Defective or damaged rope must be removed from service.

• The minimum diameter rope to be used for Live Work is 12 mm.

8.3.6 STRAIN AND TENSIONING EQUIPMENT

8•3•6•1 BLOCK AND TACKLES

These shall be of an approved type for Live Work and be fitted with approved synthetic rope and synthetic sheaves. The synthetic blocks shall be fitted with safety hooks.

The Safe Working Load (SWL) of the tackle shall be predetermined to ensure it is adequate for the task.
Minimum size rope to be used is 12 mm Dia.

SWL = 1500 kg. (Double & triple sheaved).

8•3•6•2 POLE MOUNTED CAPSTAN WINCH

These can be used for installing, vertical Air Break Switches, Gas Switches, Reclosers, small Transformers etc. They can be petrol driven or electric.

These provide a mechanical advantage that is dependent on the number of turns applied to the capstan drum.

Minimum size rope to be used is 12 mm Dia.

Refer and comply with **WP Operating Portable Winches**.

8•3•6•3 NGK WEB STRAP HOIST

NGK Web Strap Hoists

www.tengroup.com.au

Nagaki NGK Web Strap Ratchet Hoists

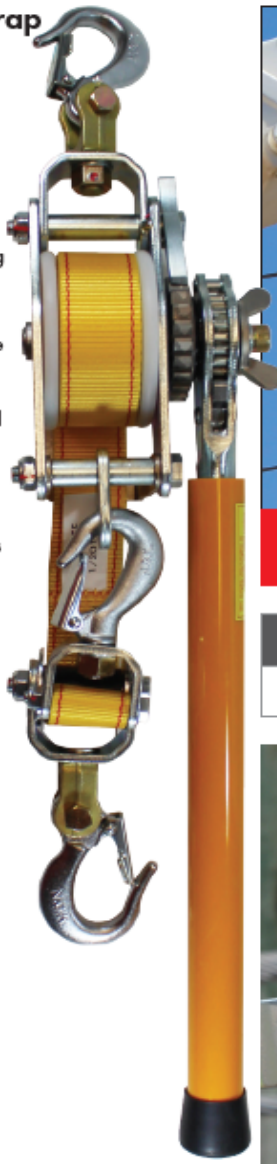
Part No. N1500P-EX-L

The Nagaki N1500P-EX-L is a lighweight hoist with a lifting capacity of 400kgs in a double line configuration. Specifically designed for use where line crews need to lift hardware during installation.

The NGK Lifting web strap hoists feature super-strength 40mm wide web straps, insulated fiberglass handles and a special handle neck that will bend if the unit is overloaded to prevent damage to the puller and injury to the operator.

Features

- Convertible series with 3 hooks
- Lightweight
- Insulated handles rotate 360°



Insulated handles rotate 360° on all models

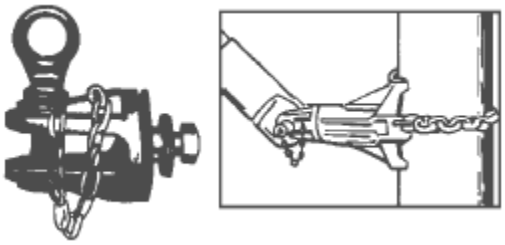
Pull	Pull WLL	Lift WLL	Handle Length	Weight
2.0m Double 3.5m Single	750kg Single 1500kg Double	200kg Single 400kg Double	460mm	4.8kg

Engraved marking to meet Australian Standards AS1418.2

8.3.7 MECHANICAL SUPPORT EQUIPMENT

8•3•7•1 WIRE TONG SADDLES

38 mm and 63 mm.



These saddles are attached to the pole and support either a 38 mm or 63 mm. wire tong stick. When additional clearance from the structure is required a tong saddle extension may be fitted to the saddle.

SWL = 360 kg. (With extension).
= 450 kg. (Without extension).

8•3•7•2 WIRE TONG SADDLE CLEVIS

Used to attach the butt ring of a wire tong to a wire tong saddle.

8•3•7•3 SNUBBING BRACKET

SWL = 450 kg.
Attached to the pole and used as an anchor point for hand or tackle ropes.

8•3•7•4 LEVER LIFT

This is attached to the pole and used in conjunction with a wire tong stick to raise or lower a conductor.

SWL = 450 kg.

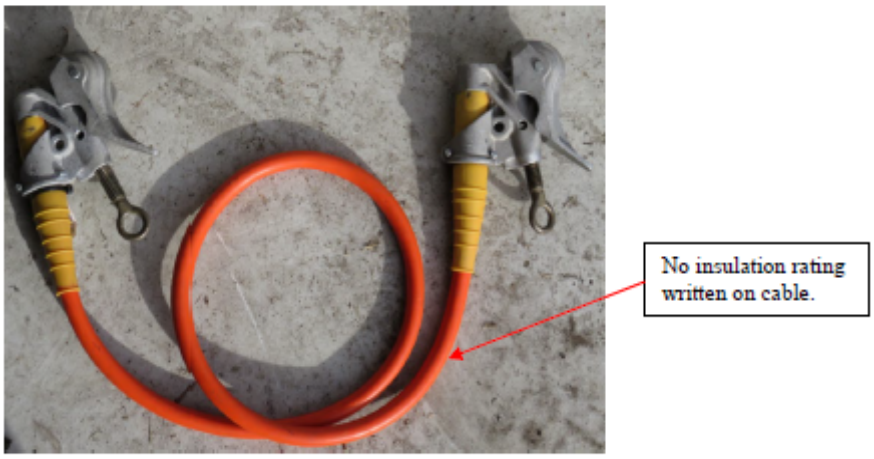
8.3.8 TEMPORARY BRIDGING AND BYPASS TOOLS

Temporary bridging / bypass tools are used for electrically bypassing the work areas where apparatus is being replaced or maintained.

8•3•8•1 TEMPORARY BYPASS JUMPER - HAND & STICK APPLICATION

Used with Live Work stick methods and is installed and removed with grip-all clamp sticks. *This can also be applied by hand using Glove & Barrier method*.

The following shows the different types of bypass jumpers used by TasNetworks



(a) Stick Application – insulation not rated

(b) Stick Application – insulation rated to 25Kv

The **cable size** selected shall be consistent with the current and fault current rating of the apparatus being bypassed.

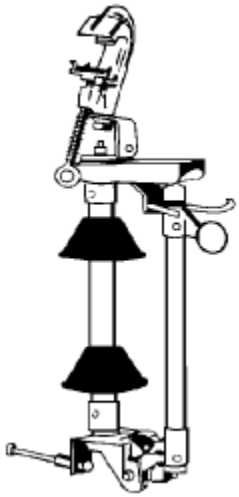
"AWG" = American Wire Gauge

Bypass Jumper Cable / Conductor Size			Continuous Current Rating
#2 AWG	33.6 mm²	(6.54 Dia)	200 amps
1/0AWG	53.5 mm²	(8.25 mm Dia.)	260 amps
2/0 AWG	67.4 mm²	(9.27 mm Dia.)	300 amps
4/0 AWG	107.3 mm²	(11.68 mm Dia.)	400 amps

Bypass Jumper "Clamps" Current Rating	15 kV size = 300 amp capacity. 25 kV size = 400 amp capacity. 35 kV size = 400 amp capacity (Large jaws)

8•3•8•2 TEMPORARY SOLID CUT OUT

This provides limited bypass capability during Live Work maintenance and is installed onto the line using a grip-all clamp stick. It may also be applied / removed using Glove & Barrier method.



Available in "ratings" for 15 kV and 27 kV.
Note. The fuse carrier shall always be opened / closed using an insulated stick. **DO NOT open / close by hand**.

Only solid elements are to be used with these units.

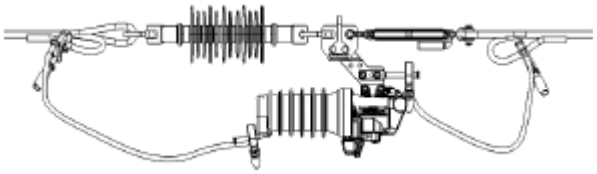
These units shall NOT be used to break or make any load.

Solid Blade Current Rating.
Continuous Current Interrupt Capacity

15 kV	300 amps	12,000 amps.
27 kV	300 amps	12,000 amps.

8•3•8•3 SIEMENS TEMPORARY ISOLATION SWITCH

The Temporary Isolation Switch comes as a set of three and can be manually operated via a HV operating stick. Operating just one switch will simultaneously operate the other two ganged switches.
Alternatively, the Temporary Isolation Switch can be operated from ground level via radio communication from software on a laptop computer (if available).



CAUTION: As the isolation occurs within the switch with no visible confirmation, it is necessary to disconnect and park the temporary bridge to ensure a visual break and confirmed isolation is made prior to personnel performing work on the load side of the switch.

NOTE: The temporary isolating switches are rated to:

- Carry up to 400 A load.
- Break load up to 2000 A.
- Take fault current up to 4000 A for 1 second.

Comply with the work practice **Live Line Portable Temporary Isolation Switch** for full details on installation and operation of temporary isolation switches.

8.3.9 HYDRAULIC EQUIPMENT

8•3•9•1 CHAINSAW

This is used to trim vegetation in proximity to energised apparatus.

Note. The chainsaw is manufactured with lightweight fibre glass handles. These handles shall not be considered as an insulating stick and shall only be operated while observing minimum approach distances.

Comply with work practice **Operating Chainsaws** covering, qualifications, training, refresher training and safe working principles.

8•3•9•2 COMPRESSION TOOL

Used to install full tension and non-tension compression sleeves on all types of conductors.

Sample Only

Sample Only

8•3•9•3 IMPACT WRENCH / DRILL

Used for all typical applications of a wrench and drill as in normal line work.

Note: The compression tool and impact wrench / drill may be used in direct contact with energised apparatus provided they are connected to approved and tested "insulated" hydraulic circuits of an EWP.

Sample Only

8.3.10 ELEVATING WORK PLATFORMS AND LADDERS

8•3•10•1 ELEVATING WORK PLATFORMS

8•3•10•1•1 STANDARDS

Elevating Work Platforms used in the performance of Live Work shall comply with the requirements of:

1. TasNetworks:

- Work procedure **Using Elevating Work Platforms**.
- Rescue Procedure **EWP And Controlled Descent Device (CDD) Rescue**.

2. *AS 1418.10 - Elevating Work Platforms* and in addition shall have:

- An insulating section in the upper boom rated at 60 kV.
- An approved insulating liner rated at 50 kV fitted into the basket.
- An approved earthing device bonded to the vehicle chassis.

- Approved emergency escape devices (2) fitted to the bucket. The release mechanisms of each shall be readily accessible so as to allow for removal by a Line Worker wearing Glove & Barrier Live Work Gloves.

Note: 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.

8•3•10•1•2 PROCEDURAL LIMITATIONS

In addition to Australian Standards AS2550.10, Cranes – Safe Use Elevating Work Platforms, statutory requirements for the operation of TasNetworks Elevating Work Platforms (EWP's) the following procedural limitations shall be strictly adhered to:

- Only EWP's, which have a current high voltage electrical test certificate, shall be used.
- At no time shall the insulated boom or basket of an EWP contact uninsulated live electrical apparatus.
- Only hydraulic tools with insulating hoses fitted to EWP's shall be permitted to make contact with energised lines.
- All persons at ground level shall be kept clear of the EWP while Live Work is being performed. HV Live Workers on the ground shall avoid making contact with the EWP when it is in close contact with energised high voltage apparatus. If "barricading" is required to achieve this – it should be installed a minimum distance of 500mm away from the EWP chassis.
- The chassis of the insulating EWP shall be earthed and where practicable be bonded to the structure to create an equipotential work zone.
- All designated safe approach distances shall be adhered to at alltimes.
- All insulating properties of the EWP and associated components shall be strictly maintained and not compromised. (Any condition / work which could affect the integrity of the insulation – shall render the EWP unserviceable).
- When one (1) EWP is used for Live Work – only **one** phase at a time may be worked on.
- When two (2) EWP's are to be used for Live Work – two phases may be worked simultaneously provided a distance of 2 metres is always maintained between the buckets of the two EWP's whilst the Live Work is performed.

Note: Two (2) Safety Observers are required for this activity.

When using two (2) EWP's – **two** phases may be worked on simultaneously, but only in the following situations:

- Outside phases on three phase intermediate poles (horizontal circuits) with the center phase appropriately insulated.
- Outside phases on three phase strain poles (horizontal circuits) with the center phase appropriately insulated and both EWP's on the same side of the cross arm. When EWP's are on opposite sides of the cross arm – any combination may be worked together, provided it is safe to do so.
- Both phases on single phase intermediate or strain poles (horizontal circuits) may be worked on together provided phase-to-phase separation is at least 1 metre.
- Any phases horizontally separated on three-phase intermediate or strain poles (double vertical circuits) may be worked together provided phase-to-phase separation is at least 1 metre. (*The 1 metre separation is to be applied to the electrical separation – air insulation distance – between the buckets and booms of the EWP's and conductors*).
- The insulating boom and basket liner shall be kept clean and free of moisture and debris.

EWP's may be used to lift or support conductors and hardware provided:

- An approved gin pole or lifting jib is used.
- An insulating section is fitted between energised conductors and the lifting jib.
- The load applied to the gin pole or lifting jib is in a vertical direction only and is within the designated SWL of the gin pole and the EWP.
- The EWP is not used to pull conductors transversely in a sideways direction.

Note: The load rating of the conductor or hardware being supported by the EWP shall be determined and continuously monitored to ensure that the safe working load (SWL) of the EWP is not exceeded. [*This is especially important when lifting a conductor over a "range" that INCREASES the tension].*

8•3•10•2 LADDERS

Ladders used by HV Live workers shall be of an insulated or non-conductive type such as fibre glass or timber.

The insulating properties of the ladder are important and MUST NOT be compromised when used for Live Work. The ladder MUST be clean and safe to use – as a support for Live Stick work.

Prior to each use, timber ladders shall be checked for cracks or splitting on the stiles and rungs.

Fibre glass ladders shall be checked for fractures or any signs of wear on the stiles and rungs, and for any rivets that may be loose.

Ropes on ladders shall be regularly checked for fraying, signs of wear, and that rope ends are securely fixed to the ladder as intended.

Note: Damaged ladders shall be removed from service until repaired.

8.3.11 VEHICLE MOUNTED CRANES

As per Section 6.11 Mobile Earthing Requirements, the chassis of lifter borers and cranes shall be bonded to a recognised earth point or driven electrode whilst being operated in the vicinity of live conductors. This also applies to, any vehicle mounted cranes as well where used for lifting around live conductors in conjunction with live work crew.

Vehicles which have their operating controls mounted on the vehicle such that they are accessed by the operator standing on the ground shall not be used**.**

The hydraulic hoses, pumps, controls etc. of borers and cranes shall be regularly inspected for hydraulic oil leaks, which could cause failure whilst the equipment is in use.

It should be in such operating condition that it allows for smooth and controlled movement of suspended loads.

Experienced operators who have the knowledge of Live Work Procedures and the requisite competence to operate plant shall only operate Cranes near live High Voltage conductors.

Personnel required to erect poles through live High Voltage conductors shall successfully complete refresher training every twelve months.

Operators shall hold a current National Certificate for plant that requires it. [Initial training shall only be conducted in proximity to dead conductors].

Parts of a crane that are not insulated shall be carefully monitored to ensure that they do not encroach within the Minimum Approach Distances.

8•4 CLEANING AND MAINTENANCE OF EQUIPMENT

The proper inspection, cleaning and maintenance of Live Work tools and equipment is an important and integral part of the HV Live Worker's role.

Well-maintained tools and equipment will result in extended life and will ensure the safety of the Line Worker and integrity of the electrical system.

Any tools or equipment suspected of being defective or requiring cleaning shall be withdrawn from service for detailed inspection / testing. Once repaired – they shall be subjected to electrical testing prior to returning to service.

Note: All Live Work equipment shall be cleaned and maintained fortnightly. Cleaning interval may be extended under certain emergency conditions provided that period is minimal and that the equipment is inspected and deemed safe for use by the Live Work team.

However, only equipment which has actually been used during the preceding two week period needs to be cleaned / maintained.

Special Note: Live Work equipment shall not be laid directly on the ground or stored ear greases and oil based substances.

8.4.1 CLEANING OF EQUIPMENT

8•4•1•1 INSULATING STICKS

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

Wiping down with Methylated spirits and then wiping over the entire stick surface with a silicone impregnated cloth.

8•4•1•2 RIGID AND FLEXIBLE INSULATING BARRIERS

Insulating barriers shall be cleaned using a cleanser that does not cause the material to deteriorate or reduce its insulating qualities. The insulating barriers shall be rinsed with clean water to remove any excess cleaner. They shall then be wiped dry with a soft cloth.

8•4•1•3 INSULATING GLOVES AND SLEEVES

Insulating gloves and sleeves shall be cleaned using a cleanser that does not cause the material to deteriorate or reduce its insulating qualities. The insulating gloves and sleeves shall be rinsed with clean water to remove any excess cleanser and then placed in a position for drying (e.g. rack), which shall not cause stressing of the material.

8•5 MAINTENANCE OF EQUIPMENT

8.5.1 INSULATING STICKS (HOT STICKS)

Insulating sticks shall be inspected for signs of over stressing 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 that have lost their gloss or been damaged can be refurbished with a plug repair kit and gloss restorer.

Note: An approved Moisture Tester should be used, where practicable, to "test" Hot Sticks after they have been cleaned.

8.5.2 INSULATING BARRIERS – FLEXIBLE

Flexible insulating barriers shall be inspected for holes, tears, cuts and any indication 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.

Note: When barriers are to be stored for lengthy periods of time – they need to be cleaned, powdered and stored in a dry clean storage space. Adhesive tape should not be used on barriers as the adhesive may react chemically with the material.

8.5.3 INSULATING BARRIERS – RIGID

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

Damaged ropes or plastic securing buttons shall be replaced.

Clean, dry barriers shall be returned back into their storage bag (where provided).

8.5.4 INSULATING GLOVES AND SLEEVES

Pure talcum powder should be applied to the inside surface of dry, insulating gloves and sleeves after cleaning and prior to using them. (This will ensure ease of use and prevent them sticking together).

If storage is required for a lengthy period, the inside and outside surfaces of insulating gloves and sleeves should be powdered (with Talcum powder).

Insulating gloves and sleeves shall always be stored with the bead on the outside (never inside out).

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.

Insulating gloves and sleeves shall not be stored in a folded or creased position, or underneath other objects.

Note:

- Insulating gloves and sleeves shall have contrasting colours inside and outside which will assist in easier damage detection. It also makes it easier to ensure the correct side is facing out.

- Insulating gloves shall always be subjected to a visual, mechanical and "air-test" **before** use. They shall be inspected both inside and out for pin holes, cuts, scratches, abrasions, aging, corona cutting or other mechanical damage.

- Insulating sleeves shall be visually inspected both inside and out by stretching the sleeve and inspecting for pin holes, cuts, scratches, abrasions, aging, corona cutting or other mechanical damage.

  Any damage that could affect their protective ability - would render the gloves or sleeves unserviceable.

- Insulating gloves shall be tested and maintained in accordance with **Australian Standard AS 2225, Insulating Gloves for Electrical Purposes**.

8.5.5 GLOVE PROTECTORS

Cotton gloves that cover the wrist should be worn beneath the insulating gloves to assist in the absorption of perspiration and improve user comfort.

Leather protector gloves shall be worn over insulating gloves at all times. These gloves shall comply with the requirements of ASTM: F696 or its equivalent.

All protector type gloves shall be visually inspected for any sign of deterioration that could affect their ability to adequately protect the insulating gloves they are to cover. Any damage that could affect the protective ability could render the gloves unserviceable.

Leather protector gloves, which have been heavily contaminated by any oil, based substances, to the extent that the rubber insulating gloves may be damaged, shall be discarded.

8.5.6 INSULATING POLE PLATFORM

The pivot mounting attachment of the insulating pole platform shall be thoroughly cleaned and lubricated.

All chains shall be inspected for signs of stress.

Chain tighteners and pivot mounts are to be maintained in a free running condition.

The securing bolt for the pivot mount is to be inspected thoroughly for any sign of damage or excessive wear.

All safety pins on the railings shall be inspected and secured.

The platform tread shall be cleaned, and when necessary - the tread should be refurbished with the manufacturer's safety tread kit.

Note: The above functions shall be carried out fortnightly and the fibreglass components of the platform cleaned with methylated spirits and then wiped over with a Silicone impregnated cloth.

8.5.7 BYPASS / BRIDGING TOOLS

(Temporary Jumpers and Dropouts).

Check the operation on all moving components and clean and lubricate as required.

Check security and condition of all electrical connections and "contact" surfaces and;

Periodically, jumper heads may need inspection and cleaning with a wire brush, shown in following picture, to remove build up of contaminants from conductors and to maintain a good electrical connection.

Typical Live Line wire cleaning brush

Note: Ensure electrical tests are carried out as stipulated. (See Section 8.6).

8.5.8 WIRE TONG SADDLES, LEVER LIFTS AND SNUBBING BRACKETS

Wire tong saddles, lever lifts and snubbing brackets shall be examined for signs of cracking, excessive wear or any other visible damage. The condition of "threaded" components shall be checked for functionality and security.

The equipment shall be lubricated such that all moving parts run free.

Saddle barrels shall be wiped over with a Silicone impregnated cloth prior to use in order to remove any dirt or grime.

8.5.9 ROPES AND TACKLES

Ropes and tackles shall be replaced if they become soiled or the surface has been roughened to an extent that insulating qualities may be reduced.

The synthetic blocks of tackles shall be inspected for cracks or distortion. They shall be maintained to ensure that the sheaves and head fitting run free.

Safety hooks on blocks and their associated springs shall be checked to ensure they are working correctly. They must spring back freely and remain closed.

Special Note:The are two (2) main types of "rope" which can be used for Live Work:

Insulating Rope

This is designed as an insulating tool. It is made of synthetic material with high insulation properties, is moisture resistant and maintains these properties for a sustained period of service. This rope shall not be used for any other purpose, and shall be clearly marked so that it is not inadvertently mistaken for conventional Live Work rope.

Insulating rope shall be ***electrically tested*** prior to service in accordance with ANSI/IEEE Standard 516 or equivalent.

Insulating Rope Usage

Insulating rope shall only be used and managed in a way that embraces the following requirements:

- It shall be visually inspected prior to each use.
- It shall be electrically tested at regular intervals.
- It shall be protected from atmospheric humidity contamination.
- The end sections of rope coils shall be periodically removed to prevent contamination or deterioration of the rope.
- It shall be kept completely dry between each use and stored appropriately.

Live Work Rope

This is normal synthetic rope which is kept clean and dry, but which has NO guaranteed insulating properties. This rope can be used in series with an insulating stick or composite insulator that has known insulating properties.

Inspection of this rope should be by "touch" and "sight" throughout the entire length. The inspection is best achieved by examining approximately 300 mm at a time after it is pulled through one hand, which is lightly closed around the rope. The rope should be slightly untwisted to reveal the inner surface and condition of the strands.

The rope should be examined for "external" wear by:

1. Noting any sign of local abrasion.

2. Noting any sign of cuts, nicks and contusions (rupturing or loosening of the strands oryarns).
3. Noting any reduction in diameter or excessive elongation oflay.
4. Noting any sign of dis-colouration, softening or powdering of thefibres.
5. Noting any sign of fusion (caused by heat generated throughfriction).

The rope should be examined for "internal" wear by:

1. Ensuring the interior of the rope is as bright and clean as it was when new.
2. Noting any sign of broken yarns, excessively loose strands / yarns or an accumulation of grit or powder-like dust.

Note: If there is any doubt about the ropes condition it should be condemned. When a rope has been condemned it should be destroyed at once by cutting it into unusable lengths.

WARNING. *Man-made fibre ropes usually give no indication of excessive strain and may part without warning*.

8.5.10 HYDRAULIC EQUIPMENT

Hydraulic equipment shall be examined for signs of cracking, excessive wear or any other signs of visible damage.

All hydraulic lines, flexible hoses and snap connections shall be inspected for signs of oil leaks, faulty components or mechanical deterioration.

All moving parts shall be inspected and checked for correct operation prior to use, and lubricated where required.

Oil rings and seals shall be inspected prior to use for sign of hydraulic oil leaks.

Note: All faulty equipment shall be removed from service until repaired / replaced.

8•6 TESTING OF LIVE WORK EQUIPMENT

8.6.1 ACCEPTANCE TESTING

Live Work equipment shall be submitted for testing at an approved electrical test facility prior to its initial issue. The equipment shall then be provided with a test certificate or individual equipment label, which indicates that it has passed the relevant tests.

8.6.2 ROUTINE TESTING OF LIVE LINE WORK EQUIPMENT

The recommended maximum testing intervals are defined in the appropriate "Standards" which are listed in Section 2.7 of this Document.

A more comprehensive listing of all the relevant "Standards" can be found in the Australian Standard **"High-voltage Live Working – Part 2: Glove and Barrier Work"**.

Note. For ease of use – a summary of the maximum testing intervals for Live Work equipment has been listed in the Table below.

8•6•2•1 PERIODIC TESTING INTERVALS FOR LIVE WORK EQUIPMENT

Equipment	Max.Test Interval
Insulating Sticks.	12 Months
Insulating Barriers – Flexible.	6 Months
Insulating Barriers – Rigid.	12 Months
Insulating Gloves and Sleeves.	6 Months
Insulated Jumpers.	6 Months
Insulated Hoses.	6 Months
Insulating Rope. (Not used in Tasmania)	6 Months
Conductor Support Equipment, Insulating Platforms & Temporary Dropout Tools, In Line Links, Temporary ABS.	12 Months
Insulating EWP's.	6 Months
Insulated EWP bucket Liner.	6 Months
EWP Hydraulic Oil.	6 Months

Table 9 - 4 Routine Test Periods

Before testing, each item of equipment shall be maintained and cleaned.

At the conclusion of the test, each item of equipment shall be provided with a test certificate or individual equipment label which indicates that it has passed the relevant test and also indicates the date when it is due for retest.

8•6•2•2 ELEVATING WORK PLATFORMS

8•6•2•2•1 MAINTENANCE

Prior to using Elevating Work Platforms (EWP's) for Live Work, all insulating components shall be visually inspected and wiped clean with a silicone-impregnated cloth.

The insulating boom and basket liner shall be cleaned of all moisture and debris. These components are to be washed "**fortnightly**" with soapy water and rinsed off. (Palmolive green detergent is suitable).

Whenever any work is performed on or with an EWP, which could affect its insulating properties - the EWP shall be electrically tested before being returned to service.

The tray of the vehicle is to be kept clear of debris and line hardware. The turret controls shall be kept freely accessible at all times.
All hydraulic lines, hoses and connections shall be closely checked for possible oil leaks.

Damaged fibreglass insulating material shall be repaired to prevent ingress of moisture through the glass fibres. This could weaken it structurally and affect its electrical insulation integrity. **Note:** All other maintenance of the EWP shall be in accordance with the manufacturer's requirements.

8•6•2•2•2 TESTING

The maximum interval for electrical testing of an Elevating Work Platform is detailed in the Table below.

Equipment	Maximum Test Interval
Elevating Work Platform. Includes all fibreglass components of theboom and bucket, the bucket liner and hydraulic oil and rubber hoses.	6 Months.

Table 9 - 4 EWP Electrical Testing.

Before testing, an Elevating Work Platform shall be maintained and cleaned in accordance with the requirements detailed in Section **8.3.10 ELEVATING WORK PLATFORMS AND LADDER.**
Note:

- Small samples of hydraulic oil are taken from each EWP (used for Live Work) and sent away for analysis to determine any presence of moisture / water in the oil.
- The presence of moisture / water in the oil has the potential to cause "blow-out" of a hose or to reduce the insulating properties of the hydraulic oil.
- At the conclusion of the electrical testing - the Elevating Work Platform shall be provided with a "test certificate" which will indicate it has passed the required tests and record the date when it is due for retest.

8•7 SAFE WORKING LOADS - LIVE WORK EQUIPMENT

The Safe Working Loads listed in the following Table (9 – 5) are based on equipment manufactured by AB Chance.

Table 9 - 5 Safe Working Loads

Chance Cat. No.	Description of Equipment	Safe Working Load
M4740-16W	38 mm Wire Tong Saddle (with extension).	360 kg.
M4740-3W	38 mm Wire Tong Saddle (without extension).	450 kg.
M4740-18W	63 mm Wire Tong Saddle (with extension).	360 kg.
M4740-5W	63 mm Wire Tong Saddle (without extension).	450 kg.
M1846W	Snubbing Bracket.	450 kg.
C400-1016	Lever Lift (long – epoxiglass type).	450 kg.
M4760W	Lever Lift (short - aluminium type).	450 kg.
T400-1940*	Conductor Support – Single (pole / strap type). 760 mm	90 kg.
T400-1939	Conductor Support - Double (pole / strap type). 1220 mm.	70 kg. / Wire holder
H4722	Spiral Link Stick.	1500 kg.
H4714-4	Roller Link Stick.	450 kg.
	Hoist Link Stick.	1800 kg.
H4862-51	Glove & Barrier Auxiliary Arm (double braced).	210 kg.
H4862-51	Glove & Barrier Auxiliary Arm (single braced).	70 kg.
M1848W	Chain / Wheel Tightener (for saddle).	1100 kg.
M1847	Extension Chain (for pole saddles – 450 mm).	1100 kg.
M4805-7	Epoxy Insulator (for temporary supports).	70 kg.
M4804-16	C Type Wire Holder.	70 kg.
M4805-15	Fork Type Wire Holder.	70 kg.
	Roller Wire Holder.	90 kg.
C400-0919	Rope Blocks (double sheave).	1500 kg.
C400-0918	Rope Blocks (single sheave).	1500 kg.
	Cross arm mounted Extension Stick	40 kg
	Ratchet Hoist.	750 / 1500 kg.

Footnote:

* Item T400-1940, Single Conductor Support bracket (Maxine bar), has a rated SWL of 90kg. - but in most cases is limited by the Wire Holder (SWL = 70kg.) fitted to it.

The roller wire holder is rated at 90kg and can be installed on the conductor support bracket when required.

9.0 CONDUCTOR LOADING

This section provides a guide for determining and calculating conductor loadings. The conductor loadings are comprised of internal forces (weight of conductor & loading) and external forces (gravity, tension and weather) and will act in a vertical and sideways manner.

The conductor sizes and corresponding details shown in the "Tables" in this section are consistent with TasNetworks *Overhead Line Design and Construction Standard*. These Tables contain all TasNetworks high voltage conductors used throughout Tasmania and have been prepared to assist with selection of the most appropriate Live Work Rig". (This is to ensure the Safe Working Load is NOT exceeded).

The calculated "**loadings**" are shown in kilograms (kg) to allow simple application to the Safe Working Load (in kilograms.) of the respective Live Work rig.

9•1 DOWN FORCE OF CONDUCTORS (INTERMEDIATE)

The following method of calculation based on a typical situation as indicated in Example 1. - Should be used to determine the forces, which are exerted on Live Work equipment.

This calculation shall ensure that:

The safe working load of the Live Work equipment is not exceeded.

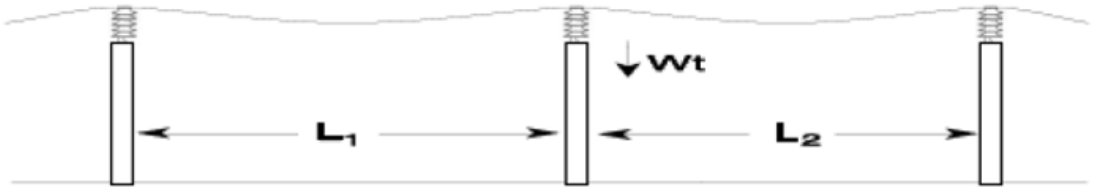
Increases in conductor tension and down force (when relocating conductors) do not place undue strain on adjacent terminations and / or ties.

Calculation of the "Down Force" of a Conductor:

The following is the overall general formula for calculating both weight and lift forces.

$$Wt = W\left(\frac{\text{Span } L_1 + L_2}{2}\right) + 2\,T_5\left(\frac{\frac{\text{Lift}}{\text{Span } L_1 + L_2}}{2}\right)$$

Where :
Wt = Down force to be lifted
W = Self load / metre of conductor (Nm)
L = Span length in metres.
T_5 = Tension @ 5^0 C.
Lift = Height conductor lifted in metres.



Example 1. Level Terrain Calculation

$$Wt = W \frac{(\text{Span } L1 + L2)}{2}$$

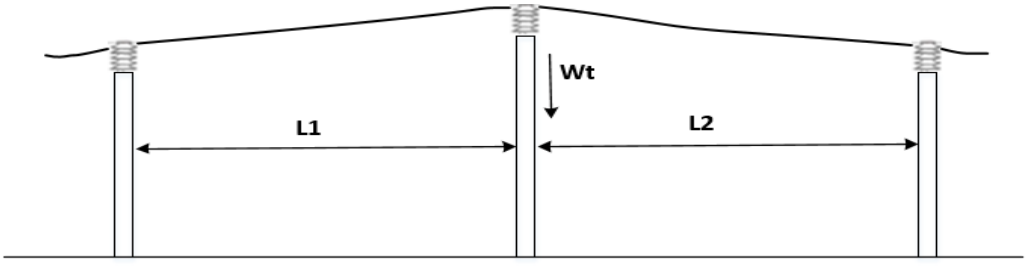
Note:

The Load Tables in Section 9.3.2 of this Manual provides details of standard size conductors as well as a cross section of current types and sizes used by TasNetworks in the distribution system.

The Tables can be used to determine the total load to be lifted at an intermediate arrangement. A suitable Live Work rig from the corresponding load diagrams may then be selected. (These are shown in Section 9.3.1 Load Diagrams)

The method of calculation used for the situation indicated in Example 1. to determine the weight lifted only, is only suitable when poles are situated on reasonably level ground and all poles are the same height.

Should there be a significant variance in the level of the poles, the load to be lifted at the intermediate arrangement location for both the weight and lift force can be calculated as detailed below in Example 1A via the accompanying formula.

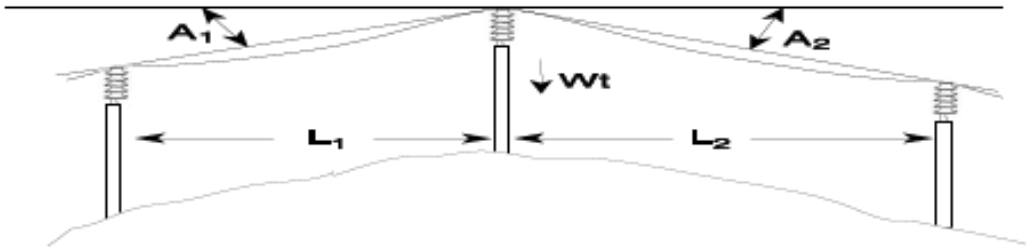


Example 1A Level Terrain Calculation – Higher Center Pole

$$Wt = W \frac{\left(\text{Span } L_1 + L_2\right)}{2} + 2\,T_5 \frac{\left(\frac{\text{Lift}}{\text{Span } L_1 + L_2}\right)}{2}$$

Where :
Wt = Down force to be lifted
W = Self load / metre of conductor (Nm)
L = Span length in metres.
T_5 = Tension @ 5^0 C.
Lift = Height conductor lifted in metres.

Where the pole heights are not the same and also the ground level is not flat, refer to Example 2. and the accompanying calculation to determine the forces involved.



Example 2. Raised Terrain Calculation

In Example 2.

$$Wt = \left(\frac{\text{Span } L_1 + L_2}{2}\right) + T\ (\text{Sin } A_1 + \text{Sin } A_2)$$

Where: Wt = Down force to be lifted.
W = Self load per metre of conductor (Nm)
L = Span length in metres
A = Angle from the horizontal to lower conductor support (in degrees)
T = Tension in newtons

The Tension shall be calculated by:

$$T = \frac{W \times (Span)^2}{8 \times Sag}$$

Where: W = Self load per metre of conductor (Nm)
Sag = Sag of span in metres.

$$Span = \frac{L_1 + L_2}{8}$$

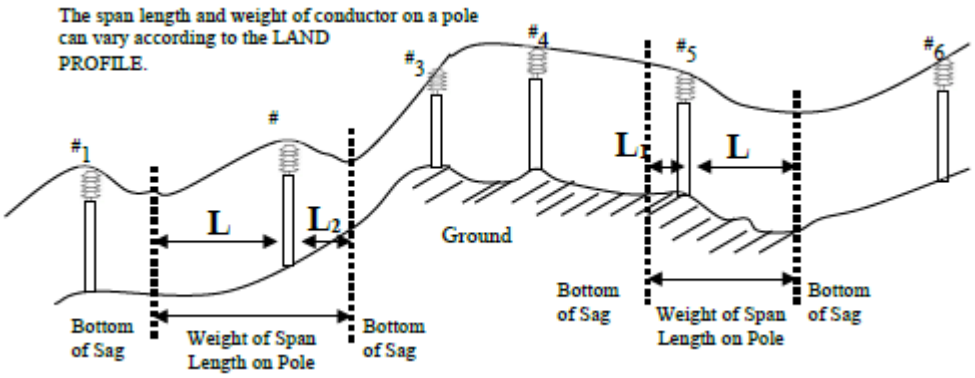
Note:

The method of calculation detailed for Example 2. - is approximate, and where there is an appreciable variance in the level of poles, the task to be performed should receive careful consideration, as the down force T (Sin A1 + Sin A2) may exceed the safe load W ((L1 + L2)÷2) of the span of conductor due to the line tension and the vertical angle.

9•2 SPAN LENGTHS AND TERRAIN

The span length on either side of a particular pole can VARY with relation to its position in the land profile. (See Example 3.)

Consequently, the weight of conductor supported on the pole can also vary with varying lengths of each span and position on the respective pole.



Example 3. Uneven Terrain

On level terrain – the lowest point of the conductor sag will be in the middle of each span (Example 1.). The "distance" between these two lowest points of conductor sag - is the "Weight of Span Length" on that pole (Example 3.).

On even sloping terrain – the weight span is also the distance between the lowest points of conductor sag in adjacent spans. The only difference is that the LOW point of the sag will be further down the slope in both spans.

On uneven terrain – the "span length" on a particular pole is similar to the others – in that it is the difference between the low points of sag in both spans. However, to calculate the actual weight of conductor supported by a pole in this situation is more difficult to calculate.

9•3 MECHANICAL LOADS OF CONDUCTORS

The calculation of mechanical loads which are to be supported by Live Work equipment when replacing insulators, cross arms or poles at strain or angle positions generally requires special calculation and reference to the design data of the particular line.

The **Reference Load Tables** in Section 9.3.2 can assist with determination of conductor weights over various span lengths, terrain profiles and pole top angle variations for specific conductor types and sizes.

The three (3) different types of Reference Tables are:

- Intermediate – Level and Sloping Terrain - Little or No Angle of Deviation.
- Hilltop Terrain.
- Line Angle.

These calculations have been determined with reference to the design data contained in TasNetworks *Overhead Line Design and Construction Standard*.
Shown on the following pages are several "load diagrams" which depict the different Live Work "rigs" fitted on poles and the corresponding Safe Working Load (SWL) of each.

Should the respective Live Work equipment have a Safe Working Load (SWL) in **excess of these values** it may be used without the need for further calculations.

Note:

Some of the following "Load Diagrams" have been included for assistance purposes only. Whilst some of them may not be regularly used here in Tasmania – they are shown in case other "Rigging" arrangements do not have the necessary SWL capacity and one of these other "arrangements" needs to be used instead.

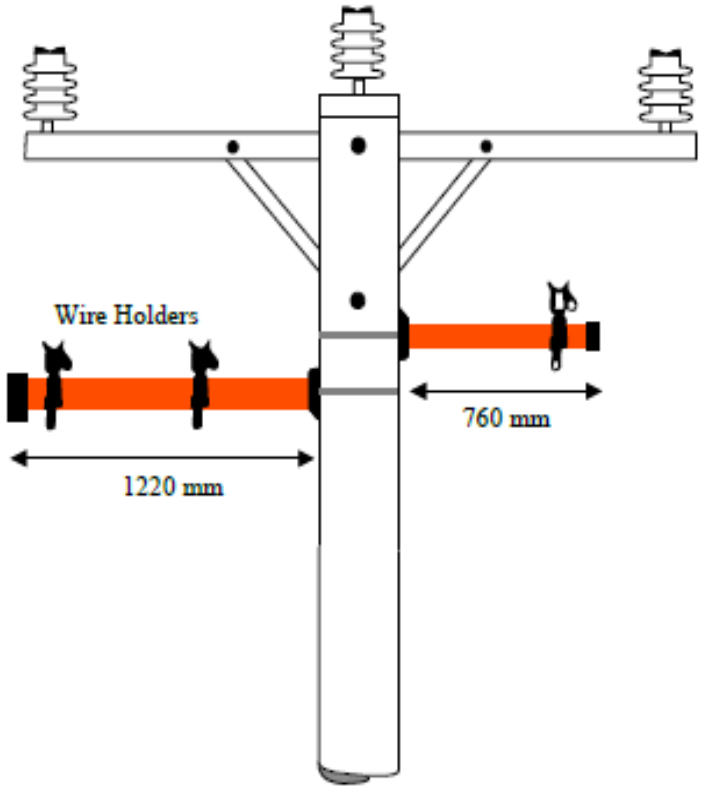
9.3.1 LOAD DIAGRAMS

9•3•1•1 TEMPORARY CONDUCTOR SUPPORTS

(Strap type).

Single (760 mm long) **SWL** = 90 kg. total. (70 kg per wire holder)

Double (1220 mm long) SWL = 140 kg. total. (70 kg. per wire holder).



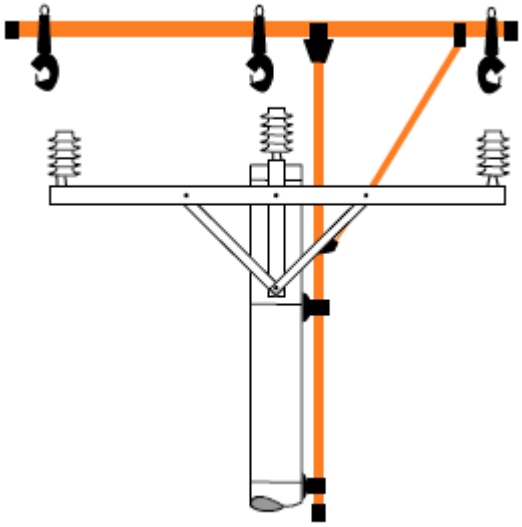
9•3•1•2 GLOVE AND BARRIER AUXILIARY ARM

Single braced (Unbalanced Load) **SWL.** = 70 kg.

(23 kg per wire holder)

Total = 70 kg.

Auxiliary Arm = 63 mm Brace = 38 mm

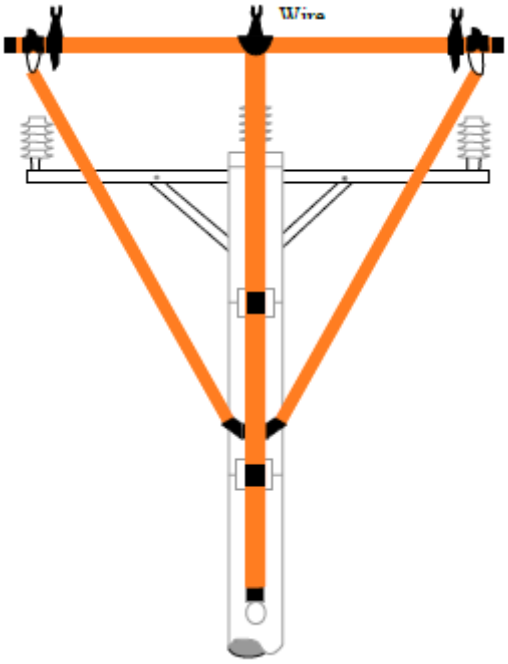


9•3•1•3 GLOVE & BARRIER AUXILLIARY LIFTING ARM

Double Braced (Balanced Load) **SWL.** = 210 kg.

(70 kg. per wire holder) Total = 210 kg.

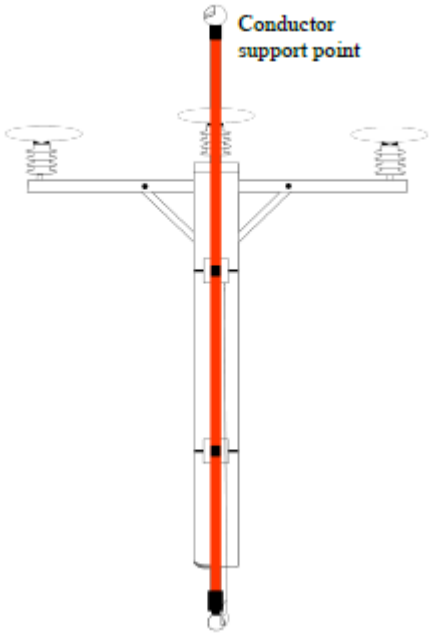
Stick Diameters: Mast = 63 mm Auxiliary Arm = 63 mm Brace = 38 mm



9•3•1•4 CENTRE CONDUCTOR LIFT

SWL = 320 kg.

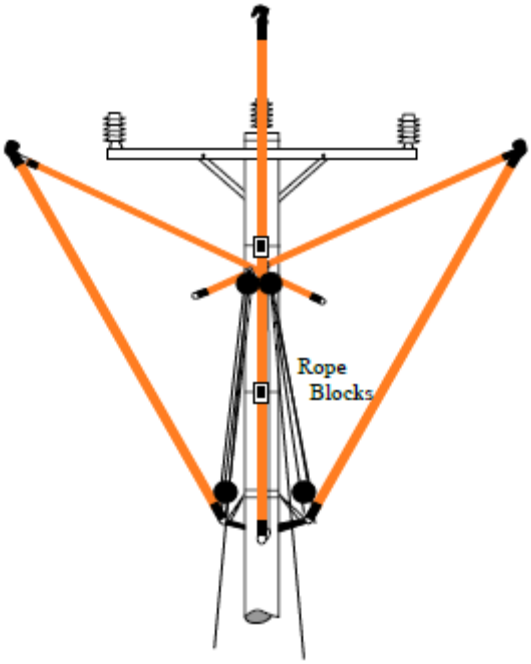
Stick dimension.
Mast = 63 mm Dia.



9•3•1•5 WIRE TONG RIG – LEVER LIFT

SWL. = 110 kg.
(per wire holder)

Stick dimensions:
Hand stick - 38 mm a.

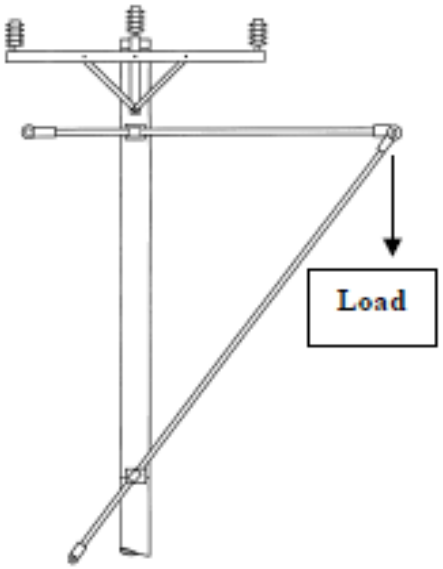


9•3•1•6 WIRE TONG RIG – POLE SADDLE TYPE

Size. 38mm & 63 mm Dia.

SWL. = 110 kg.

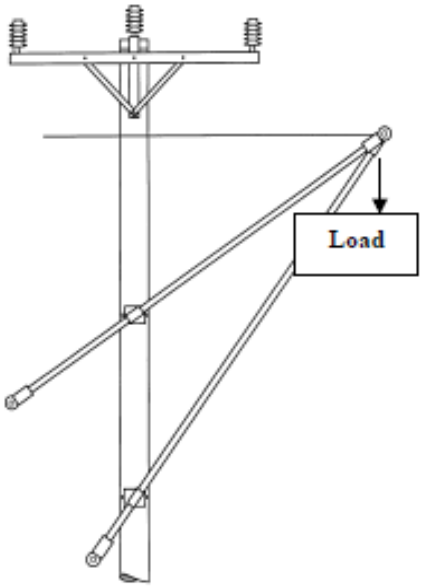
Note. If the TOP "Tong" is moved lower down the pole the SWL is reduced, as shown in next diagram.



9•3•1•7 WIRE TONG RIG – POLE SADDLE TYPE (SHORT)

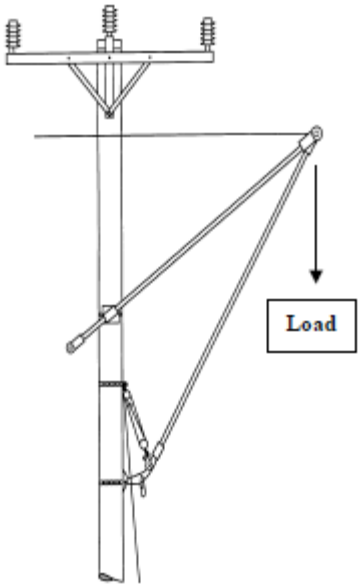
Size. 38 mm & 63 mm x 3050 mm
SWL. = 68 kg.

Wire Tong – Pole Saddle Type (Long).
SWL. = 60 kg.



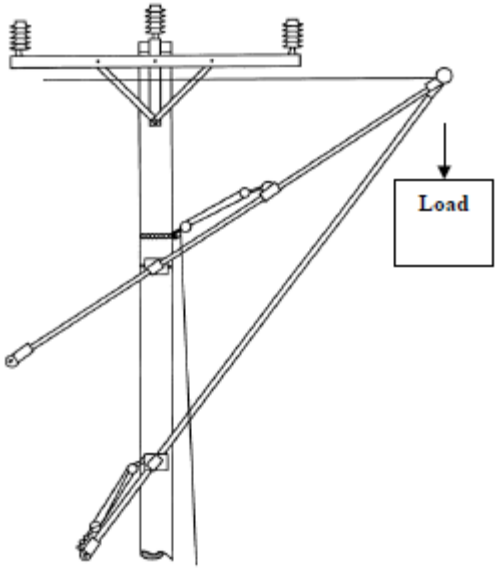
9•3•1•8 WIRE TONG RIG - LEVER LIFT (SHORT)

38 mm & 63 mm x 3050 mm
SWL. = 95 kg.



9•3•1•9 WIRE TONG RIG – SADDLE TYPE

SWL = 86 kg.



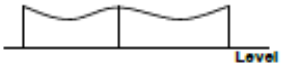
9.3.2 LOAD TABLES

Level Terrain

Sloping Terrain

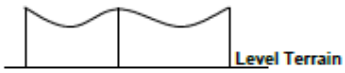
Intermediate - Level and Sloping Terrain - Little or no angle of deviation

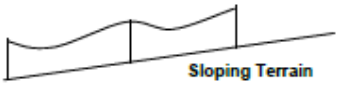
Conductor	Stranding	Diameter	Mass	Lift	Working Load (kg) Sum of half Spans (m)												Tension No wind
		mm	kg	m	40	60	80	100	120	140	160	200	250	300	350	400	kg
AAC	7/2.50	7.5	0.0943	0	4	6	8	10	12	14	16	19	24	29	34	38	106.4
				0.5	7	8	9	11	13	14	16	20	25	29	34	38	
				1	10	10	11	12	14	15	17	20	25	29	34	39	
				1.5	12	11	12	13	14	16	18	21	25	30	34	39	
				2	15	13	13	14	15	17	18	21	26	30	35	39	
				3	20	17	16	16	17	18	20	23	27	31	35	40	
	7/3.00	9	0.135	0	6	9	11	14	17	19	22	27	34	41	48	54	145
				0.5	10	11	13	15	18	20	23	28	35	41	48	55	
				1	13	13	15	17	19	21	24	29	35	42	49	55	
				1.5	17	16	17	18	20	23	25	30	36	42	49	56	
				2	20	18	19	20	22	24	26	30	37	43	49	56	
				3	28	23	22	23	24	26	28	32	38	44	50	57	
	7/3.75	11.3	0.212	0	9	13	17	22	26	30	34	43	53	64	75	85	218.3
				0.5	14	17	20	24	28	32	36	44	54	65	75	86	
				1	20	20	23	26	30	33	37	45	55	66	76	86	
				1.5	25	24	26	28	31	35	39	46	56	66	77	87	
				2	31	28	28	30	33	36	40	47	57	67	77	87	
				3	42	35	34	35	37	40	43	49	59	68	78	89	
	7/4.50	13.5	0.305	0	13	19	25	31	37	43	49	61	77	92	107	122	308.3
				0.5	20	24	29	34	40	45	51	63	78	93	108	123	
				1	28	29	33	37	42	48	53	65	79	94	109	124	
				1.5	36	34	36	40	45	50	55	66	80	95	110	125	
				2	44	39	40	43	47	52	57	68	82	96	111	126	
				3	59	50	48	49	53	56	61	71	84	98	113	127	
	19/3.25	16.3	0.433	0	18	26	35	44	52	61	70	87	109	130	152	174	453.2
				0.5	29	34	41	48	56	64	73	89	111	132	153	175	
				1	40	42	46	53	60	68	75	92	112	133	155	176	
				1.5	52	49	52	57	64	71	78	94	114	135	156	177	
				2	63	57	58	62	68	74	81	96	116	136	157	178	
				3	86	72	69	71	75	81	87	101	120	139	160	180	



Intermediate - Level and Sloping Terrain - Little or no angle of deviation

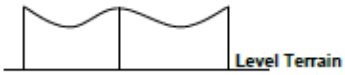
Conductor	Stranding	Diameter	Mass	Lift	Working Load (kg) Sum of half Spans (m)												Tension No wind
		mm	kg	m	40	60	80	100	120	140	160	200	250	300	350	400	kg
Copper	7/.048	3.66	0.0731	0	3	5	6	8	9	11	12	15	19	22	26	30	77.1
				0.5	5	6	7	9	10	11	13	16	19	23	26	30	
				1	7	7	8	9	11	12	13	16	19	23	27	30	
				1.5	9	9	9	10	11	12	14	16	20	23	27	30	
				2	11	10	10	11	12	13	14	17	20	23	27	31	
				3	15	13	12	12	13	14	15	17	21	24	27	31	
	7/.064	4.88	0.1295	0	6	8	11	13	16	19	21	26	33	39	46	52	136.8
				0.5	9	11	13	15	17	20	22	27	33	40	46	53	
				1	13	13	14	16	18	21	23	28	34	40	47	53	
				1.5	16	15	16	18	19	22	24	28	35	41	47	53	
				2	19	17	18	19	21	23	25	29	35	41	47	54	
				3	26	22	21	22	23	24	26	31	36	42	48	54	
	7/.080	6.1	0.2024	0	9	13	17	21	25	29	33	41	51	61	71	81	211.9
				0.5	14	16	19	23	27	30	34	42	52	62	72	82	
				1	19	20	22	25	28	32	36	43	53	63	73	83	
				1.5	24	23	25	27	30	33	37	44	54	63	73	83	
				2	30	27	27	29	32	35	38	45	54	64	74	84	
				3	40	34	33	33	35	38	41	47	56	65	75	85	
	7/.097	7.39	0.2986	0	12	18	24	30	36	42	48	60	75	90	105	120	308.4
				0.5	20	24	28	33	39	45	50	62	76	91	106	121	
				1	28	29	32	37	41	47	52	63	78	92	107	121	
				1.5	36	34	36	40	44	49	54	65	79	93	108	122	
				2	43	39	40	43	47	51	55	66	80	94	109	123	
				3	59	49	48	49	52	56	60	69	83	96	110	125	
	19/.064	8.1	0.3438	0	14	21	28	35	42	49	56	69	86	104	121	138	353.4
				0.5	23	27	32	38	45	51	58	71	88	105	122	139	
				1	32	33	37	42	48	54	60	73	89	106	123	140	
				1.5	41	39	41	45	51	56	62	75	91	107	124	141	
				2	50	45	46	49	54	59	64	76	92	108	125	142	
				3	67	56	55	56	59	64	69	80	95	111	127	143	
	19/.083	10.54	0.5953	0	24	36	48	60	72	84	96	120	149	179	209	239	603.7
				0.5	39	46	56	66	77	88	100	123	152	181	211	240	
				1	54	56	63	72	82	92	103	126	154	183	212	242	
				1.5	70	66	71	78	87	97	107	129	157	185	214	243	
				2	85	76	78	84	92	101	111	132	159	187	216	245	
				3	115	97	93	96	102	110	118	138	164	191	219	248	
	19/.101	12.83	0.881	0	36	53	71	89	106	124	141	177	221	265	309	353	887
				0.5	58	68	82	97	114	130	147	181	224	268	311	355	
				1	80	83	93	106	121	137	153	186	228	271	314	357	
				1.5	102	98	104	115	128	143	158	190	231	274	316	360	
				2	124	112	115	124	136	149	164	194	235	277	319	362	
				3	169	142	138	142	151	162	175	203	242	283	324	366	

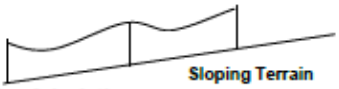




Intermediate - Level and Sloping Terrain - Little or no angle of deviation

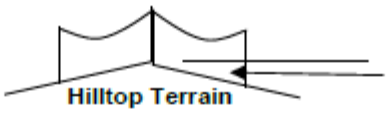
Conductor	Stranding	Diameter	Mass	Lift	Working Load (kg) Sum of half Spans (m)												Tension No wind
		mm	kg	m	40	60	80	100	120	140	160	200	250	300	350	400	kg
ACSR	6/1/2.50	7.5	0.119	0	5	8	10	12	15	17	20	24	30	36	42	48	235.5
				0.5	11	12	13	15	17	19	21	25	31	37	43	49	
				1	17	15	16	17	19	21	22	27	32	38	43	49	
				1.5	23	19	19	19	21	22	24	28	33	39	44	50	
				2	29	23	22	22	23	24	25	29	34	39	45	50	
				3	41	31	28	27	27	27	28	31	36	41	46	52	
	6/1/3.00	9	0.171	0	7	11	14	18	21	24	28	35	43	52	60	69	334.1
				0.5	16	16	18	21	24	27	30	38	45	53	61	70	
				1	24	22	23	24	27	29	32	38	46	54	62	71	
				1.5	32	27	27	28	29	32	34	40	47	55	63	71	
				2	41	33	31	31	32	34	36	41	49	56	64	72	
				3	57	44	39	38	38	39	40	45	51	58	66	74	
	6/1/3.75	11.3	0.268	0	11	17	22	27	33	38	43	54	67	81	94	108	511.3
				0.5	24	25	28	32	37	42	47	57	70	83	96	109	
				1	37	34	35	38	41	45	50	59	72	84	97	110	
				1.5	50	42	41	43	45	49	53	62	74	86	99	112	
				2	62	51	48	48	50	53	56	64	76	88	100	113	
				3	88	68	60	58	58	60	63	69	80	91	103	115	
	3/4/2.50	7.5	0.193	0	8	12	16	20	24	28	31	39	49	58	68	78	547.2
				0.5	22	21	23	25	28	31	35	42	51	60	70	79	
				1	36	30	30	31	33	35	38	45	53	62	71	80	
				1.5	49	39	36	36	37	39	42	47	55	64	73	82	
				2	63	49	43	42	42	43	45	50	58	66	74	83	
				3	90	67	57	53	51	51	52	56	62	69	77	86	
	6/4.75-7/1.60	14.3	0.404	0	17	25	33	41	49	57	65	81	101	122	142	162	744.5
				0.5	35	37	42	48	55	62	70	85	104	124	144	164	
				1	54	50	51	56	61	68	74	89	107	127	146	166	
				1.5	72	62	61	63	68	73	79	92	110	129	148	168	
				2	91	74	70	71	74	78	84	96	113	132	150	170	
				3	128	99	89	86	86	89	93	104	119	137	155	173	





Intermediate - Level and Sloping Terrain - Little or no angle of deviation

Conductor	Stranding	Diameter	Mass	Lift	Working Load (kg) Sum of half Spans (m)												Tension No wind
		mm	kg	m	40	60	80	100	120	140	160	200	250	300	350	400	kg
AAAC	7/3.00	9	0.135	0	6	9	11	14	17	19	22	27	34	41	48	54	231.87
				0.5	12	12	14	16	19	21	24	29	35	42	48	55	
				1	17	16	17	19	21	23	25	30	36	43	49	56	
				1.5	23	20	20	21	22	24	26	31	37	43	50	56	
				2	29	24	23	23	24	26	28	32	38	44	50	57	
				3	41	32	29	28	28	29	31	34	40	46	52	58	
	7/4.5	13.5	0.305	0	13	19	25	31	37	43	49	61	77	92	107	122	545
				0.5	26	28	32	36	42	47	53	64	79	94	109	124	
				1	40	37	39	42	46	51	56	67	81	96	110	125	
				1.5	54	46	45	47	51	55	60	70	83	97	112	127	
				2	67	55	52	53	55	59	63	72	85	99	113	128	
				3	94	73	66	64	64	67	70	78	90	103	117	131	
	19/4.75	23.8	0.926	0	38	56	75	93	112	130	149	186	232	278	325	371	1650.6
				0.5	79	84	95	110	125	142	159	194	239	284	329	375	
				1	120	111	116	126	139	154	169	202	245	289	334	379	
				1.5	161	139	136	143	153	166	180	210	252	295	339	383	
				2	203	166	157	159	167	177	190	219	258	300	343	387	
				3	285	221	198	192	194	201	211	235	272	311	353	396	
Steel	.3/12	5.69	0.1295	0	6	8	11	13	16	19	21	26	33	39	46	52	488.9
				0.5	18	16	17	18	20	22	24	29	35	41	47	54	
				1	30	25	23	23	24	26	27	31	37	43	49	55	
				1.5	42	33	29	28	28	29	30	34	39	44	50	56	
				2	55	41	35	33	32	33	33	36	41	46	51	57	
				3	79	57	48	43	40	40	40	41	45	49	54	60	
	3/2.75	5.6	0.139	0	6	9	12	14	17	20	23	28	35	42	49	56	522.5
				0.5	19	18	18	20	22	24	26	31	37	44	51	57	
				1	32	26	25	25	26	27	29	34	39	46	52	59	
				1.5	45	35	31	30	30	31	33	36	42	47	54	60	
				2	58	44	38	35	35	35	36	39	44	49	55	61	
				3	84	61	51	46	43	42	42	44	48	53	58	64	

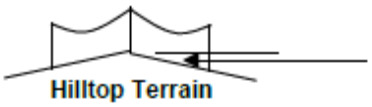


Slope angle 5 Degrees

Mass (kg) 5

Conductor	Stranding	Diameter	Mass	Distance between lowest sag points (m)												Tension	Tension
				40	60	80	100	120	140	160	200	250	300	350	400	No wind	vertical
		mm	kg													kg	kg
AAC	7/2.50	7.5	0.0943	23	25	27	28	30	32	34	38	43	47	52	57	106.4	19
	7/3.00	9	0.135	31	34	37	39	42	45	47	53	60	66	73	80	145	25
	7/3.75	11.3	0.212	47	51	56	60	64	68	72	81	92	102	113	123	218.3	38
	7/4.50	13.5	0.305	66	73	79	85	91	97	103	115	130	146	161	176	308.3	54
	19/3.25	16.3	0.433	97	105	114	123	131	140	149	166	188	209	231	253	453.2	79
Copper	7/.048	3.66	0.0731	17	18	20	21	23	24	26	29	32	36	40	43	77.1	13
	7/.064	4.88	0.1295	30	32	35	37	40	42	45	50	57	63	70	76	136.8	24
	7/.080	6.1	0.2024	46	50	54	58	62	66	70	78	88	98	108	118	211.9	37
	7/.097	7.39	0.2986	66	72	78	84	90	96	102	114	129	144	159	174	308.4	54
	19/.064	8.1	0.3438	76	83	90	96	103	110	117	131	148	165	182	200	353.4	62
	19/.083	10.54	0.5953	130	141	153	165	177	189	201	225	255	284	314	344	603.7	105
	19/.101	12.83	0.881	190	208	226	243	261	278	296	331	375	419	463	508	887	155
AAAC	7/3.00	9	0.135	52	55	57	60	63	66	68	74	80	87	94	101	264.6	46
	7/4.5	13.5	0.305	108	114	120	126	132	138	144	156	172	187	202	217	545	95
	19/4.75	23.8	0.926	325	344	362	381	399	418	436	473	520	566	612	659	1650.6	288
ACSR	6/1/2.50	7.5	0.119	46	49	51	53	56	58	61	65	71	77	83	89	235.5	41
	6/1/3.00	9	0.171	66	69	72	76	79	83	86	93	101	110	119	127	334.1	58
	6/1/3.75	11.3	0.268	100	106	111	116	122	127	133	143	157	170	183	197	511.3	89
	3/4/2.50	7.5	0.193	104	107	111	115	119	123	127	134	144	154	163	173	547.2	95
	6/4.75-7/1.6	14.3	0.404	146	155	163	171	179	187	195	211	231	251	272	292	744.5	130
Steel	.3/12	5.69	0.1295	91	93	96	99	101	104	106	112	118	125	131	138	488.9	85
	3/2.75	5.6	0.139	97	100	103	105	108	111	114	119	126	133	140	147	522.5	91

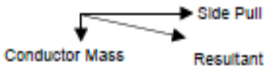
Mass = Conductor mass x span + tension vertical component.



Mass (kg) 10

Conductor	Stranding	Diameter	Mass	Distance between lowest sag points (m)												Tension	Tension
				40	60	80	100	120	140	160	200	250	300	350	400	No wind	vertical
		mm	kg													kg	kg
AAC	7/2.50	7.5	0.0943	41	43	45	47	49	51	53	56	61	66	70	75	106.4	37
	7/3.00	9	0.135	56	59	62	64	67	70	72	78	85	91	98	105	145	50
	7/3.75	11.3	0.212	85	89	93	98	102	106	110	119	129	140	151	161	218.3	76
	7/4.50	13.5	0.305	120	126	132	138	144	150	156	169	184	199	214	230	308.3	107
	19/3.25	16.3	0.433	175	184	193	201	210	219	227	244	266	288	309	331	453.2	157
Copper	7/.048	3.66	0.0731	30	32	33	35	36	38	39	42	46	49	53	57	77.1	27
	7/.064	4.88	0.1295	53	56	58	61	64	66	69	74	80	87	93	100	136.8	48
	7/.080	6.1	0.2024	82	86	90	94	98	102	106	115	125	135	145	155	211.9	74
	7/.097	7.39	0.2986	120	126	131	137	143	149	155	167	182	197	212	227	308.4	107
	19/.064	8.1	0.3438	137	144	151	158	164	171	178	192	209	226	244	261	353.4	123
	19/.083	10.54	0.5953	234	246	258	270	282	294	305	329	359	389	419	448	603.7	210
	19/.101	12.83	0.881	344	361	379	397	414	432	450	485	529	573	617	661	887	308
AAAC	7/3.00	9	0.135	98	100	103	106	109	111	114	119	126	133	140	146	264.6	92
	7/4.5	13.5	0.305	202	208	214	220	226	232	239	251	266	281	297	312	545	189
	19/4.75	23.8	0.926	611	629	648	666	685	703	722	759	805	852	898	944	1650.6	573
ACSR	6/1/2.50	7.5	0.119	87	89	92	94	97	99	101	106	112	118	124	130	235.5	82
	6/1/3.00	9	0.171	123	127	130	134	137	140	144	151	159	168	176	185	334.1	116
	6/1/3.75	11.3	0.268	189	194	200	205	210	216	221	232	245	258	272	285	511.3	178
	3/4/2.50	7.5	0.193	198	202	206	210	214	218	221	229	239	248	258	268	547.2	190
	6/4.75-7/1.6	14.3	0.404	275	283	291	299	308	316	324	340	360	380	400	421	744.5	259
Steel	.3/12	5.69	0.1295	175	178	181	183	186	188	191	196	203	209	216	222	488.9	170
	3/2.75	5.6	0.139	188	190	193	196	199	201	204	210	217	224	231	238	522.5	181

Mass = Conductor mass x span + tension vertical component.



Angle of Deviation 15 Degrees

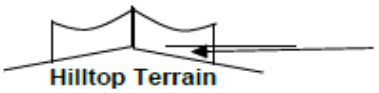
				Mass (kg) sum of half Spans (m)												15 Tension	
Conductor	Stranding	Dia mm	Mass kg	40	60	80	100	120	140	160	200	250	300	350	400	No wind kg	side pull kg
AAC	7/2.50	7.5	0.0943	29	29	29	30	30	31	32	34	37	40	44	47	106.4	28
	7/3.00	9	0.135	39	39	40	41	42	43	44	47	51	56	61	66	145	38
	7/3.75	11.3	0.212	58	59	60	61	63	65	67	72	78	86	94	103	218.3	57
	7/4.50	13.5	0.305	82	83	85	87	89	92	95	101	111	122	134	147	308.3	80
	19/3.25	16.3	0.433	120	122	124	126	130	133	138	147	161	176	193	210	453.2	118
Copper	7/.048	3.66	0.0731	21	21	21	22	22	23	24	25	28	30	33	36	77.1	20
	7/.064	4.88	0.1295	37	37	38	38	39	41	42	45	49	53	58	63	136.8	36
	7/.080	6.1	0.2024	56	57	58	59	61	63	65	69	75	83	90	99	211.9	55
	7/.097	7.39	0.2986	82	83	84	86	89	91	94	101	110	121	132	145	308.4	81
	19/.064	8.1	0.3438	94	95	97	99	102	105	108	116	127	139	152	166	353.4	92
	19/.083	10.54	0.5953	160	162	165	169	174	179	185	198	217	239	262	286	603.7	158
	19/.101	12.83	0.881	235	238	243	248	255	263	272	291	320	352	386	422	887	232
AAAC	7/3.00	9	0.135	70	70	70	71	71	72	73	75	77	81	84	88	264.6	69
	7/4.5	13.5	0.305	143	144	145	146	147	149	151	155	162	170	178	188	545	142
	19/4.75	23.8	0.926	433	435	438	441	445	450	456	470	490	513	540	569	1650.6	431
ACSR	6/1/2.50	7.5	0.119	62	62	63	63	64	64	65	66	69	72	75	78	235.5	61
	6/1/3.00	9	0.171	88	88	89	89	90	91	92	94	98	102	106	111	334.1	87
	6/1/3.75	11.3	0.268	134	135	136	137	138	139	141	144	150	156	164	172	511.3	133
	3/4/2.50	7.5	0.193	144	144	144	145	145	146	147	148	151	155	159	163	547.2	143
	6/4.75-7/1.	14.3	0.404	196	196	198	199	201	203	205	211	220	230	241	253	744.5	194
Steel	.3/12	5.69	0.1295	128	128	129	129	129	129	130	131	132	134	136	138	488.9	128
	3/2.75	5.6	0.139	137	137	137	138	138	138	139	140	141	143	145	148	522.5	136

Mass =resultant of Conductor mass x span & side pull tension

Slope angle 15 Degrees

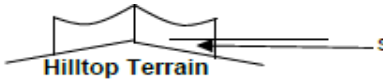
				Mass (kg) Distance between lowest sag points (m)												Tension	15 Tension
Conductor	Stranding	Diameter mm	Mass kg	40	60	80	100	120	140	160	200	250	300	350	400	No wind kg	vertical kg
AAC	7/2.50	7.5	0.0943	59	61	63	65	67	69	71	74	79	84	89	93	106.4	55
	7/3.00	9	0.135	81	84	86	89	92	94	97	103	109	116	123	130	145	75
	7/3.75	11.3	0.212	122	126	130	135	139	143	147	156	167	177	188	198	218.3	113
	7/4.50	13.5	0.305	172	178	184	191	197	203	209	221	236	252	267	282	308.3	160
	19/3.25	16.3	0.433	252	261	270	278	287	296	304	322	343	365	387	408	453.2	235
Copper	7/.048	3.66	0.0731	43	45	46	48	49	51	52	55	59	62	66	70	77.1	40
	7/.064	4.88	0.1295	76	79	82	84	87	89	92	97	104	110	117	123	136.8	71
	7/.080	6.1	0.2024	118	122	126	130	134	139	143	151	161	171	181	191	211.9	110
	7/.097	7.39	0.2986	172	178	184	190	196	202	208	220	235	250	265	280	308.4	160
	19/.064	8.1	0.3438	197	204	211	218	225	232	238	252	269	287	304	321	353.4	183
	19/.083	10.54	0.5953	337	349	361	373	384	396	408	432	462	492	521	551	603.7	312
	19/.101	12.83	0.881	495	513	530	548	565	583	601	636	680	724	768	812	887	459
AAAC	7/3.00	9	0.135	143	146	148	151	154	156	159	164	171	178	185	191	264.6	137
	7/4.5	13.5	0.305	295	301	307	313	319	325	331	344	359	374	389	405	545	282
	19/4.75	23.8	0.926	892	910	929	948	966	985	1003	1040	1086	1133	1179	1225	1650.6	854
ACSR	6/1/2.50	7.5	0.119	127	130	132	134	137	139	141	146	152	158	164	170	235.5	122
	6/1/3.00	9	0.171	180	184	187	191	194	197	201	208	216	225	233	242	334.1	173
	6/1/3.75	11.3	0.268	276	281	287	292	297	303	308	319	332	346	359	372	511.3	265
	3/4/2.50	7.5	0.193	291	295	299	303	307	311	315	322	332	342	351	361	547.2	283
	6/4.75-7/1.6	14.3	0.404	402	410	418	426	434	442	451	467	487	507	527	547	744.5	385
Steel	.3/12	5.69	0.1295	259	261	264	267	269	272	274	279	286	292	299	305	488.9	253
	3/2.75	5.6	0.139	277	279	282	285	288	290	293	299	306	313	320	327	522.5	270

Mass = Conductor mass x span + tension vertical component.



				Mass (kg)													20
				Distance between lowest sag points (m)												Tension	Tension
Conductor	Stranding	Diameter mm	Mass kg	40	60	80	100	120	140	160	200	250	300	350	400	No wind kg	vertical kg
AAC	7/2.50	7.5	0.0943	77	79	81	83	85	86	88	92	97	102	106	111	106.4	73
	7/3.00	9	0.135	105	108	110	113	116	119	121	127	133	140	147	154	145	99
	7/3.75	11.3	0.212	158	163	167	171	175	180	184	192	203	213	224	235	218.3	149
	7/4.50	13.5	0.305	224	230	236	242	248	254	260	272	288	303	318	333	308.3	211
	19/3.25	16.3	0.433	328	336	345	354	362	371	380	397	419	440	462	484	453.2	310
Copper	7/.048	3.66	0.0731	56	58	59	61	62	63	65	68	72	75	79	82	77.1	53
	7/.064	4.88	0.1295	99	102	104	107	110	112	115	120	126	133	139	146	136.8	94
	7/.080	6.1	0.2024	154	158	162	166	170	174	178	186	196	206	216	226	211.9	145
	7/.097	7.39	0.2986	223	229	235	241	247	253	259	271	286	301	316	331	308.4	211
	19/.064	8.1	0.3438	256	263	270	277	283	290	297	311	328	345	363	380	353.4	242
	19/.083	10.54	0.5953	437	449	461	473	485	497	509	533	562	592	622	652	603.7	413
	19/.101	12.83	0.881	642	660	678	695	713	731	748	783	827	872	916	960	887	607
AAAC	7/3.00	9	0.135	187	190	192	195	198	200	203	208	215	222	229	235	264.6	181
	7/4.5	13.5	0.305	386	392	398	404	410	416	422	434	450	465	480	495	545	373
	19/4.75	23.8	0.926	1167	1185	1204	1222	1241	1259	1278	1315	1361	1407	1454	1500	1650.6	1129
ACSR	6/1/2.50	7.5	0.119	166	169	171	173	176	178	181	185	191	197	203	209	235.5	161
	6/1/3.00	9	0.171	236	239	243	246	250	253	256	263	272	280	289	297	334.1	229
	6/1/3.75	11.3	0.268	361	366	372	377	382	388	393	404	417	431	444	457	511.3	350
	3/4/2.50	7.5	0.193	383	386	390	394	398	402	406	413	423	433	442	452	547.2	374
	6/4.75-7/1.6	14.3	0.404	526	534	542	550	558	566	574	591	611	631	651	671	744.5	509
Steel	.3/12	5.69	0.1295	340	343	345	348	350	353	356	361	367	374	380	387	488.9	334
	3/2.75	5.6	0.139	363	366	369	372	375	377	380	386	393	400	407	414	522.5	357

Mass = Conductor mass x span + tension vertical component.



				Mass (kg)												25	
				Distance between lowest sag points (m)												Tension	Tension
Conductor	Stranding	Diameter mm	Mass kg	40	60	80	100	120	140	160	200	250	300	350	400	No wind kg	vertical kg
AAC	7/2.50	7.5	0.0943	94	96	98	100	102	104	106	109	114	119	123	128	106.4	90
	7/3.00	9	0.135	128	131	134	137	139	142	145	150	157	164	170	177	145	123
	7/3.75	11.3	0.212	193	198	202	206	210	215	219	227	238	249	259	270	218.3	185
	7/4.50	13.5	0.305	273	279	285	292	298	304	310	322	337	353	368	383	308.3	261
	19/3.25	16.3	0.433	401	410	418	427	436	444	453	470	492	513	535	557	453.2	383
Copper	7/.048	3.66	0.0731	69	70	72	73	74	76	77	80	84	88	91	95	77.1	65
	7/.064	4.88	0.1295	121	124	126	129	132	134	137	142	149	155	161	168	136.8	116
	7/.080	6.1	0.2024	188	192	196	200	204	208	212	220	230	240	250	261	211.9	179
	7/.097	7.39	0.2986	273	279	285	291	297	303	309	321	336	351	366	381	308.4	261
	19/.064	8.1	0.3438	313	320	327	334	340	347	354	368	385	402	420	437	353.4	299
	19/.083	10.54	0.5953	535	546	558	570	582	594	606	630	660	689	719	749	603.7	510
	19/.101	12.83	0.881	785	803	821	838	856	874	891	926	970	1015	1059	1103	887	750
AAAC	7/3.00	9	0.135	230	232	235	238	240	243	246	251	258	265	271	278	264.6	224
	7/4.5	13.5	0.305	473	479	486	492	498	504	510	522	537	553	568	583	545	461
	19/4.75	23.8	0.926	1433	1451	1470	1488	1507	1525	1544	1581	1627	1673	1720	1766	1650.6	1395
ACSR	6/1/2.50	7.5	0.119	204	207	209	211	214	216	219	223	229	235	241	247	235.5	199
	6/1/3.00	9	0.171	290	293	297	300	303	307	310	317	326	334	343	351	334.1	282
	6/1/3.75	11.3	0.268	443	449	454	459	465	470	476	486	500	513	526	540	511.3	432
	3/4/2.50	7.5	0.193	471	475	478	482	486	490	494	502	511	521	531	540	547.2	463
	6/4.75-7/1.6	14.3	0.404	646	654	662	670	678	686	694	711	731	751	771	791	744.5	629
Steel	.3/12	5.69	0.1295	419	422	424	427	429	432	434	440	446	453	459	466	488.9	413
	3/2.75	5.6	0.139	448	450	453	456	459	462	464	470	477	484	491	498	522.5	442

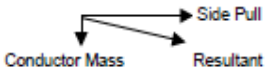
Mass = Conductor mass x span + tension vertical component.

Angle of Deviation 30 Degrees

Mass (kg) 30

Conductor	Stranding	Dia mm	Mass kg	sum of half Spans (m) 40	60	80	100	120	140	160	200	250	300	350	400	Tension No wind kg	side pull kg
AAC	7/2.50	7.5	0.0943	56	56	56	56	57	57	58	59	60	62	65	67	106.4	55
	7/3.00	9	0.135	76	76	76	77	77	78	79	80	83	86	89	93	145	75
	7/3.75	11.3	0.212	114	114	115	115	116	117	118	121	125	130	136	142	218.3	113
	7/4.50	13.5	0.305	161	161	162	163	164	166	167	171	177	184	192	201	308.3	160
	19/3.25	16.3	0.433	236	237	238	239	241	243	245	251	259	269	280	292	453.2	235
Copper	7/.048	3.66	0.0731	41	41	41	41	41	42	42	43	44	46	48	50	77.1	40
	7/.064	4.88	0.1295	72	72	72	72	73	74	74	76	78	81	85	88	136.8	71
	7/.080	6.1	0.2024	110	111	111	112	113	114	115	117	121	126	131	137	211.9	110
	7/.097	7.39	0.2986	161	161	162	163	164	166	167	171	177	184	191	200	308.4	160
	19/.064	8.1	0.3438	184	185	185	187	188	190	192	196	203	211	219	229	353.4	183
	19/.083	10.54	0.5953	314	315	317	319	321	324	327	335	347	360	376	393	603.7	312
	19/.101	12.83	0.881	461	463	465	468	472	476	481	492	510	530	554	579	887	459
AAAC	7/3.00	9	0.135	138	138	138	138	138	139	139	140	142	143	145	148	264.6	137
	7/4.5	13.5	0.305	283	283	284	284	285	286	287	289	293	297	302	308	545	282
	19/4.75	23.8	0.926	856	857	858	860	862	865	868	875	886	899	914	932	1650.6	854
ACSR	6/1/2.50	7.5	0.119	122	123	123	123	123	124	124	125	126	128	129	131	235.5	122
	6/1/3.00	9	0.171	174	174	174	174	175	175	176	177	179	181	184	186	334.1	173
	6/1/3.75	11.3	0.268	265	266	266	267	267	268	269	271	274	277	281	286	511.3	265
	3/4/2.50	7.5	0.193	284	284	284	284	285	285	285	286	288	290	292	294	547.2	283
	6/4.75-7/1.	14.3	0.404	386	387	387	388	389	390	391	394	399	404	411	418	744.5	385
Steel	.3/12	5.69	0.1295	254	254	254	254	254	254	254	255	256	257	258	259	488.9	253
	3/2.75	5.6	0.139	271	271	271	271	271	272	272	272	273	274	275	277	522.5	270

Mass =resultant of Conductor mass x span & side pull tension



Angle of Deviation 45 Degrees

Mass (kg) 45

Conductor	Stranding	Dia mm	Mass kg	sum of half Spans (m) 40	60	80	100	120	140	160	200	250	300	350	400	Tension No wind kg	side pull kg
AAC	7/2.50	7.5	0.0943	82	82	82	82	83	83	83	84	85	87	88	90	106.4	81
	7/3.00	9	0.135	112	112	112	112	113	113	114	115	116	119	121	124	145	111
	7/3.75	11.3	0.212	168	168	168	169	170	170	171	173	176	179	183	188	218.3	167
	7/4.50	13.5	0.305	237	237	238	238	239	240	241	244	248	254	259	266	308.3	236
	19/3.25	16.3	0.433	348	348	349	350	351	353	354	358	364	371	379	388	453.2	347
Copper	7/.048	3.66	0.0731	60	60	60	60	60	60	61	61	62	63	65	66	77.1	59
	7/.064	4.88	0.1295	105	105	106	106	106	107	107	108	110	112	115	117	136.8	105
	7/.080	6.1	0.2024	163	163	163	164	164	165	166	168	170	174	177	182	211.9	162
	7/.097	7.39	0.2986	237	237	238	238	239	240	241	244	248	253	259	265	308.4	236
	19/.064	8.1	0.3438	271	272	272	273	274	275	277	280	284	290	297	304	353.4	270
	19/.083	10.54	0.5953	463	464	465	466	468	470	472	478	486	496	507	520	603.7	462
	19/.101	12.83	0.881	680	681	683	685	688	690	694	702	714	729	746	765	887	679
AAAC	7/3.00	9	0.135	203	203	203	203	204	204	204	205	206	207	208	210	264.6	203
	7/4.5	13.5	0.305	418	418	418	419	419	420	420	422	425	428	431	435	545	417
	19/4.75	23.8	0.926	1264	1265	1266	1267	1269	1270	1272	1277	1285	1294	1305	1317	1650.6	1263
ACSR	6/1/2.50	7.5	0.119	181	181	181	181	181	182	182	182	183	184	185	187	235.5	180
	6/1/3.00	9	0.171	256	256	257	257	257	257	258	258	260	261	263	265	334.1	256
	6/1/3.75	11.3	0.268	392	392	392	393	393	394	394	395	398	400	403	406	511.3	391
	3/4/2.50	7.5	0.193	419	419	420	420	420	420	420	421	422	423	425	426	547.2	419
	6/4.75-7/1.	14.3	0.404	571	571	571	572	572	573	574	576	579	583	588	593	744.5	570
Steel	.3/12	5.69	0.1295	375	375	375	375	375	375	375	376	376	377	377	378	488.9	374
	3/2.75	5.6	0.139	400	400	401	401	401	401	401	401	402	403	403	404	522.5	400

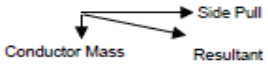
Mass =resultant of Conductor mass x span & side pull tension

Angle of Deviation 60 Degrees

Mass (kg) 60

Conductor	Stranding	Dia mm	Mass kg	sum of half Spans (m) 40	60	80	100	120	140	160	200	250	300	350	400	Tension No wind kg	side pull kg
AAC	7/2.50	7.5	0.0943	107	107	107	107	108	108	108	109	109	111	112	113	106.4	106
	7/3.00	9	0.135	146	146	146	146	146	147	147	148	149	151	153	155	145	145
	7/3.75	11.3	0.212	219	219	219	220	220	221	221	223	225	228	231	235	218.3	218
	7/4.50	13.5	0.305	309	309	310	310	311	312	313	315	318	322	327	332	308.3	308
	19/3.25	16.3	0.433	454	454	455	456	457	458	459	462	466	472	478	486	453.2	453
Copper	7/.048	3.66	0.0731	78	78	78	78	78	78	78	79	80	81	82	83	77.1	77
	7/.064	4.88	0.1295	137	138	138	138	138	138	139	140	141	143	145	147	136.8	137
	7/.080	6.1	0.2024	213	213	213	213	214	214	215	216	218	221	224	227	211.9	212
	7/.097	7.39	0.2986	309	309	310	310	311	312	313	315	318	322	326	331	308.4	308
	19/.064	8.1	0.3438	354	355	355	356	356	357	358	361	364	369	374	380	353.4	353
	19/.083	10.54	0.5953	605	605	606	607	608	610	612	616	622	630	639	649	603.7	604
	19/.101	12.83	0.881	888	889	890	892	894	896	899	905	914	926	940	955	887	887
AAAC	7/3.00	9	0.135	265	265	265	265	266	266	266	266	267	268	269	271	264.6	265
	7/4.5	13.5	0.305	546	546	546	546	547	547	548	549	551	553	556	559	545	545
	19/4.75	23.8	0.926	1652	1652	1653	1654	1655	1656	1658	1661	1667	1674	1683	1692	1650.6	1651
ACSR	6/1/2.50	7.5	0.119	236	236	236	236	236	237	237	237	238	239	240	241	235.5	236
	6/1/3.00	9	0.171	335	335	335	335	335	335	336	336	337	339	340	342	334.1	334
	6/1/3.75	11.3	0.268	512	512	512	513	513	513	514	515	516	518	520	523	511.3	511
	3/4/2.50	7.5	0.193	548	548	548	548	548	548	549	549	550	551	552	553	547.2	547
	6/4.75-7/1	14.3	0.404	745	745	746	746	747	747	748	749	752	755	758	762	744.5	745
Steel	.3/12	5.69	0.1295	489	489	490	490	490	490	490	490	490	491	491	492	488.9	489
	3/2.75	5.6	0.139	523	523	523	523	523	523	523	524	524	525	525	526	522.5	523

Mass =resultant of Conductor mass x span & side pull tension



Angle of Deviation 75 Degrees

Mass (kg) 75

Conductor	Stranding	Dia mm	Mass kg	sum of half Spans (m) 40	60	80	100	120	140	160	200	250	300	350	400	Tension No wind kg	side pull kg
AAC	7/2.50	7.5	0.0943	130	130	130	130	131	131	131	131	132	133	134	135	106.4	130
	7/3.00	9	0.135	177	177	177	178	178	178	178	179	180	182	183	185	145	177
	7/3.75	11.3	0.212	266	267	267	267	267	268	268	270	272	274	276	279	218.3	266
	7/4.50	13.5	0.305	376	376	377	377	378	378	379	381	384	387	391	395	308.3	375
	19/3.25	16.3	0.433	553	553	553	554	555	556	557	559	563	567	573	579	453.2	552
Copper	7/.048	3.66	0.0731	94	94	95	95	95	95	95	96	96	97	98	99	77.1	94
	7/.064	4.88	0.1295	167	167	167	168	168	168	168	169	170	172	173	175	136.8	167
	7/.080	6.1	0.2024	259	259	259	259	260	260	261	262	263	266	268	271	211.9	258
	7/.097	7.39	0.2986	376	376	377	377	378	378	379	381	383	387	390	395	308.4	375
	19/.064	8.1	0.3438	431	431	432	432	433	433	434	436	439	443	447	452	353.4	430
	19/.083	10.54	0.5953	736	736	737	738	739	740	742	745	750	757	764	773	603.7	735
	19/.101	12.83	0.881	1081	1082	1083	1084	1086	1087	1090	1095	1103	1112	1124	1136	887	1080
AAAC	7/3.00	9	0.135	323	323	323	323	323	323	323	324	324	325	326	327	264.6	322
	7/4.5	13.5	0.305	664	664	664	665	665	665	666	667	668	670	673	675	545	664
	19/4.75	23.8	0.926	2010	2011	2012	2012	2013	2014	2016	2019	2023	2029	2036	2044	1650.6	2010
ACSR	6/1/2.50	7.5	0.119	287	287	287	287	288	288	288	288	289	289	290	291	235.5	287
	6/1/3.00	9	0.171	407	407	408	408	408	408	408	409	410	410	412	413	334.1	407
	6/1/3.75	11.3	0.268	623	623	623	624	624	624	624	625	627	628	630	632	511.3	623
	3/4/2.50	7.5	0.193	667	667	667	667	667	667	667	668	668	669	670	671	547.2	666
	6/4.75-7/1.	14.3	0.404	907	907	908	908	908	909	909	911	913	915	918	921	744.5	906
Steel	.3/12	5.69	0.1295	596	596	596	596	596	596	596	596	597	597	597	598	488.9	595
	3/2.75	5.6	0.139	637	637	637	637	637	637	637	637	638	638	639	639	522.5	636

Mass =resultant of Conductor mass x span & side pull tension

10.0 WORK PROCEDURES

10•1 PRELIMINARY LIVE WORK PROCEDURES

Before commencing work the condition of the following structures, hardware and conductors shall be checked:

- In accordance with Section 10.2 Common Work Procedural Rules.
- The live voltage(s) involved and associated MADs to be considered and for communication to the plant operator.
- The structure on which work is to be carried out.
- The two adjacent structures.
- The conductors in the spans either side of the structure on which work is to be carried out. Check if any of these conductors may be **Substandard** or **Suspect** and treat accordingly.
- The integrity of porcelain insulators in the immediate work area.
- Clearances to potential mid span hazards.

Prior to commencement of work, the above checks are to be considered and any control measures required must be recorded on the Live Line JRA and from that;

A work-site briefing shall be held to establish the exact procedures to be used. The work-site briefing should include an explanation of the following:

- **Why** the work is to be done;
- **What** is to be accomplished;
- A discussion of **how** the work is to be carried out; and
- **Who** will do the various tasks associated with the work.
- Any noted hazards, control measures, special issues to address etc. must be documented on the JRA.

Note:

This shall also include the designated appointment of a Safety Observer for all tasks.
The work-site briefing shall also include the identification and evaluation of risks and hazards.
When Live Work is to be performed on circuits with automatic reclosing facilities, these facilities shall be disabled in accordance with the requirements for Live Work and tagged for the duration of the work.

The weight of the conductor, size of the angle, amount of sag and the stringing tension shall be determined to ensure that the load being applied to the Live Work equipment does not exceed the safe working load of that equipment. If there is any doubt seek engineering advice.

10•2 COMMON WORK PROCEDURAL RULES

The ultimate decision as to whether a task is to be performed using Live Work techniques rests with the Live Work Team.

If a potential hazard is identified during a Live Work procedure, work shall cease and appropriate action shall be taken to ensure safety of personnel and property.

If the circuit on which Live Work is being carried out becomes de-energised due to the operation of protective equipment, the circuit shall not be re-energised without consultation with the crew / team leader in charge of the Live Work.

When moving conductors, conductor movement throughout the adjacent spans shall be closely observed.

The free end of body belt straps shall be prevented from contacting any points at a different potential from that of the HV Live Worker.

When Live Work is being performed, no other activity which could compromise the safety of the Live Work team shall be performed on the same structure or on adjacent spans or structures.

Live Work insulating equipment should not be left on energised lines for extended periods of time such as overnight. Where this event is necessary they shall not be depended upon to protect the HV Live Worker.

Before re-use the equipment shall be removed, cleaned, visually inspected, and if suspect, submitted for electrical testing.

Work shall be performed on only “one” phase at a time – except as indicated in Section 10.5.1 of this document.

Flying shackles should not be fitted in the same conductor span where work is to be conducted unless there will be no significant displacement, restraining or movement of conductors within that bay.

All Live Work insulating equipment shall have an electrical rating suitable for the voltage being worked on.

Conductor "ties" and "loops" shall be kept as short as possible when installing or removing them. This will prevent the possibility of flashover.

When Live Work is to be performed on poles that are condemned - the pole shall be appropriately "secured" in accordance with the following options:

- WP Replace Condemned Poles.
- Section 12.2.2.1 **Securing Of Poles Prior To Work** in the LWRHB.

NOTE: LIVE WORK LIFTING EQUIPMENT SHALL NOT BE ATTACHED/RIGGED TO A CONDEMNED POLE.

The removal of a condemned or redundant pole from a work area shall be prepared by first removing all cross arms, hardware and then cut the pole top down to approximately 2.0 metres below the conductors. The remainder of the pole can then be removed at any time in the approved manner (e.g. crane, pole jack etc.).

See Section 7, "Safety Requirements", for additional information.

Live Work shall NOT be performed on the following Substandard conductors "alive":

- 7/.044 Copper.
- 7/.064 Copper.
- No. 8 Steel

The only tasks permitted will be the making or breaking of non-tension loops and the replacement of surge diverters where it does not alter or affect current forces acting on the conductor or pole top. No existing conductor ties shall be removed.

The following are **Suspect** conductors:
- 7/.080 copper conductor.
- 7./093 Aluminium

All other GI Steel conductors that are not 8 gauge size.

In addition to the above, all conductors need to be visually inspected at least one pole either side to determine their suitability prior to live work being undertaken and also;

Any attached fittings (e.g. clamps on the line) need to be carefully inspected to check if any joint/ connection deterioration has occurred that may pose a risk of the conductor breaking and falling down. Refer to the **Amber Alert Near Hit – Live Line Clamp** for guidance and control measures to use (e.g. may need to temporarily use strain gear across the suspect joint).

Note. Live Work may be carried out on **Suspect** conductors but only under the following conditions:

- An on-site risk assessment has determined it is safe to work on.
- Existing conductor ties are not removed or interfered with.
- It is a non-tension conductor loop only.
- The work to be undertaken will not introduce a sudden significant increase in strain on the conductors.
- It is a loop to a surge diverter (lightning arrestor) that is being replaced.

10•3 WORK ON STEEL COMPOSITE STRUCTURES

A comprehensive risk assessment is required for all work on live conductors or hardware in the vicinity of, or attached to steel / composite support structures that have steel work extending from ground level to the pole top.

Special consideration is required to identify any differences in technique generally employed for work on wood poles with earthed steelwork at the pole top.

All pole tops on steel / composite support structures in the Distribution network shall be treated as an "**EARTHED**" situation.

Steel support structures within the Tasmanian electricity distribution network include steel lattice towers (box section), steel lattice towers (transmission type) and tubular steel poles.

Composite material support structures within the Tasmanian electricity distribution network include spun concrete poles and stobie poles.

"Live" work on steel / composite material structures shall only be performed from an insulated Elevating Work Platform.

Two (2) levels / double insulation shall be used when working on steel / composite material structures.

Use of the structure as a work platform is prohibited.

Lever lift methods shall not be performed on steel support structures.

10•4 APPLICATION OF INSULATING BARRIERS

Insulating barriers are designed to protect Line Workers from momentary inadvertent contact with energised lines, not to enable the minimum approach distance to be reduced.

HV Live Workers shall always maintain a MADs clearance 50mm for 11Kv and 100mm for 22Kv between the uninsulated part of their body and any energised apparatus.

Insulating barriers shall be applied to apparatus in the immediate work area to prevent inadvertent phase to phase contact or phase to earth contact.

All apparatus in the immediate work area such as energised conductors, earthed conductors or stay wires which are within reach of the HV Live Worker's body and which are, or could be, at a different potential from those being worked on by the HV Live Worker - shall be covered with insulating barriers.

When fitting insulating barriers the HV Live Worker shall cover the nearest and / or lowest energised apparatus first. When removing insulating barriers, the reverse order shall be followed. Insulating barriers should, whenever possible, be applied from a position below the conductors.

Live Work insulating equipment should not be left on “energised” lines for extended periods of time (i.e. overnight). Should it be necessary to do so, they shall not be depended upon to provide the same level of insulation. They shall be removed, cleaned and visually inspected be ore re-use. If their insulation condition is suspect they shall be electrically tested.

10•5 LIVE WORK CONCEPTS

10•5•1 STICK METHOD PROCEDURAL RULES

HV Live Workers working on live high voltage apparatus shall not allow any conducting material which they are directly in contact with or allow any part of their body to come within the minimum approach distances of that apparatus as shown in Table 11 - 1 below.

The **minimum approach / separation distances** set out in Table 11 - 1, shall be strictly observed at all times during Live Work Stick.

Conductor Line Voltage	Safe Working Minimum Approach Distance (mm) [Phase to Earth]	Moving Conductors Minimum Separation Distance (mm) [Phase to Phase]
11,000 volts (11 kV)	350	400
22,000 volts (22 kV)	400	500
33,000 volts (33 kV)	450	550

Table 11 – 1 Minimum Approach Distances

Note:

Where working clearances between phases are restricted and the work is being completed using the Stick method – work is performed on one (1) phase at a time.

When moving conductors – they shall be kept under control at all times and prevented from encroaching any closer than the minimum separation distances listed in the Table above.

10•5•2 GLOVE AND BARRIER PROCEDURAL RULES

Work shall be performed from the basket of an insulated EWP or from an insulated platform, never directly from a pole or structure.

When using an insulated EWP or insulated platform between circuits:

A minimum of **250 mm** clearance shall be maintained from the lowercircuit.
Adequate insulated barriers (rated for the higher voltage) shall be fitted to the lower circuit. The barriers shall cover the drop zone area where an item may fall to.

Insulating gloves and sleeves shall be “air-tested” and “visually inspected” prior to commencement of work, or at any other time when their condition is in doubt.

Insulating gloves and sleeves shall be worn at all times within the “contact area”.

10•6 METHODS

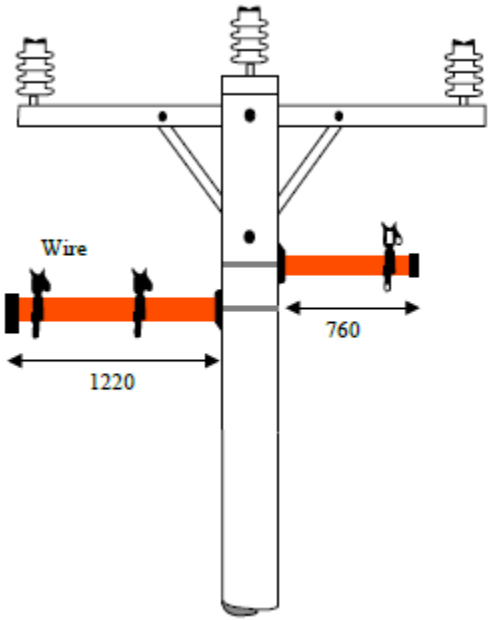
HV Live Workers employed by TasNetworks are trained and authorised to perform Live Work using either the Stick method, the Glove and Barrier method or a combination of both methods.

The decision as to which method is applied rests solely with the Live Work Team.

10•6•1 RIGGING METHODS

10•6•1•1 POLE MOUNTED TEMPORARY CONDUCTOR SUPPORTS

Diagram 11 - 1



(Strap type).
Single (760 mm long)
SWL = 90 kg.

Double (1220 mm long) **SWL** = 140 kg. total. **(**70 kg. per wire holder).
Stick dimension (support) = 63 mm.

Rigging procedure:

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit fork type wire holders and insulators to supports at per-determined position depending upon desired location of conductors.

2. Release chain tightener fully and cock spring take-up on conductorsupport.

Note. Items 1 and 2 to be completed at ground level.

3. Locate support at desired height on pole in line with the crossarm.

4. Attach chain to attachment on support and release springtake-up.

5. Adjust support to final position and secure chain tightener.

Note.

Chain tighteners are only to be secured by hand. Do not use levering devices (i.e. spanners, screwdrivers) to secure a chain tightener.

6. Repeat items 3 to 5 to fit second support if required.

7. Untie the chosen outside conductor from its insulator.

8. Relocate the conductor to the wire holder directly below.

9. Repeat items 7 and 8 for the other outside conductor.

Note:

- Should it be required to relocate the center conductor (i.e., for cross arm or pole replacement) use *Glove & Barrier Auxiliary Arm, Diagram 11 – 2 in Section 10.6.1.2.*

- This rig shall not be used for angle pole top arrangements.

10•6•1•2 GLOVE AND BARRIER AUXILIARY ARM

Single braced SWL. = 70 kg.
(23 kg per wire holder)

Total = 70 kg.

Stick dimensions

Mast = 63 mm
Auxiliary Arm = 63 mm (Unbalanced Load)

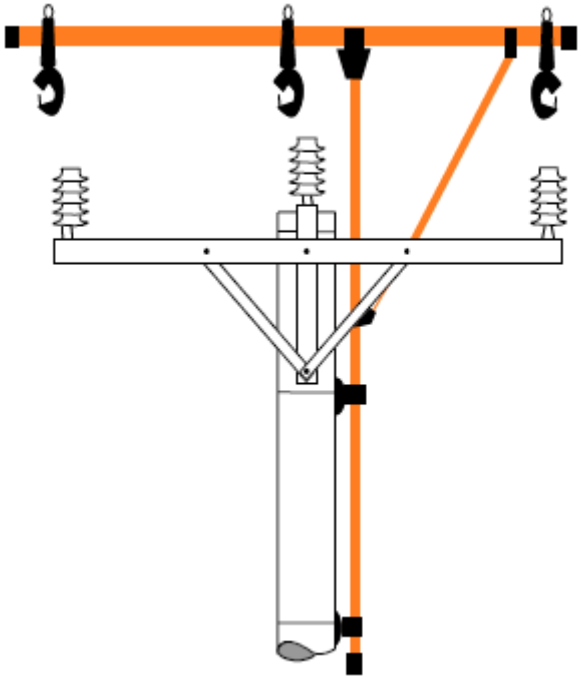


Diagram 11 - 2

Rigging Procedure:

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures page 120).

1. Fit C-type wire holders and insulators to auxiliary arm at pre-determined position depending upon desired location of conductors.

2. Fit wire tong band and brace to auxiliary arm at desired position.

3. Fit wire tong pole clevis to mast at correct position to receive brace.

Note: Items 1 to 3 are to be completed at ground level.

4. Attach 63 mm wire tong saddle to the pole approximately 150 mm below the cross arm straps.

5. Attach second 63 mm wire tong saddle to pole approximately 1000 mm below the first wire tong saddle.

6. Fit mast to wire tong saddles and secure at desired height above conductors.

7. Fit auxiliary arm to mast, fit brace to mast and secure all clamps.

8. Fit approved strap hoist pulling device, or other approved restraint.

9. Install one end of the strap hoist to the "D" shackle in the top wire tong saddle,

10. Connect the other end of the Strap hoist to the Butt Ring of the auxiliary Arm Mast

11. Tension strap hoist device until there is no slack in the webbing of the strap hoist.

Note. The strap hoist device is not to be used to lift or lower the rig whilst conductors have been placed on the Auxiliary mast. It is there as a back up to the 63 mm wire tong saddles only.

12. Check all clamps are secure and tight.

13. Untie the chosen conductor from its insulator.

14. Relocate the conductor to the wire holder directly above.

15. Repeat items 10 and 11 for the other two (2) conductors.

Note. This rig shall not be used for angle pole top arrangements.

10•6•1•3 AUXILIARY LIFTING ARM

Double braced SWL. = 210 kg.

(70 kg. per wire holder)

Total = 210 kg.

Stick dimensions: Mast = 63 mm Auxiliary Arm = 63 mm Brace = 38 mm

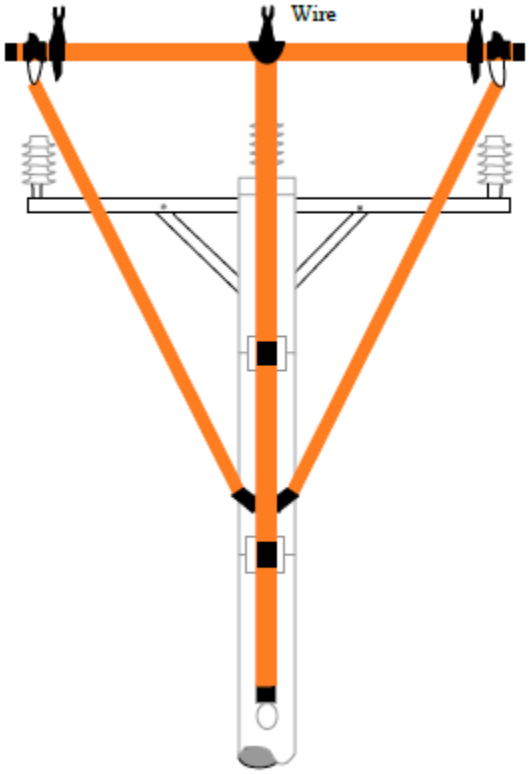


Diagram 11 – 3

Rigging procedure:

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit a 63 mm wire tong clamp at the center of the auxiliaryarm.

2. Fit fork type wire holders and insulators at each end of the auxiliary arm at the same distance apart as the two outside conductors.

3. Fit a 63 mm lifting tong (mast), butt end up, to the 63 mm wire tong clamp previously fitted to the center of the auxiliary arm.

4. Fit a wire tong clevis to the 63 mm lifting tong (mast) at the correct position to receive 38 mm braces.

5. Fit stirrups at each end of the auxiliary arm.

6. Fit 38 mm braces between stirrups on auxiliary arm and wire tong clevis on mast and secure all clamps.

Note. Items 1 to 7 to be completed at ground level.

7. Attach a 63 mm wire tong saddle to the pole approximately 150 mm below the cross arm straps on the opposite side of the pole to the cross arm.

8. Raise the auxiliary arm assembly to the work area and place the mast in the 63 mm wire tong saddle.

9. Attach a second 63 mm wire tong saddle to the pole below the wire tong clevis.

10. Place the mast in the 63 mm wire tong saddle.

11. Leave the clamps on both 63 mm wire tong saddles loose enough for the lifting tong to slide.

12. Attach a tackle between the lower 63 mm wire tong saddle and the bottom of the mast.

13. Using the tackle, raise the auxiliary arm assembly so all wire holders engage the conductors and the safety latches close.

14. Secure the clamps on both 63 mm wire tong saddles and secure the fall of the tackle to a snubbing bracket fitted at ground level.

15. Untie the conductors from the insulators.

16. Loosen the clamps on both 63 mm wire tong saddles and using the tackle raise the conductors to allow for safe working.

17. Secure the clamps on both 63 mm wire tong saddles and secure the fall of the tackle.

Note. This rig shall not be used for angle pole top arrangements.

10•6•1•4 LEVER LIFT

SWL. = 110 kg.
(per wire holder) (Outside phases)

Stick dimensions:
Hand stick - 38 mm

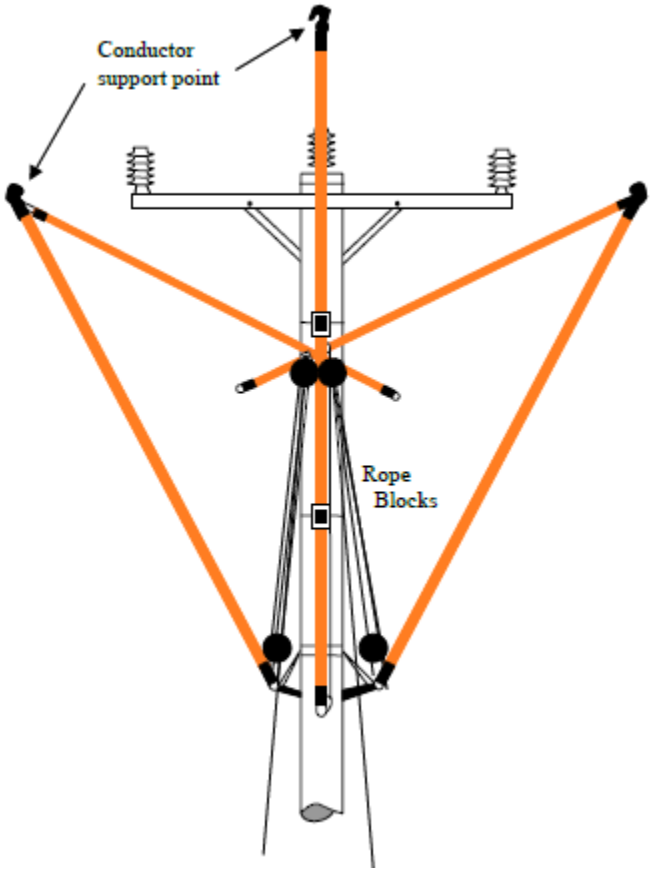


Diagram 11 - 4

Rigging procedure:

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Attach a 63 mm wire tong (lifting stick) to the first conductor to be moved on the opposite side to the cross arm. Locate the wire tong a short distance from the insulator.

2. Fit a lever lift to the butt ring of the wire tong and attach the lever lift to the pole.

   Note. The lever lift is attached to the pole at a position which allows the desired movement of the conductor (i.e. full range of lift up or down).

3. Attach a 38 mm wire tong saddle to the pole approximately 600 mm below the cross arm straps and offset from the center line of the pole.

4. Attach a 38 mm wire tong (hand stick) to the conductor alongside the 63 mm wire tong (lifting stick).

5. Place the 38 mm wire tong (hand stick) in the wire tong saddle, pull down on the wire tong (hand stick) to hold the conductor in the insulator groove and tighten the saddle clamp.

6. Attach a snubbing bracket to the pole directly below the 38 mm wire tong saddle.

7. Attach a tackle between the snubbing bracket and the clevis on the leverlift.

8. Secure the fall of the tackle to a snubbing bracket at groundlevel.

10. Untie the conductor from the insulator.

11. Loosen the clamp on the 38 mm wire tong (hand stick) and, with the tackle working in unison, guide the conductor upward from the insulator and then outward to allow for safe working.

12. Secure the clamp on the 38 mm wire tong and secure the fall of thetackle.

13. Repeat items 1 to 11 for the other outside conductor and ensure that the 38 mm wire tong saddle and the lever lift are attached directly above the existing 38 mm wire tong saddle and the lever lift respectively.

10•6•1•5 CENTRE CONDUCTOR LIFT

SWL = 110 kg. (in above rig set-up).

SWL = 320 kg. (when by itself) **Stick dimensions:**

Mast = 63 mm

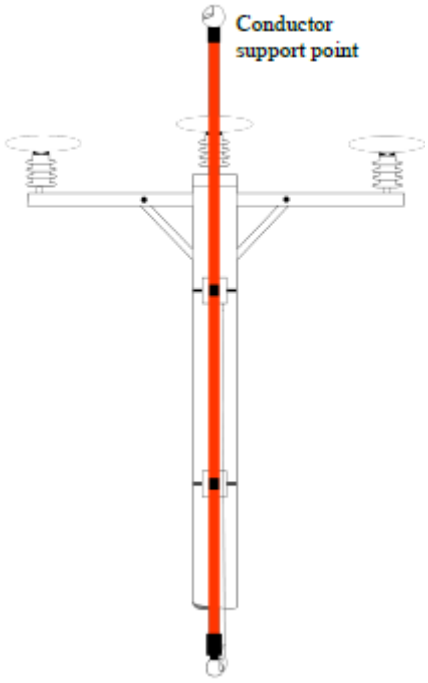


Diagram 11 - 5

Moving the Centre Conductor:

1. Attach a 63 mm wire tong saddle, with a 100 mm extension fitted, to the pole between the top 38 mm wire tong saddle and the cross arm straps.

   Note. The 100 mm extension will allow the 63 mm wire tong to slide past the two 38 mm wire tongs already attached.

2. Attach a second 63 mm wire tong saddle, with a 100 mm extension fitted, to the pole approximately 1800 mm below the first 63 mm wire tong saddle. The second saddle is to be in line with the first saddle.

3. Place a 63 mm wire tong into the two 63 mm saddle clamps. Leave the saddle clamps loose enough for the wire tong to slide.

4. Guide the wire tong onto the conductor and secure.

5. Attach a tackle between the clevis on the upper 63 mm wire tong saddle and the butt ring of the wire tong.

6. Pull down on the wire tong to hold the conductor in the insulator groove and tighten both saddle clamps.

7. Secure the fall of the tackle to a snubbing bracket fitted at ground level.

8. Untie the conductor from the insulator.

9. Loosen the clamps on the 63 mm wire tong and using the tackle raise the conductor from the insulator to allow for safe working.

10. Secure the clamps on the 63 mm wire tong and secure the fall of the tackle.

10•6•2 SUPPORTING CONDUCTORS USING A MOBILE CRANE

10•6•2•1 INTRODUCTION

These procedures outline the safe working practices and procedures for supporting and /or raising Live 11/ 22kV conductors using a mobile slewing crane.

This procedure can be used in conjunction with other approved procedures e.g. replacing / erecting poles.

10•6•2•2 POLES WITHOUT ANGLE

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

Note: A minimum of 4 HV Live Workers is required to perform this task.

Switching Requirements

Auto reclose facilities to be suppressed prior to commencement of work.

Safe Working Load
1500kg per conductor.

Principal Tools and Equipment

Mobile Slewing Crane: reach to suit.
- 1 EWP.
- 2 of 1.75 metre 2 tonne slings.
- 5 of 22 kV synthetic insulator.

3 Spiral link sticks (Use only AB CHANCE Spiral Link Sticks as they are rated to 3500lbs).

'D' Shackles as required (min 1500 kg rating).

1 Load Rated Lifting Beam (min 1500 kg rating).

Procedure:

1. Check adjacent structures/poles, insulators and ties.

2. Position and set up mobile slewing crane.

3. Attach one synthetic insulator and one spiral link stick per phase to the lifting beam.

4. Attach the ends of the fibre slings to the lifting beam.

5. Attach the fibre slings to the crane hook via two polymeric insulators.

6. Glove and Barrier personnel to fit insulating barriers to all second points of contact within reach of the work position.

7. Raise the mobile slewing crane hook and position the spreader beam into a position to attach the synthetic insulators and spiral link sticks to the conductors.

8. Untie conductor/s.

9. With clear instructions, instruct the mobile crane operator to slowly raise the winch rope, raising the conductors to allow necessary clearances for the job requirements and;

   Ensure all parts of the crane / boom etc. maintains a minimum of 2 metres clearance to the nearest energised HV apparatus.

10. Prior to lowering the conductors fit adequate insulating barriers to provide safe access to the work area.

11. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

12. Instruct the mobile crane operator to slowly lower the winch rope to position the conductors onto the insulators.

13. Re-tie the conductors to the insulators.

14. Detach the synthetic insulators and spiral link sticks from the conductors.

15. Move mobile crane winch rope out of work area and lower to the ground and remove all items.

16. Lower all equipment.

17. Remove all insulating barriers.

10•6•2•3 POLES WITH ANGLE

This procedure shall only be performed on poles with a conductor angle of less than 15 degrees. The conductor loading tables in Section 10 should also be consulted to establish the side rope weight.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

Seven HV Live workers and one crane operator are required to perform this task. The following list states the duties required on site:

2 HV Live Workers in the EWP Basket
1 Safety Observer for EWP
1 Safety Observer for Crane / Side Ropes
3 HV Live Workers Controlling the Side Ropes
1 Authorised Crane Operator

Switching Requirements

Auto reclose facilities to be suppressed prior to commencement of work.

Safe Working Load

1500kg per conductor down force, 150kg per conductor side force.

Principal Tools and Equipment

1……Mobile Slewing Crane: reach to suit.
1……EWP.
2 ……...1.75 metre 2 tonne slings.
5……22 kV synthetic insulators.
6……Spiral link sticks (Use only AB CHANCE Spiral Link Sticks as they are rated to 3500lbs).
3……16mm Side Ropes
3……Rope Blocks with a 5:1 Ratio
1……Load Rated Lifting Beam

'D' Shackles as required (min 1.5 tonne rating). 3 additional "D" Shackles are required to perform this task.

Procedure:

1. Check adjacent structures/poles, insulators and ties.

2. Position and set up mobile slewing crane on the outside of the angle.

3. Position and setup vehicle for side rope restraint.

4. Attach one synthetic insulator and one spiral link stick per phase to the lifting beam.

5. Attach the ends of the fibre slings to the lifting beam.

6. Attach the fibre slings to the crane hook via 2 polymeric insulators.

7. Glove and Barrier personnel to fit insulating barriers to all second points of contact within reach of the work position.

8. Raise the mobile slewing crane hook and position the spreader beam into a position to attach the synthetic insulators and spiral link sticks to the conductors via a "D" Shackle.

9. Take up minimal weight on the conductors with the crane.

10. Attach side ropes to conductors via spiral link sticks and "D" Shackles (see photo below).

11. Take weight on side ropes utilising rope blocks. These are to be secured to a vehicle.

12. Untie conductor/s.

13. With clear instructions, instruct the mobile crane operator to slowly raise the winch rope, raising the conductors to allow necessary clearances for the job requirements.

14. Side ropes will have to controlled throughout this movement to ensure that the supporting spiral link sticks remain in a vertical position.

15. Note: Ensure all parts of the crane / boom etc maintains a minimum of 2 metres clearance to the nearest energised HV apparatus.

16. Prior to lowering the conductors fit adequate insulating barriers to provide safe access to the work area.

17. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

18. Instruct the mobile crane operator to slowly lower the winch rope to position the conductors onto the insulators.

19. Side ropes will have to controlled throughout this movement to ensure that the supporting spiral link sticks remain in a vertical position

20. Re-tie the conductors to the insulators.

21. Remove weight off rope blocks and remove side ropes.

22. Detach the supporting synthetic insulators and spiral link sticks from the conductors.

23. Move mobile crane winch rope out of work area and lower to the ground and remove all items.

24. Lower all equipment.

25. Remove all insulating barriers.

10•7 WORK INSTRUCTIONS

10•7•1 BRIDGE OUT EDO FROM EARTH STIRRUP & PERFORM TASKS

This work instruction is suitable on pole top arrangements where earthing stirrups are fitted to bottom of EDO units.

Note: Where no earthing stirrup is fitted, the Live Line Crew, where practical to do so, shall take the opportunity to replace the EDO earthing bolt with an earthing stirrup on ABB V Series and NGK C Series EDO as per the requirements in the **Blue Lesson On EDO Earthing Stirrups**.

The stirrup will ensure that installing a temporary earth does not breach the 700mm SADs minimum.

Prior to performing this work instruction carry out a detailed risk assessment to identify and hazards, and implement control strategies to mitigate the risk(s).

CAUTION: If unsure of the integrity of the EDO unit or the risk assessment deems the task is not safe, arrange for an outage to undertake task under dead conditions.

Be performed by a minimum of two (2) Live Work personnel at the pole top.

1) Equipment Required :-

- Should only require a two to three metre bypass jumper lead.
- Wire Brush.

2) Pre Checks :-

- Live line suppression is in place – contact Ops. Section to confirm.
- Check no cracks around the EDO unit.
- Employ appropriate measures, identified in JRA, to manage the mechanical stresses applied to the EDO unit whilst performing this task.
- Check lead into bottom of EDO unit is secure.
- Check earthing stirrup is appropriately tightened.
- **NOTE** - If required cover electrical drop zone.
- Fit adequate insulating barriers to the work area – all 2nd points of contact to be covered up.

3) Bridging Out From Earth Stirrup :-

- First brush conductor.
- Apply jumper to top conductor.
- Apply jumper to earthing stirrup.
- Using Amp meter, confirm jumper is taking some load.
- Confirm with safety observer jumper is taking some load before removing EDO fuse with insulating stick.
- Repeat above steps for other phases as required.

4) Complete Task :-

Tasks that can be done after bridging out are :-

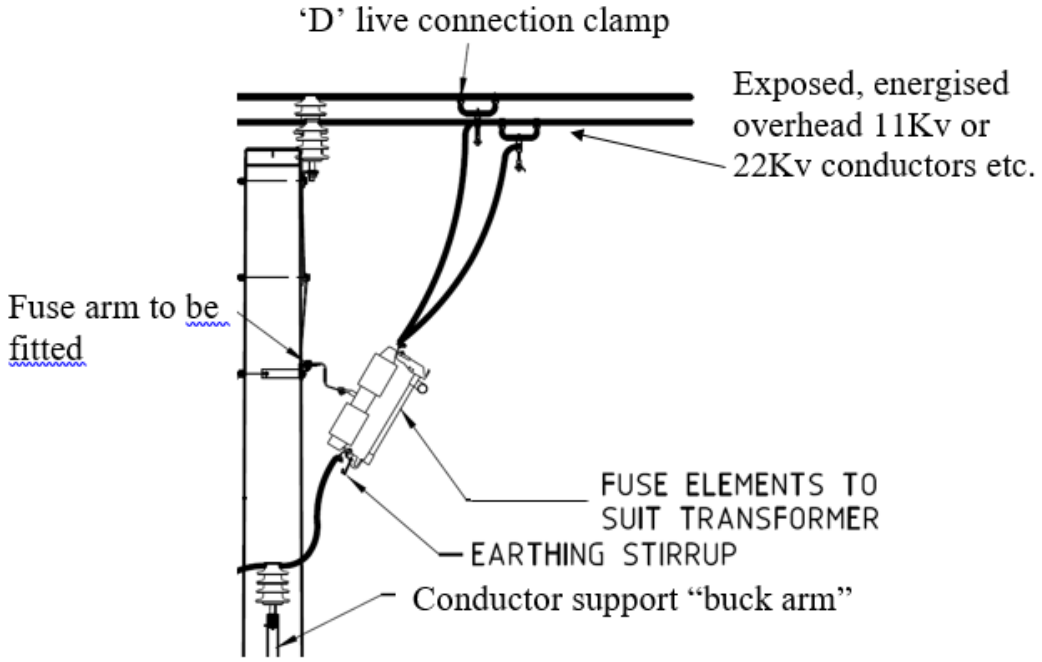
- Removing hard connection to install D clamp.
- Change fuse casing.
- Replacement of fuse carrier or upgrade fuse size.
- Fix damaged dropper.

5) Once work is completed :-

- Confirm with Safety Observer that the permanent loop from top of EDO unit is reconnected to top conductor and the fuse carrier is reinstalled into EDO unit.
- Using Amp meter, confirm permanent circuit through EDO unit/fuse is taking some.
- Disconnect temporary bypass jumper from earthing stirrup first.
- Disconnect temporary bypass jumper from overhead conductor
- Remove all insulating barriers.
- Live line suppression is restored back to normal settings – contact Ops. Section to confirm.

10•7•2 INSTALL FUSE ARM IN CLOSE PROXIMITY TO LIVE HV

Covers installation of a fuse arm under live overhead High Voltage (HV), 22Kv or 11Kv conditions where the industry standard of 700mm Safe Approach Distance (SAD) may be breached.



1) Resources Required :-

- Minimum of two (2) HV Live Line Workers for the fuse arm work to be done a one man task, with one in EWP bucket and the other as a ground Safety Observer.

- **Note**: If more than two HV Live Line Workers are on site, the fuse arm work shall be done as per standard live line practice, with two workers in the EWP bucket.

- Appropriate size fuse arm, and tools, equipment and fittings required to affix it.

2) Pre Checks :-

- Live Line Suppression in place before work commences.
- Fit insulation barriers to energised exposed overhead conductors and associated assets as required to guard against inadvertent contact and;
- Inspect condition of assets and conduct a JRA to assess and identify any other hazards or risks and, implement safety control measures where required.
- Safety Observer is in appropriate location to monitor safe work.

3) Work Steps :-

1) Measure and mark new cross arm bolt hole.

2) Drill new cross arm bolt hole.

3) Fit tie straps to pole or onto existing strap bolt.

4) Fit fuse arm onto new bolt and tighten nut up to help hold cross arm in place.

5) Connect tie straps to cross arm.

6) Fit EDOs and fuses as required and also, fit EDO earthing stirrup if required.

7) Measure, cut new permanent loops, fit live line clamps onto new loops and secure loops onto top of EDO fuses.

8) Fit Dees onto overhead conductors.

9) Remove insulating barriers.

5) Job Close Out :-

1) Check and certify completed worked complies with the relevant requirements for installation of a HV fuse arm in the Overhead Construction Standard and if so;

2) Record the work completed in the relevant section on the Electrical Work Certification (EWC) Form.

3) Notify Ops. Section to restore line suppression settings back to normal.

4) Where applicable, notify that remainder of work can be completed by standard line crew e.g. complete transformer install/replacement.

10•7•3 INSTALLATION OF SPIRAL VIBRATION DAMPERS

This covers installation of spiral vibration dampers on overhead High Voltage (HV) 22KV or 11KV conductors, to dampen down excessive conductor movement and minimise risk of damage from conductor breakage or clash that could otherwise occur, especially from vibration on windy days.

Comply with work practice **IMS-WPI-13-66 Installation Of Spiral Vibration Dampers**.

10•7•4 INSTALLING STAND ALONE FAULT INDICATORS

Horstmn Navigator LM 'Type A' fault indicators are a new conductor-mounted fault indicator that will replac the existing pole-mounted fault indicators in the overhead power distribution network. Each fault indictor site will consist of 3 single-phase fault indicators that detect and indicate short circuit faults downstream of the devices.

There are four work method options for installing the fault indicators, and one of these is Live Line Glove And Barrier method, in accordance with the **Installing Standalone Fault Indicators** work practice.

10•7•5 LOWERING WINCH ROPE THROUGH HV CROSS ARMS

1) Move LBS/recloser to position on ground under the pole where it can be lifted from above.

2) Before raising hook in the air, attach spiral link stick onto the hook.

3) Have all conductors either side of the pole insulated with at least one line hose or hard cover per phase minimum, plus mat over JDs.

4) The road and center phases are to be jumped out with loops removed, if path side is not jumped out it must be completely covered.

5) Road phase jumper to be double insulated and the center phase jumper to be located over the other side of pole away from road.

6) Live line crew must be located aloft at the cross arms to give instruction directions to the proline operator, with an insulating stick to guide the hook through the middle of the cross arms.

7) With the spiral link stick/ hook lowered to a position above the LBS/recloser, ground work to hook up LBS/recloseer, caution only handle spiral link stick NOT the winch rope or hook.

8) Preferable the proline to be the same side of the pole as the LBS/recloser is to be installed on.

9) Only live line accredited proline operators permitted to do this task.

10•7•6 REMOVAL OF SUSPECT AIR BREAK SWITCHES (ABS)

1) All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

2) Two EWPs are required for this task

3) Use the **ABS Decision Flow Chart** to determine if the ABS can be removed under live line conditions or not.

4) Conduct an aerial visual inspection from a EWP of all the air break insulator post 360 degrees around, top and bottom of the post.

5) Any cracking will be in the first 150mm from the top down or 150mm from the bottom up the insulator post.

6) Looking down on the top of the insulator post signs of cracking may be seen as rust lines extending out from around the center pin.

7) **Note: Any sign of cracking all work shall cease and**;

- Remove the orange tag and replace with a Red tag, and report the change to distribution operations.

8) **Note: At this stage, "The Air break switch earth is to remain connected"**

9) **Temporary jumpers must be connected onto the mains not onto the air break switch loops**.

10) Removal of loops may be cut away using stick method or by using battery operated cutters to reduce movement of loops

11) **Road phase**: Two live line crews simultaneous connect temporary bypass jumpers across air break switch

- Check current flow in jumpers by doing tong test.
- Two live line crews simultaneous cut loops away from air break post. Either by cutting away using sticks or battery operated cutters.
- **Note**: To avoid breakage during transport, crew to wrap padding around remove insulator post(s).

12) **Path phase**: Two live line crews simultaneous connect temporary bypass jumpers across air break switch.

- Check current flow in jumpers by doing tong test.

- Two live line crews simultaneous cut loops away from air break post. Either by cutting away using sticks or battery operated cutters.

13) Centre phase: Two live line crews simultaneous connect temporary bypass jumpers across air break switch.

- Check current flow in jumpers by doing tong test.

- Two live line crews simultaneous cut loops away from air break post. Either by cutting away using sticks or battery operated cutters.

14) Physically check air break switch porcelain post for structural integrity now with conductor tension removed

15) Porcelain post may need to be secured by cable ties, electrical tape or plastic wrap

16) Remove air break switch earth from switch and handle positions

17) Between live line crews coordinate the removal of down rod and handle from unit and pole

18) If no cross arm under air break switch then install a new cross arm. Then, disconnect conductors from air break switch and affix to new cross arm in preparation to install replacement unit (e.g. Load Break Switch or Recloser).

19) Remove amber air break switch unit from pole position.

20) Secure for transport.

10•7•7 INSTALL RECLOSER ON TOP OF POLE

Note: Although the following steps cover off installing a recloser, the same principles apply to installing a Load Break Switch on top of a pole.

1) **All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures)**.

2) Proline may assist by lifting the recloser or load break (LBS) switch to a clear position for testing.

3) Before raising hook in the air, attach spiral link stick onto the hook.

4) Attach control cable cord to the bottom of the recloser or LBS and secure in a position where it will be excess able for the live line crew once attached to the pole. This is required due to the clearance between bottom of the recloser and the HV cross arms.

5) Fit earth lug to recloser and two earth lugs to bracket and connect earth lead from recloser to bracket. Extra lug is fitted to take the earth wire from ground once the bracket is attached to pole.

6) Have all conductors either side of the pole insulated with at minimum one line hose or hard cover per phase minimum, plus mat over JDs.

7) The road and center phases are to be jumped out with loops removed, if path side is not jumped out it must be completely double covered.

8) Road phase jumper to be double insulated and the center phase jumper to be located over the other side of pole, path side away from road.

9) Live line crew must be located aloft at the cross arms to give instruction/directions to the proline operator, with an insulating stick to guide the recloser bracket through the middle of the cross arms.

10) Preferable the proline to be the same side of the pole as the recloser is to be installed on.

11) Only live line accredited proline operators to do this task.

10•7•8 INSULATOR REPLACEMENT

10•7•8•1 PIN INSULATOR REPLACEMENT – INTERMEDIATE

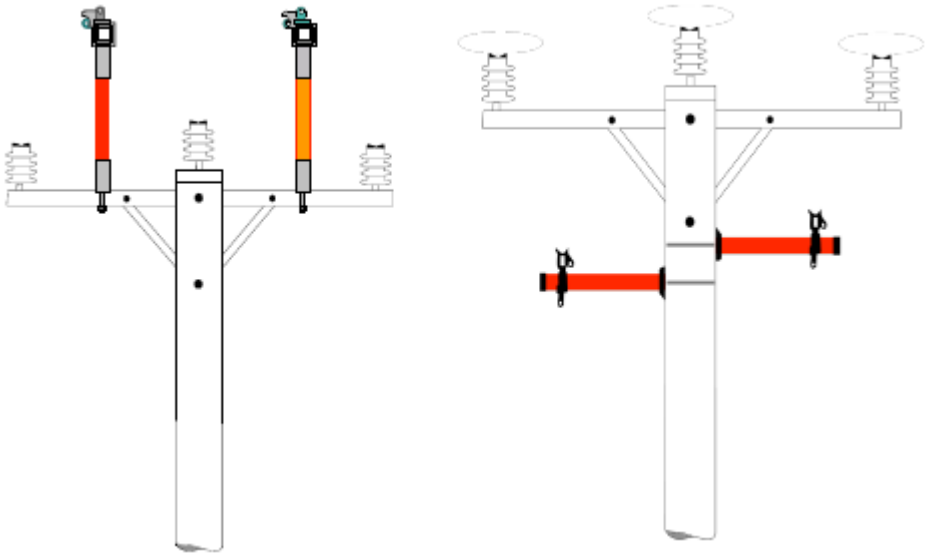


Diagram 11 - 6

Typical rig arrangements for Pin Insulator Replacement – Intermediate.

This procedure is suitable for 22 kV three phase pole top arrangements 1/22/3, 1B/22/3, IV/22/3, DV/22/3, TR/22/3, TR6/22/3, I/12.7/1 and 22 kV single phase arrangements as well as respective 11 kV three phase and single phase arrangements.

All preliminary Live Work procedures shall be carried out prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures*).*

1. Fit adequate insulating barriers to provide safe access to the workarea.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Rig the appropriate support sticks. (Refer to Section 3.3).

Note. Provided two levels of insulation are maintained and the conductor loading may be lifted manually, the conductor may be positioned on the cross arm to complete the insulator replacement.

4. Untie the conductor and relocate the conductor to a position, which allows adequate working clearance, and secure it.

5. Replace the insulator.

6. Reposition the conductor and secure to the insulator.

7. Lower all equipment.

8. Remove all insulating barriers.

10•7•8•2 PIN INSULATOR REPLACEMENT – ANGLE

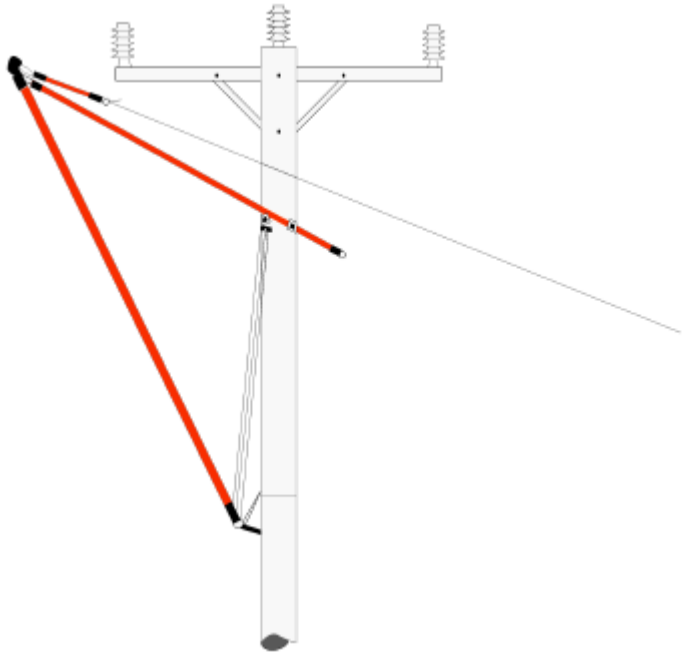


Diagram 11 - 7

Typical rig arrangement for Pin Insulator Replacement – Angle

This procedure is suitable for 22 kV three phase pole top arrangements I/22/3, IB/22/3, and I/12.7/1 and 22 kV single phase arrangement as well as respective 11 kV three phase and single phase arrangements.

All preliminary Live Work procedures shall be carried out prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the workarea.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Rig a lever lift support **or** a 63 mm wire tong for outside conductors and two (2) wire tong saddles for center conductor.

4. Attach a 16 mm rope to an insulating link stick.

5. Install a temporary anchor (eg. gad, stay pole) at a position which bisects the angle of the conductor.

6. Attach a sling and tackle to the anchor point.

7. Attach the insulating link stick to the conductor adjacent to the jaws of the wire tong.

8. Connect the tail of the 16 mm rope to the tackle and take up the tension.

9. Operate the tackle simultaneously with the rig to disengage the conductor from the insulator.

10. Untie the conductor and relocate the conductor to a position which allows adequate working clearance and secure.

11. Replace the insulator.

12. Reposition the conductor and secure to the insulator.

13. Lower all equipment.

14. Remove all insulating barriers.

10•7•9 DISC INSULATOR REPLACEMENT

10•7•9•1 DISC INSULATOR REPLACEMENT – STRAIN

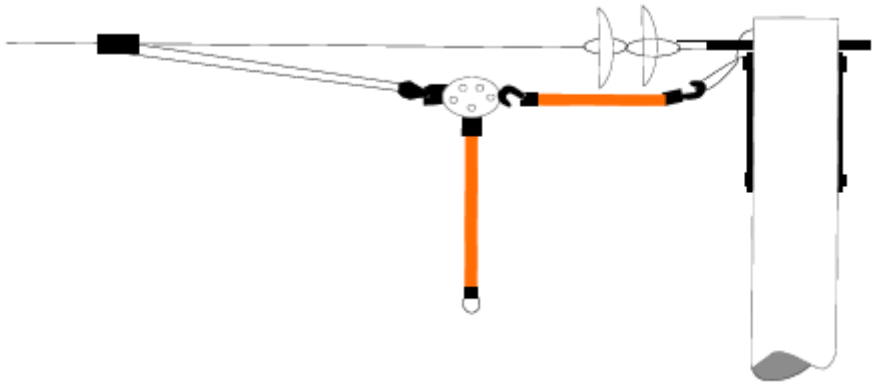


Diagram 11 - 8

Typical rig arrangement for Disc Insulator Replacement – Strain

This procedure is suitable for 22 kV three phase pole top arrangements S5/22/3, S7/22/3, SU5/22/3, DE5/22/5, DE7/22/3, RS5/22/3, RS7/22/3, SV/22/3, SUV/22/3, RSV/22/3, TR1/22/3, TR2/22/3, TR3/22/3, S/12.7/1, DE/12.7/1 and 22 kV single phase arrangement as well as respective 11 kV three phase and single phase arrangements.

All preliminary Live Work procedures shall be carried out prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Attach a sling to the cross arm or pole (depending upon the insulator to be replaced) as close as possible to the insulator.

4. Attach the strap hoist to the sling via an insulating link stick.

5. Attach a come-along to the conductor and connect the strap hoist to the come-along.

6. Operate the strap hoist and disconnect the termination from the insulator.

7. Relocate the conductor to a position which allows adequate working clearance and secure.

8. Replace the insulator.

9. Reposition the conductor and secure the termination to the insulator.

10. Lower all equipment.

11. Remove all insulating barriers.

10•7•9•2 DISC INSULATOR REPLACEMENT – SUSPENSION

Diagram 11 - 9

Typical rig arrangement for Disc Insulator Replacement – Suspension

This procedure is suitable for pole top arrangement A/12.7/1.

All preliminary Live Work procedures shall be carried out prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Attach two slings to the pole as close as possible to the insulator.

4. Attach a strap hoist to each sling via an insulating link stick.

5. Attach a come-along to the conductor on each side of the insulator and connect the strap hoists to the come-alongs.

6. Operate the strap hoists alternately to release tension from the suspension clamp.

7. Disconnect the suspension clamp from the insulator.

8. Relocate the conductor to a position which allows adequate working clearance and secure.

9. Replace the insulator.

10. Reposition the conductor and secure the suspension clamp to the insulator.

11. Lower all equipment and remove all insulating barriers.

10•7•10 POLE ERECTION / REMOVAL / REPLACEMENT

10•7•10•1 GENERAL REQUIREMENTS

The pole replacement procedures include a description of the positions in which the new pole should be erected to ensure that the most efficient Live Work replacement procedure is utilised.

A wood pole may be erected prior to the arrival of the Live Work team, provided it can be done under normal line work conditions in accordance with the procedure.

In certain circumstances or when the new pole is to be installed more than 1.5 metres from the existing pole, the Live Work team will be required to relocate or cover the conductors prior to installing the pole.

Note. In all cases where a Live Work team is involved with the installation of a pole, they shall control all installation work.

This section details the principles for erecting, removing or replacing poles in close proximity to energised high voltage conductors. It is relevant for all wood, steel and composite material type Distribution poles.

The position of the HOLE for a new pole will need to be:

Selected carefully to ensure the pole can be installed safely between the conductors and will stand erect and clear of live conductors.
Where it will allow the least amount of work at the pole top in relocating existing conductors.

In order to provide adequate safety, POLES will need to be:

- Positioned and / or set up correctly.
- Fitted correctly with appropriate insulating covers where required.
- Constantly monitored during installation / removal.
- Installed / removed without cross arms, etc unless safe to do so.
- Shortened by removing top of redundant pole to two (2) metres below conductors before pulling out, where conductors have not been relocated.
- Turned by using a Cant Hook with an insulated (i.e. wood, fibreglass, etc) handle.

In order to provide increased safety, CONDUCTORS may need to be:

- Covered with approved insulating covers.
- Relocated or spread to increase separation distances.
- Monitored to ensure their safety and security.
- Fitted and secured to the appropriate pole(s) after installation / removal.

To guide a new pole into the hole, two 18 mm diameter non-conductive polypropylene ropes shall be attached to the pole butt and held by two Line Workers. The ropes will be used to guide the pole butt into the hole. 18 mm ropes are required to ensure the ropes can be securely held by hand whilst under tension. Sometimes three ropes maybe required to control pole into pole hole due to pole being lifted close to balance.

Alternatively, person/s handling the butt of the pole during installation or removal process shall wear appropriately rated Gloves for the voltage being worked. The Gloves shall be worn at all times while positioning the pole into the hole.

The work procedure **Erecting Poles Through Or Near Live High Voltage Conductors** (Refer Section 10.7.7.4) shall be used in conjunction for this activity.

Note:

1. The crane Operator shall be competent/authorised and fully conversant with Live Work techniques for installing / removing poles. The operator shall be under the direct and immediate supervision of a nominated member of the HV live work crew at all times.

2. The crane Operator shall be fully briefed by being involved in the work-site and Hazard Risk Assessment process as well as the task planning process.

3. The crane shall be "earthed" to a recognised earth point.

4. A conductive pole shall be "earthed" during installation / removal.

(A) Wood Pole Installation / Removal, Live High Voltage Conductors.

1. If the minimum approach distances shown in Table 11-2 can be maintained between the wood pole and live high voltage conductors during pole erection or removal – then no level of insulation is required.

Voltage Level	Minimum Approach
11 kV	700 mm
22 kV	1000 mm
33 kV	1000 mm

Table 11 - 2

2. If, during installation / removal, the pole will encroach closer than the minimum approach distances in Table 11-2 and possibly up to the minimum approach distances shown in Table 11-3 then, at least, one level of insulation shall be used.

Voltage Level	Minimum Approach
11 kV	150 mm
22 kV	250 mm
33 kV	250 mm

Table 11 - 3

3. If there is any possibility of the pole encroaching closer than the minimum approach distances in Table 11-3 or possible contact with conductors could occur – then two levels of insulation shall be used. (For example, covers on the pole and on conductors).

Note. Whenever a wood pole is to be erected between live high voltage conductors within a span it shall be done under Live Work conditions.

(B) Conductive Pole Installation / Removal, Live H.V. Conductors.

Greater care and attention is required when installing / removing conductive type poles (steel / concrete) near live high voltage conductors because of the possibility of a direct short between the live conductors and earth.

Under no condition shall these types of poles be installed or removed in / near live high voltage conductors without the direct assistance and control of Live Work personnel. It shall be done under Live Work conditions.

Extreme caution must be exercised at all times in order to prevent "contact" between the pole and any live conductors.

Two levels of insulation shall be used at all times and applied to the pole and/or the high voltage conductors prior to installing / removing the pole.

10•7•10•2 POLE ERECTION MID SPAN

1. Poles being erected more than 1.5 metres from an existing pole must be installed by Live Work personnel using Live Work methods.

2. All conductors shall be "covered" (as required) with approved insulating covers prior to installing the pole.

3. Both HV and LV conductors shall be spread (as required) to provide adequate clearance between conductors and pole, especially when installing a conductive pole.

4. The pole shall be appropriately "covered" with approved insulating covers as required.

5. The conductors must be secured to the pole top after the pole has been installed.

Note. Insulating covers shall not be left on the pole or conductors overnight.

10•7•10•3 POLE REMOVAL

All preliminary Live Work procedures shall be carried out prior to the commencement of any Live Work. (Refer Section 10.1 - Preliminary Live Work Procedures*).*

1. Arrange for Feeder "protection" to be SET for Live Work.

2. Fit a minimum of three (3) rigid insulating covers to center conductor.

3. Attach a rope to rigid insulating covers to enable them to be moved from the ground if required.

4. Fit a minimum of three (3) rigid insulating covers to side conductor (beside pole).

5. Attach a rope to rigid insulating covers to enable them to be moved from the ground if required.

6. Fit rigid insulating covers to the pole (if required) and remove it using an appropriate crane in the approved manner.

7. Return all conductors to their normal position and remove all insulating covers.

8. Arrange for Feeder "protection" to be returned to normal operation.

Note. It may not be necessary to install insulating barriers to conductors, if minimum approach distances can be maintained.

An alternative method is to cut the top off the pole (in manageable size sections) to a distance of at least 2.0 metres below the lowest conductor and then remove the pole with a suitable crane in the approved manner. The small pole sections would be lowered to the ground in the bucket of an Elevating Work Platform.

Ensure all cross arms, brackets, bolts, etc are removed from the pole top BEFORE attempting to REMOVE any part of the pole.

10•7•10•4 ERECTING POLES THROUGH OR NEAR LIVE HV CONDUCTORS

All preliminary Live Work procedures shall be carried out prior to the commencement of any Live Work. (Refer Section 10.1 - Preliminary Live Work Procedures)

1) **Erecting Pole**

- Live Line Workers may erect any type of pole in any location provided they apply appropriate Live Line Techniques.

- Reference is made to a PHBE Unit as this is the only type of "crane" fitted with hydraulically operated pole claws (jaws) at the top end of the jib. The Instructions require the pole to be firmly held by these pole claws when in close proximity to live conductors. The PHBE Unit will be referred to in these Instructions as the "Crane".

2) CAUTION: The Erection of Poles through / near LIVE HV conductors is Prohibited when:

- The HV substandard conductors are **No. 8** GI steel, **7/.048** copper or **7/.064** copper.

- Inspection of two spans either side of the work location – if HV conductor is suspect i.e. 7/.080 Cu. Or 7/.093 Al. and condition of the conductor has shown sufficient deterioration to deem it unsafe to perform the work.

- The new wood pole is to be erected in-span more than **1.5 metres** away from the existing HV pole where it would be subject to "in-span" movement of the HV conductors.

- The weather and wind conditions are unsuitable.
- The PHBE Crane Operator does NOT have the necessary level of Competence.
- The Minimum Approach Distances can NOT be achieved and maintained.

3) Exceptions

- A WOOD pole may be installed more than 1.5 metres away from an existing HV pole through conductors when it is erected by Live Line workers using live line techniques. The conductors must be "attached" to the new pole after it is erected.
- A CONDUCTIVE pole may be installed provided it is installed by Live Line workers using live line techniques. In addition, the pole must be temporarily earthed whilst the installation work is being done. The conductors must be "attached" to the new pole after it is erected.

4) Erection of Poles May Only be Carried Out:

- With clean, dry, approved insulating covers fitted to the pole, the conductors or both as required (*See Table-1 and 2*).
- If the prescribed minimum approach distances can be maintained between the "Crane" and all live conductors as per the following Tables.

Crane – Minimum Approach Distance.

Line Voltage	Uninsulated Conductors	Covered Conductor
Low Voltage.	300mm	100mm
11 kV.	1.0 metres	400mm
22 kV.	1.0 metres	400mm
33 kV.	1.0 metres	450mm

Note. *A Safety Observer is required*

Wood Pole Erection – Minimum Separation of Pole and Conductor.

Line Voltage	No Insulation	One Level of Insulation	Two Levels of Insulation
Low Voltage.	As required	As required	Contact
11 kV.	700 mm	150 mm	Contact
22 kV.	1.0 metre	250 mm	Contact
33 kV.	1.0 metre	250 mm	Contact

Note. *A Safety Observer is required*

5) Separation Distances and Fitting of Insulated Covers

The insulated covers referred to in the following Tables as "levels of insulation" are:

- The approved pole insulating covers as described in section 4.0 above.
- The approved insulating covers (barriers) used by Live Line personnel to place over conductors and pole top hardware.

Wood Pole Erection – Minimum Separation of Pole and Conductor.

Table - 1	Level of Insulation Fitted to Pole, Conductors or Both		
Line Voltage	**No Insulation**	**1 Level of Insulation**	**2 Levels of Insulation**
Low Voltage.	Air Gap	Air Gap	Air Gap
11 kV.	700 mm	150 mm	Less than 150 mm
22 kV.	1000 mm	250 mm	Less than 250 mm
33 kV.	1000 mm	250 mm	Less than 250 mm

Note. A Safety Observer is required.

Conductive Pole Erection - Minimum Separation Of Pole And Conductor

Table - 2	Level of Insulation Fitted to Pole, Conductors or Both
Line Voltage	**2 Levels of Insulation**
Low Voltage. 11 kV. 22 kV. 33 kV.	Air Gap 150 mm 250 mm 250 mm

Note. A Safety Observer is required.

6) Personal Required

As a minimum, five suitably qualified persons (four live line employees plus a Crane Operator) are required to erect a pole through live conductors.

Additional persons (Live Line), above the minimum of five, may be required when live line techniques are employed, depending upon the complexity of the work and outcomes from a JRA assessment.

- The Crane Operator.
- Two side guy rope controllers to control movement of pole butt into the hole.
- A Safety Observer.
- Additional live line employee to provide support where ever required.

Note. If a pole is being erected under the direction of a Live Line team, the Safety Observer MUST be a qualified live Line worker.

The Safety Observer shall be so positioned as to be able to see and communicate with the Crane operator and the Guy Rope Controllers whilst having an unobstructed view of the whole pole erection activity.

7) Equipment Required

The following list of approved items of equipment shall be used at all times when erecting wood poles either through or near live high voltage conductors at distances closer than:

700 mm for 11 kV. 1000 mm for 22 and 33 kV.

8) Pole Insulating Covers

AB Chance type polyethylene covers (or similar) coloured orange or red.

• Cat. No. M4937-6. 225 mm (9”) diameter x 1.8 metres (6 feet) long.
• Cat. No. C406-0000. 300 mm (12”) diameter x 1.8 metres (6 feet) long.

Note. One 10 mm diameter polypropylene “release rope” and one 8 mm diameter polypropylene “retaining rope” are required to be used in conjunction with the insulated pole covers in accordance with Drawing DA4-931 (see Attachment - 1). Length of both ropes shall suit height of respective poles.

9) Conductor Insulating Covers

These shall be approved Live Line covers (barriers).

Note. These are only required when a pole is erected by Live Line personnel and the situation calls for their use.

10) Winch Rope Insulation

Round Terylene Sling of suitable length - to be fitted to pole for attachment of Crane hook.

11) Guy Ropes

Two Manila or Polypropylene Guy Ropes 18 mm in diameter and 10 metres long. These must be kept dry and in good condition. They should be fitted with an “eye” in one end for attachment to the pole.

12) Portable Earthing Device

One 10 metre long earthing cable fitted with a screw-up clamp either end. Cable is to be either 35 mm2 bridging cable or insulated welding cable. The earth shall be attached to the metal chassis on the front of the Crane vehicle and an approved earth stake as shown in Attachment – 2 OR recognised earthing point as indicated in the Power System Safety Documents.

13) Pole Cant Hook

The cant hook shall have an approved insulated handle similar to that shown in Equipment Manual Drawing A2 - 2445 (see Attachment - 3).

14) HV Insulating Gloves

These shall be approved HV operating gloves (or similar) and are to be worn whenever the cant hook is used to turn the pole. They should be worn under and protected by leather or PVC work gloves. The insulating gloves shall be “air tested” before and after use and stretched by hand to ensure their

mechanical strength is adequate. They shall be electrically tested every twelve (12) months or whenever their integrity has been compromised.

Note. When Live Line personnel are erecting the pole, the gloves used may be their own approved Live Line gloves.

15) Feeder Access

The Distribution Network in Tasmania is the responsibility of TasNetworks and authority must be obtained from the TasNetworks to allow work to be carried out on Distribution lines.

Before commencing to erect poles through or near live high voltage conductors using this procedure, arrangements shall be made TasNetworks, Operations Section for the appropriate HV Feeder protection to be identified and "SET" in accordance with their requirements.
Note. The Feeder protection shall be returned to "normal" after the job has been completed.

16) Site Preparation

- Mobile plant such as EWP's, Cranes, PERU's or Task Trucks used in conjunction with HV Live Work shall be electrically connected to earth via a conductor from the chassis to a permanent earth or temporary driven earth electrode. The lowering of an earth chain is not an adequate means of earthing when undertaking HV Live Work.

  Refer to the section on **Mobile Earthing Requirements** in the HV Live Work Manual for full details.

- **Note.** The earth stake should be kept as far as practicable from the work location. The height of the existing H.V. conductors shall be checked and accurately determined.

- The pole hole location, its depth and the length of the pole shall be carefully checked to ensure the new pole will stand erect and clear of the high voltage conductors when erected.

- All live low voltage conductors in the vicinity of the work area shall either be de-energised or insulated with the approved low voltage insulating covers, or alternatively spread or relocate the conductors.

- The new pole shall be correctly positioned alongside the hole in such a way that will enable it to be lifted straight up and in to the hole, without any unnecessary sideways slewing.

- Set up an adequate **Traffic Management Plan**.

17) Positioning Of The Crane

Prior to commencing erection of the pole, the Crane vehicle shall be positioned such that:

- It is in the best possible position to lift the pole up and into the hole with minimal movement.
- The Operator's vision of the work site is not obstructed at any time during the erection of the pole.
- The Maximum Approach Distance (also known as Safe Approach Distance in the TasNetworks Power System Safety Rules) is maintained between all uninsulated exposed parts of the Crane and "live" conductors.

Note: MADs for mobile and vehicles shall comply with the following requirements as per the Power System Safety Rules (PSSR):

- **Mobile Plant**

  (1) Operated By An Ordinary Person - **Section 5.5 of the PSSR**.
  (2) Operated By An IP Or Authorised Person - **Section 5.6 of the PSSR**.

- **Vehicles**

  (1) Operated by An Ordinary Person - **Section 5.7 Table 5 of the PSSR**.
  (2) Operated By An IP Or Authorised Person - **Section 5.8 Table 6 of the PSSR.**

- The top end of the Crane jib (with pole claws in the open position) can be raised directly above the excavated pole hole. This is to ensure there is no need to slew the jib during the lifting of the pole into the vertical position.
- During the erection, a minimum of positional adjustment of the pole head would occur while the pole is between or near the live high voltage conductors.

Special Note. The crane operator shall not leave the vehicle until the pole is positioned in the hole and the required safe distance between the pole and the conductor(s) is achieved.

18) Insulation Of The Pole Head

Before erection:-

- De-energise, insulate or spread L.V. Conductors.

• Fit insulating covers to HV conductors or spread/relocate conductors (as applicable).

• The pole head shall be insulated by wrapping with the approved pole insulating covers. Such wrapping shall ensure full covering with at least **300mm** above the pole top (pole cap). (see Attachment - 1).

• The slip-on insulating cover(s) shall be so arranged to ensure that the lower edge of the wrapping is at least 300mm below any point likely to make accidental contact with the high voltage conductors.

• When two or more insulating covers are used - the minimum overlap shall be 300mm and all covers shall completely encircle the pole with at least 50mm side overlap.

Note:

– The "retaining rope system" should be used when the slip-on pole insulating covers fail to tightly grip the pole head. (See Attachment- 1 for detail).

– If the retaining rope system is not used - a clean dry hand line shall be attached to the pole insulating cover handles. This will also allow them to be pulled down after pole is erected.

19) Erection Of The Pole

To guide a new pole into the hole, two 18 mm diameter non- conductive polypropylene ropes shall be attached to the pole and held by two persons suitably qualified and acceptable. The ropes will be used to guide the pole butt into the hole. Eighteen (18) mm ropes are required to ensure the ropes can be securely held by hand whilst under tension.

Alternatively, person/s handling the butt of the pole during installation or removal process shall wear appropriately rated Gloves for the voltage being worked. The Gloves shall be worn at all times while positioning the pole into the hole.

• The pole shall be lifted slowly upwards between the conductors to a point where it can be grasped securely by the "claws". It will then be lifted further and placed in the hole. The pole claws shall be engaged to hold the pole firmly (under control) but loose enough to allow the pole and its insulating covers to be lowered intact through the claws.

• An approved insulated cant hook and insulating gloves shall be used to turn the pole, while it is still held securely by the crane and before the hole is backfilled and rammed.

• The pole shall be aligned (using plumb bob) but left in a position where the minimum required "air clearance" between pole and high voltage conductors can be maintained.

Note:

- During the erection process *no person shall come into direct contact with the pole (or Crane) or be located within the **4.0 metre wide strip** directly under the overhead conductors* (Attachment - 4*),* until the pole has been gripped firmly in the pole claws, UNLESS that person is a qualified Live Line Worker performing a live line activity.

- The Crane operator, during the erection process, shall take extreme care to avoid contact between the pole and the high voltage conductors. **While the pole insulating cover(s) provide satisfactory insulation for voltages up to 33,000 volts - they are provided only as an additional safeguard against accidental contact**.

20) Removal Of The Insulating Covers

Once the pole has been erected, aligned, backfilled and rammed - the insulating covers can be lowered to the ground by releasing the retaining rope system from the pole base and using it to pull them to the ground. If the retaining rope system has not been used - the covers can be lowered to the ground by pulling the hand line down which is attached to the handles on the insulating covers.

The covers will then be pulled from the pole and stored in a clean, dry place.

Note. Insulating Covers shall not be left on the Pole – Overnight or longer than is necessary.

21) Inspection And Care Of The Insulating Covers

The insulating pole covers shall be:

- Inspected (and cleaned if necessary) before use to ensure they are safe to use.

- Kept clean and dry and stored in container provided. Dirty covers shall be washed in a detergent solution of 1% mix of Palmolive dish washing liquid and clean warm water using a soft cloth or sponge, then rinsed and air dried before storage.

- Free of mechanical damage, abrasions and rough handling.

- Rejected for use if damaged in any way that prohibits their safe use.

- Electrically tested at least every twelve (12) months.

The Live Line CONDUCTOR covers, when used, shall be:

- Inspected, maintained and stored in accordance with approved Live Line processes.

22) Minimum Air Clearances

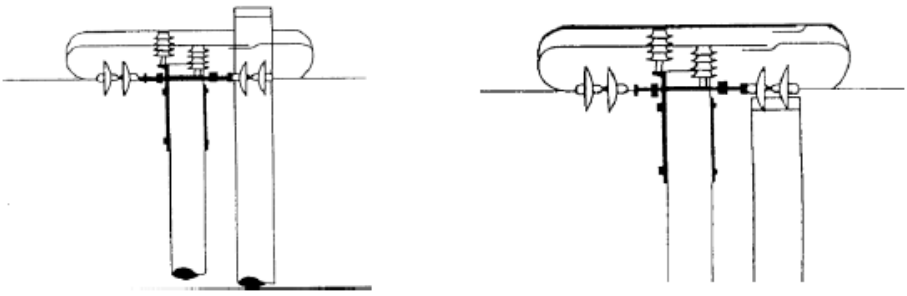
The minimum air clearance that MUST be maintained between live H.V conductors and the surface of an erected pole, pending change-over, shall comply with the following Table.

Voltage	Minimum Air Clearance
Low Voltage.	Air Gap.
11,000 volts.	150 mm.
22,000 volts.	250 mm.
33,000 volts.	250 mm.

Note.
This applies where the new pole and the old pole are within 1.5 metres of each other and braced together by wooden battens nailed near the top of the pole. The two poles may be "roped" together.

23) New Pole Locations

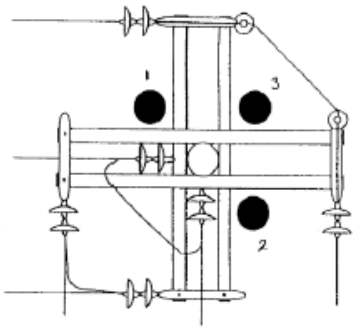
Shown below are samples of pole locations. In most cases, the new pole may be erected either side of an existing pole. However, it should be positioned where the required "air clearance" between pole and conductors can be achieved after the pole has been aligned, backfilled
and rammed.



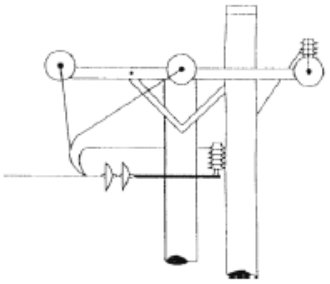
Note. Consideration MUST be given to position of cross arms, etc.

Note the alternative positions for the installation of the new pole.

Obviously position "1" below is the best location for ease of restraining the conductors to the new pole.



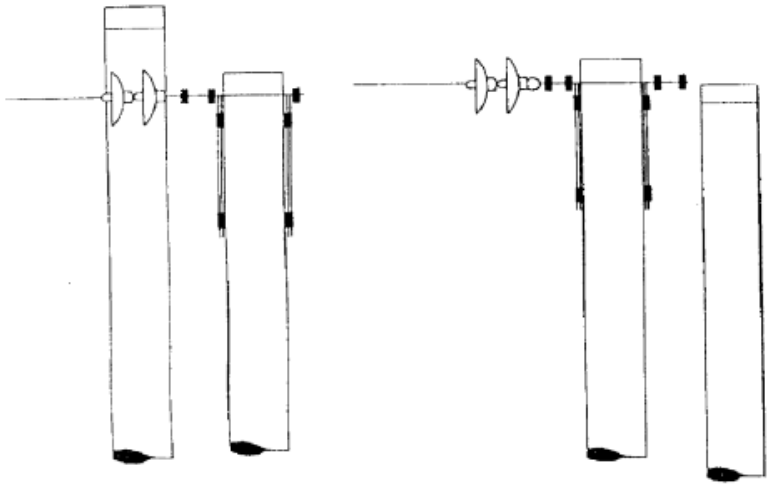
Plan View



Side View

The replacement pole may be erected either in front of or behind the existing pole. However, it is advisable to erect the pole in front of the existing pole whenever possible.

This will eliminate the necessity to sleeve additional wire onto the conductors in order to reach the new pole.



24) Removing A Pole

• Arrange for Feeder "protection" to be SET for Live Work.

• Fit a minimum of three (3) rigid insulating covers to center conductor.

• Attach a rope to rigid insulating covers to enable them to be moved from the ground if required.

• Fit a minimum of three (3) rigid insulating covers to side conductor (beside pole).

• Attach a rope to rigid insulating covers to enable them to be moved from the ground if required.

• Fit rigid insulating covers to the pole (if required) and remove it using an appropriate crane in the approved manner.

• Return all conductors to their normal position and remove all insulating covers.

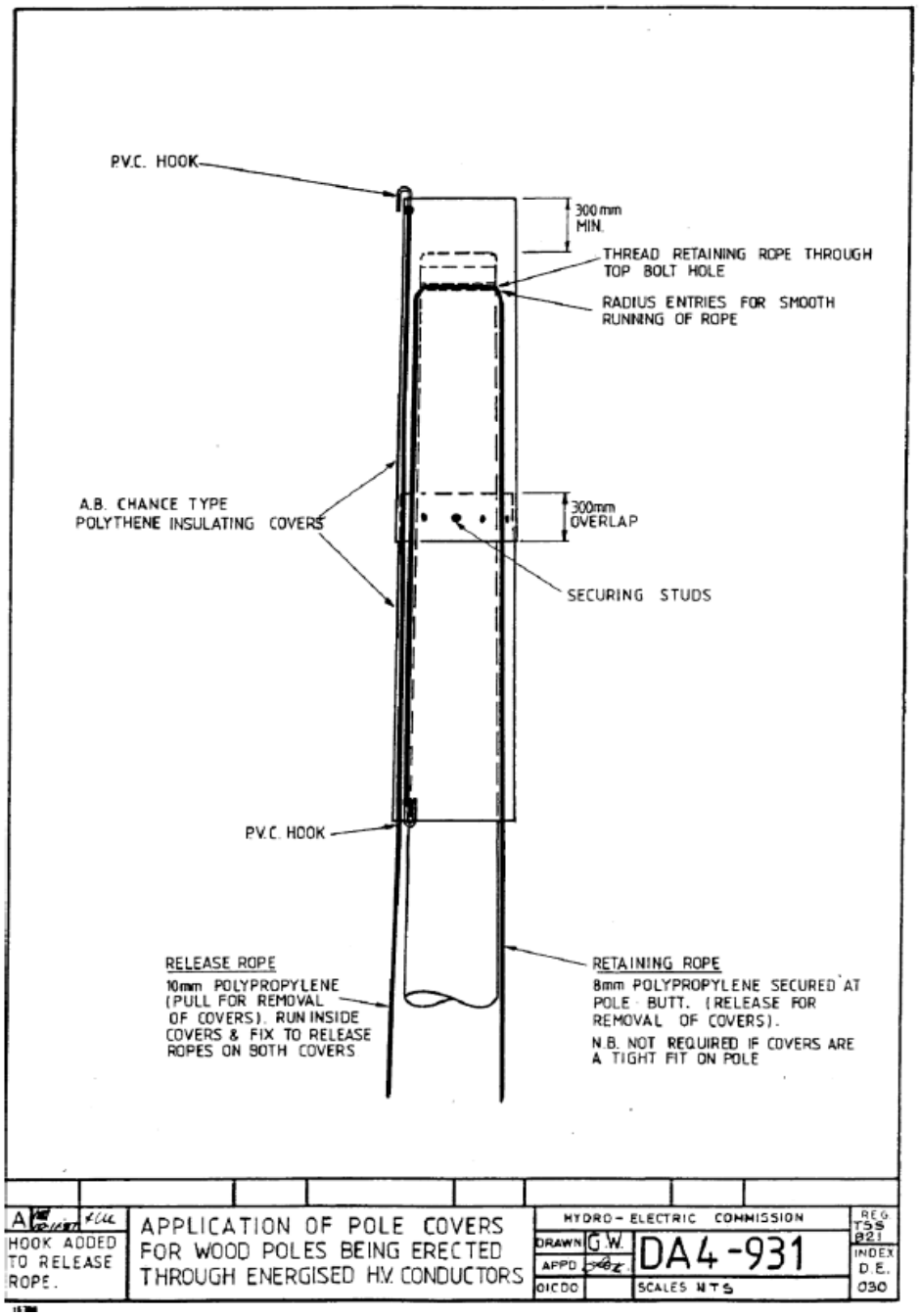
• Arrange for Feeder "protection" to be returned to normal operation.

• **Note.** It may not be necessary to install insulating barriers to conductor(s), if minimum approach distances can be maintained.

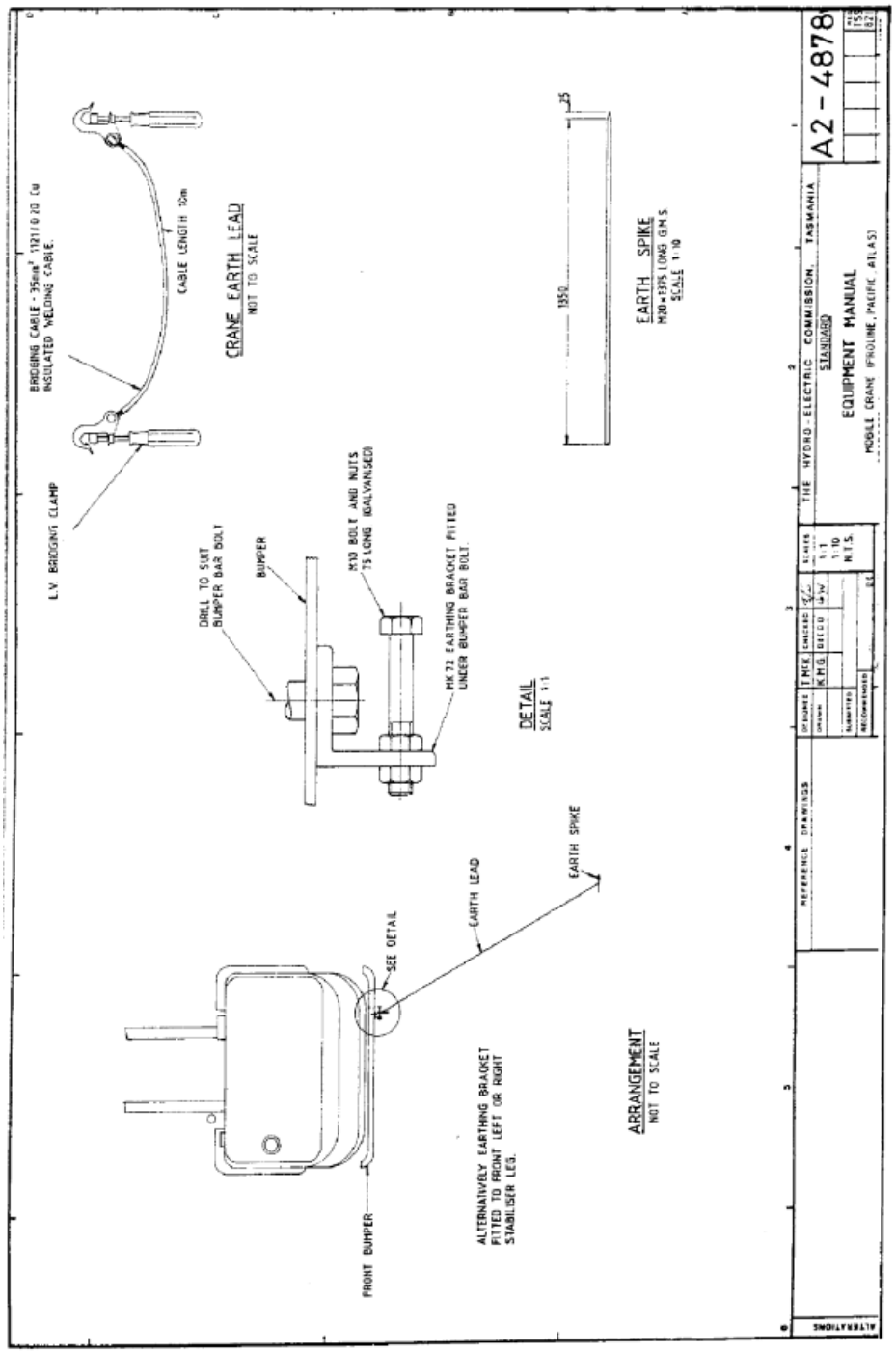
• An alternative method is to cut the top off the pole (in manageable size sections) to a distance of at least 2.0 metres below the lowest conductor and then remove the pole with a suitable crane in the approved manner. The small pole sections would be lowered to the ground in the bucket of an Elevating Work Platform.

• **Ensure all cross arms, brackets, bolts, etc are removed from the pole top BEFORE attempting to REMOVE any part of the pole**.

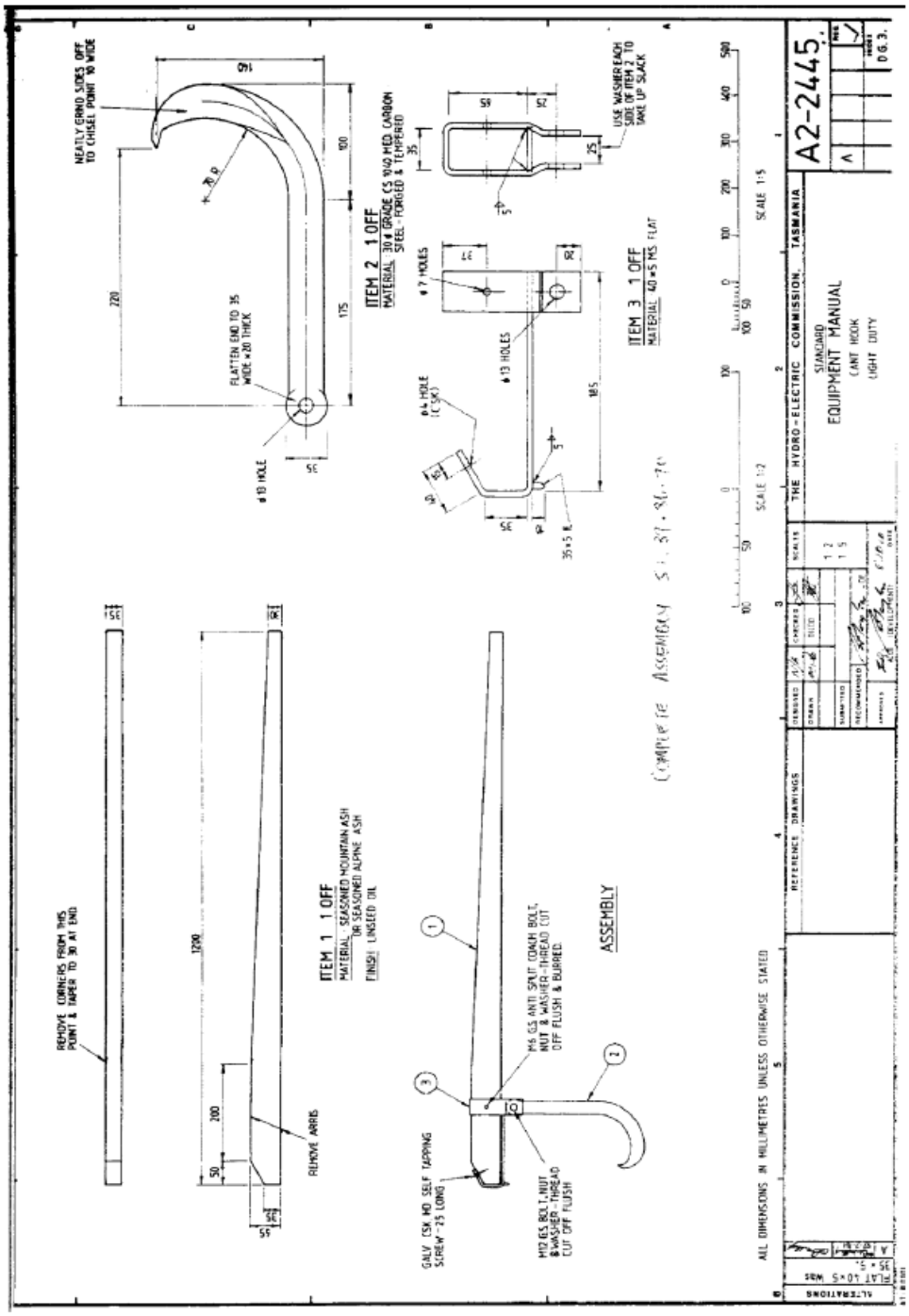
Attachment–1



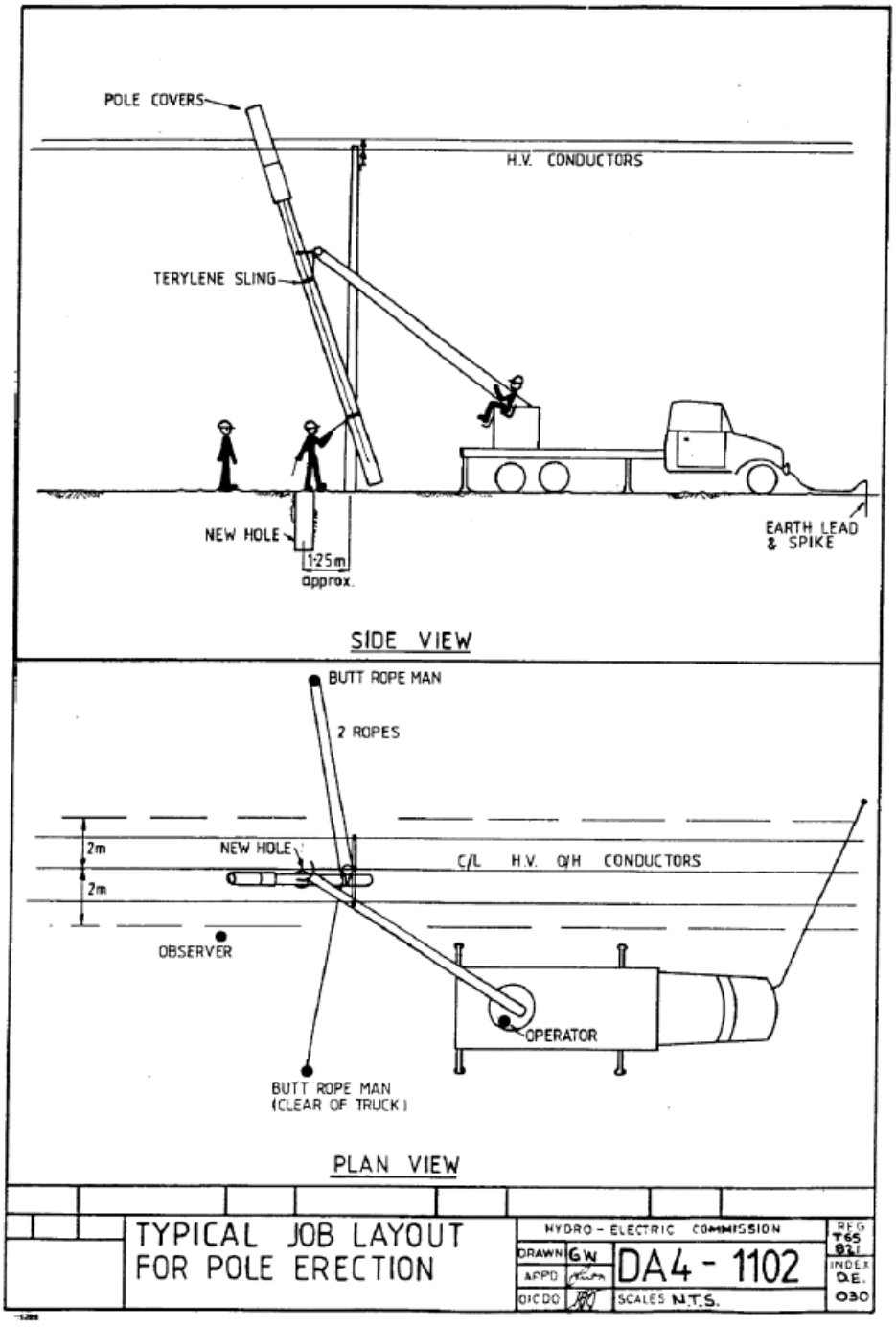
Attachment –2



Attachment – 3



Attachment –4



10•7•7•5 CROSS ARM REPLACEMENT

The replacement of cross arms on pole top arrangements that are constructed of steel are only performed for specific situations (i.e. traditional delta spacing to intermediate spacing or longer cross arms to eliminate conductor clashing).

If it is necessary to perform cross arm replacements, the procedures detailed in the section, *Pole Replacement* are to be applied. The only difference being that
the procedure is performed on the existing pole instead of the new pole.

10•7•7•6 INTERMEDIATE PIN POLE REPLACEMENT

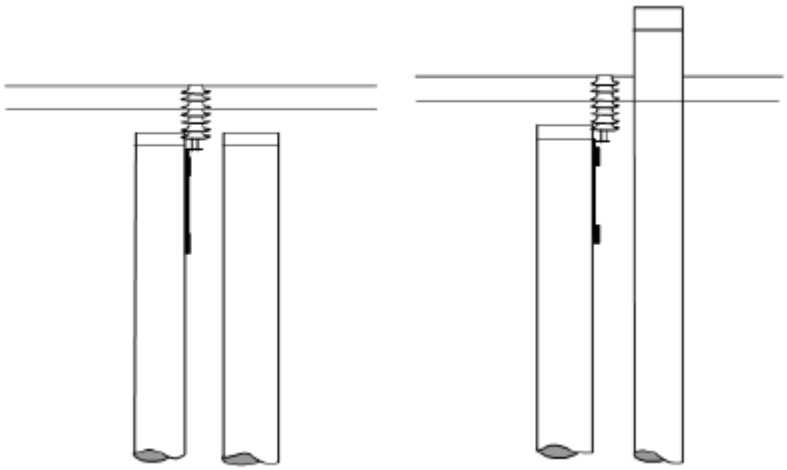


Diagram 11 - 10 **Diagram 11 - 11**

Replacement pole lower or at existing pole height: (Diagram 11 - 10).

Replacement pole higher than existing pole: (Diagram 11 - 11).

The replacement pole may be erected on either side of the existing pole and in line with the existing pole layout.

The replacement pole may be erected on either side of the existing pole.

The position will need to be offset from the existing pole layout to allow the pole to stand between the center and outside conductors.

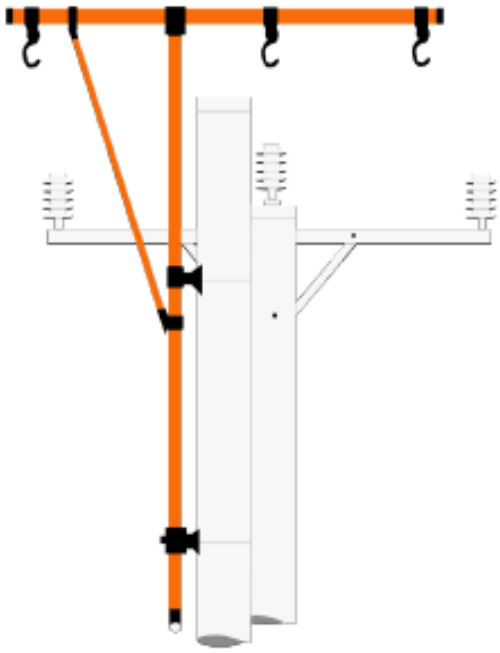


Diagram 11 - 12

Typical rig arrangement for Intermediate Pin Pole Replacement.

This procedure is suitable for 22 kV three phase pole top arrangements I/22/3, IB/22/3, I/12.7/1 and 22 kV single phase arrangement as well as respective 11 kV three phase and single phase arrangements.

Note.

Should the existing pole be condemned, it shall be "secured" - prior to the commencement of this procedure.

Live Work equipment shall not be attached to a condemned pole.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures.)

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Rig the appropriate support sticks. (Refer Section 3.3).

   Note. Any rig from Section 10.6 may be adopted for this procedure provided due regard is given to conductor loadings. The rig illustrated is the Glove and Barrier auxiliary arm rig.

4. Untie the conductors and relocate to a position which allows adequate working clearance and secure conductors.

5. Remove the cross arm arrangement from the existing pole.

6. Remove the head of the existing pole to allow adequate clearance from conductors **or** remove the existing pole entirely

   Note. Ensure that sufficient length is cut from the top of the pole to permit it to clear conductors during removal.

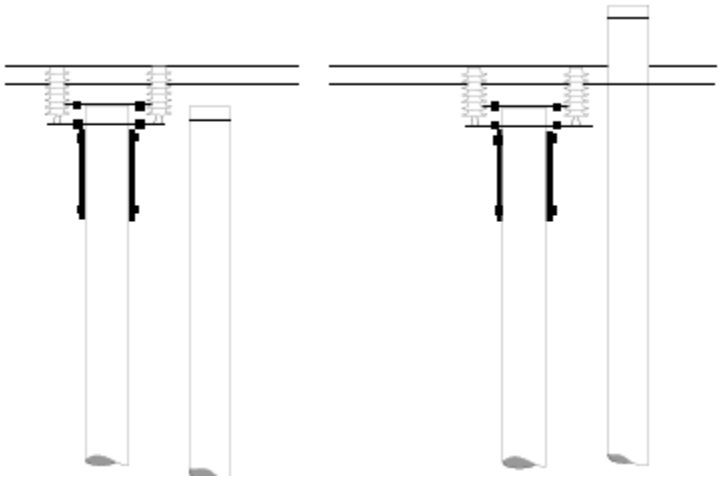
7. Construct the cross arm arrangement on the replacement pole.

8. Reposition conductors, in turn, and secure to their respective insulators.

9. Lower all equipment.

10. Remove all insulating barriers.

10•7•7•7 DOUBLE PIN POLE REPLACEMENT (ANGLE UP TO 28°)



(Pole Position)

Diagram 11 - 13 **Diagram 11 - 14**

Replacement pole lower or at existing pole height: (Diagram 11 - 13)

Replacement pole higher than existing pole: (Diagram 11 - 14**)**

The replacement pole may be erected on either side of the existing pole and in line with the existing pole layout.

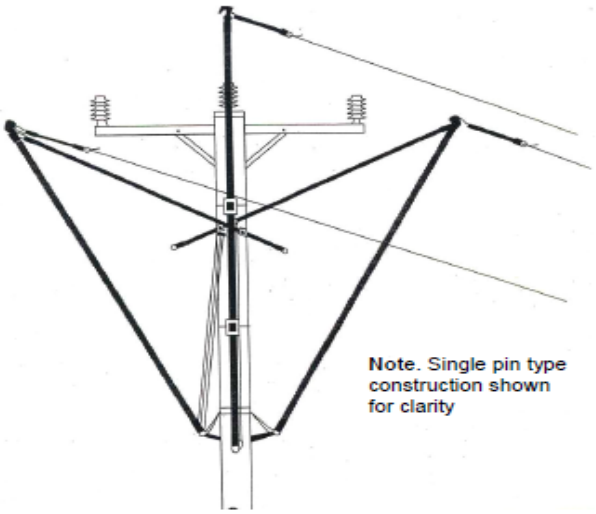


Diagram 11 - 15

The replacement pole may be erected on either side of the existing pole. The position will need to be offset from the existing pole layout to allow the pole to stand between the center and outside conductors.

This procedure is suitable for 22 kV three phase pole top arrangements and 22 kV single phase arrangement as well as respective 11 kV three phase and single phase arrangements.

Note. Should the existing pole be condemned, it shall be secured prior to the commencement of this procedure. Live Work equipment shall not be attached to a condemned pole.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures*).*

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Rig a lever lift support. (Refer to *Section* 10.6.1.4)

Note. A lever lift support is the only rig suitable for these pole top arrangements due to the conductor loading and/or angle.

Additional procedure for angle pole:

3A. Attach 16 mm ropes to insulating link sticks.

3B. Install temporary anchors (eg. gads, stay pole) at a position that bisects the angle of the conductors.

3C. Attach a sling and tackle to each anchor point.

Note. Each conductor shall have an individual anchor.

3D. Attach the insulating link sticks to the conductors adjacent to the jaws of each wire tong.

3E. Connect the tails of the 16 mm ropes to the tackles and take up the tension. 3F. Operate the tackle simultaneously with the lever lift to disengage the conductor from the insulator.

4. Untie the conductors and relocate to a position that allows adequate working clearance and secure them.

5. Remove the cross arm arrangement from the existing pole.

6. Remove the head of the existing pole to allow adequate clearance from conductors or remove the existing pole entirely.

   Note. Ensure that sufficient length is cut from the top of the pole to permit it to clear conductors during removal.

7. Construct the cross arm arrangement on the replacement pole.

8. Reposition conductors, in turn, and secure to their respective insulators.

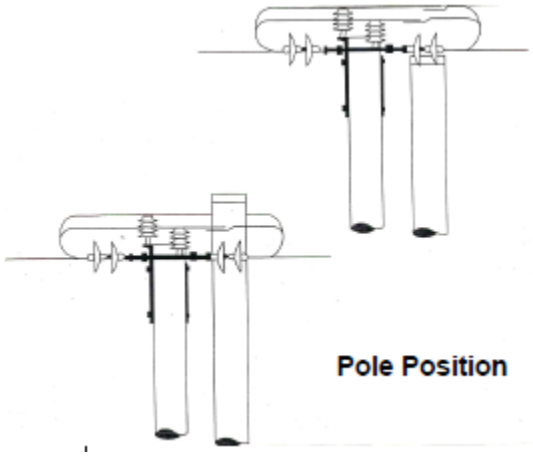
9. Lower all equipment.

10. Remove all insulating barriers.

10•7•7•8 IN LINE STRAIN POLE REPLACEMENT

Diagram 11 - 16

Diagram 11 - 17



Replacement pole lower or higher than existing pole: (Diagrams 11 - 16 and 11 - 17)

The replacement pole may be erected on either side of the existing pole. However, it is advisable to erect the pole on the side where the bridging is shortest whenever possible. This will often allow the opposite side conductors to be terminated to the replacement pole without the necessity to sleeve in a section of conductor. The position will need to be offset from the existing pole layout to allow the pole to stand between the center and outside conductors.

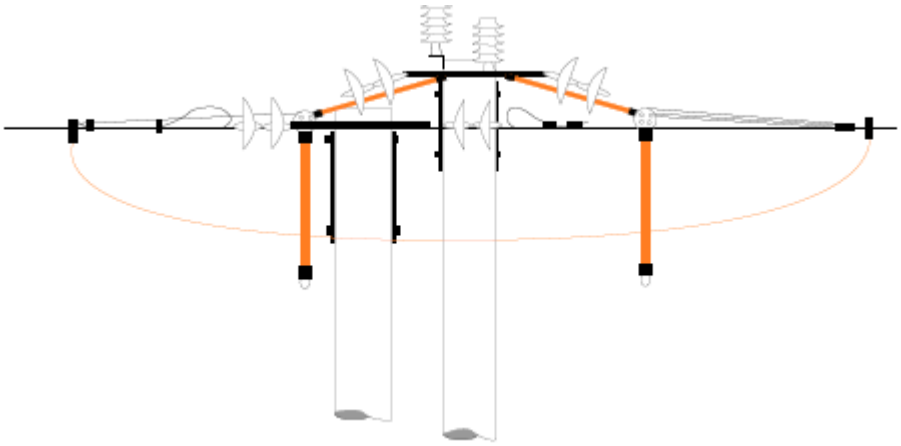


Diagram 11 - 18.
Typical rig arrangement for In Line Strain Pole Replacement

This procedure is suitable for 22KV three phase pole top arrangements S5/22/3, S7/22/3, SU5/22/3, S/12.7/1 and 22KV single phase arrangement as well as respective 11KV three phase and single phase arrangements.

Note. Should the existing pole be condemned, it shall be secured prior to the commencement of this procedure. Live Work equipment shall not be attached to a condemned pole.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Bypass loops on existing pole with temporary bypass jumpers.

   Note. Ensure bypass jumpers are positioned so they will not interfere with helical terminations when terminating conductors on the replacement pole.

4. Remove permanent loops and pin insulators from existing pole.

5. Construct the cross arm arrangement on replacement pole.

6. Working from an outside conductor, attach a sling on each side of the new cross arms as close as possible to the strain insulators.

7. Attach a strap hoist to each sling via an insulating link stick.

8. Attach a come-along to the conductor on each side of the cross arm on the existing pole.

9. Attach each strap hoist to its respective come-along.

10. Operate the strap hoists to release tension on the terminations. Ensure that equal tension is maintained on each strap hoist to avoid twisting the cross arm.

11. Remove the terminations from the strain insulators on the existing pole cross arms and reposition and reconnect the conductors to the strain insulators on the new cross arms.

    Note. On certain pole top arrangements the conductor may be too short to terminate on one side. This will require a section of conductor to be removed to a point that will allow for a termination to be fitted to the new cross arm strain insulators and a longer section of conductor sleeved in.

12. Connect permanent loop across newly constructed in line strain arrangement on replacement pole.

13. Remove come-alongs, strap hoists, slings and temporary bypass jumpers from conductors.

14. Repeat items 7 to 13 for the center and outside conductors.

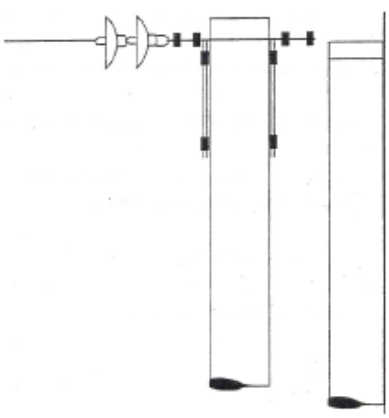
15. Remove the cross arm arrangement from the existing pole.

16. Remove the head of the existing pole to allow adequate clearance from conductors **or** remove the existing pole entirely.

17. Lower all equipment.

18. Remove all insulating barriers.

10•7•7•9 DEAD END POLE REPLACEMENT



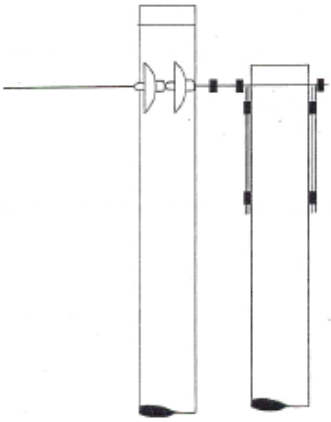


Diagram 11 – 19 **Diagram 11 - 20**
(Pole Positions)

Replacement pole lower / higher than existing pole: (Diagrams 11 - 19 & 11 - 20)

The replacement pole may be erected either in front of or behind the existing pole.

However, it is advisable to erect the pole in front of the existing pole whenever possible. This will eliminate the necessity to sleeve a section of wire into the existing conductor when the replacement pole is erected behind the existing pole.

The pole position will need to be offset from the existing pole layout to allow the pole to stand between the center and outside conductors. This is only necessary when the pole is erected in front of the existing pole.

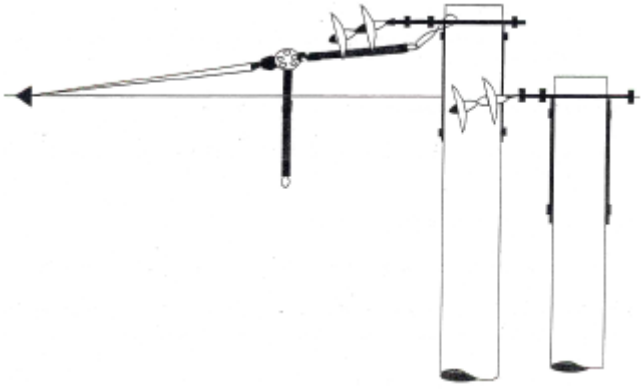


Diagram 11 - 21 Typical rig arrangement for Dead End Pole Replacement

This procedure is suitable for 22 kV three phase pole top arrangements DE5/22/3, DE7/22/3, DE/12.7/1 and 22 kV single phase arrangements as well as respective 11 kV three phase and single phase arrangements.

Note. Should the existing pole be condemned, it shall be secured prior to the commencement of this procedure. Live Work equipment shall not be attached to a condemned pole.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Construct the cross arm arrangement on the replacement pole.

4. Attach a sling to each end of the new cross arm arrangement as close as possible to the strain insulators.

5. Attach a strap hoist to each sling via an insulating link stick.

6. Attach a come-along to each outside conductor and connect the strap hoist to the come-along.

7. Operate the strap hoists to release the tension on the terminations. Ensure that equal tension is maintained on each strap hoist to avoid twisting the cross arms.

8. Remove the terminations from the strain insulators on the existing pole cross arms and reposition and reconnect the conductors to the strain insulators on the new cross arms.

   Note. If the replacement pole has been erected behind the existing pole a section of conductor will need to be sleeved into the existing conductors.

9. Remove come-alongs, strap hoists and slings.

10. Repeat items 4 to 9 for the center conductor.

11. Remove the cross arm arrangement from the existing pole.

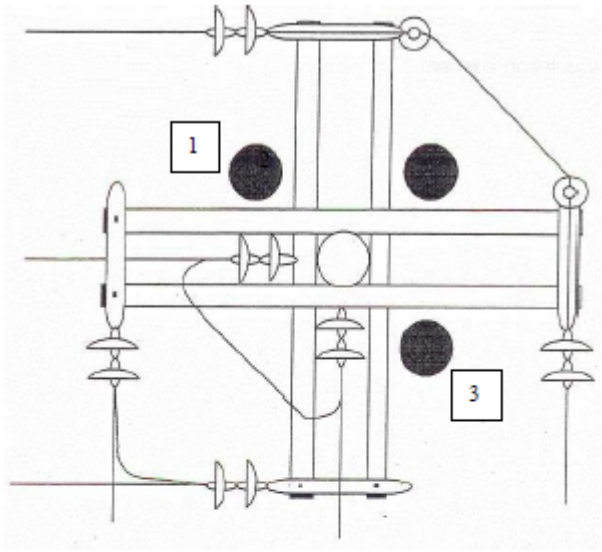
12. Remove the head of the existing pole to allow adequate clearance from conductors **or** remove the existing pole entirely.

13. Lower all equipment.

14. Remove all insulating barriers.

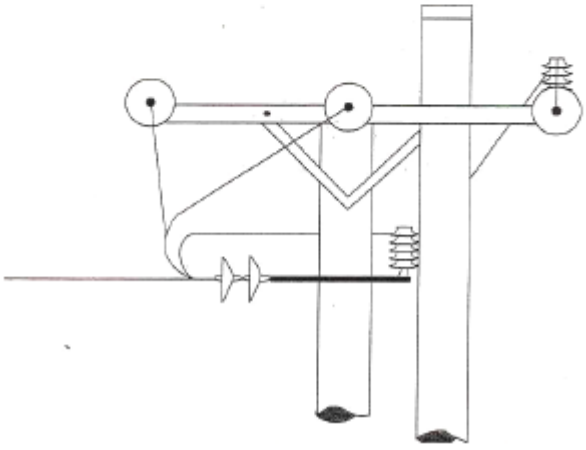
10•7•7•10 RIGHT ANGLE STRAIN POLE REPLACEMENT

Diagram 11 - 22



Pole Positions

Diagram 11 - 23



Replacement pole higher than existing pole with location options

The replacement pole may be erected in any of the positions (shaded circles) indicated in top Diagram 11 - 22.

However, it is advisable to erect the pole in position 1 or 3 whenever possible. This will eliminate the necessity to sleeve a section of conductor into the existing conductors on one side.

Note. Prior to erecting the pole it may be necessary to install temporary bypass jumpers and remove the permanent loops to allow access for the replacement pole.

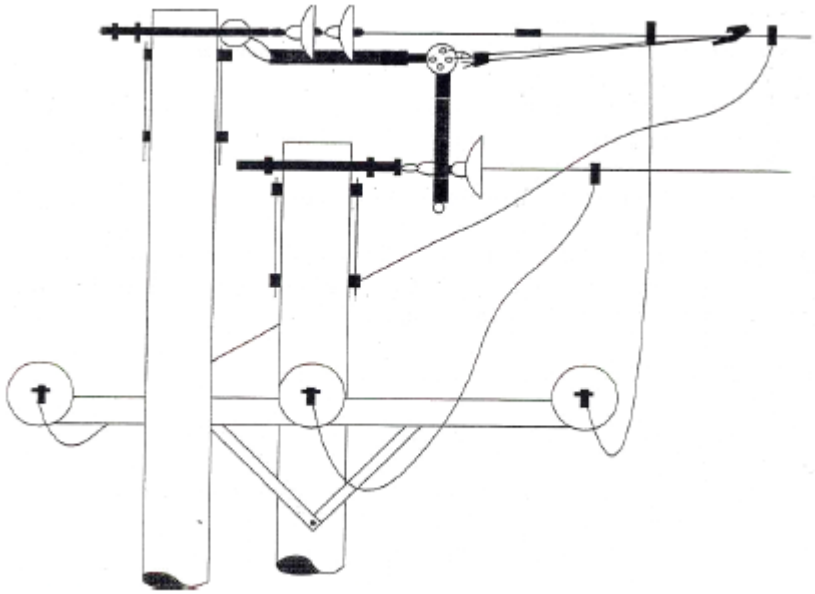


Diagram 11 - 24

Typical rig arrangement for Right Angle Strain Pole Replacement

This procedure is suitable for 22 kV three phase pole top arrangements RS5/22/3, RS7/22/3 and 22 kV single phase arrangement as well as respective 11 kV three phase and single phase arrangements.

Note. Should the existing pole be condemned, it shall be secured prior to the commencement of this procedure. Live Work equipment shall not be attached to a condemned pole.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Bypass loops on existing pole with temporary bypass jumpers.

Note. Ensure bypass jumpers are long enough for transfer of conductors to replacement pole and are positioned so they will not interfere with helical terminations when terminating conductor on replacement pole.

4. Remove permanent loops and pin insulators from existing pole.

5. Construct the cross arm arrangement on the upper position of the replacement pole.

6. Attach a sling to each end of the new cross arms as close as possible to the strain insulators.

7. Attach a strap hoist to each sling via an insulating link stick.

8. Attach a come-along to each outside conductor and connect the strap hoist to the come-along.

9. Operate the strap hoists to release the tension on the terminations. Ensure that equal tension is maintained on each strap hoist to avoid twisting the cross arms.

10. Remove the terminations from the strain insulators on the existing pole cross arm and reposition and reconnect the conductors to the strain insulators on the new cross arm.

Note. Depending on the position of the replacement pole, the conductor may be too short to terminate. This will require a section of conductor to be removed to a point that will allow a termination to be fitted to the new cross arm strain insulators, and a longer section of conductor sleeved in.

11. Remove come-alongs, strap hoists and slings.

12. Repeat items 6 to 11 for the center conductor.

13. Remove the cross arm arrangement from the existing pole.

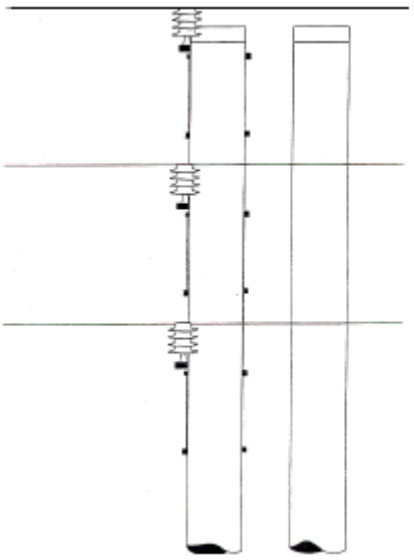
14. Construct the cross arm arrangement on the lower position of the replacement pole.

10•7•7•11 INTERMEDIATE VERTICAL DOUBLE CIRCUIT POLE REPLACEMENT

(Single Pin and Double Pin)

Diagram 11 - 25

Replacement pole lower, or higher than existing pole height

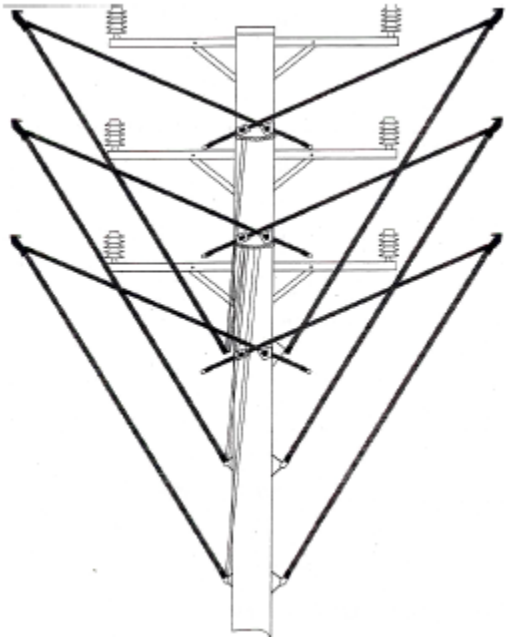


Pole Position

The replacement pole may be erected on either side of the existing pole and in line with the existing pole layout.

Diagram 11 - 26

Typical rig arrangement for Intermediate Vertical Double Circuit Pole Replacement - (Single Pin and Double Pin).



This procedure is suitable for 22 kV three phase pole top arrangements IV/22/3, DV/22/3 and respective 11 kV three phase arrangements.

Note. Should the existing pole be condemned, it shall be secured prior to the commencement of this procedure. Live Work equipment shall NOT be attached to a condemned pole.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - *Preliminary Live Work Procedures*).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Rig a lever lift support (Refer to Section 10.6.1.4) commencing from the lowest conductors and working upwards.

Note. Where the conductors are at an angle a lever lift support is the only rig suitable for these pole top arrangements.

Additional procedure for angle (Pole top arrangement DV/22/3).

3A. Attach 16 mm ropes to insulating link sticks.

3B. Install temporary anchors (eg. gads, stay pole) at a position which bisects the angle of the conductors.

3C. Attach a sling and tackle to each anchor point.

Note. Each conductor shall have an individual anchor.

3D. Attach the insulating link sticks to the conductors adjacent to the jaws of each wire tong.

3E. Connect the tails of the 16 mm ropes to the tackles and take up the tension.

3F. Operate the tackle simultaneously with the lever lift to take up the weight of the conductor.

4. Untie the conductors and relocate the conductors to a position that allows adequate working clearance and secure.

5. Remove the cross arm arrangement from the existing pole.

6. Remove the head of the existing pole to allow adequate clearance from conductors **or** remove the existing pole entirely.

7. Construct the cross arm arrangement on the replacement pole.

8. Reposition conductors, in turn, and secure the conductors to their respective insulators commencing from the top conductors and working downwards.

9. Lower all equipment.

10. Remove all insulating barriers.

10•7•7•12 STRAIN VERTICAL (DOUBLE CIRCUIT) POLE REPLACEMENT

Pole Position

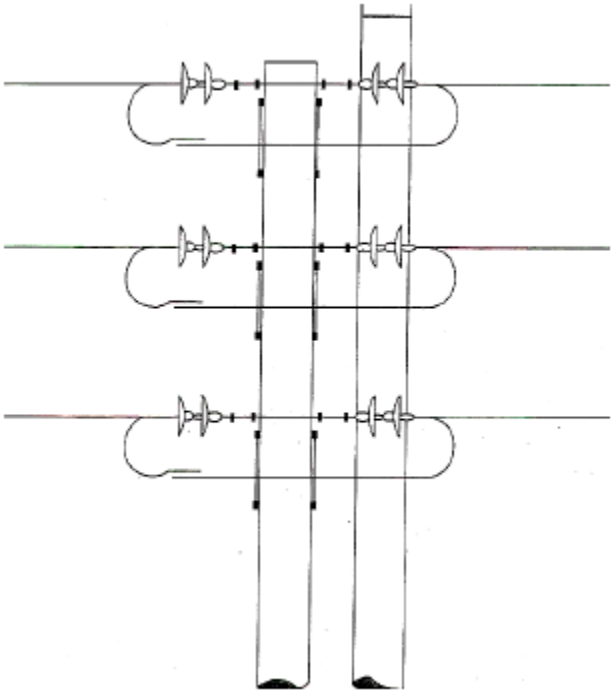


Diagram 11 - 27

Replacement pole - lower or higher than existing pole.

The replacement pole may be erected on either side of the existing pole and in line with the existing pole layout.

However, it is advisable to erect the pole on the side where the bridging is shortest whenever possible.

This will often allow the opposite side conductors to be terminated to the replacement pole without the necessity to sleeve in a section of conductor.

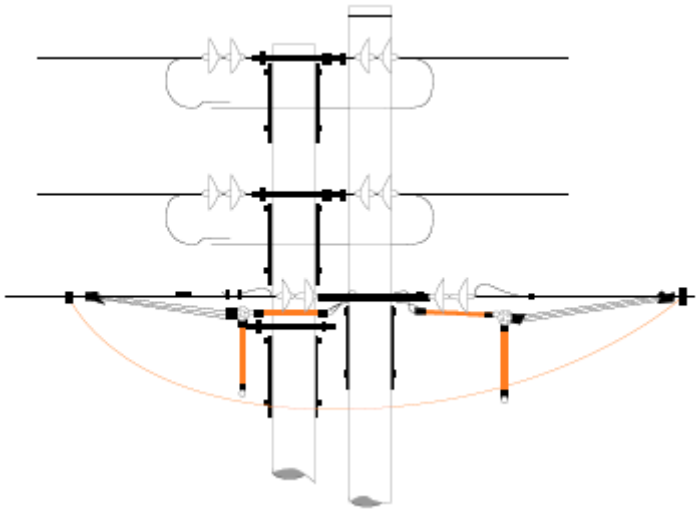


Diagram 11 - 28

Typical rig arrangement for Strain Vertical (Double Circuit) Pole Replacement.

This procedure is suitable for 22 kV three phase pole top arrangements SV/22/2, RSV/22/3 and respective 11 kV three phase arrangements.

Note. Should the existing pole be condemned, it shall be secured prior to the commencement of this procedure. Live Work equipment shall not be attached to a condemned pole.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - *Preliminary Live Work Procedures*).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Bypass loops on lower cross arm of existing pole with temporary bypass jumpers.

   Note. Ensure bypass jumpers are positioned so that they will not interfere with helical terminations when terminating conductors on replacement pole.

4. Remove permanent loops and insulators on the lower cross arm of the existing pole.

5. Construct the cross arm arrangement on the lower position of the replacement pole.

6. Attach a sling on each side of the new cross arms as close as possible to the strain insulators.

7. Attach a strap hoist to each sling via an insulating link stick.

8. Attach a come-along to the conductor on each side of the cross arm on the existing pole.

9. Attach each strap hoist to its respective come-along.

10. Operate the strap hoists to release the tension on the terminations. Ensure that equal tension is maintained on each strap hoist to avoid twisting the cross arms.

11. Remove the terminations from the strain insulators on the existing pole cross arm and reposition and reconnect the conductors to the strain insulators on the new cross arm.

    Note. On certain pole top arrangements the conductor may be too short to terminate on one side.

    This will require a section of conductor to be removed to a point that will allow a termination to be fitted to the new cross arm strain insulators, and a longer section of conductor sleeved in.

12. Connect permanent loops across newly constructed strain on replacement pole.

13. Remove come-alongs, strap hoists, slings and temporary bypass jumpers from conductors.

14. Repeat items 7 to 13 for the other conductor on the lower cross arm.

15. Remove the cross arm arrangement from the existing pole.

16. Repeat the entire procedure for the center cross arm and then for the top cross arm.

17. Remove the head of the existing pole to allow adequate clearance from conductors or remove the existing pole entirely.

18. Lower all equipment.

19. Remove all insulating barriers.

10•7•8 ENERGISE / DE-ENERGISE CONDUCTORS, CABLES & POLE MOUNTED APPARATUS

10•7•8•1 ENERGISE / DE-ENERGISE OVERHEAD CONDUCTORS

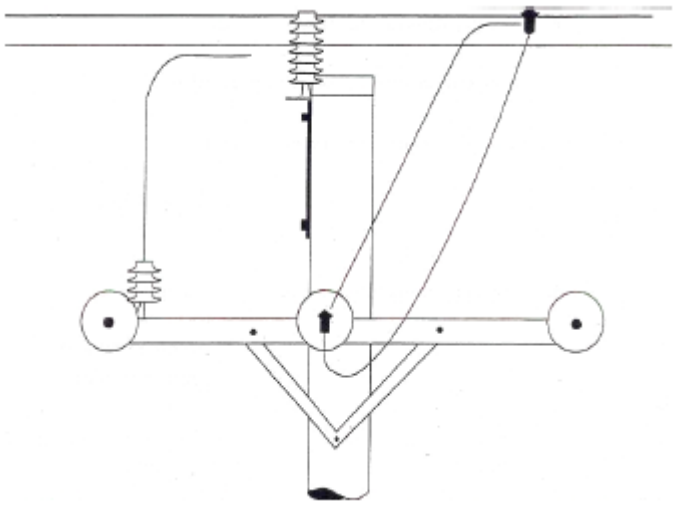


Diagram 11 - 29

Typical bypass arrangement to Energise / De-energise Overhead Conductors

This procedure is suitable for 22 kV three phase pole top arrangements S5/22/3, S7/22/3, SU5/22/3, R5/22/3, RS7/22/3, T5/22/3, T7/22/3, S1/22/3, SUV/22/3, RSV/22/3, TR1/22/3, TR2/22/3, TR3/22/3, S/12.7/1 and 22 kV single phase arrangement as well as respective 11 kV three phase and single phase arrangements.

This procedure shall only be performed using authorised operating procedures which include the requirements that:

1. All earths are removed.

2. All load removed and transformers isolated.

3. The loops have been “tested” to check for any current flow as per Section 10.7.25.

4. The procedure is itemised as a component of a switching instruction.

The maximum length of conductor that may be energised / de-energised for the specified voltages are detailed as follows:

Rated Voltage	Maximum length of overhead line to be energised / de-energised WITHOUT a temporary EDO unit
11 kV.	8 km.
22 kV.	4 km.
33 kV.	0.8 km.

Table 11 - 2 Maximum Lengths for Energising Overhead Line

If the Glove and Barrier method is used a temporary bypass jumper shall be installed in parallel to energise / de-energise all conductor lengths up to those lengths specified in Table 11 – 2.

If the length of conductor being energised / de-energised is greater than those lengths specified in Table 11 – 2, for Glove and Barrier or Stick method - a temporary Expulsion Dropout Fuse Fitting (EDO) shall be installed in parallel.

Note. Refer to **Section 10.7.25, Testing Current Flow in Conductor Loops** for information about testing for the presence of "current" flow in loops prior to disconnecting them.

10•7•8•2 ENERGISING STICK METHOD

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Measure, cut and prepare conductor tails for loops.

4. Tie conductor tails to pin insulators as required.

5. Secure conductor tails in a safe position.

6. Connect the permanent loop, ensuring that the tail is supported and controlled at all times.

Note. If the energising length is greater than those lengths specified in Table 11 - 2, install a temporary EDO as follows:

7. Connect the temporary EDO (with solid link removed) to the energised conductor to be connected first.

8. Connect the temporary EDO tail to the respective de-energised conductor.

9. Insert temporary EDO solid link and close.

10. Connect the permanent loop, ensuring that the tail is supported and controlled at all times.

11. Open the temporary EDO solid link and remove.

12. Disconnect the temporary EDO tail and secure it back to temporary EDO base.

13. Remove temporary EDO.

14. Repeat item 6 or 7 to 13 for other conductors.

10•7•8•3 ENERGISING GLOVE AND BARRIER METHOD

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Measure, cut and prepare conductor tails for loops.

4. Tie conductor tails to pin insulators as required.

5. Secure conductor tails in a safe position.

6. Connect a temporary bypass jumper between the first conductors to be connected.

7. Connect the permanent loop, ensuring that the tail is supported and controlled at all times.

8. Remove the temporary bypass jumper.

Note. If the expected "load" or the energising length is greater than those lengths specified in Table 11 - 2, install a temporary EDO as follows:

9. Connect temporary EDO with the solid link removed to the energised conductor to be connected first.

10. Connect the temporary EDO tail to the respective de-energised conductor.

11. Insert temporary EDO solid link and close.

12. Connect the permanent loop, ensuring that the tail is supported and controlled at all times.

13. Open the temporary EDO solid link and remove.

14. Disconnect temporary EDO tail and secure it to temporary EDO base.

15. Remove temporary EDO.

16. Repeat item 6 to 8 **or** 9 to 15 for other conductors.

17. Lower all equipment.

18. Remove all insulating barriers.

10•7•8•4 DE-ENERGISING STICK METHOD

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Disconnect the permanent loop, ensuring that the tail is supported and controlled at all times and secure in a safe position.

4. **Note.** If the de-energising length is greater than those lengths specified in Table 11 - 2, install a temporary EDO as follows:

5. Connect the temporary EDO with the solid link removed to the energised conductor to be connected first.

6. Connect the temporary EDO tail to the respective conductor.

7. Insert temporary EDO solid link and close.

8. Disconnect the permanent loop, ensuring that the tail is supported and controlled at all times and secure in a safe position.

9. Open the temporary EDO solid link and remove.

10. Disconnect the temporary EDO tail and secure it back to temporary EDO base.

11. Remove temporary EDO.

12. Repeat item 3 or 4 to 10 for other conductors.

10•7•8•5 DE-ENERGISING GLOVE AND BARRIER METHOD

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.
2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure

3. Connect a temporary bypass jumper between the first conductors to be connected.

4. Disconnect the permanent loop, ensuring that the tail is supported and controlled at all times and secure in a safe position.

5. Remove the temporary bypass jumper.

Note. If the presence of "current" in the loop(s) or the de-energising length is greater than those specified in Table 11 - 2, install a temporary EDO as follows:

6. Connect the temporary EDO with the solid link removed to the energised conductor to be connected first.

7. Connect the temporary EDO tail to the respective conductor.

8. Insert temporary EDO solid link and close.

9. Disconnect the permanent loop, ensuring that the tail is supported and controlled at all times and secure in a safe position.

10. Open the temporary EDO solid link and remove.

11. Disconnect the temporary EDO tail and secure it back to temporary EDO base.

12. Remove temporary EDO.

13. Repeat item 3-5 or 6 to 12 for other conductors.

14. Lower all equipment.

15. Remove all insulating barriers.

10•7•8•6 ENERGISE / DE-ENERGISE AERIAL BUNDLED CABLE

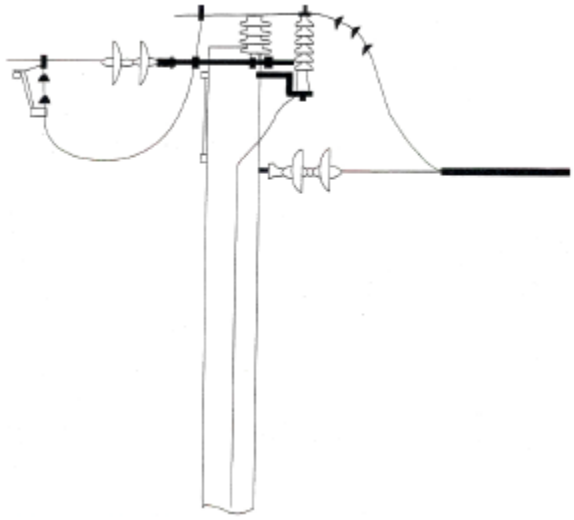


Diagram 11 - 30

Typical bypass arrangement to energise / De-energise ABC.

This procedure is suitable for 22 kV three phase pole top arrangements.
The procedure shall only be performed using authorised operating procedures which include the requirements that:

1. All earths are removed.

2. All load is removed and transformers are isolated.

3. Test loops for the presence of "current" flow as per section 10.7.25

4. The procedure is itemised as a component of a switching instruction.

Note. *Any length of cable over 1 kilometre shall only be energised / de-energised using a temporary Air Break Switch with the capacity to make or break 600 amps. For lengths of cable under 1 kilometre a temporary EDO may be used.*

Energising.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Measure, cut and prepare permanent loops.

4. Connect the permanent loops to the ABC, ensuring that each loop is securely positioned and separated.

5. Connect the temporary EDO with the solid link removed to the overhead conductor above / adjacent to the ABC phase to be energised first.

   Note. If required three, (3) temporary EDOs may be connected to reduce energising time.

6. Connect the temporary EDO tail to the respective permanent loop on the ABC phase.

7. Insert temporary EDO solid link and close.

8. Connect the permanent loop to the overhead conductor.

9. Open the temporary EDO solid link and remove.

10. Disconnect the temporary EDO tail and secure it back to temporary EDO base.

11. Remove temporary EDO.

12. Repeat items 5 to 11 for the remaining two ABC phases.

13. Lower all equipment.

14. Remove all insulating barriers.

De-energising.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures*).*

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Connect the temporary EDO with the solid link removed to the overhead conductor above / adjacent to the ABC phase to be de-energised first.

   Note. If required three (3) temporary EDOs may be connected to reduce energising time.

4. Connect the temporary EDO tail to the respective permanent loop on the ABC phase.

5. Insert temporary EDO solid link and close.

6. Disconnect the permanent loop from the overhead conductor and the ABC phase and remove from work area.

7. Open the temporary EDO solid link and remove.

8. Disconnect the temporary EDO tail and secure it back to temporary EDO base.

9. Remove temporary EDO.

10. Repeat items 3 to 9 for the remaining two ABC phases.

11. Lower all equipment.

12. Remove all insulating barriers.

10•7•8•7 ENERGISE / DE-ENERGISE UNDERGROUND CABLE (WITHOUT LINKS)

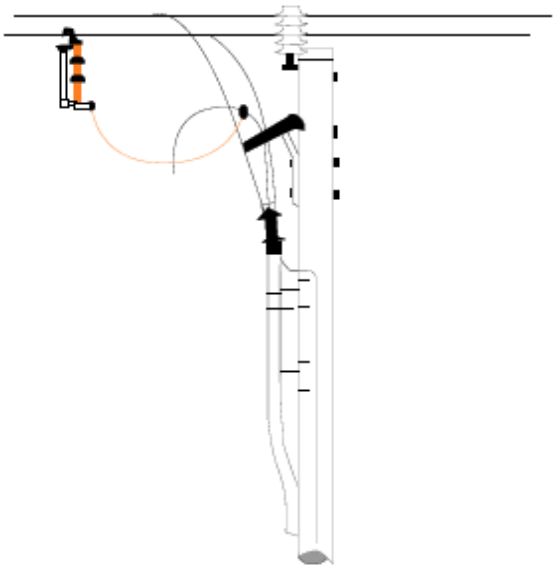


Diagram 11 - 31.
Typical Bypass Arrangement to Energise / De-energise Underground Cable (without links).

This procedure is suitable for pole top arrangement CP/11/3 and CP22/3.

This procedure shall only be performed using authorised operating procedures which include the requirements that:

Note. *Any length of cable over 1 kilometre shall only be energised / de-energised using a temporary Air Break Switch with the capacity to make or break 600 amps. For lengths of cable under 1 kilometre a temporary EDO may be used.*

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

Energising.

1. Pre-checks:

- All earths are removed.
- All load is removed and transformers isolated.
- A cable insulation test has been completed and test form sighted.
- The procedure is itemised as a component of a switching instruction.

2. Fit adequate insulating barriers to provide safe access to the work area.

3. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

4. Measure, cut and prepare permanent loops.

5. Connect the permanent loops to the cable termination, ensuring that each loop is securely positioned and separated.

6. Connect the temporary EDO with the solid link removed to the overhead conductor above the cable phase to be energised first.

7. Note.If required three (3) temporary EDOs may be connected to reduce energising time.

8. Connect the temporary EDO tail to the respective permanent loop on the cable termination.

9. Insert temporary EDO solid link and close.

10. Connect the permanent loop to the overhead conductor.

11. Open the temporary EDO solid link and remove.

12. Disconnect the temporary EDO tail and secure it back to temporary EDO base.

13. Remove temporary EDO.

14. Repeat items 5 to 11 for the remaining two phases.

15. Lower all equipment.

16. Remove all insulating barriers.

De-energising.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Pre-checks:

- All load is removed and transformers are isolated.
- Test loops for the presence of "current" flow as per Section 10.7.25.
- The procedure is itemised as a component of a switching instruction.

2. Fit adequate insulating barriers to provide safe access to the work area.

3. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

4. Connect the temporary EDO with the solid link removed to the overhead conductor above the cable phase to be de-energised first.

5. **Note**. If required three (3) temporary EDOs may be connected to reduce energising time.

6. Connect the temporary EDO tail to the respective permanent loop on the cable termination.

7. Insert temporary EDO solid link and close.

8. Disconnect the permanent loop from the overhead conductor and cable termination and remove from work area.

9. Open the temporary EDO solid link and remove.

10. Disconnect the temporary EDO tail and secure it back to temporary EDO base.

11. Remove temporary EDO.

12. Repeat items 3 to 9 for the remaining two cable phases.

13. Lower all equipment.

14. Remove all insulating barriers.

10•7•8•8 ENERGISE / DE-ENERGISE UNDERGROUND CABLE (WITH LINKS)

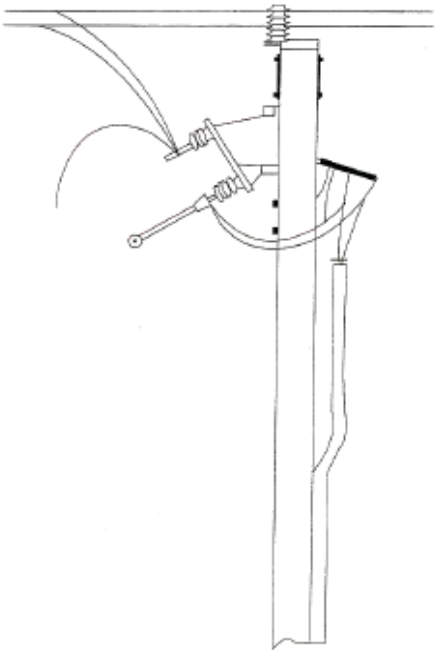


Diagram 11 - 32

Typical Looping Arrangement to Energise / De-energise Underground Cable (with links).

This procedure is suitable for pole top arrangements CPL/11/3 and CPL/22/3.

The procedure shall only be performed using authorised operating procedures which include the requirements that:

- All earths are removed.
- All load is removed and the links are open.
- A cable test has been completed.
- The procedure is itemised as a component of a switching instruction.

Energising.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Pre-checks:
   - All earths are removed.

- All load is removed and transformers isolated.
- A cable insulation test has been completed and test form sighted.
- The procedure is itemised as a component of a switching instruction.

2. Fit adequate insulating barriers to provide safe access to the work area.
3. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.
4. Ensure links are in the open position.
5. Connect the cable terminations to the bases of the isolating links.
6. Measure, cut and prepare the permanent loops from the top of the links to the overhead conductors.
7. Connect the permanent loops to the tops of the links, ensuring each loop is securely positioned and separated.
8. Connect the permanent loop, in turn, to the respective overhead conductor.
9. Lower all equipment.
10. Remove all insulating barriers.

De-energising.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures*).*

1. Pre-checks:

- All load is removed and transformers are isolated.
- Test loops for the presence of "current" flow.
- The procedure is itemised as a component of a switching instruction.

2. Fit adequate insulating barriers to provide safe access to the work area.
3. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.
4. Ensure links are in the open position.
5. Disconnect the permanent loops, in turn, from the overhead conductor and the top of the link and remove from the work area.
6. Lower all equipment.
7. Remove all insulating barriers.

10•7•8•9 ENERGISE / DE-ENERGISE A NOJA RECLOSER

• What

Work practice steps for all persons working for or on behalf of TasNetworks involved with:

- High Voltage (HV) Live Line replacement/installation of Reclosers in the Power Distribution System.
- Workshop preparation and setting up Reclosers ready for installation.
- Switching operations related to installation/replacement and commissioning of Reclosers.
- Commissioning of Reclosers in the field.

• Why

To ensure Reclosers are consistently installed/replaced in the most fail safe way possible from work shop preparation right through to installation and commissioning.

• Pre-requisites

- **Job Planning/Scoping/Scheduling**

  Shall comply with the requirements of this work practice where applicable.

- **Workshop Preparation And Field Commissioning Of Reclosers**

  Qualified Electrical Practitioner, trained and competent with sufficient experience and authorised by TasNetworks to perform this work.

- **Switching Operations**

  Qualified Field Operator authorised by TasNetworks to perform switching operations on Reclosers.

- **High Voltage (HV) Live Line Work**

  This also includes support personnel such as Crane Operators.

- **Work Steps**
  - **Work Shop Preparation**

Electrical Practitioner shall prepare Recloser for installation in accordance with TasNetworks work procedure **Automatic Reclosers Load Break Switches And Sectionalisers** as per Section on Work Shop Preparation and use of the **Check List For Reclosers**.

Note: The following steps cover the full process of replacing an existing Noja recloser with a replacement Noja recloser.

However, the same work step principles shall apply to any other model type (e.g. Load Break Switch or RL27 Sectionaliser) being replaced/installed. Refer to the work procedure **Automatic Reclosers Load Break Switches And Sectionalisers** for full technical details of the different model switching devices.

Note: Commissioning of Load Break Switches and RL27 Sectionalisers must be done in accordance with the **Check List For Load Break Switches And Sectionalisers,** and all relevant tests and checks must be completed and the "certification of electrical work" section filled out and signed off in the check list by the relevant Electrical Practitioner.

  - **Remove/Replace Recloser (Closed Operating Mode)**

1) Prior to removing existing recloser, contact Ops. Section to set suppression in place for live line work and;

2) Live Line suppression is in place on upstream recloser or feeder breaker.

3) Protection is turned off on recloser to be worked on to avoid tripping out from detection of out of balance current.

4) Tong test that load current is flowing through each phase conductor to confirm the recloser is closed operating mode and if so;

5) Okay to close Air Break Switch (ABS) bypass or, install overhead bypass jumpers and;

6) Visually inspect ABS is properly closed on all phases and, if okay and bypass jumpers used, tong to confirm each bypass loop is drawing current prior to;

7) Local person opening recloser and then confirm this by;

8) Tonging there is no current flow on the load side of the recloser dropper then;

9) Open incoming ABS.

10) Disconnect outgoing recloser leads.

11) After disconnecting all the line side recloser droppers from the ABS, disconnect from the control cabinet and then remove old recloser from service.

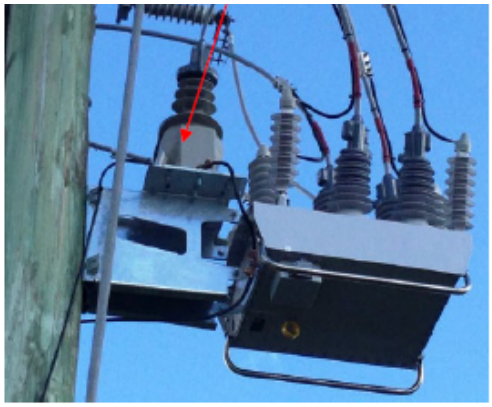
o Replacement Or New Recloser

12) Confirm with the Electrical Practitioner doing the recloser commissioning checks that the recloser is in the OPEN position. If Electrical Practitioner not about or if you are not 100% sure then do a continuity test to confirm then;

13) Lock/tag in OPEN position if this facility is available.

14) Install replacement or new recloser:

- ♦ Comply with, safe work practice and, construction/installation requirements in work procedure **Automatic Reclosers Load Break Switches And Sectionalisers.**
- ♦ Quality of construction/installation work to comply with drawings and details contained in the **Legacy Overhead Line Design Construction Manual** or the **Current Overhead Line Design Construction Manual. NOTE**: If installation will vary in any way to that specified in the relevant Construction Drawing (e.g. recloser would be installed on the wrong side of the ABS) you must STOP and contact Design Section to rectify this problem before proceeding with installation work.
- ♦ Connect line side droppers to incoming ABS.
- ♦ Connect load side droppers to the outgoing mains.
- ♦ Visually confirm the Voltage Transformer (VT) is connected to the line side to ensure low voltage supply is always available to operate the control cubicle.



- ♦ Unlock/un-tag if applicable, and hand over recloser in open position ready for testing and commissioning.

o Testing/Commissioning Recloser

15) Electrical Practitioner shall test and commission recloser in accordance with Commissioning Procedure in procedure **Automatic Reclosers Load Break Switches And Sectionalisers** Section 5.3.4.6 Commissioning And Operating and the **Check List For Reclosers**.

16) If commissioning confirms correct operation of the recloser then;

17) Electrical Practitioner confirms recloser is in closed operating position and;

18) Live Line suppression is in place on upstream recloser or feeder breaker.

19) Protection is turned off, on recloser to be commissioned, to avoid recloser trip from detection of out of balance current prior to handing back to Live Line.

o Live Line Crew – Open Bypass Circuit Or Remove Loops

20) Confirm again recloser is in closed position and also confirm this by;

21) Tonging each recloser phase dropper is drawing current prior to;

22) Removing bypass jumpers or opening ABS.

23) Notify Ops. Section to remove feeder suppression and return feeder and, recloser protection setting, back to remote operation.

24) Job close out – ensure site left neat and tidy and all electrical and construction work certification work details etc. are properly recorded in TasNetworks, Work Management System.

• Remove/Replace Recloser (Open Operating Mode)

The following steps cover the situation where a recloser is meant to stay in OPEN mode when operating as normal, as may be required in a loop automation arrangement.

o Removing Recloser:

1) Live Line suppression is in place on the upstream feeder (may be more than one if an automation loop).

2) Protection, on the recloser to be replaced, is turned off to avoid recloser being inadvertently operated.

3) Confirm recloser still in OPEN mode by tonging load side conductors to confirm zero current flow.

4) Open incoming ABS.

5) Disconnect outgoing recloser leads.

6) After disconnecting all the line side recloser droppers from the ABS disconnect from the control cabinet and then remove old recloser from service.

o Installing New Or Replacement Recloser:

7) Confirm with the Electrical Practitioner doing the recloser commissioning checks that the recloser is in the OPEN position. If Electrical Practitioner not about or if you are not 100% sure then do a continuity test to confirm then;

8) Lock/tag in open position if this facility is available.

9) Connect line side droppers to incoming ABS.

10) Connect load side droppers to the outgoing mains.

11) Visually confirm the Voltage Transformer (VT) is connected to the line side to ensure low voltage supply is always available to operate the control cubicle.

12) Unlock/un-tag if applicable, and hand over recloser in open position ready for testing and commissioning.

o Testing/Commissioning Recloser

13) Electrical Practitioner shall test and commission recloser in accordance with Commissioning Procedure in procedure **Automatic Reclosers Load Break Switches And Sectionalisers** Section 5.3.4.6 Commissioning And Operating and the **Check List For Reclosers**.

14) If commissioning confirms correct operation of the recloser then;

15) Electrical Practitioner confirms recloser is in open operating position prior to contacting Ops. Section to restore suppression settings back to normal operating mode.

16) Job close out – ensure site left neat and tidy and all electrical and construction work certification work details etc. are properly recorded in TasNetworks, Work Management System.

• References

TasNetworks:

• Work Procedure **Automatic Reclosers Load Break Switches And Sectionalisers.**
Check List For Reclosers.
• **Check List For Load Break Switches And Sectionalisers.**

10•7•8•10 ENERGISE / DE-ENERGISE A RECLOSER OR LOAD BREAK SWITCH / SECTIONALISER (BRIDGED SOLID)

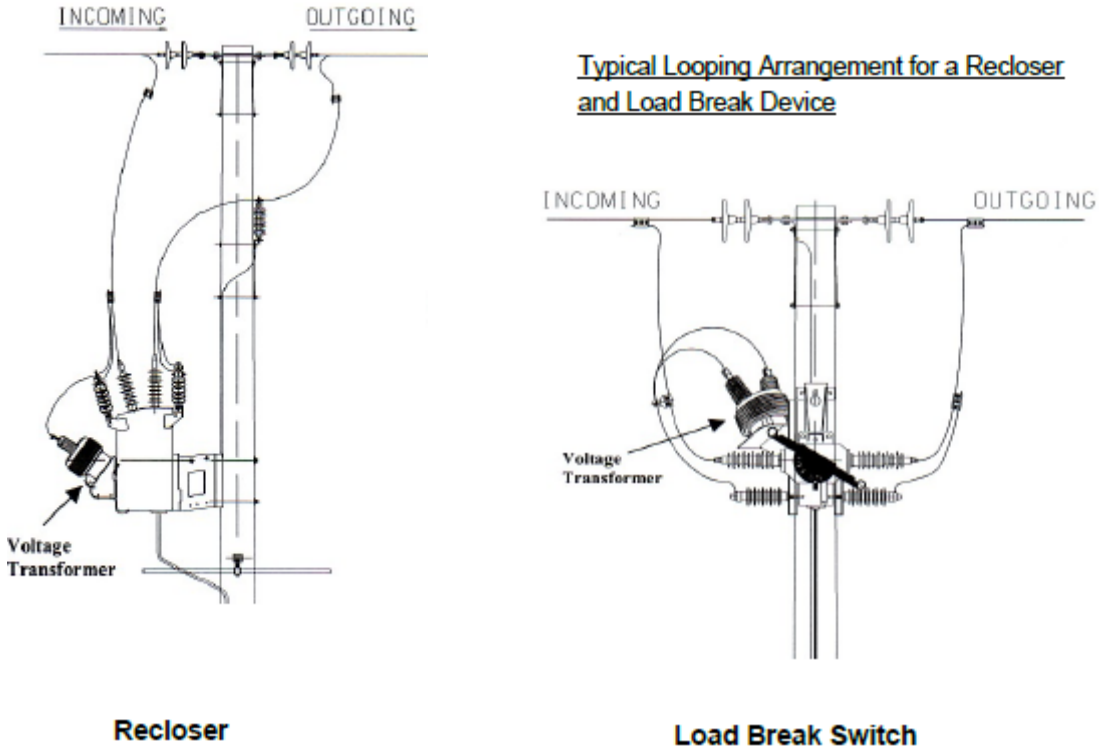


Diagram 11 - 35

Typical Looping Arrangement for a Recloser and Load Break Device Recloser.

Voltage Transformer (VT) loops can have Inductive LOAD when connecting.

This procedure is suitable for Nulec Recloser or Load Break Device pole top arrangements.

The procedure shall only be performed using authorised operating procedures which shall include the requirement that:

- The recloser / load break device is **OPEN**.
- The procedure is itemised as a component of a switching instruction.
- The "incoming" supply side of the Feeder has been determined.
- The Voltage Transformer (VT) leads are connected / disconnected using the "temporary Expulsion Dropout" (EDO) unit and a "parking bush".

Note. This procedure is for energising a recloser or load break device at an "existing" strain arrangement.

Should it be necessary to install a recloser or load break device at a pole top arrangement that is not an existing strain arrangement (i.e. intermediate arrangement) refer to *Section 10.7.20, "Pole Top Arrangement Conversions",* and complete the conversion prior to commencement of this procedure.

Energising.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

Special Note. Conduct, or ensure the recloser or load break device has had an insulation resistance test conducted on-site and is safe for connection PRIOR to starting any connection process. The unit must be tested "**on-site**".

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Check the physical configuration of the overhead conductor phasing to ensure the loops from the Recloser or Load Break Device will be connected in a straight through configuration and the phasing will be correct.

4. Measure, cut and prepare loops to fit from outgoing side of recloser or load break device to the overhead conductors (outgoing side).

5. Measure, cut and prepare loops to fit from incoming side of recloser or load break device to the overhead conductors (incoming side).

6. Connect the loops, in turn, from the outgoing side of the recloser or load break device to the overhead conductors (outgoing side) ensuring each loop is securely positioned and separated. This can be done without the use of the temporary EDO unit providing the recloser or load break device is in the OPEN position and has been "tested" on-site.

7. Connect the loops, in turn, from the incoming side of the recloser or load break device to the overhead conductors (incoming side) ensuring each loop is securely positioned and separated. This can be done without the use of the temporary EDO unit providing the recloser or load break device is in the OPEN position.

8. Hang both loops from the voltage transformer (VT) on insulated parking bushes and then using the temporary EDO unit - connect each loop, in turn, from the VT to the "incoming" side in accordance with the construction standard. Close / open the EDO unit with an insulated stick.

9. The (VT) will have some inductive load on it with one lead connected. The second lead can, therefore, have a potential difference that could create an "arc" when connected.

10. All new reclosers and load break devices will have "external" VTs.

11. Some older type reclosers and load break devices could have "internal" VTs. CHECK.

Note. At this point, normal authorised operating procedures shall commence to bring the recloser or load break device on line.

12. Recheck "phasing" to ensure it is correct (Two people to confirm this).

13. Perform the necessary operations to CLOSE the recloser or load break device and bring it on-line.

14. Disconnect and remove the overhead conductor loops, in turn, from across the overhead strain arrangement and remove them from the work area.

15. Note. Ensure "Trip" and "Close" toggle switches are turned OFF first.

16. Lower all equipment.

17. Remove all insulating barriers.

De-energising.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Connect permanent conductor loops **or** temporary bypass jumpers, in turn, across the overhead strain arrangement.

Note. Ensure "Trip" and "Close" toggle switches are turned OFF first.

Note. At this point normal authorised operating procedures shall commence to OPEN the recloser or load break device and take it off line.

4. Hang two insulated parking bushes and using these with the temporary EDO unit - disconnect the two Voltage Transformer (VT) loops, in turn, from the "incoming" side. Open / close EDO unit with an insulated stick.

5. Disconnect the outgoing recloser or load break device loops, in turn, from the overhead conductors (outgoing side) and REMOVE them, OR make them SAFE.

6. Disconnect the incoming recloser or load break device loops, in turn, from the overhead conductors (incoming side) and REMOVE them, OR make them SAFE.

7. Remove the recloser or load break device from the pole, as required.

8. Lower all equipment.

9. Remove all insulating barriers.

10•7•8•11 ENERGISE / DE-ENERGISE A GAS INSULATED SWITCH

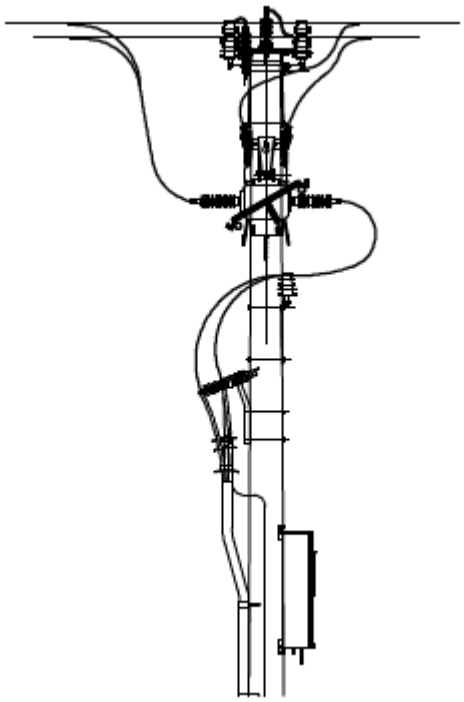


Diagram 11 - 36

Typical Looping Arrangement to Energise / De-energise a Gas Insulated Switch.

This procedure is suitable for pole top arrangements where the "switch" unit is connected to an underground cable.

This procedure shall only be performed using authorised operating procedures which shall include the requirements that:

1. The gas insulated switch unit is open.
2. The procedure is itemised as a component of a switching instruction.

Note. This procedure is for energising a gas-insulated switch at an **existing** pole top arrangement.
Energising.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Measure, cut and prepare the loops from the outgoing side of the gas insulated switch and connect them to the underground cable (outgoing side) ensuring each loop is securely positioned and separated.

4. Measure, cut and prepare the loops from the incoming side of the switch unit to the overhead conductors (incoming side) ensuring each loop is securely positioned and separated.

5. Ensure the Switch unit is in the OPEN position.

6. Connect the loops, in turn, from the incoming side of the switch unit to the overhead conductors (incoming side). This can be done without the use of the temporary EDO unit providing the switch unit is in the OPEN position.

7. Note. This assumes the "overhead conductors" are the "incoming supply" side of the switch unit. If this is not the case, the connection process can be reversed.

8. Hang both loops from the Voltage Transformer (VT) on insulated parking bushes and then using the temporary EDO unit - connect each loop, in turn, from the VT to the "incoming" side in accordance with the construction standard. Close / open the EDO unit with an insulated stick.

   • The (VT) will have some inductive load on it with one lead connected. The second lead can, therefore, have a potential difference that could create an "arc" when connected.

   • All new switch units will have "external" VTs.

   Note. At this point normal authorised operating procedures shall commence to energise the gas insulated switch.

9. Perform the necessary operations to CLOSE the switch unit and bring it on-line.

10. Lower all equipment.

11. Remove all insulating barriers.

De-energising.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

   Note. At this point normal authorised operating procedures shall commence to OPEN the gas insulated switch.

3. Using the temporary EDO unit and insulated parking bushes disconnect the two loops for the Voltage Transformer (VT) from the overhead conductors (incoming side) and remove them, or make them safe.

4. Disconnect the loops, in turn, from the overhead conductors (incoming side) and the incoming side of the switch unit and remove from the work area or make safe.

5. Disconnect the loops, in turn, from the underground cable (outgoing side) and the outgoing side of the gas insulated switch and remove from the work area or make safe.

6. Remove the switch unit from the pole, as required.

7. Lower all equipment.

8. Remove all insulating barriers.

10•7•9 INSTALLATION OF LINKS – HORIZONTAL

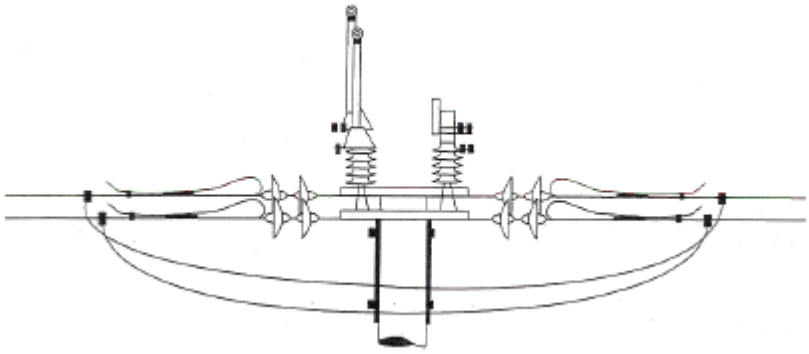


Diagram 11 – 37

Typical bypass Arrangement for Installation of Links – Horizontal.

This procedure is suitable for 22 kV three phase pole top arrangements L/22/3, VL/22/3 and TL/22/3 and respective 11 kV three phase arrangements.

Note. This procedure is for installing links at an **existing** strain arrangement - S5/22/3 and altering to pole top arrangements L/22/3 or VL/22/3. Should it be necessary to install links at a pole top arrangement which is not an existing strain arrangement (i.e. intermediate arrangement) refer to **Section 10.7.20, Pole Top Arrangement Conversions** and complete the conversion prior to commencement of this procedure.

Installation:

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Connect temporary bypass jumpers, in turn, across the existing strain arrangement loops.

4. Disconnect the permanent loops and secure to respective conductors.

5. Fit the links to strain arrangement. Ensure links are fitted with opening “blades” to “outgoing” side.

Note. It will be necessary to replace the strain plate with a link mounting plate on an existing strain arrangement.

6. Ensure the links are fully open.

7. Connect the permanent loops to the outgoing side of the links.

8. Connect remaining permanent loops to the incoming side of the links.

9. Close the links.

10. Remove temporary bypass jumpers.

11. Lower all equipment.

12. Remove all insulating barriers.

10•7•10 INSTALLATION OF LINKS – VERTICAL

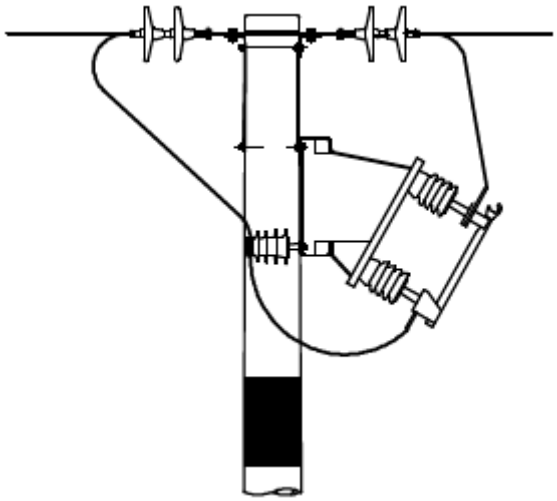


Diagram 11 - 38

Typical Bypass Arrangement for Installation of Links – Vertical Installation.

Note. This procedure is for installing links at an **existing** strain arrangement. Should it be necessary to install links at a pole top arrangement which is not an existing strain arrangement (i.e. intermediate arrangement) refer to **Section 10.7.20, Pole Top Arrangement Conversions** and complete the conversion prior to commencement of this procedure.

Installation.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Construct the cross arm / link arrangement on the pole, ensuring the links are mounted on the "incoming supply" side of the pole where practicable.

4. Ensure that the links are fully open.

5. Measure, cut and prepare the loops from the bottom of the links to the overhead conductors (outgoing side).

6. Connect the loops to the bottom of the links ensuring each loop is securely positioned and separated.

7. Measure, cut and prepare the loops from the top of the links to the overhead conductors (incoming side).

8. Connect the loops to the top of the links, ensuring each loop is securely positioned and separated.

9. Connect the loops, in turn, from the bottom of the links to the overhead conductors (outgoing side).

10. Connect the loops, in turn, from the top of the links to the overhead conductors (incoming side).

11. Close the links.

12. Disconnect the loops, in turn, from across the strain arrangement and remove from the work area.

13. Lower all equipment.

14. Remove all insulating barriers.

10•7•11 INSTALLATION OF LINKS - TEE OFF

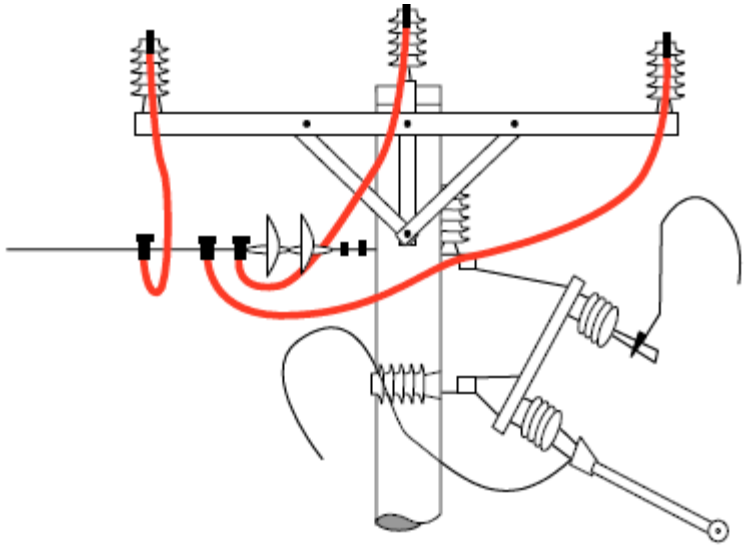


Diagram 11 - 39

Typical bypass arrangement for Installation of Links on Tee Off

Note. This procedure is for installing links at an **existing** tee off arrangement - T5/22/3 and altering to pole top arrangement TL/22/3.

Installation.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Connect temporary bypass jumpers, in turn, across the existing tee off arrangement loops, disconnect the permanent loops and secure them.

4. Construct the strain cross arm arrangement and top link cross arm arrangement above the existing tee off strain cross arm arrangement.

5. Relocate the conductors to the new strain cross arm arrangement.

6. Remove the existing strain cross arm arrangement.

7. Construct the bottom cross arm and link arrangement.

8. Fit the links ensure that the links are fully open.

9. Measure, cut and prepare the permanent loops from the bottom of the links to the overhead conductors (outgoing side).

10. Connect the loops to the bottom of the links ensuring each loop is securely positioned and separated.

11. Measure, cut and prepare the permanent loops from the top of the links to the overhead conductors (incoming side).

12. Connect the loops to the top of the links ensuring each loop is securely positioned and separated.

13. Connect the loops, in turn, from the bottom of the links to the overhead conductors (outgoing side).

14. Connect the loops, in turn, from the top of the links to the overhead conductors (incoming side).

15. Close the links.

16. Disconnect and remove the temporary bypass jumpers, in turn, from across the overhead conductors.

17. Lower all equipment.

18. Remove all insulating barriers.

10•7•12 MAINTENANCE OF LINKS

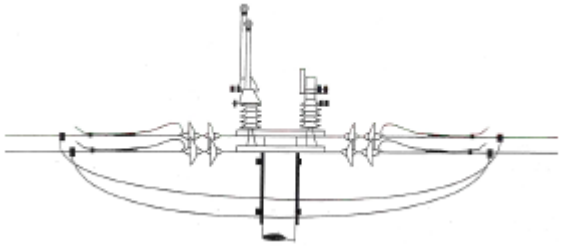


Diagram 11 - 40

Typical Bypass Arrangement for Maintenance of Links

This procedure is suitable for links on any pole top arrangement.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.
2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.
3. Connect a temporary bypass jumper across the faulty link or links.
4. Disconnect the permanent loops from both sides of the link ensuring each loop is securely positioned.
5. Replace the faulty link (or faulty link component as necessary).
6. Ensure that the link is operating correctly.
7. Ensure that the link is open.
8. Connect the permanent loops to both sides of the link.
9. Leave the link in the open or closed position as required.
10. Disconnect the temporary bypass jumpers from across the link.
11. Lower all equipment.
12. Remove all insulating barriers.

10•7•13 INSTALLATION OF FUSES – STRAIN

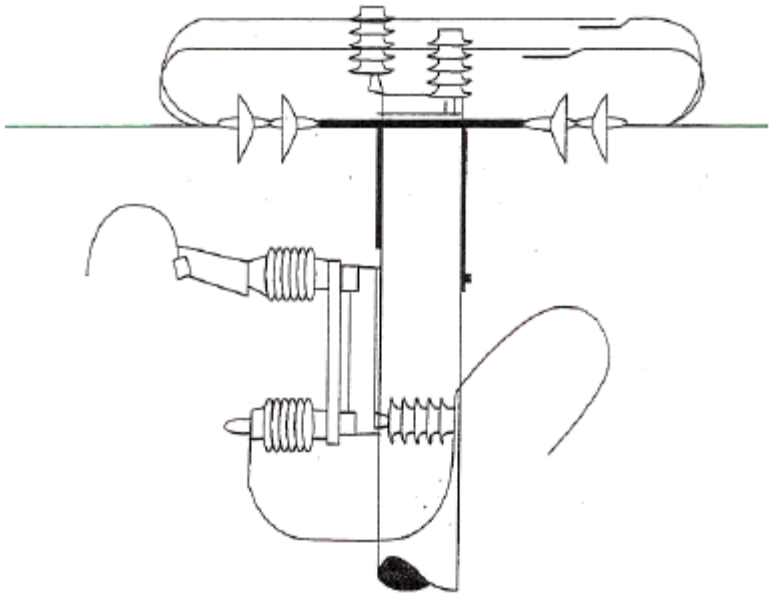


Diagram 11 - 41

Typical bypass arrangement for Installation of Fuses - Strain.

This procedure is suitable for 22 kV three phase pole top arrangements FP/22/3, FDO/22/3 and 22 kV single phase and respective 11 kV three and single phase arrangements.

Note. This procedure is for installing fuses at an **existing** strain arrangement. Should it be necessary to install fuses at a pole top arrangement which is not an existing strain arrangement (i.e. intermediate arrangement) refer to **Section 10.7.20, "Pole Top Arrangement Conversions"** and complete the conversion prior to commencement of this procedure.

Installation.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Construct the cross arm fuse arrangement on the pole.

4. Install the fuse fittings, ensuring the fuses are mounted on the “incoming supply” side of the pole where practicable and ensure that the fuse holders are removed.

5. Measure, cut and prepare the loops from the bottom of the fuse fittings to the overhead conductors (outgoing side).

6. Connect the loops to the bottom of the fuse fittings ensuring each loop is securely positioned and separated.

7. Measure, cut and prepare the loops from the top of the fuse fittings to the overhead conductors (incoming side).

8. Connect the loops to the top of the fuse fittings ensuring each loop is securely positioned and separated.

9. Connect the loops, in turn, from the bottom of the fuse fittings to the overhead conductors (outgoing side).

10. Connect the loops, in turn, from the top of the fuse fittings to the overhead conductors (incoming side).

11. Insert the fuse holders in the fuse fittings and close.

Note. Ensure the correct size “fuse” are installed in the fuse holders.

12. Disconnect the loops, in turn, from across the strain arrangement and remove from the work area.

13. Lower all equipment.

14. Remove all insulating barriers.

10•7•14 INSTALLATION OF FUSES - TEE OFF

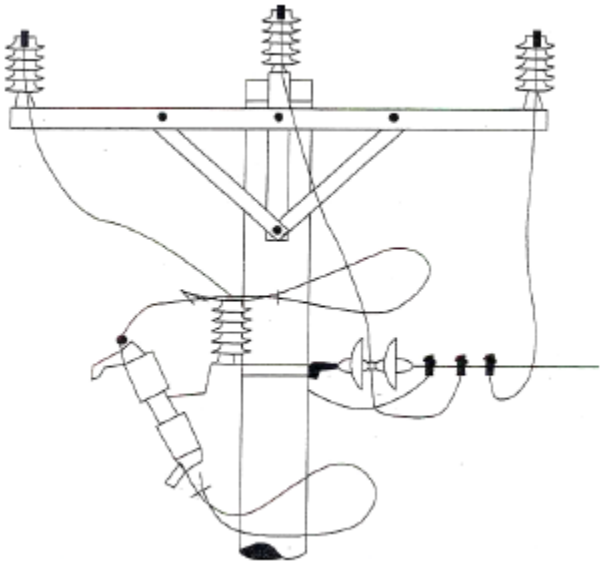


Diagram 11 - 42

Typical Bypass Arrangement for Installation of Fuses – Tee Off.

Note. This procedure is for installing expulsion dropout fuses at an **existing** tee off arrangement.

Installation.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Connect temporary bypass jumpers, in turn, across the existing tee off arrangement loops, disconnect the permanent loops and secure.

4. Construct the cross arm / fuse arrangement below the existing tee off strain cross arm arrangement.

5. Relocate the conductors to the new strain cross arm arrangement.

6. Remove the existing strain cross arm arrangement.

7. Fit the fuse fittings to the cross arm arrangement.

8. Ensure that the fuse holders are removed.

9. Measure, cut and prepare the loops from the bottom of the fuse fittings to the overhead conductors (outgoing side).

10. Connect the loops to the bottom of the fuse fittings ensuring each loop is securely positioned and separated.

11. Measure, cut and prepare the loops from the top of the fuse fittings to the overhead conductors (incoming side).

12. Connect the loops to the top of the fuse fittings ensuring each loop is securely positioned and separated.

13. Connect the loops, in turn, from the bottom of the fuse fittings to the overhead conductors (outgoing side).

14. Connect the loops, in turn, from the top of the fuse fittings to the overhead conductors (incoming side).

15. Insert the fuse holders in the fuse fittings and close.

Note. Ensure the correct size "fuse" are installed in the fuse holders.

16. Disconnect the temporary bypass jumpers, in turn, from across the top and bottom overhead conductors.

17. Lower all equipment.

18. Remove all insulating barriers.

10•7•15 MAINTENANCE OF FUSE FITTINGS (REVISED)

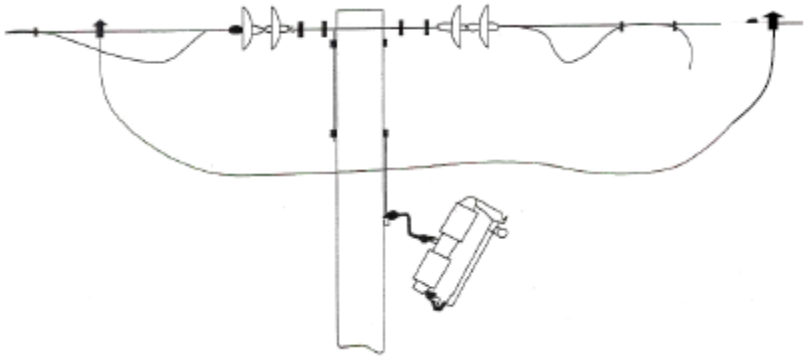


Diagram 11 - 43

Typical bypass arrangement for Maintenance of Fuses.

This procedure is suitable for fuses on any pole top arrangement & includes replacement of EDO units.

Note:

- EDO units, and in particular NGK units stamped Oct'05 to June'06, have a history of mechanical failure in the insulator section.

- Prior to performing this procedure perform a detailed risk assessment to;

  - identify and hazards, and
  - implement control strategies to mitigate the risks.

  If unsure of the integrity of the EDO unit or the risk assessment deems the task is not safe, arrange for an outage to undertake task under dead conditions.

- The replacement of a suspect / faulty EDO unit must be performed by a minimum of two (2) Live Work personnel at the pole top.

Maintenance/Replacement.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Ensure close visual inspection of EDO units prior to commencing works, (check porcelain sections for signs of cracking).

   Note: NGK units stamped Oct'05 to June'06 are particularly suspect.

2. Fit adequate insulating barriers to provide safe access to the work area.

3. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

4. Employ the appropriate measures, identified in the detailed risk assessment, required to manage the mechanical stresses applied to the EDO unit whilst performing this task.

5. Connect one end of the temporary bypass jumper to the line side of the overhead conductor above the fuse fitting(s).

6. Connect the other end of the temporary bypass jumper to the conductor on the load side of the fuse fitting(s), bypassing the EDO unit(s).

   Note: Keep Jumper as short as possible.

7. Repeat for all phases

8. Using Sticks to support the permanent loops, so as not to apply any additional mechanical load to the EDO, cut away the permanent loops from the fuse fitting and the main line.

9. Repeat for all phases

10. Replace the fuse fitting(s) with new EDO units.

11. Fit "Dees" to overhead conductors if not already fitted.

12. Reconnect the permanent loops to both sides of the new fuse fitting(s).

13. Insert the fuse holder(s) and close.

    Note. Ensure the correct size "fuse" is installed in each fuse holder.

14. Disconnect the temporary bypass jumper(s) and secure.

15. Remove the temporary bypass jumper(s) from the overhead conductor.

16. Lower all equipment.

17. Remove all insulating barriers.

18. Electrically test to ensure power supply working correctly

10•7•16 INSTALLATION AND MAINTENANCE OF AN AIR BREAK SWITCH - PERMANENT

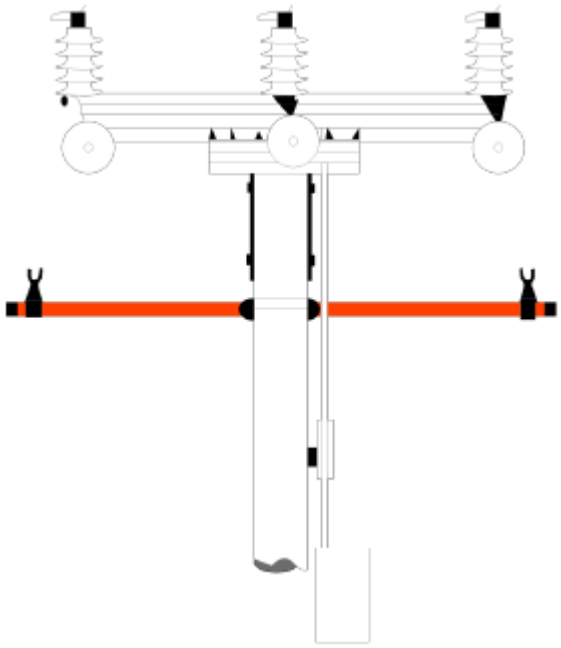


Diagram 11 - 44

Note: *Application of a non-flammable aerosol lubricant is recommended for Air Break Switch maintenance. Documentation on the exterior of the can will describe its contents with regard to its combustion properties. Application could also be made using a paintbrush.*

This procedure is suitable for installing an air break switch at an **existing** intermediate arrangement I/22/3 and altering to pole top arrangement ABS/22/3.

10•7•16•1 INSTALLATION

Note: In addition to the general maintenance steps listed below, the following **Section 9.14.9.2** in the Line Workers Reference Handbook should be followed for special checks required for AK Power Silicon Type Air Break Switches.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Rig either pole mounted conductor supports or lever lifts (depending on conductor loading and circuit to circuit clearances) to support the outside conductors.

4. Untie the outside conductors and relocate to a position that allows adequate working clearance.

5. Untie the center conductor and relocate to a position that allows adequate working clearance. Rig a conductor lift as for a full lever lift.

6. Remove the existing cross arm arrangement.

7. Install the air break switch support bracket.

8. Fit adequate insulating barriers to the conductor and support bracket.

9. Position the center conductor into the support bracket and remove the rig.

10. Construct the air break switch arrangement and ensure that it operates correctly. Lock switch handle in the closed position.

Note: DO NOT CONNECT THE "EARTH" AT THIS STAGE.

11. Ensure that the air break switch is fully closed.

12. Attach two slings and insulating link sticks to each side of the air break switch and in line with the **center** conductor.

13. Attach two come-alongs to the **center** conductor on each side of the pole and connect the strap hoists to the come-alongs.

14. Connect a temporary bypass jumper to the **center** conductor outside the come-alongs.

15. Tension **center** conductors and terminate to the respective insulators.

16. Remove the section of the center conductor across the support bracket.

17. Remove strap hoists, come-alongs, insulating sticks and slings.

18. Measure, cut and prepare the permanent loops from each side of the center switch unit to the center conductor.

19. Connect the permanent loops, in turn, from each side of the center switch unit to the center conductor.
20. Disconnect the temporary bypass jumper from the center conductor.
21. Attach a sling, insulating stick and strap hoist to one outside phase of the air break switch, as close as possible to the insulators for the outside conductor to be tensioned and made off.
22. Position this outside conductor directly under the insulators.

    Note. Ensure that there are two levels of insulation on the section of conductor and / or the cross arm.
23. Terminate the outside conductor to the insulator on the opposite side of the "switch" to where the strap hoist is rigged.
24. Attach a come-along to this same conductor above the strap hoist and attach the strap hoist to the come-along.
25. Tension the conductor and terminate to the remaining insulator. Operate the strap hoist to release the tension on the section of conductor between the terminations.
26. Connect a temporary bypass jumper to this outside conductor on the outside of each termination.
27. Cut this outside conductor between the two terminations, ensuring an adequate length of tail remains for connection.
28. Remove the strap hoist, come-along, insulating stick and sling.
29. Measure, cut and prepare the permanent loops from each side of the outside switch unit to this outside conductor.
30. Connect the permanent loops, in turn, from each side of the outside switch unit to this outside conductor.
31. Disconnect and remove the temporary bypass jumper.
32. Repeat items 21 to 31 for the other outside conductor.
33. Complete the connection of the earth wire to the air break switch. [Switch and Handle]
34. Lower all equipment.
35. Remove all insulating barriers.

10•7•16•2 MAINTENANCE

Note: In addition to the general maintenance steps listed below, the following work instructions and safety alerts must be followed when encountering and operating/maintaining specific aged air break switches:

- Green Alert - Air Break Failures
- Safety Alert ABB And Stanger Type ABS
- Safety Alert AK Power ABS Operational Restrictions
- Work Practice Safe Operation Of Air Break Switches

Maintenance of Air Break Switch in Closed Position.

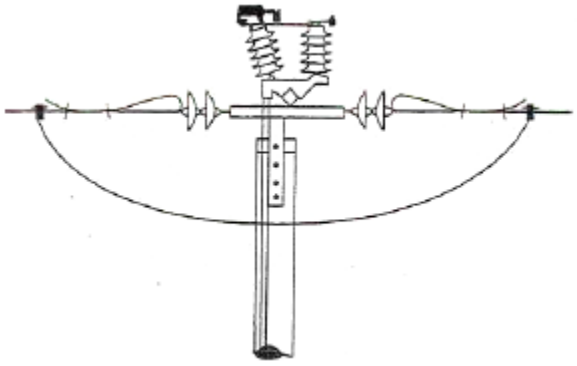


Diagram 11 - 45

This procedure is suitable for any type of air break switch.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Disconnect earth lead from air break switch structure and handle.
2. Fit adequate insulating barriers to provide safe access to the work area.
3. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.
4. Connect temporary bypass jumpers, in turn, across all three phases of the switch units. Ensure they are clear of the moving parts of the switch unit.
5. Operate the air break switch, locate and diagnose any problems.
6. Adjust and maintain the air break switch as required.

Note. Should it be necessary to access a switch unit, disconnect the permanent loops from each side of the unit and secure them along the conductor.

7. Ensure that the air break switch is fully operational.

8. Reconnect conductor loops to the air break switch.

9. Close the air break switch.

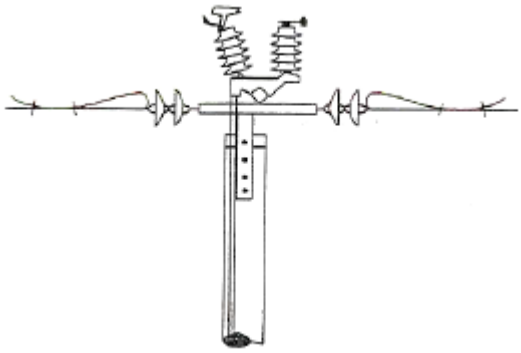
10. Disconnect and remove, in turn, the temporary bypass jumpers from across the three phases of the air break switch.

11. Reconnect Earth Lead to the air break switch structure and handle.

12. Lower all equipment.

13. Remove all insulating barriers.

Maintenance of Air Break Switch in Open Position.



This procedure is suitable for any type of air break switch.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer 10.1 – Preliminary Live Work Procedures).

1. Disconnect earth lead from air break switch structure and handle.

2. Fit adequate insulating barriers to provide safe access to the work area.

3. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

4. Disconnect the permanent loops, in turn, from one side only of each switch unit and secure back along the conductor.

5. Operate the air break switch, locate and diagnose any problems.

6. Adjust and maintain the air break switch as required.

Note. Should it be necessary to access a switch unit, disconnect the permanent loop from the other side of the unit and secure along the conductor.

7. Repair or replace that particular switch unit as required.

8. Ensure that the air break switch is operational.

9. Open the air break switch and lock in the open position.

10. Connect the permanent loops, in turn, to the respective switch units.

11. Reconnect Earth Lead to the air break switch structure and handle.

12. Lower all equipment.

13. Remove all insulating barriers.

10•7•17 INSTALLATION AND REMOVAL OF AN AIR BREAK SWITCH – (TEMPORARY TYPE)

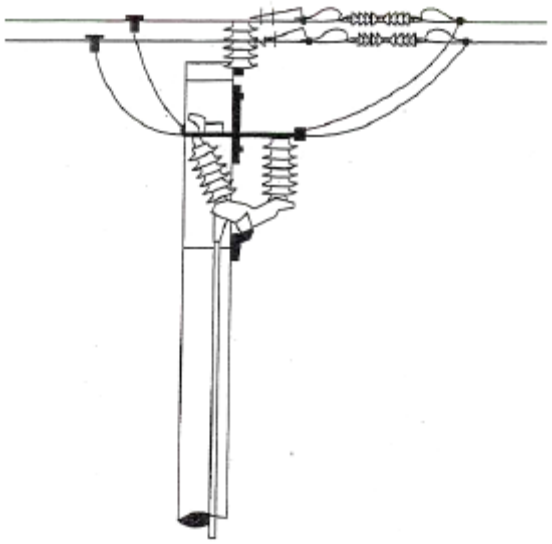


Diagram 11 - 47

Typical arrangement for Installation of an Air Break Switch – Temporary.

Note. *Application of a non-flammable aerosol lubricant is recommended for Air Break Switch maintenance. Documentation on the exterior of the can will describe its contents with regard to its combustion properties. Application could also be made using a paintbrush*.

This procedure is suitable for installing a temporary air break switch at an existing strain arrangement - S5/22/3 or mid span flying shackle.

Note. Should it be necessary to install a temporary air break switch at a pole top arrangement which is **not an existing** strain or mid span flying shackle arrangement, refer to **Section 10.7.20, Pole Top Arrangement Conversions** and complete the required conversion prior to commencement of this procedure.

Manage Installation Time Period

Someone in the work crew must be nominated to record the install date and address details of the temporary ABS installed and arrange for a reminder in the Works Management System that automatically alerts a Job Scheduler:

• Four (4) weeks later on, from the initial install date, that the ABS needs to be removed otherwise if not;

- Six (6) weeks later on, from the initial install date, a live line crew to check ABS and fittings from an EWP, and remove if ABS looks suspect otherwise;

- Eight (8) weeks later on is the maximum allowed from the initial install date, therefore the ABS must be removed or jumpered out and remove connections, and brush and re-apply grease unless;

- There is a specific requirement to have the ABS installed longer than eight weeks. If so, an automatic reminder date must be set up to notify the Job Scheduler when the install period has ended so the ABS can be removed.

Installation.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Fit the mounting bracket to the pole approximately 600 mm below the existing cross arm and on the required side of the pole.

4. Fit the temporary air break switch into the mounting bracket.

   Note. Ensure that the temporary loops are removed.

5. Fit the down rod and operating handle assembly to the temporary air break switch and pole.

6. Ensure that the temporary air break switch is operational.

7. Open the temporary air break switch.

8. Connect the temporary loops to each side of the switch units, ensuring that each loop is securely positioned and separated.

9. Connect the temporary loops, in turn, to the overhead conductors on each side of the strain arrangement.

10. Close the temporary air break switch.

11. Disconnect the loops, in turn, from across the strain arrangement and remove from the work area.

12. Lower all equipment.

13. Remove all insulating barriers.

14. **Note.** On ABS without insulated handle – Install temporary earth and attach to Switch Handle.

Removal.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Connect the permanent loops, in turn, across the strain arrangement.

4. Open the temporary air break switch.

5. Disconnect the temporary loops, in turn, from the conductors and the switch units and remove from the work area.

6. Close the temporary air break switch.

7. Remove the down rod and operating handle assembly.

8. Remove the temporary air break switch and mounting bracket.

9. Lower all equipment.

10. Remove all insulating barriers.

10•7•18 REPLACING FAULTY LIGHTNING ARRESTORS

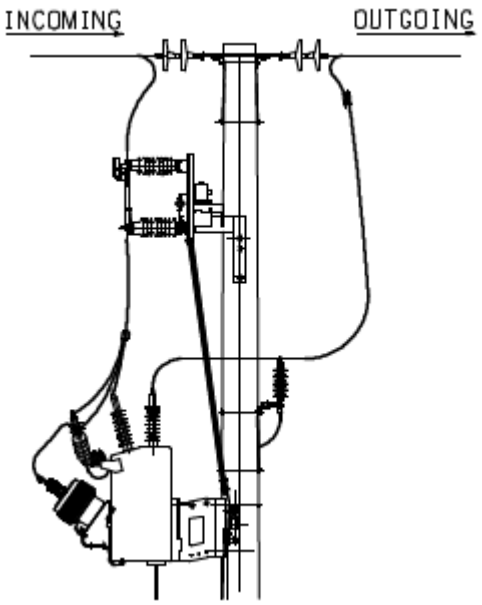


Diagram 11 - 48

Typical bypass arrangement for Maintenance of Lightning Arrestors.

This procedure is suitable for lightning arrestors on any pole top arrangement.

Note. Prior to performing this procedure the replacement lightning arrestor/s shall have undergone an approved insulation test. Refer to **Section 10.7.24, Testing Lightning Arrestors – Live Work Installation**, for the approved method of testing and marking the lightning arrestors.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures*).*

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Disconnect the top loop from the energised side of the faulty lightning arrestor and securely position it.

4. Disconnect the bottom loop or if possible the earth connection from the faulty lightning arrestor and securely position it.

5. Replace the faulty lightning arrestor.

6. Connect the bottom loop or earth connection to the lightning arrestor.

7. Conduct a “touch test” by grasping the free end of the top loop with a wire holding stick and touching it momentarily against the energised point for the lightning arrester. No sign of arcing will ensure the lightning arrester is electrically sound and is safe to permanently connect to the live HV conductor.

8. Connect the top loop to the energised side of the lightning arrestor.

9. Lower all equipment.

10. Remove all insulating barriers.

10•7•19 INSTALL HV METERING

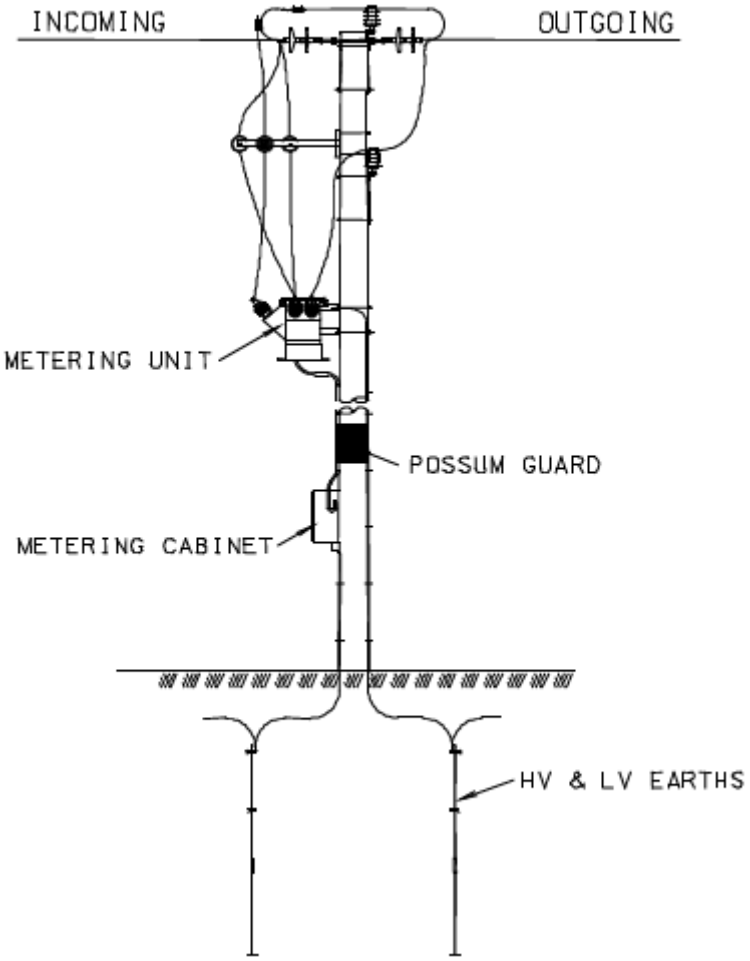


Diagram 11 – 49

This procedure is suitable for installation of HV Metering unit on any pole top arrangement up to 22 kV.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

Temporary EDO units shall be used when making all overhead HV electrical connections.

A Metering Technician must be on-site prior to and during commissioning of the metering unit and must complete a "Commissioning Checklist".

Safety Precaution

Never leave a Current Transformer (C.T.) open-circuited.

In a live situation a dangerous voltage will build up which could cause the C.T. to burn out and cause structural damage or injury to any person in close proximity to the C.T.

Installation:

1. Fit adequate insulating barriers to provide safe access to the work area.
2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.
3. Fit permanent stand-off bracket to pole above metering unit if required.
4. **Note**. The Metering Technician to check and ensure secondary windings are connected and shorted out.
5. Mount the ABB HV metering unit on the pole in accordance with the respective technical drawing.
6. If the meters are to be located at the pole, mount the Metering cabinet on the pole in accordance with the respective technical drawing.
7. Cut the loops to the required length to reach from the HV terminals of the metering unit to the respective overhead incoming and outgoing conductors.
8. Connect one end of each of the loops to the terminals of the metering unit. Coil and secure loops ready for connection to overhead conductors.
9. Install metering cabinet on the pole.

Note. *Meters and associated wiring shall be installed and connected prior to energising the HV side of the metering unit. This work would normally be done by metering staff at the same time as the HV metering unit is to be installed, but needs to have been completed prior to energising the metering unit to prevent internal damage.*

10. Earth rods and earthing leads for HV and LV earths shall all be installed according to drawing D-OH1-2.3/19, connected and tested **prior to energising** the HV Metering unit.

11. The case earth from the HV metering unit shall be connected to the HV earth prior to commissioning.

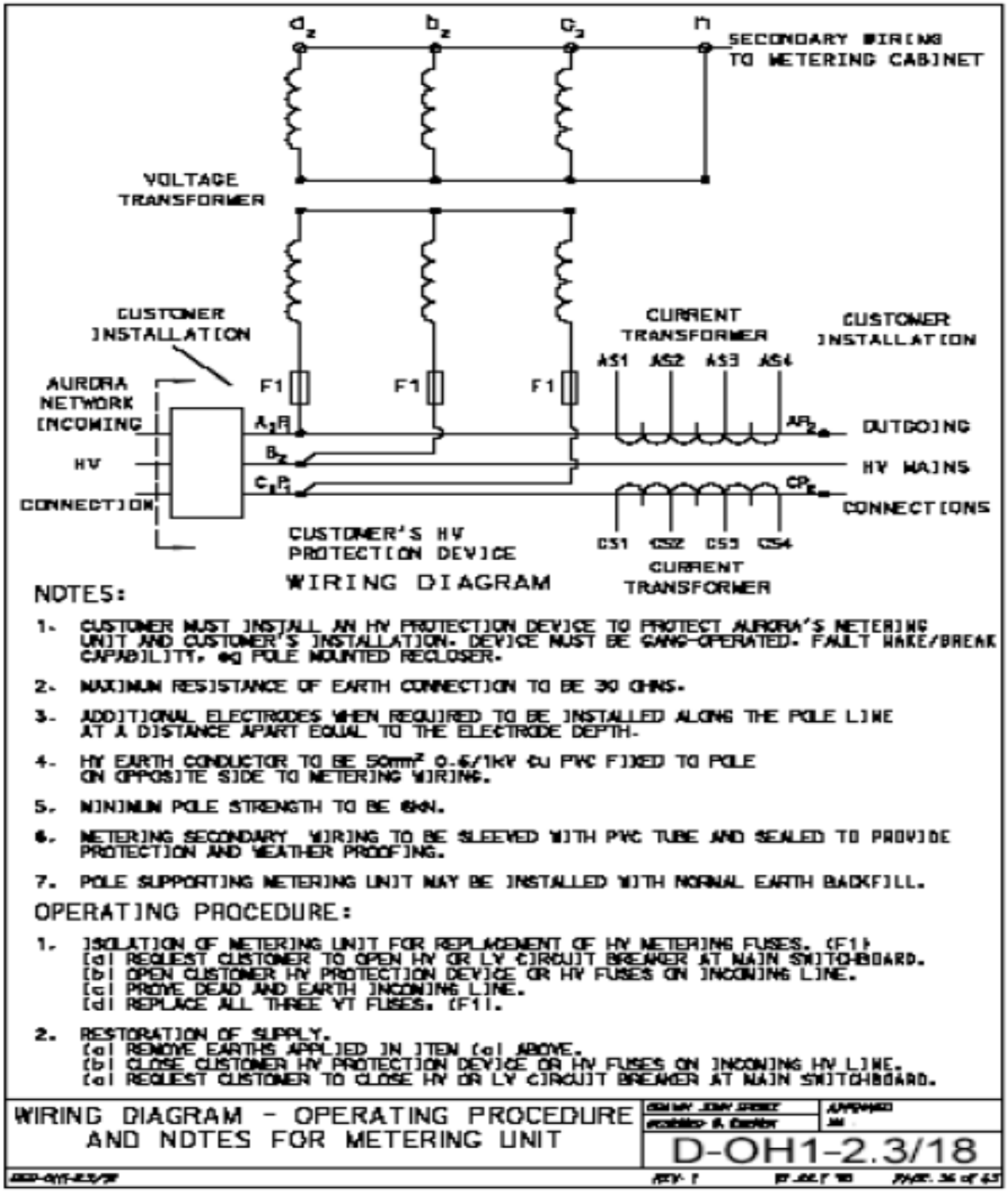
Pre-Commissioning Checks.

The following "checks" shall be made and confirmed BEFORE the HV Metering unit is energised:

1. Are all requirements listed in NOTES on D-OH1-2.3/18, below, met? □

2. Are C.T. secondary windings connected & shorting out links installed? □

3. Have all continuity tests been completed with results recorded? □



NOTES:

1. CUSTOMER MUST INSTALL AN HV PROTECTION DEVICE TO PROTECT AURORA'S METERING UNIT AND CUSTOMER'S INSTALLATION. DEVICE MUST BE GANG-OPERATED. FAULT MAKE/BREAK CAPABILITY, eg POLE MOUNTED RECLOSER.
2. MAXIMUM RESISTANCE OF EARTH CONNECTION TO BE 30 OHMS.
3. ADDITIONAL ELECTRODES WHEN REQUIRED TO BE INSTALLED ALONG THE POLE LINE AT A DISTANCE APART EQUAL TO THE ELECTRODE DEPTH.
4. HV EARTH CONDUCTOR TO BE 50mm² 0.6/1KV Cu PVC FIXED TO POLE ON OPPOSITE SIDE TO METERING WIRING.
5. MINIMUM POLE STRENGTH TO BE 6KN.
6. METERING SECONDARY WIRING TO BE SLEEVED WITH PVC TUBE AND SEALED TO PROVIDE PROTECTION AND WEATHER PROOFING.
7. POLE SUPPORTING METERING UNIT MAY BE INSTALLED WITH NORMAL EARTH BACKFILL.

OPERATING PROCEDURE:

1. ISOLATION OF METERING UNIT FOR REPLACEMENT OF HV METERING FUSES. (F1)
   (a) REQUEST CUSTOMER TO OPEN HV OR LV CIRCUIT BREAKER AT MAIN SWITCHBOARD.
   (b) OPEN CUSTOMER HV PROTECTION DEVICE OR HV FUSES ON INCOMING LINE.
   (c) PROVE DEAD AND EARTH INCOMING LINE.
   (d) REPLACE ALL THREE VT FUSES. (F1).
2. RESTORATION OF SUPPLY.
   (a) REMOVE EARTHS APPLIED IN ITEM (c) ABOVE.
   (b) CLOSE CUSTOMER HV PROTECTION DEVICE OR HV FUSES ON INCOMING HV LINE.
   (c) REQUEST CUSTOMER TO CLOSE HV OR LV CIRCUIT BREAKER AT MAIN SWITCHBOARD.

WIRING DIAGRAM - OPERATING PROCEDURE AND NOTES FOR METERING UNIT

D-OH1-2.3/18

Energising.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures*).*

1. Ensure appropriate insulating barriers remain installed as described in installation procedure steps 1 and 2 above.

2. Ensure NO customer load is present.

3. Connect leads from the HV metering unit to the outgoing HV conductors.

4. Connect leads from the HV metering unit to the incoming HV conductors.

5. Connect the center phase loop from metering unit to the center phase HV conductor.

6. If HV loops are installed across the pole top, the loops for the two outer phases can now be removed, as supply will pass through the HV metering unit.

   Note. Use temporary fused EDO unit to bridge across pole top loops prior to removal.

7. Remove the two outer phase pole top loops, ensuring that center phase loop remains connected in place,

8. Lower all equipment.

9. Remove all insulating barriers.

10. Ensure the HV metering unit is now functioning on line.

10•7•20 POLE TOP ARRANGEMENT CONVERSIONS

10•7•20•1 CONVERT AN INTERMEDIATE ARRANGEMENT TO A STRAIN ARRANGEMENT

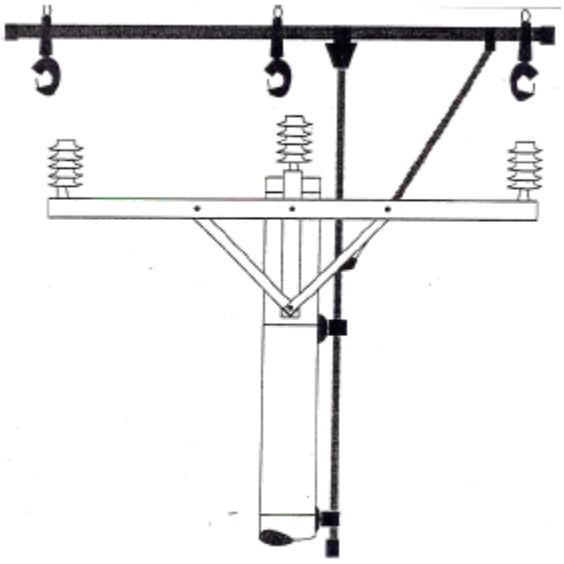


Diagram 11 - 49

Typical Rig Arrangement to Convert an Intermediate Arrangement to a Strain Arrangement.

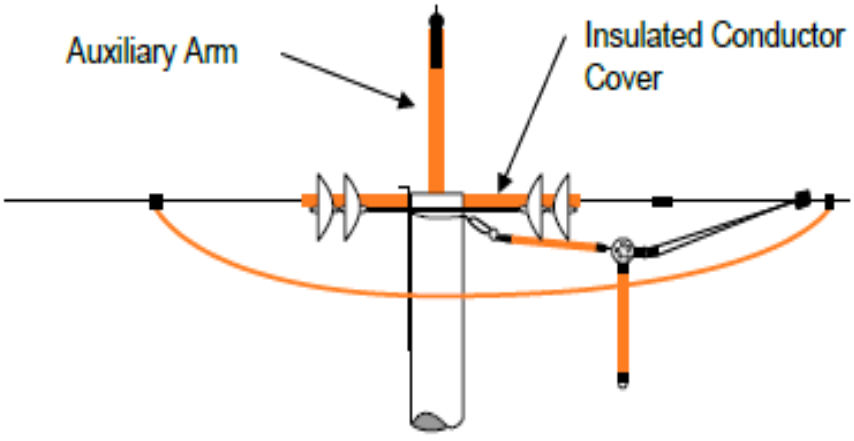


Diagram 11 - 50

This procedure is suitable for converting 22 kV three phase pole top arrangements I/22/3, to S5/22/3, S7/22/3, SU5/22/3, and respective 11 kV three phase arrangements.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.
2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.
3. Rig either Glove and Barrier auxiliary arm or lever lifts.
4. Untie the conductors and relocate to a position that allows adequate working clearance.
5. Remove the existing cross arm arrangement.
6. Construct the required strain arrangement.
7. Attach a sling, insulating stick and strap hoist to one side of the strain cross arm as close as possible to the insulators for the conductor to be tensioned first.
8. Position the conductor to be tensioned first on the cross arm directly above the strap hoist.

   Note: Ensure that there are two levels of insulation on the section of conductor and / or cross arm.
9. Terminate the conductor to the insulator on the opposite side of the strap hoist.
10. Attach a come-along to the conductor above the strap hoist and attach the strap hoist to the come-along.
11. Tension the conductor and terminate to the remaining insulator.
12. Connect a temporary bypass jumper to the conductor on the outside of each termination.
13. Operate the strap hoist to release the tension on the section of conductor between the terminations.
14. Cut the conductor on the inside of each termination, ensuring an adequate length of tail remains for connection.
15. Remove the strap hoist, come-along, insulating stick and sling.
16. Measure, cut and prepare the permanent loop.
17. Connect the permanent loop across the strain position.
18. Disconnect the temporary bypass jumper.
19. Repeat items 7 - 18 for remaining two conductors.
20. Lower all equipment.
21. Remove all insulating barriers.

10•7•21 CONVERT A STRAIN ARRANGEMENT TO AN INTERMEDIATE ARRANGEMENT

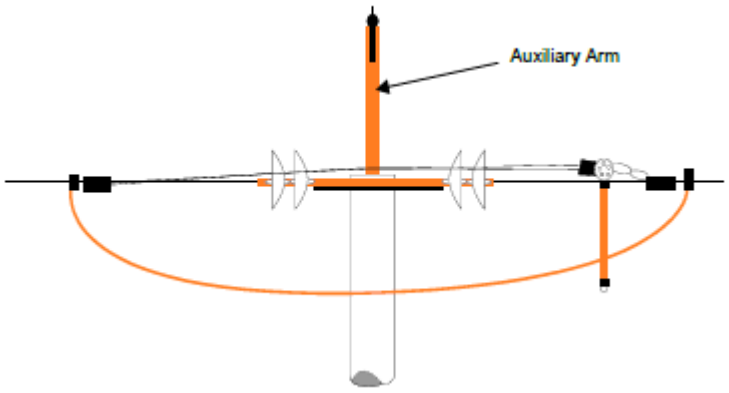


Diagram 11 - 51

Typical Rig Set-up to Convert a Strain Arrangement to an Intermediate Arrangement

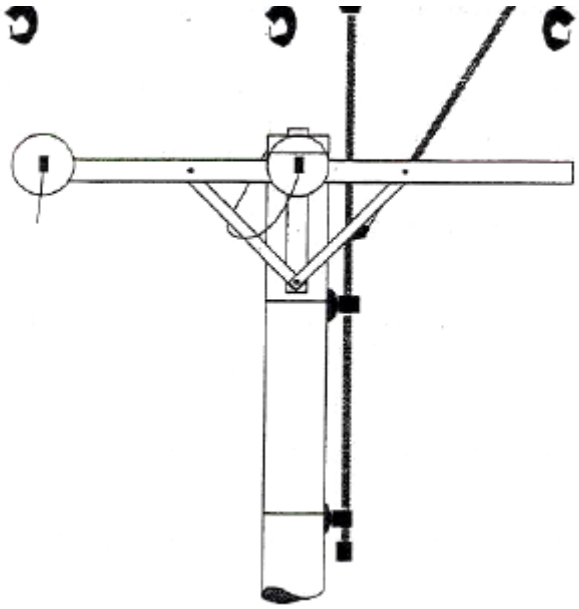


Diagram 11 - 52

Typical Rig Set-up to Convert a Strain Arrangement to an Intermediate Arrangement

This procedure is suitable for converting 22 kV three phase pole top arrangements S5/22/3, SU5/22/3, SU7/22/3 to I/22/3, and respective 11 kV three phase arrangements.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Fit adequate insulating barriers to provide safe access to the work area.
2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.
3. Bypass loops on the existing strain arrangement with temporary bypass jumpers.
4. Remove the permanent loops and insulators.
5. Rig either Glove and Barrier auxiliary arm or lever lifts.
6. Attach a come-along to the outside conductor to be sleeved through first on either side of the terminations (refer to *Diagram 11 - 51*).
7. Attach a strap hoist to the come-along(s).

   Note. Position the strap hoist across the strain cross arms, ensuring that there are two levels of insulation on the section of conductor and / or cross arm.
8. Operate the strap hoist to release the tension on the terminations.
9. Remove the terminations and securely position the conductor tails.
10. Measure, cut and prepare a section of conductor to sleeve into the existing conductor.
11. Sleeve the new section of conductor into the existing conductor.
12. Remove come-along(s), strap hoist and sling.
13. Disconnect the temporary bypass jumper.
14. Relocate the conductor to a position that allows adequate working clearance and secure it.
15. Repeat items 6 to 14 for the remaining two conductors.

    Note. Complete the center conductor next and then the outside conductor.
16. Remove the existing strain arrangement.
17. Construct the required intermediate arrangement.
18. Reposition the conductors, in turn, to their respective insulator and tie off.
19. Lower all equipment.
20. Remove all insulating barriers.

10•7•21•1 INSTALL / REMOVE MID SPAN FLYING SHACKLES

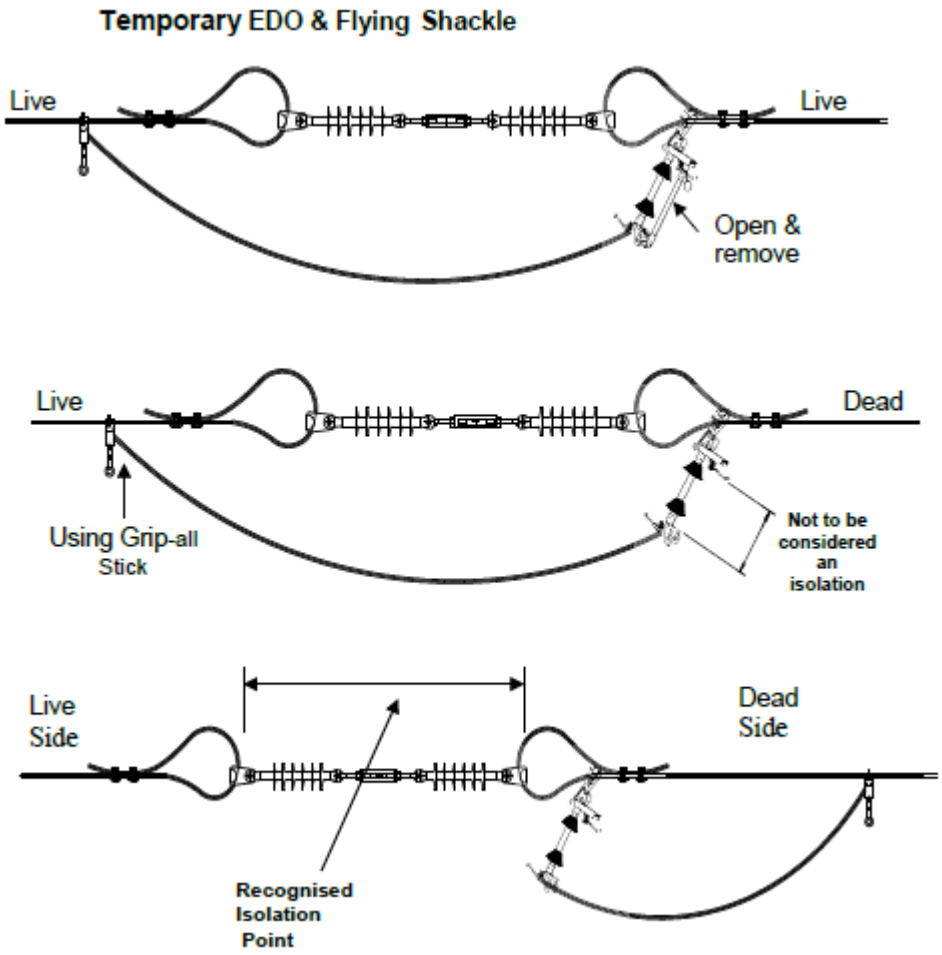


Diagram 11 - 51

Typical Mid Span Flying Strain arrangement

This arrangement shall NOT be used to break any load

This procedure is suitable for converting any mid span arrangement to a mid span flying strain arrangement for 22 kV and 11 kV three phase arrangements.

Installation.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. Flying shackles should not be fitted in the same conductor span where work is to be conducted unless there will be no significant displacement, restraining or movement of conductors within that bay.

2. Fit adequate insulating barriers to provide safe access to the work area.

3. At a predetermined position, ideally within 2.5m from the pole, fit the flying shackle with helical terminations. Come-alongs may be used in place of helical terminations for temporary installations, of no longer than 4 weeks duration, provided the conductor is not 3/2.75 GI.

   Note. The insulators used shall be twice the insulating value of the voltage being worked (i.e. for 22 kV use two 22 kV insulators).

4. Attach a strap hoist and come-alongs across the insulator and helical terminations.

5. Operate the strap hoist to release tension from the section of conductor across the insulators.

6. Connect a temporary EDO and bypass jumper across the section of conductor. Ensure a solid EDO element is in the closed position.

7. Cut the conductor, ensuring that the tails are long enough to fit a full tension compression sleeve when removing the flying strain arrangement.

8. Secure tails to the conductor and remove strap hoist and come-alongs.

9. Repeat items 4 to 8 for the remaining two conductors so that all temporary EDOs are fitted.

10. Remove all insulating barriers.

11. Open temporary EDOs.

    Note. Ensure all electrical load has been removed prior to operating.

12. Remove bypass jumper from the live side and tie back as shown in diagram 11-51.

Removal.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer *10.1 - Preliminary Live Work Procedures).*

1. Fit adequate insulating barriers to provide safe access to the work area.

2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

3. Connect a temporary bypass jumper between the temporary EDO and the live side across the flying strain arrangement.

4. Repeat items 1 to 3 for remaining two conductors.

5. Close temporary EDOs.

Note. Ensure all electrical load has been removed prior to operating.

6. Attach a strap hoist and come-alongs across the flying strain arrangement.

7. Operate the strap hoist to bring the tails on each side of the flying strain arrangement together.

Note. Should it be necessary to remove the insulators and terminations at this stage, ensure that the tails are secured to the strap hoist.

8. Fit a full tension compression sleeve.

9. Remove the strap hoist and come-alongs.

10. Open temporary EDO and disconnect the temporary bypass jumper.

11. Remove the insulators terminations and temporary EDO.

12. Repeat items 6 to 11 for the remaining two conductors.

13. Remove all insulating barriers.

10•7•21•2 INSTALL / REMOVE "HV IN-LINE LINKS"

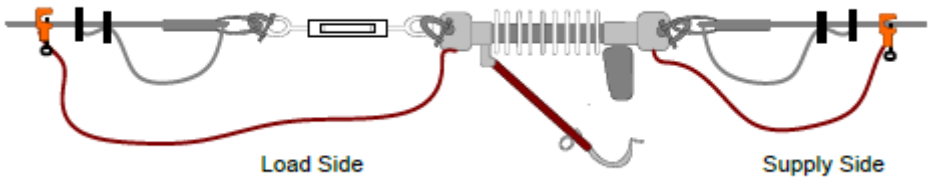


Diagram 11 - 52

Typical Mid Span "In line HV link" arrangement.

This procedure is suitable for converting any mid span arrangement to a mid span flying strain arrangement for 22 kV and 11 kV three phase arrangements.

Installation.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

1. HV In Line Links should not be fitted in the same conductor span where work is to be conducted unless there will be no significant displacement, restraining or movement of conductors within that bay.

2. Confirm line loadings with Operations section and ensure they do not exceed 600kVA for 11kV or 1000kVA for 22kV.

3. Fit adequate insulating barriers to provide safe access to the work area.

4. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.

5. At a predetermined position, ideally within 2.5m from the pole, fit the closed HV In- line link with helical terminations. Come-alongs may be used in place of helical terminations for temporary installations, of no longer than 4 weeks duration, provided the conductor is not 3/2.75 GI.

NOTE: Ensure that the HV In Line Link is installed so that the blade opens to the load side.

6. Operate the turnbuckle to take up tension on the conductor.

7. Connect the bypass jumper's from the ends of the HV In Line Link to the conductor.

NOTE: Ensure that the HV In Line Link is firmly closed.

8. Cut the conductor, ensuring that the tails are long enough to fit a full tension compression sleeve when removing the HV In Line Links.

9. Secure tails to the conductor.

10. Repeat for the remaining two conductors.

11. Remove all insulating barriers.

Removal.

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer *10.1 - Preliminary Live Work Procedures).*

1. Fit adequate insulating barriers to provide safe access to the work area.
2. Ensure all second points of contact within the work area are covered with insulating barriers throughout the procedure.
3. Ensure the “In line HV link” is in the closed position.
4. Operate the turnbuckle to bring the tails on each side of the “In line HV link”.
5. Fit a full tension compression sleeve.
6. Release tension off the turnbuckle.
7. Remove the “In line HV link” arrangement.
8. Repeat items 3 to 7 for the remaining two conductors.
9. Lower all equipment.
10. Remove all insulating barriers.

10•7•21•3 INSTALL SIEMENS TEMPORARY ISOLATING SWITCH

Principle of use and Operation

The Temporary Isolation Switch comes as a set of three and can be manually operated via a HV operating stick such that operating just one switch will simultaneously operate the other two ganged switches.

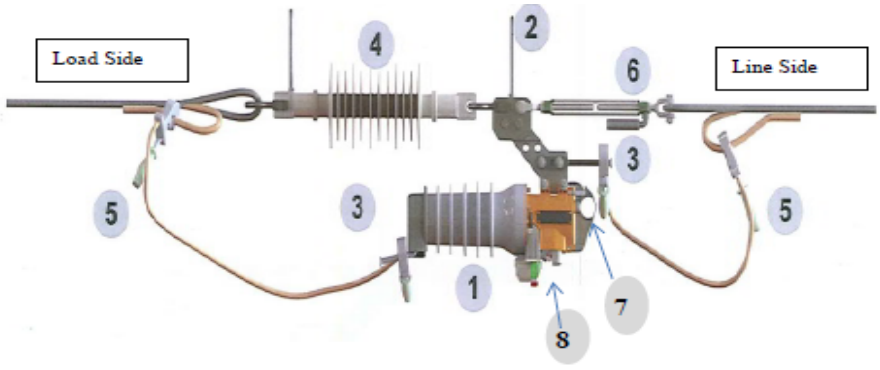
Alternatively, the Temporary Isolation Switch can be operated from ground level via radio communication from software on a laptop computer, if you are set up to use this mode.

CAUTION: As the isolation occurs within the switch with no visible confirmation, it is necessary to disconnect and park the temporary bridge (Item no. 5) to ensure a visual break and confirmed isolation is made prior to personnel performing work on the load side of the switch.

General

Check requirements for a RAD and switching sheet from Distribution Control Section.

If required, ensure a RAD is submitted with appropriate lead time in respect to the intended commissioning date.



Item No.	Description	Item No.	Description
1	Switch unit based on old Kaon Fusesaver circuit breaker design with communications module.	5	Temporary Bridge
2	Tension hanging bracket with hook	6	Ratchet Turnbuckle
3	Parking bars	7	Protection lever
4	Isolating tension insulator	8	Battery pack and Red and Green actuating levers

Isolation Switch And Parts Description

NOTE: The temporary isolating switches are rated to:

• Carry up to 400 A load.
• Break load up to 2000 A
• Take fault current up to 4000 A for 1 second

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer *10.1 - Preliminary Live Work Procedures*).

Installation:

Pre checks and tests:

Note: As a pre-check - Siemen Switches should not be fitted in the same conductor span where work is to be conducted unless there will be no significant displacement, restraining or movement of conductors within that bay.

At ground level, carry out the following tasks and checks to confirm each Temporary Isolation Switch is set up and functioning correctly prior to installing aloft.

Check Comms. Module Packs Work Correctly:

Note: This check must be done on each communications module pack, prior to inserting the packs into the Temporary Isolation Switches.

1. On any switch press both levers (red and green) simultaneously and hold down for a few seconds before letting go.
2. The LED blinks once brightly and then rapidly showing a small flashing light while the test is underway.

3. At the end of the test the LED will blink a number of times showing a larger flashing light to indicate the battery charge level and;

4. This will be repeated three (3) times. E.g. for a battery with a "low" charge the blink pattern will be xx-2s-xx-2s-xx where "x" is a blink.

5. Check the number of blinks as per the following table to determine if the battery has sufficient charge to use or not.

6. Do NOT use a battery if number of blinks is 2 or below.

7. Repeat above process for the remaining comms. module packs.

No. Blinks	Battery Level	Recommendation
0	Battery totally flat	DO NOT USE
1	Battery very low	DO NOT USE
2	Battery low	USE NOT RECOMMENDED
3	Battery OK	OK to use
4	Battery well charged	OK to use
5	Battery fully charged	OK to use

8. Check Operation of Isolating Switches at Ground Level

9. Test Operation of Switches to OPEN Position:

- Insert a comms. module pack into each Temporary Isolation Switch and wait 40 seconds to allow the isolating switches to communicate with each other
- Press the green lever on any switch (does not matter which one) and wait 60 seconds.
- During the 60 seconds all the isolating switches will talk to each other via the comms. module packs and after 60 seconds a loud clunk sound will confirm all the switches have operated into the OPEN position (**GREEN** status).
- Confirm each switch is in the OPEN position (**GREEN** status) by checking with a continuity tester.

10. Test Operation of Switches to Closed Position

NOTE: Before installing aloft, all the isolating switches must be set into the CLOSED position (**RED** status) as shown in Fig. 3 below via the following steps:

- Operate the Red Lever on any switch and wait 60 seconds.
- After 60 seconds all switches should operate into the CLOSED position (RED status).
- Pull the protection lever down into the LOCKED position (OFF).
- Remove all the comms. module packs.

11. Confirm CLOSED circuit through each switch with a continuity tester.

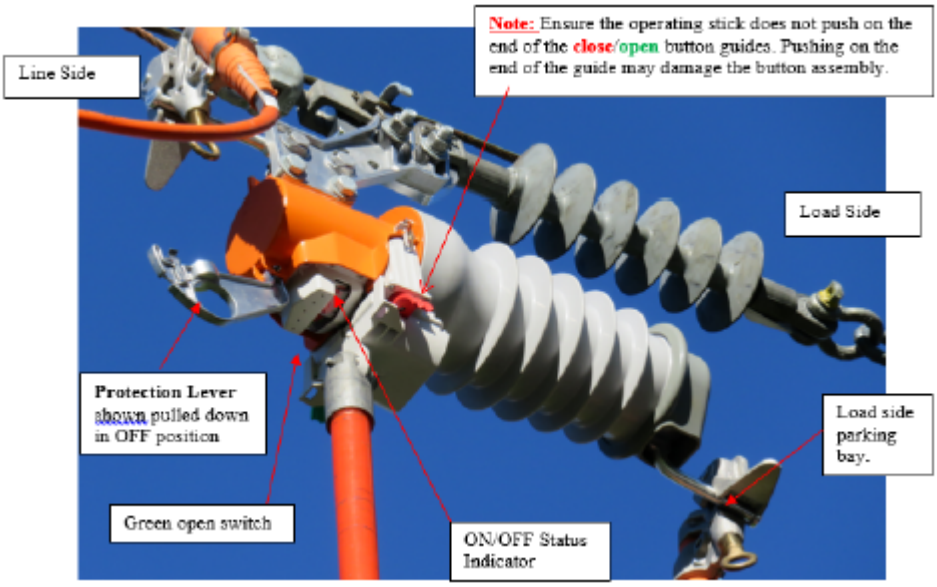
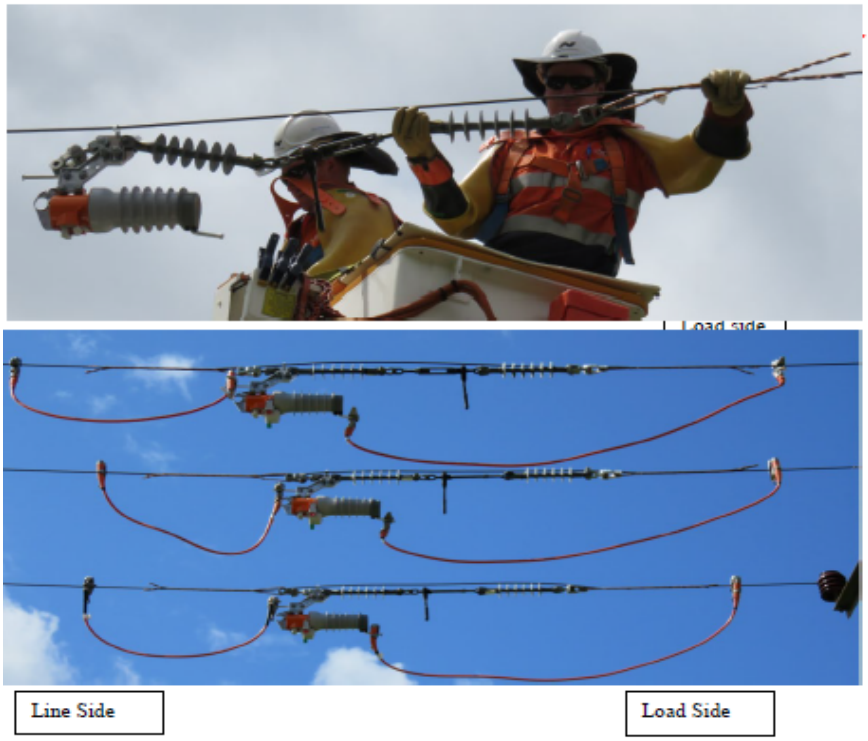


Fig. 3 Isolation Switch With Battery Pack & Comms. Module Inserted And Protection Lever Pulled Down Into Off Position

NOTE: Bridging leads connected prior to operating the switches.



12. At a predetermined position, ideally within 2.5m from the pole, fit the closed Siemen Switch with helical terminations. Come-alongs may be used in place of helical terminations for temporary installations, of no longer than 4 weeks duration, provided the conductor is not 3/2.75 GI. Hang the Temporary Isolation Switch onto the conductor using the hanging hooks.

13. Using a rotor pull and wrap-ons secure the switch to the conductor.

14. Then connect temporary bridging leads.

CAUTION: Confirm isolating switch is in the CLOSED position (**RED** status), prior to open circuiting the main conductors. For additional confirmation, if you have a HV Ampstik measure current flow through the isolating switch.

15. Cut conductor and tie back the main conductor.

16. Repeat above steps for the other two isolating switches.

17. Insert comms. module into each isolation switch and wait 40 seconds to allow the isolating switches to communicate with each other and then;

18. Ensure each protection lever is placed in the CLOSED position (lever UP).

19. All the isolating switches should now be CLOSED (check for RED status) taking current flow through the switch ready for switching to occur.

Operating switch and performing isolation:

1. Persons shall have OH2 level operating authorisation to perform operating and switching of temporary isolation switches in accordance with instruction "**SIEMENS 3AD8 TEMPORARY SWITCHES**" in the TasNetworks, **Distribution Switchgear Operating Manual** and;
2. The only exception to this is when a Live Line crew is required to install or, remove a set of temporary isolating switches from service.

Removing the isolation switches:

1. **CAUTION**: check and confirm the temporary isolation switches are all in the open status (**GREEN**) with **protection lever** in the off position (DOWN) prior to;
2. Reconnecting the bridging lead for each isolator switch.
3. Close the **protection lever** to the CLOSE position (UP) for each switch.
4. Then press the RED lever to close all the switches (**RED** status).
5. Confirm each temporary isolator circuit is closed by using, a Modiewark to check for voltage on the load side and/or, an Ampstik to check all switches are drawing current.
6. Then ensure **protection lever** is in the off position (DOWN) and, for added safety, remove all the comms. modules prior to;
7. Reconnecting the cut main conductors back together.
8. Disconnect the bridging leads and then remove the isolating switches from the circuit.

10•7•22 HIGH PRESSURE INSULATOR WASHING FROM EWP

Introduction

An employee required to wash HV insulators shall be a HV Live Worker, selected trained and authorised to undertake this type of Live Work.

When trained, the selected HV Live Worker shall be authorised to:

• Operate the HV Insulator Washing Unit,

• Test the resistivity of the water,

• Operate the washing gun, whilst maintaining the required Minimum Approach Distances (M.A.D's).

Resistivity

The resistivity of the water to be used for high-pressure washing shall be checked with a resistivity meter. Water having a resistivity value above 400µS / cm should not be used.

Equipment:

• Elevating Work Platform (EWP) Vehicle

The EWP boom must have passed a routine electrical insulation test within the last 6 months. The vehicle must be capable of towing the desired water unit. The water units used within TasNetworks has a capacity of 1200 litres of water (1.2 tonne).

The EWP operator is responsible for manoeuvering the bucket, maintaining clearances and acting as an observer while the HV Live Worker carries out his duties.

- The washing should be carried out from as near to the insulator/s as the operator can manoeuvre the bucket of the EWP, but still work at the required M.A.D's as specified.
- When washing commence from the lowest insulator and work upwards. This prevents accumulation of excess contamination and the risk of flashover. To complete the operation, all insulators are flush washed.

NOTE: Under no circumstances shall the spray jet be directed near any person or animal as impact of the jet would cause injury.

• **Washing Unit**

- The washing unit shall be fitted with a motorised water pump and capable of pumping water at such a pressure that will create a constant stream over a distance of a least 6000mm at such a force to thoroughly clean the insulators.
- The normal washing unit works at a pressure of approximately 5500 kPa (800psi) with a flow rate of approximately 100 l/m.

• **Washing Gun**

- A high pressure washing gun should be capable of producing a consistent stream of 6000mm before any break up occurs.
- There are three different makes of washing guns being used:
  - ♦ John Bean Champion Spray Gun No1:200-119 with a No 8 orifice disc in the nozzle.
  - ♦ Spraying system ‘Gunjet” 432 with a No 8 orifice disc in the nozzle.
  - ♦ Speedie Kleen, which is to be used in conjunction with the same model washing unit.

Resistivity Testing of Water

A resistivity test SHALL be performed each time the washer unit is filled with water.

Method

1. Take a small sample of water from the supply source. This should be in a small clean plastic container.
2. Connect the test probe to the test unit via the socket connector.
3. Turn on the test unit by holding down the on / off button for 2 seconds. This should give a battery indication.
4. Take note that the test instrument is calibrated correctly by observing the calibration symbol (CAL) in the bottom left hand screen. If this symbol is not visible the unit will have to be calibrated. To calibrate the unit follow the calibration procedure listed in Section 12 Appendices.

5. Place test probe into water sample and tap bottom of container gently to remove air bubbles.

6. Leave probe in container until stability indicator (◷) disappears. This is situated in the top left hand corner of the display screen.

7. Record reading of water resistivity on the Hazard ID (JRA) form. If reading is below 400µS / cm water is alright to use for washing insulators.

Method of Washing

All preliminary Live Work procedures shall be performed prior to the commencement of any Live Work (Refer Section 10.1 - Preliminary Live Work Procedures).

Clearances

A minimum distance of 2000mm must be maintained between the spray gun and the insulators, while the EWP must remain at least 1000mm from any live HV apparatus.

General:

1. The high pressure washing of insulators shall be carried out by a HV Live Worker.

2. Personal clearance from HV apparatus and EWP clearances must be those specified for Live Work.

3. For best results, a two or three man crew is necessary depending on the type of construction and location of the HV lined to be washed. Preferably all should be authorised to drive and operate the EWP, trained in the use of the spray gun and authorised to operate the washing units. This allows an interchange of duties and lessens fatigue.

4. The EWP HV Live Worker is responsible for manoeuvering the bucket, maintaining clearances and acting as an observer while the other HV Live Worker carries out his duties.

5. The washing should be carried out from as near to the insulator/s as the operator can manoeuvre the bucket of the EWP, but still work at the required limits of approach as specified.

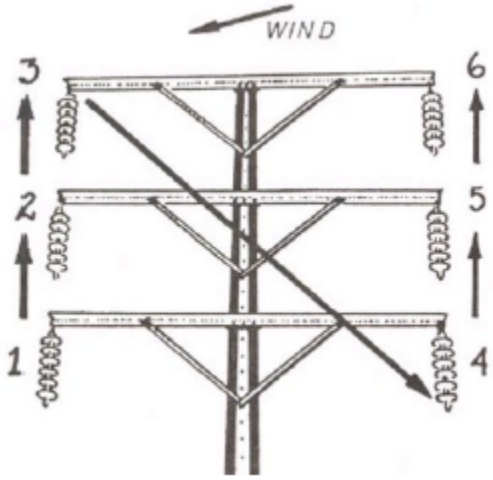
6. When washing, commence from the lowest insulator and work upwards. This prevents accumulation of excess contamination and the risk of flashover.

Work-Site Conditions:					
Item	**"Condition"**	**S**	**N/S**	**N/A**	**Remarks / Comments**
1.	Feeder Protection "SET" for Live Work (Local recloser tagged)				
2.	Feeder Authorisation obtained (Permission to Work)				
3.	Team briefing conducted effectively				
4.	Appropriate Traffic Management in place (Vehicle & Pedestrian)				
4.a.	Adequate warning system(s) .ie. flashing lights working				
5.	Work-Site maintained in a safe manner (Site housekeeping)				
6.	Plant set up appropriately (Hazard lights on / wheels chocked / stabilisers down / vehicle earthed)				
7.	Hazardous environmental conditions at work-site (fire hazards / mid span clearances / thunderstorms / wind / vegetation)	**E**	**D/E**		**Action Taken**
8.	Poor visibility (Fog / fading light / smoke)				

S = Satisfactory, N/S = Not Satisfactory, N/A = Not Applicable, E = Exists, D/E = Doesn't Exist

Work-Site Practices:					
Item	**"Practice"**	**S**	**N/S**	**N/A**	**Remarks / Comments**
1.	Number of personnel compliant with task (appropriately qualified)				
2.	Risk assessment completed as per standing instructions (JSA)				
3.	Conductor loadings calculated correctly and recorded				
4.	Work-site prepared as per risk assessment / JSA requirement				
5.	Operate plant with appropriate qualification (National Cert./ Close prox.)				
6.	Use of insulating equipment (in test/out of test) ie. PPE, insulated tools & equipment				
7.	Use of general equipment (in test/out of test) ie. Lifting gear, Height & safety gear				
8.	Appropriate use of PPE ie. Helmet, boots, gloves, glasses, work clothing (ankle-wrist-neck) & ear muffs				
9.	All jewellery removed whilst aloft on "LIVE" work				
10.	Correct manual handling technique				
11.	Correct positioning of plant / employees / Live Work rigging equip, etc.				
12.	Limits of approach maintained at all times (EWP / crane / employees / others)				
13.	Correct use of Safety Observer .ie. Nominated, Recorded, Position, Function				
14.	Insulating equipment used correctly				
15.	General work tasks as per standing instruction(s)				
16.	Conductor relocation as per standing instructions. Monitored & addressed correctly .ie. Sag/Sideways movement/clearances Movement controlled correctly				
17.	Correct installation & removal of poles				

S = Satisfactory, N/S = Not Satisfactory, N/A = Not Applicable



Washing Sequence:

1. To complete the operation, all insulators must be back washed.

2. Insulators should be washed from both sides of the cross arm to ensure that the insulator is washed thoroughly.

3. For pin and post type insulators, start from the base and work up. For suspension and strain construction, commence at the disc insulator closest to the conductor.

4. When washing in high pollution areas (industrial and coastal), the far side insulator should be washed first and work your way back. This will help to eliminate any chance of a flashover occurring.

5. Care should be taken when washing substation and switch poles. Water should not be directed across the insulators (if possible) as a flashover can occur, especially in polluted areas. These insulators should be washed with a low pressure.

6. The lower the pressure also reduces the likelihood of dislodging a HV fuse.

7. Cable head poles should only be washed with a low pressure as damage can be done to the porcelain bushings around the seals.

10•7•23 VEGETATION TRIMMING BY HV LIVE WORKERS

Why

Vegetation in close proximity to power lines can cause problems with supply reliability, public safety and bush fires.

TasNetworks engages contractors to keep the lines clear of vegetation, however sometimes the vegetation has grown too close to the lines for the contractors to remove safely (Ref PSSR limits of approach).

To remove this vegetation safely the lines must be de-energised or Live Work techniques employed.

Live Work techniques are employed to minimise interruptions to supply and involve the application of Live Work principles and tools to clear the vegetation.

What

Our policy is to clear the minimum vegetation required to allow the contractors to come in and complete the task from a safe working distance (Ref PSSR limits of approach) and to the clearing specification required by TasNetworks.

TasNetworks Live Work crews do not currently have the equipment and facilities to remove and clean up large amounts of vegetation the associated waste. TasNetworks Live Work crews are more effectively utilised in performing line work.

How

Risk Assessment

Perform a risk assessment as per normal Live Work process, and consider the following;

- Weather Conditions
- Size, weight and position of vegetation to be removed.
- Proximity of vegetation to conductors
- Position of EWP
- Public Safety

Setup

Plan the work and layout of the work site. This must include the mitigations included in the risk assessment.

Set upstream protection with sensitive earth fault protection on and 1 trip to lockout as per normal Live Work protocols.

Setup traffic and pedestrian management controls.

Position EWP.

Establish “drop zone” under work area.

Position the safety observer at a place outside the “Drop Zone”, that offers a clear view of works.

Establish and maintain effective communications between safety observer and work crew.

Vegetation Removal

Normal Live Work principles and protocols shall be used for these operations.

Additional requirements

- Selected tools, equipment and personnel must not encroach on the Live Work minimum approach distance.
- Vegetation must be cut into manageable lengths (up to maximum 300mm lengths) to allow for controlled transportation from the tree to the ground, without touching the conductors or creating safety hazards for those working in the vicinity.
- Sticks and insulated ropes may be utilised to pull vegetation from the lines provided that all operations are performed in a controlled manner.

10•7•24 TESTING LIGHTNING ARRESTORS - LIVE WORK INSTALLATION

10•7•24•1 WHEN ONSITE TESTING OF LIGHTNING ARRESTORS IS NOT REQUIRED

A 5KV insulation resistance test (commonly known as a megger test), as a minimum, is not required on lightning arrestors on site prior to installation where the lightning arrestors are already affixed to new equipment (e.g. poles transformers and reclosers) supplied to TasNetworks (arrestors factory tested beforehand) subject to the equipment:

(1) At a Depot Store being protected against the affects of environment or weather (e.g. dust, grime, oil, rain, ingress of moisture etc.) and/or;

(2) Not being in a Depot Store more than 12 months without being installed.

10•7•24•2 WHEN ONSITE TESTING OF LIGHTINING ARRESTORS IS REQUIRED

An onside 5KV megger test, as minimum, is required prior to installing lightning arrestors where any of the following conditions apply:

1) Were condition (1) or (2) in Section 10.7.24.1 above is exceeded.

2) Where new lightning arrestors to be used are not already affixed to new equipment (e.g. pole transformer or recloser) to be installed, regardless of when they have been tested and how long they have been sitting in a Depot store.

3) Where re-cycled and re-tested lightning arrestors will be used regardless of when they have been tested and how long they have been sitting in a Depot store.

10•7•24•3 ONSITE MEGGER TESTING METHOD

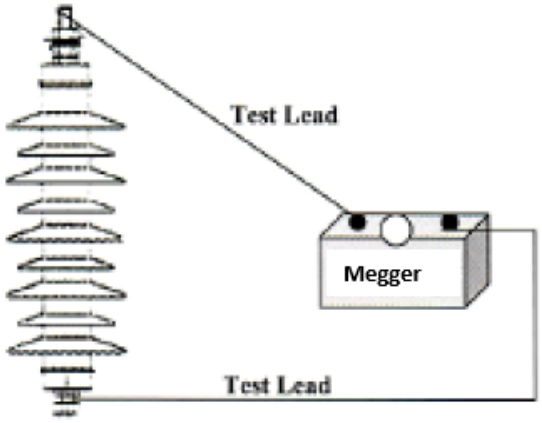
A suitable High Voltage Megger Tester, similar to the following model shown below, shall be used to conduct an insulation resistance test, when required, on each lightning arrestor onside before installation as per following steps:

1) Clip red and black test leads to conductive terminals of lightning arrestor as shown.

2) Select 5KV output from the tester. **Ensure everyone is clear and not touching test leads and/or lightning arrestor.**

3) Conduct test applying 5KV for one (1) minute duration.

4) Required pass result - 10 Gig Ohms or greater.

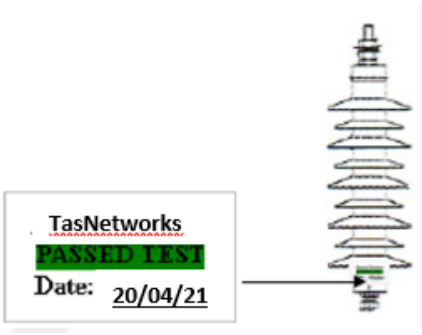


5) If reading less that 10 Gig Ohms - redo test to confirm and if still below 10 Gig Ohms fail lightning arrestor and do not install it. Replace with a lightning arrestor that has passed the test.

Example Of Typical HV Insulation Tester

10•7•24•4 TESTING RE-CYCLED LIGHTNING ARRESTORS

Lightning arrestors that have been taken off from removed or replaced equipment, and are in sound condition and have not incurred a lightning strike, can be re-cycled and re-used after they are sent to one of the following TasNetworks Depots to be properly tested at the correct High Voltage Value and at 50Hz frequency using a Hi-Pot Test Kit as per work practice **Testing Lightning Arrestors.**



• Rocherlea Depot, Launceston.

• Cambridge Depot, Hobart.

Newly tested lightning arrestors shall have a passed test sticker affixed as shown, indicating the new test date.

Note: Regardless of re-cycled lightning arrestors being re-tested at the Depot, a megger test must be conducted onsite for each lightning arrestor prior to installation under de-energised or energised conditions.

10•7•24•5 INSTALLING LIGHTNING ARRESTORS UNDER LIVE HV CONDITIONS

- On a fault response, if a lightning arrestor blows then all three must be replaced. This avoids the potential problem of having a brand new replacement arrestor being installed with existing arrestors that have reduced service life.

- You must ensure a 5KV Megger Test, as a minimum, has been done on site on each lightning arrestor before it can be installed.

- For added safety, a "dab test" must always be conducted on each lightning arrestor (arrestor tail dabbed onto live HV conductor for minimum of 5 seconds) via use of a dab stick with the employee away at a safe distance prior to permanent connection.

10.7.25 TESTING CURRENT FLOW IN CONDUCTOR LOOPS

This is a method for testing the presence of "current" flow in high voltage loops prior to the loop(s) being disconnected.

This "test" will be applied to all existing loops on high voltage conductors up to and including 33 kV where Live Work personnel are required to disconnect the loop(s) under Live Work conditions.

The test "process" will only be performed using a tester approved for this purpose.

The Tester currently approved is an open-ended high voltage ammeter capable of registering and recording the current level that may be flowing through the conductor loop.

The "Tester" must be used in accordance with the manufacturer's "Operators Manual" provided with the particular Tester.

Process:

- Check the Tester to ensure it is operating correctly.

- Apply the Tester to the required conductor loop in the recommended manner and note the "reading".

  Note. It may be an advantage to "test" all corresponding loops simultaneously to determine the presence of any current.

- Recheck the Tester on the first loop.

(A) NO Current Present in Loop.

- Attach temporary bypass "jumper" across the loop.
- Break the loop & secure tail.
- Remove temporary jumper.
- Repeat with other loop(s) as required.

(B) Current Present in Loop – Up to Maximum of "15" amps.

- Attach temporary "Load Break Device" (EDO unit) across the loop.
- Break the loop & secure tail.
- Open off the Load Break Device.
- Remove the Load Break Device as required.
- Repeat with other loop(s) as required.

Note.

- If the current is higher than 15 amps – load must be shed before attempting to break loops or else use the temporary Air Break Switch.

- If the EDO unit is fitted with a permanently attached flexible lead – the lead must be at least 35 mm^2 welding cable or equivalent.

- Ensure the temporary EDO is fitted with a solid element.

Precaution – Ferro resonance and Single Phase Switching:

Avoid, wherever possible, switching underground cable connected transformer installations on single-phase devices such as pole mounted fuses or the temporary Live Work Load Break Device.

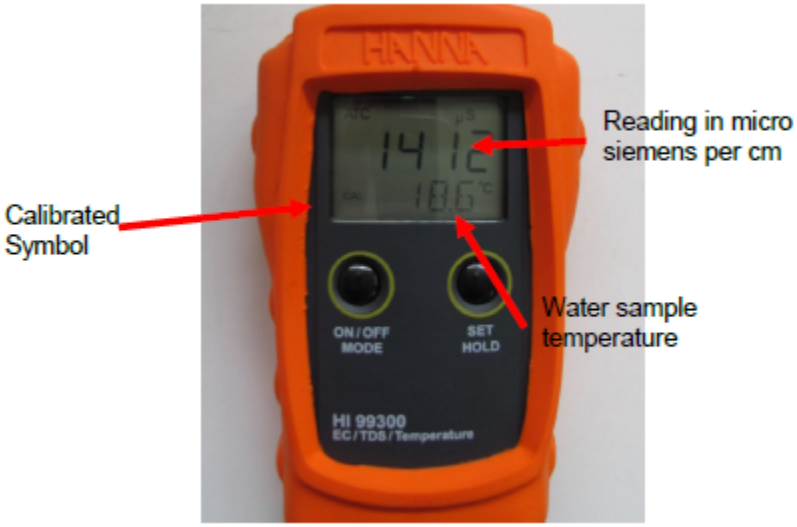
If HV Cable loops need to be broken where more than 30 metres of underground HV cable has to be disconnected with a transformer, ENSURE that some form of resistive load (eg, heating or similar) is connected on all three (3) low voltage phases of the transformer before isolating the transformer.

Alternatively, use the temporary Live Work three phase Air Break Switch in conjunction with the breaking of loops.

Note. For additional information on switching where Ferro resonance could become an issue refer to **Section 6.12.11 in the Line Workers Reference Hand Book** covering this topic.

10•7•26 CALIBRATION OF HANNA WATER TESTER HI 99300

This is a method used to calibrate the HANNA Instruments HI 99300 Water Resistivity Meter. This **MUST** be performed when the Instrument display does **NOT** show the Calibration (CAL) symbol in the lower left hand corner of the display screen.



1. Insert the test probe into the DIN socket at the top of the tester.

2. Turn the test instrument on by pushing the on/off button.

3. If the CAL symbol is not displayed push and hold the on/off button for approximately 2 seconds. The word CAL should now be displayed at the bottom of the screen.

4. The display should now read something like the following:

5. Place the test probe into a bottle of Calibration Solution (HI 7031 @ 1413 µS/cm)

6. Gently tap the probe on the bottom to release all air bubbles and let the probe sit still.

7. Once calibration has been automatically performed the screen will display OK for 1 second and then return to normal measurement mode.

8. The CAL symbol now should be displayed in the lower left hand corner of the screen indicating that the instrument is correctly calibrated.

10•7•27 EMPLOYEE EMERGENCY RESCUE – LIVE WORK HV

The following procedure applies to HV Live Workers who get into difficulty whilst working on live high voltage apparatus at the pole top.

Method 1. ..... **RESCUE FROM POLE STRUCTURE / PLATFORM.**

• Ensure high voltage conductors are DEAD or arrange immediate isolation and prove dead.

• Cover live low voltage conductors with appropriate insulation if required.

• Rescue the employee using approved Pole Top Rescue equipment and method.

• Or alternatively, rescue employee using an EWP if appropriate and safe to do so.

Method 2. ..... **RESCUE FROM ELEVATING WORK PLATFORM (EWP).**

Do NOT touch or approach the EWP at this stage – It may be alive

1. Make a quick visual assessment to ensure that no H.V. "UNINSULATED" part of the EWP is in direct contact with LIVE high voltage conductors.

2. IF EWP IS IN CONTACT WITH HIGH VOLTAGE CONDUCTORS:

   • If possible, have the Operator in the bucket immediately manoeuvre EWP away from conductors, or
   • Ensure high voltage conductors are DEAD, or
   • Arrange immediate isolation and prove conductors are dead.

3. **When safe to do so** - move quickly but cautiously to the EWP turret controls (*or ground controls in the case of the Redmond Gary*) and lower the EWP bucket (basket) away from conductors and down as close as possible to the ground.

4. Tilt the EWP bucket to enable removal of the casualty. (Refer EWP type).

5. Continue rescue in accordance with approved EWP Rescue method.

Note. *Apart from the above – all EWP rescues shall be carried out in accordance with current EWP Rescue procedures for both single or dual person rescue methods*.

The above procedures are for EMERGENCY USE ONLY and the high voltage conductors / apparatus must be isolated and proven dead, where necessary, before a rescue is attempted.

11.0 APPENDICES

11•1 ABBREVIATIONS

A	Angle
AAC	All aluminium conductor
ABC	Aerial Bundled Cable
ABS	Air break switch
ABS	Acrylo-Nitrile Butadiene Styrene
ACGSR	Aluminium conductor galvanised steel reinforced
ANSI	American National Standards Institute
AS	Australian Standard
ASTM	The American Society for Testing and Materials
CAN/CSA	Canadian Standards Association
EDO	Expulsion dropout
EMF	Electric and magnetic fields
ESAA	Electricity Supply Association of Australia
EWP	Elevating work platform
HV	High Voltage
IEC	International Electro-technical Commission
IEEE	The Institute of Electrical and Electronics Engineers
kg	Kilogram
kN	Kilo newton (1 kN = 101.9 kg **or** 1 kg = 9.81 Newtons)
kV	Kilovolt
L	Length
Links	High Voltage Disconnect Links
m	Metre
mm	Millimetre
NB	Note Well
Nm	Newton metre
SAA	Standards Association of Australia
SC/GZ	Steel conductor galvanised
SIA	Scaffold Industry Association Incorporated in America
W	Self load per metre of conductor
Wt	Down force to be lifted

11•2 REQUIREMENTS FOR MEDICAL / PHYSICAL EXAMINATION

LIVE WORK
MEDICAL EXAMINATION & REPORT

DATE:.....

NAME:..... DATE OF BIRTH:.....

ADDRESS:.....

FAMILY DOCTOR:.....

PROSPECTIVE EMPLOYER:.....

BRIEF JOB DESCRIPTION:.....

DETAILED JOB DESCRIPTION FROM EMPLOYER..... YES
.....NO

SPECIAL INVESTIGATION REQUIRED VFT ECG AUDIO

OTHER

The purpose of this examination, and the consequent opinions expressed by the examining doctor, are in the interests of prevention of industrial injury and/or illness by the proper placement of employees in those positions best suited to their physical capabilities. This examination is not for the purpose of determining the success or otherwise of this person's application for employment.

If you are in doubt about any questions please ask the nurse or doctor.

PREVIOUS OCCUPATIONS

DATES	OCCUPATION	EMPLOYMENT

Have you ever worked with any of the following? Dust Heat Noise Radiation
Please give details:.....

QUESTIONS	YES	NO	DETAILS/COMMENTS
• Have you ever had any problems with chemicals?			
• Have you ever had any problems with wearing any personal protective clothing or equipment?			

PERSONAL MEDICAL HISTORY

Please tick YES or NO in the box provided.
Please fill in the DETAILS box for questions 1-8 if appropriate.

QUESTIONS	YES	NO	DETAILS/COMMENTS
• Are you taking any regular medication (prescribed or OTC)? If YES for what condition.			
• Within the past 5 years have you ever had any other medical advice, examination, investigation or treatment? If YES please provide details of doctor and /or hospital.			
• Have you had any work-related injuries? If YES please provide details of occupation, injury and treating doctor.			
• Have you been involved in any road traffic or other accidents?			
• When were you last immunised against tetanus?			
• Do you drink alcohol? If YES in what form and daily quantity?			
• Do you use tobacco? If YES in what form and daily quantity?			
• Have you had any of the Hep A, B, C injections?			

Have you had any of the following?
The doctor will fill in the COMMENTS box for these questions.

• Change in weight of more than 3kg in the past year?			
• Problems with your eyesight? Do you wear glasses or contact lenses?			
• Problems with your hearing?			
• High or low blood pressure, heart or circulation problems?			
• Asthma, TB, emphysema, bronchitis, other lung problems?			
• Recurrent hay fever, or sinusitis?			
• Indigestion, hiatus hernia, gastric, peptic or duodenal ulcer, bowel, liver or gall bladder disease?			
• Kidney or bladder disease, including stones?			
• Diabetes, thyroid or other disease of your glands?			
• Epilepsy, faints or fits, mental or nervous disorders?			
• Frequent headaches- eg migraines or tension?			
• Arthritis, rheumatism, joint pains or gout?			
• Head or spinal injury? Neck or back trouble?			
• Rupture/hernia?			
• Cancer or tumour?			
• Dermatitis, psoriasis, or other skin complaints?			
• Allergies, including drug reactions?			
• Other illness/operations?			

APPLICANT'S DECLARATION

I,…… hereby declare that, to the best of my knowledge and belief, the above information supplied by me is true, complete and correct and nothing affecting my employment or ability to work has been withheld.

I consent to the examining doctor, Dr……, releasing medical information to appropriate officers of my prospective employer……

SIGNED:	DATE:

WITNESSED:	DATE:

PHYSICAL EXAMINATIONS

Underweight (BMI <20) / Healthy weight / Overweight (BMI>25) / Obese (BMI>30)

	Cm				

Comments:

Visual Acurity R L
Uncorrected 6/ 6/
Corrected 6/ 6/

Visual fields (confrontation) Normal / Abnormal
Colour Vision (Ishihara) /14 Normal / Abnormal

Comments:

Hearing Normal / Abnormal
Otoscopy Normal / Abnormal
Audiogram Normal / Abnormal

Comments: - see p6

Nose, throat, neck (including thyroid) Normal / Abnormal

Comments:

Skin Normal / Abnormal

Comments:

Lymph Nodes (cervical, axillary, inguinal) Normal / Abnormal

Comments:

Blood Pressure

Systolic			
Diastolic			

Pulse /min Regular / Irregular
Heart sounds Normal / Abnormal
Peripheral pulses (including carotids) Normal / Abnormal

Comments on cardiovascular system

Lung sounds Normal / Abnormal
Lung function tests Normal / Abnormal

Comments – see p6

Abdomen Normal / Abnormal
Hernia Absent / Present

Comments:

Spinal curvature Normal / Abnormal
Spinal movement Cervical Normal / Abnormal
Thoracic Normal / Abnormal
Lumbar Normal / Abnormal
Limbs Arms Normal / Abnormal
Legs Normal / Abnormal

Comments:

Neurological examination Normal / Abnormal

Comments:

Psychological assessment

Comments:

ASSESSMENT

Having examined this prospective employee I find that he / she is (tick box)

Fit for work without restriction Comment:	
Fit for work with restriction Comment:	
Unfit for the position applied for Comment:	

SIGNED:	DATE:

DOCTORS STAMP

11•3 TESTING DETAILS – LIVE WORK EQUIPMENT.

Shown in the following five (5) tables are details listing the ""test" requirement insulating equipment used by Live Work personnel.

Included here is information relevant to:

- Gloves & Sleeves.
- Insulating Barriers.
- Epoxiglass Insulating Sticks.
- Elevating Work Platforms.

Insulating Gloves & Sleeves			
Test Standard = ASTM. D120, D1051 & AS 2225			
Class	Test Interval	Test Voltage (Rated Voltage)	Working Voltage ((Phase to Phase)
2	6 months	20 kV	15 kV
3	6 months	30 kV	25 kV
4	6 months	40 kV	35 kV

Insulating Barriers (Flexible)			
Test Standard = ASTM. D1048, D1049, D1050, F478 & F479			
Class	Test Interval	Test Voltage (Rated Voltage)	Working Voltage ((Phase to Phase)
2	12 months	20 kV	15 kV
3	12 months	30 kV	25 kV
4	12 months	40 kV	35 kV

Insulating Barriers (Rigid)			
Test Standard = ASTM. F711 & F712			
Class	Test Interval	Test Voltage (Rated Voltage)	Working Voltage ((Phase to Phase)
1	12 months	25 kV	25 kV
2	12 months	34.5 kV	34.5 kV
3	12 months	46 kV	46 kV

Insulating Sticks (Epoxiglass Foam Filled)			
Test Standard = ASTM. F711			
Separation of Test Electrodes	Test Interval	Test Voltage	Duration of Test Voltage
300 mm	12 months	45 kV	1 minute

Elevating Work Platform (Includes Bucket Liner & Hydraulic Hoses / Oil)			
Test Standard = AS 1418.10 & ANSI/SIA A92.2			
Test Interval	Test Type	Test Voltage	Duration of Test Voltage
6 months	*Type Test*	2.5 times phase-to-phase line voltage.	1 minute
	Acceptance Test	1.5 times phase-to-phase line voltage.	
	Routine Test	Phase-to-phase line voltage – with less than 10% variation.	

Note.

On completion of an electrical test – each piece of equipment shall be given a unique identification number. This number last the life of the piece of equipment.

Accurate records shall be kept of each piece of equipment with regard to "test" dates. They shall be clearly marked with the "test" date and the next "due" test date.

It is the HV Live Worker's responsibility to ensure that every piece of this "equipment" is within its prescribed test "date".

11•4 LIVE WORK AUDIT ASSESSMENT FORM

This Work-site Safety Audit form is the document used for the auditing of HV Live Workers. It is referred to in Section 2.11.2, Audit Process.

Work-site conditions and practices are those to which the work shall be performed.

GENERAL INFORMATION:

- There is a requirement within TasNetworks Energy to conduct work-site safety Audits in order to ensure that, all work carried out by TasNetworks Energy employees and contractors is performed in accordance with established work "procedures", and individual work-sites are maintained in a safe manner.

- Any "work-site" or "piece of equipment" found to be defective and / or unsafe shall be removed / rectified as soon as is practicable. Any substandard "condition" and / or "practice" shall be rectified as soon, as is practicable.

- **NOTE:** Prior to commencing the Audit, the auditor shall liaise with the work crew to discuss the audit process.

Click on the **LIVE LINE WORK AUDIT ASSESSMENT FORM** to use the current approved form.

12.0 REFERENCES

- TasNetworks Current Overhead Construction Manual
- TasNetworks Legacy Overhead Construction Manual
- TasNetworks Line Workers Reference Handbook
- TasNetworks Power System Safety Rules