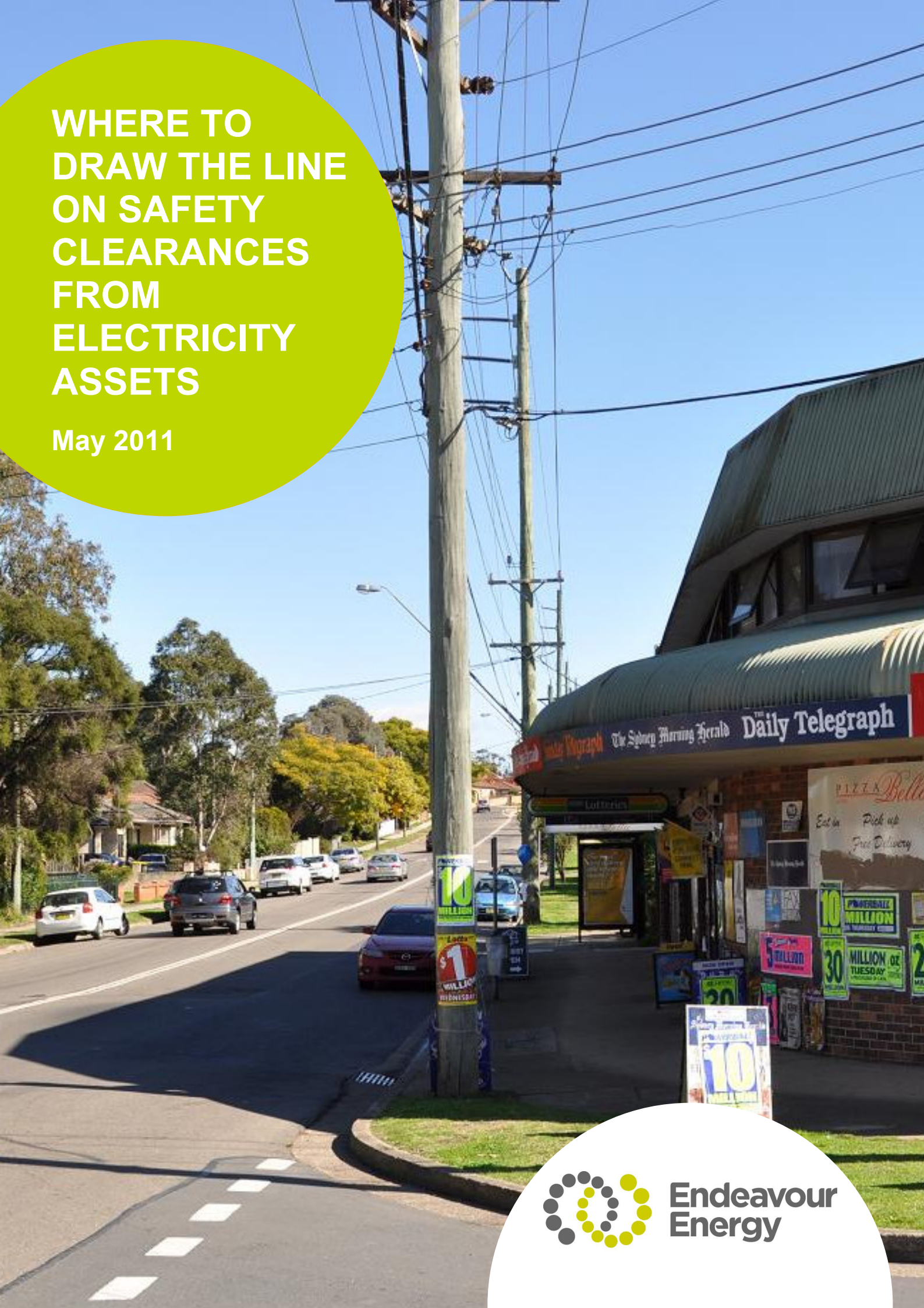
WHERE TO DRAW THE LINE ON SAFETY CLEARANCES FROM ELECTRICITY ASSETS

May 2011



Endeavour Energy

Where to draw the line on safety clearances from electricity assets

Are you in the clear?

Important information on safe distances

This brochure is designed to inform anyone working on or around buildings or sites that are connected to or in the vicinity of electricity assets of safe distances that must be maintained from electricity assets, overhead or underground.

Awareness of safety clearances could mean the difference between a safe, successful project and a fatal accident.

It may also save time and money by ensuring the design of a home or building complies with safety requirements without additional measures being taken.

Drawings in this brochure specify the minimum safety clearances for working or living near electrical assets.

Note: Full details about safe work practices, including penalties for non-compliance, are set out in the WorkCover NSW document *Work near overhead power lines: Code of practice 2006*. The Code can be viewed at the following link:

www.workcover.nsw.gov.au/formspublications/publications/Documents/work_near_overhead_power_lines_code_of_practice_1394.pdf

The requirements for maintaining safe distances from electricity assets are also set out in the **State Environmental Planning Policy (Infrastructure) Regulation, 2007** (Division 5 - Electricity transmission or distribution, Subdivision 2 - *Development likely to affect an electricity transmission or distribution network*).

This requires local councils to seek comments from Endeavour Energy before approving any development application where electricity infrastructure is present.

Types of assets

The following pictures show typical electricity assets that may be installed in residential areas.

High and low voltage overhead mains

Underground service pillar

Ensuring you're in the clear

All buildings and other structures must comply with minimum safety clearances from overhead electricity conductors.

The minimum distances from the closest conductor to the building or other structures must be maintained during strong winds or high operating temperatures. Under these conditions, the conductor can swing or sag considerably towards the building or structure.

The minimum safety clearances are shown in the illustrations in this brochure. They have been prepared to suit Endeavour Energy's asset construction practices.

If it appears that conductors are closer than the minimum safety clearances shown in the table, call Endeavour Energy for advice.

Some important considerations regarding minimum safety clearances include:

- Knock-down/rebuilds, where a small, single storey home is replaced by a larger or double storey home, or where land is rezoned to allow multi-storey construction, such as apartments or town houses.
- Moving the location of a driveway or building driveways close to pillars or poles.
- Installing a tall antenna in areas where broadcast reception is poor.
- Erecting a flagpole.
- Any building work near underground or overhead power lines.
- Erecting a cubby house.
- Raising the ground level below power lines.
- Erecting metal fences or scaffolding close to poles or lines.
- Excavating near poles or where electricity assets run underground.
- Using a crane near overhead lines

Swimming pools are generally unsuitable for installation near electricity assets, and are rarely allowed. Above-ground pools, in particular, are regarded as inherently unsafe.

Working with safety near the point of attachment

The point of attachment is where the electrical wires attach to a home or building. When work is being carried out near the point of attachment, special care must be taken to avoid contact with these electrical wires, and the mounting bracket, or to avoid damaging them.

The safe distance from a point of attachment is 1000mm.

Care must be taken with activities such as:

- Cleaning leaves from guttering.
- Painting gutters, fascias and eaves.
- Pruning trees and shrubs (particularly around the electrical wires).
- Attaching aluminium cladding to the fascias and the eaves.
- Replacing the guttering.

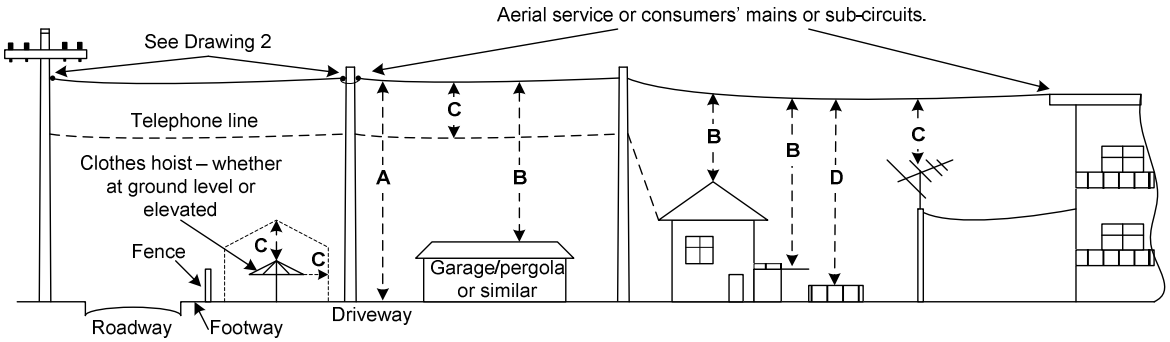
Keeping your distance

The minimum safety clearances over structures, roads and driveways are shown in the following drawings.

Remember – these are the **minimum** safe distances. In some cases, the distance may increase to ensure public safety.

Drawing 1: Minimum safety clearances over structures

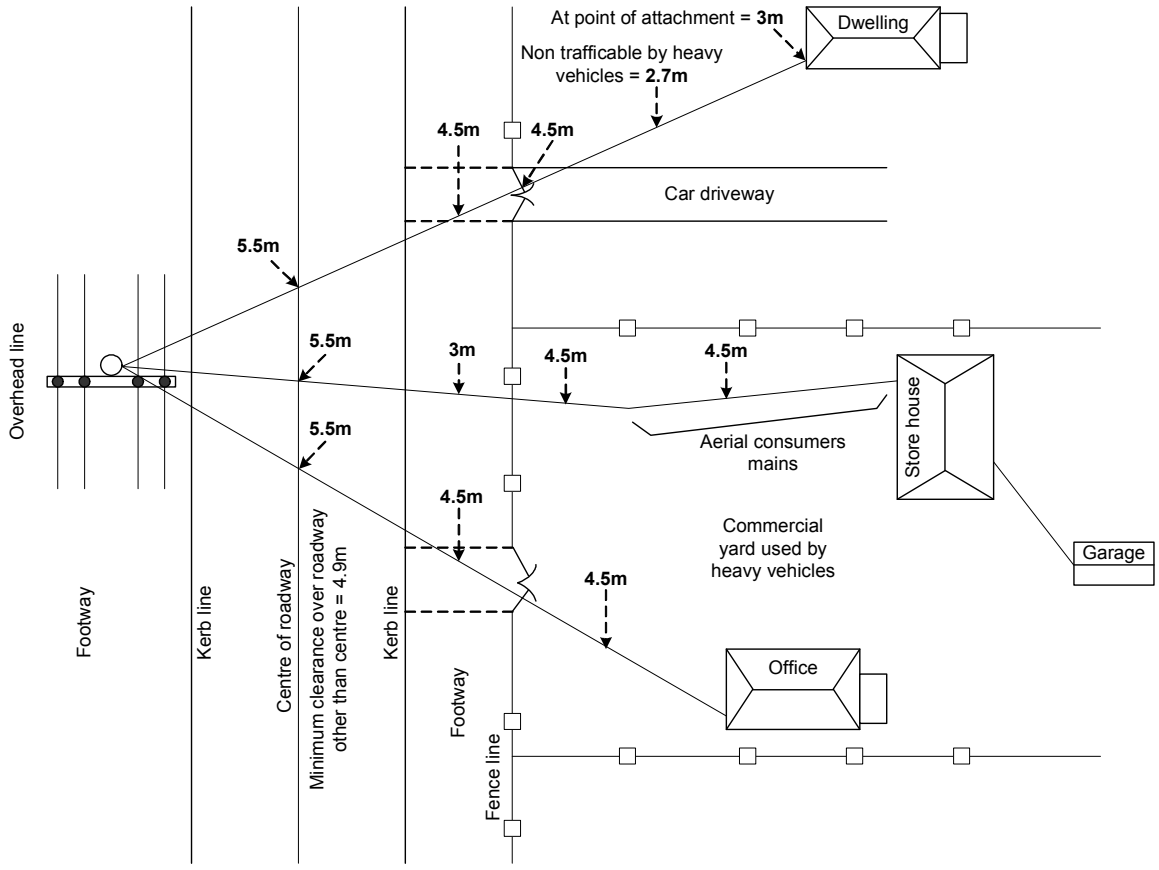
Aerial consumers' and service mains



Application / Type of aerial conductor	Minimum height above buildings, structures, ground or elevated areas (mm)		From, **buildings, TV/ radio** antenna or stay wire and **telephone lines** (mm)**.**	Above water level in swimming pool, above walkway around pool	Above areas where irrigation pipes are used, or above areas where sail craft are used
	Over ground	Over roofs			
	A	B	C	D	
Bare or insulated live conductors	Bare 5500 Insulated 4500	3700	2000 3000 for clothes lines	Not permitted	Refer to Integral Energy

Drawing 2: Minimum safety clearances over roads and driveways

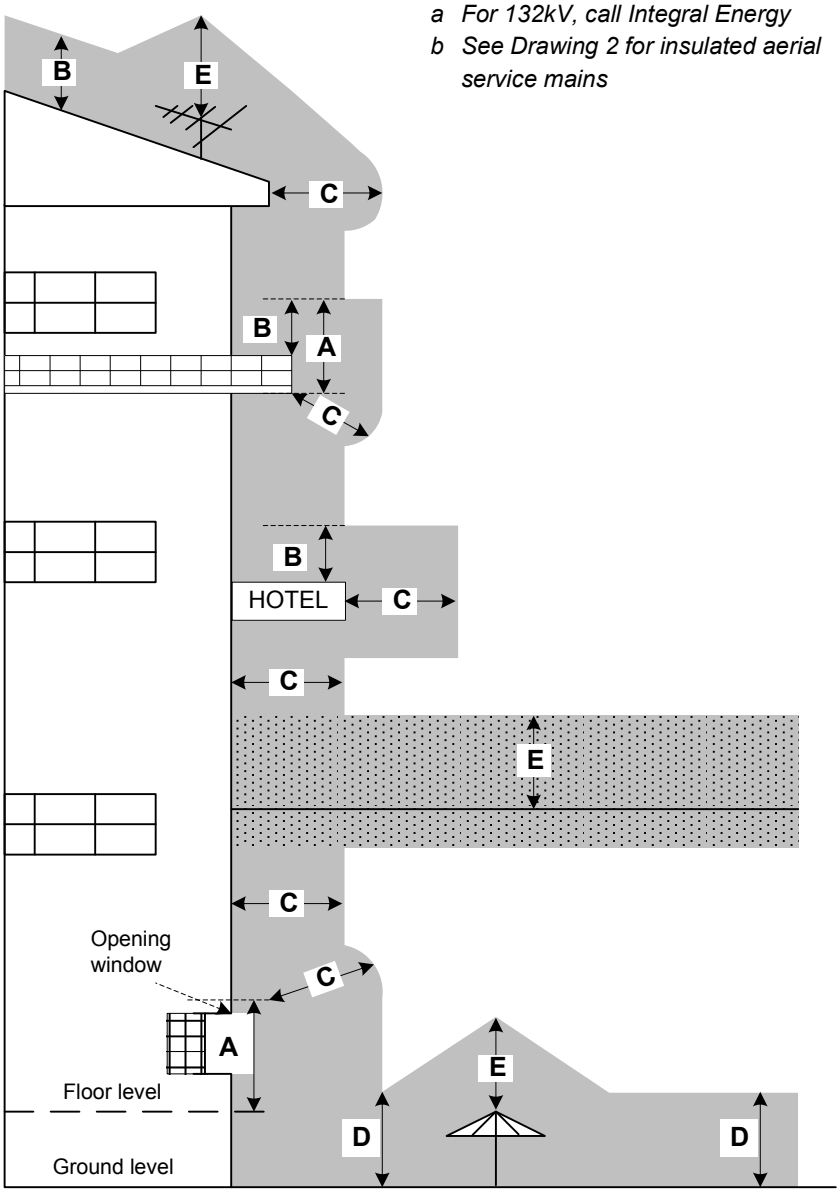
For insulated aerial service mains



Drawing 3: Minimum safety clearances near structures

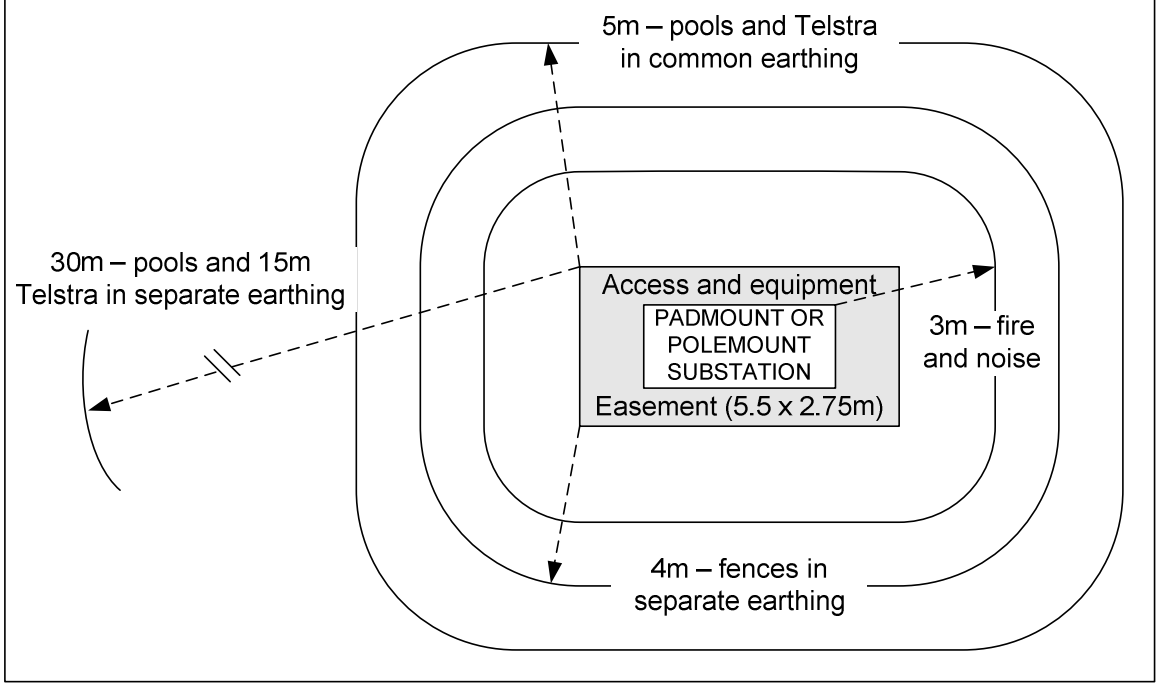
	0-1000V LV	1-22kV HV	33kV[a] Trans.
A Above standing areas	3700mm	3700mm	5000mm
B Accessible areas	2700mm	2700mm	4500mm
C Non-accessible areas	1000mm	2100mm	2500mm
D Ground	5500mm[b] (bare)	7300mm	7300mm
E Above outdoor TV antennas, aerial cables or clothes lines	1800mm	3000mm	3000mm

a For 132kV, call Integral Energy
b See Drawing 2 for insulated aerial service mains



The above drawing specifies the minimum safety clearances for working or living near electrical power lines.

Drawing 4: Substations - segregation requirements from other structures



Padmount substation (above) and pole mounted substation (right)

Underground services

Care must also be taken to ensure that building or excavation activities do not infringe on underground cable, ducts and protective covers. Before undertaking any work in the vicinity of underground cables, advice should be obtained from the ***Dial Before You Dig*** service (see page 7 for phone number).

Who to call

For further information on safe distances, please call:

Region	Local government areas	Contact name and number
North	Bathurst, Baulkham Hills, Blacktown, Blue Mountains, Hawkesbury, Lithgow, Parramatta, Penrith, plus parts of Hornsby, Mid-Western and Ryde.	Project Manager **131 081**
Central	Camden, Campbelltown, Fairfield, Holroyd, Liverpool, Wingecarribee, Wollondilly, plus parts of Bankstown.	Customer Service Manager **131 081**
South	Kiama, Shellharbour, Shoalhaven, Wollongong.	Customer Service Manager **131 081**

Application forms for asset relocation on connection can be found on Endeavour Energy's website at ***www.endeavourenergy.com.au/Our network/How do I get started?*****,** or by calling Endeavour Energy's Network Connections Customer Consultant on **9853 6234**.

Drawings contained in this document are a general guide only to Endeavour Energy's safe distances requirements. Full details are contained in Endeavour Energy's design and construction drawings and Standards, which are available on request.

The key drawings are:

- Drawing no. 0011985, sheets 1 and 2; Drawing no. 086232; and, Drawing no. 086242.

Reference should also be made to Mains Maintenance Instruction MMI 0015 – Management of Endeavour Energy's electricity easements.

Dial Before You Dig service - **1100**.

WorkCover Assistance Service - **13 10 50**.

LIVING SAFELY WITH ELECTRICITY

When working outside, whether it's a small job or large job or even something you do every day, you need to be aware of the electrical dangers of working near overhead power lines or underground cables.

Endeavour Energy wants to help protect you from potential electrical dangers on your work site. In turn, this will ensure families, households and businesses can continue to enjoy a safe and reliable electricity supply.

This brochure highlights some of the things you can do to avoid electrical dangers on the job.

Did you know?

Australian households receive communication, gas, water and electrical services via a labyrinth of cables stretching millions of kilometres underground. If just one of these cables is damaged, you could potentially be seriously injured and/or isolate thousands of households from essential services. Such incidents can result in hefty fines.

01 Call Emergency Services on **000**.

02 Request an ambulance if anyone is injured.

03 Report the incident to Endeavour Energy on **131 003** as soon as possible.

SAFETY EXCELLENCE

IN EMERGENCIES CALL 131 003

24 hours a day, 7 days a week

If you have any questions about what you should do to stay safe around damaged power lines and other electrical infrastructure please call 131 081 or visit us at www.endeavourenergy.com.au

0611-ENE2351-CONT

SAFETY ON THE JOB

51 Huntingwood Drive
Huntingwood NSW 2148
PO Box 6366 Blacktown NSW 2148
T: 131 081 • F: 61 2 9853 6000

Endeavour Energy

Call 131 003 and put safety first.
www.endeavourenergy.com.au

Endeavour Energy

BE ALERT AT WORK

Do you know where the underground cables are?

Unfortunately, serious incidents occur when excavators hit underground cables because cables aren't identified before work has commenced. Obtaining information about underground cable locations once involved making numerous calls to many utility providers.

Now there's really no excuse. Information and site maps showing the general location of underground services can be obtained by calling **1100** or visit **www.1100.com.au**. Remember it's the law.

Check, double check, triple check and reassess

Always check, double check, triple check and reassess for electrical dangers on the job. Remember, earthmoving operations often require material to be relocated to mounds or piles. When this happens under and around power lines it reduces the clearance distances between plant and the electrical infrastructure.

Completed your job?

Stay alert when packing up or removing scaffolding or equipment or when returning plant to its transit position.

Transporting trees?

Remember tall trees and shrubs such as palms can come into contact with power lines. Water is a good conductor of electricity and can therefore conduct through vegetation due to its water content.

Excavating?

Always check the voltage of cables listed on plans so that you can then apply this to *Work Near Underground Assets Guide 2007*, WorkCover NSW, to determine what the clearance and other requirements are to commence excavation. Select the safest plant for the job, e.g. toothless buckets and blunt hand tools. Before using mechanical plant to dig, use a cable location service to check the accuracy of plans. Always pothole by hand with non-conductive, blunt hand tools.

Look up and live

If a tip-truck, scaffolding, pump, ladder, crane or metal platform approaches or comes in contact with overhead power lines, the operator and even people nearby, could be electrocuted. Before starting work always look up and identify the location of any overhead power lines. Plan the job to minimise work near and around power lines.

Compare the height of power lines to the maximum height of your equipment, and ensure the full reach of your equipment will not breach the approach distances outlined in the *Work Near Overhead Power Lines Code of Practice 2006*, WorkCover NSW. For "ordinary persons" WorkCover requires an approach distance of at least three metres from overhead power lines (up to 132,000 volts).

Additional clearances are required when working near power lines carrying higher voltages. It's also a good idea to nominate a co-worker to observe and check that you and your equipment do not go into the approach distance zone.

HOW CAN YOU HELP?

Electricity can jump

You don't have to be touching power lines to get an electric shock because electricity can 'jump' – also known as arcing. A safe 'clearance' distance needs to be maintained to prevent electricity from arcing across to you and your equipment.

Five things to remember

01 Check, double check, triple check and reassess – always assess your work site for electrical dangers before you start and stay alert until you've left the site.

02 Look up and live – identify the location of overhead power lines and plan your job away from them.

03 Dial **1100** or visit **www.1100.com.au** before you dig – confirm the location of all underground cables before you begin any excavation work.

04 Before using mechanical plant to dig, check the accuracy of your plans using a cable location service. Pothole by hand using blunt plant items.

05 Always maintain a minimum approach distance from power lines and assign a co-worker as an observer while you operate and move machinery around power lines.

DIAL BEFORE YOU DIG® www.1100.com.au

ELECTRICAL SAFETY

FOR BUILDING AND CONSTRUCTION WORKERS

WORKPLACE FACT SHEET

KNOW THE DANGERS

Employees and contractors in the building and construction industry may run the risk of receiving an electric shock and causing substantial damage to plant and equipment when operating plant near overhead power lines or when excavating. This fact sheet has been developed to help you understand why you may be at risk and what you can do to work safely.

THINGS YOU SHOULD DO BEFORE STARTING WORK

- Complete a risk assessment. This should identify hazards (including work practices and procedures) and help you implement appropriate control measures.
- Find out the location of underground and overhead power lines and their proximity to your work activities and transit routes before commencing digging or other activities by phoning **131 081**.
- Know the location of underground and overhead power lines and their proximity to your work activities and transit routes before commencing digging or other activities.
- Dial **1100** or visit **www.1100.com.au** when planning underground work.
- Visually inspect points of attachment, at both ends, before commencing work as gutters and metal roofs may become "alive" due to deteriorating insulation on electrical wiring.
- Use a safety switch to reduce the risk of shock from portable tools.
- Before commencing work, install eye level visual markers in any area where overhead power lines are identified.
- Carefully monitor weather conditions – power lines can sway in the wind, sag as temperatures increase and are difficult to see at dawn and dusk.
- Ensure operators are aware of the height and reach of their machinery in their travel, stowed and working positions to ensure that minimum approach distances to power lines are maintained. For more information refer to *Work Near Overhead Power Lines Code of Practice 2006*, WorkCover NSW.
- Determine electricity asset safety clearances and whether an isolation needs to occur by referring to *Where to draw the line on safety clearances from electricity assets*, available at www.endeavourenergy.com.au
- Ask the occupant if they have experienced any minor electrical shocks from plumbing or appliances.

Call 131 081 and put safety first.
www.endeavourenergy.com.au

Endeavour Energy

BEFORE YOU DIG

- Apply for Dial Before You Dig plans for each location where you intend to dig.
- Use cable location services and technologies such as Global Positioning Systems (GPS) and Ground Penetrating Radar (GPR) to accurately identify the location of underground utilities.
- Pothole once you reach the applicable approach distance – for more information on approach distances for underground assets refer to *Work Near Underground Assets Guide 2007*, WorkCover NSW.

SAFE WORK HABITS

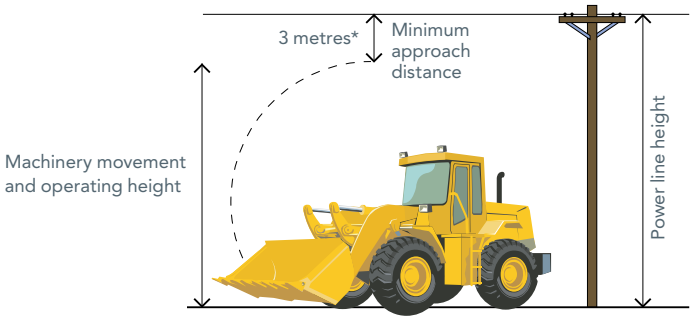
- Look up and locate overhead power lines and maintain at least the minimum approach distance from them.

Minimum safe approach distances when working near power lines

Workers and their equipment should not approach overhead power lines any closer than the following, when machinery is being operated:

Power lines with voltages up to 132,000 volts	e.g. low voltage distribution and subtransmission lines, usually on poles	3 metres
Between 132,000 and 330,000 volts	e.g. subtransmission and transmission lines, usually on either poles or towers	6 metres
More than 330,000 volts	e.g. transmission lines usually on towers	8 metres

The distance that must be assessed prior to work



*Voltages up to 132,000 volts.

- Remember that WorkCover requires a minimum approach distance of at least three metres from overhead power lines (up to 132,000 volts).
- Exercise extreme caution when working near the point of attachment of the electrical service line to the house/building.
- Look for cables and the signs of underground assets whenever digging, such as changes in grass, depressions or mounds and pipe work.
- Look out for electrical arcs. If identified, do not commence work and contact Endeavour Energy immediately on **131 003**.
- To eliminate the possibility of making contact with power lines on a job site, plan and communicate safe traffic paths by providing diagrams of plant and vehicle travel paths away from overhead power lines.
- Assign a spotter to each operator of high machinery and excavators to guide movements near overhead power lines and underground cables and ensure that minimum approach distances are maintained.
- Before every relocation, lower all machinery into the transport position.
- Use proximity sensor technologies on plant while you dig.

PERMIT TO WORK SYSTEMS

Using a permit to work (PTW) system can be an effective way to be sure preventative measures have been taken before any digging commences. It acts as a checklist that can only enable digging work to commence (usually with supervisor sign off) once all preventative actions have been taken *first*.

A typical permit to work checklist should ask/specify the following:

01 Has Dial Before You Dig been undertaken?

02 Have cable location services/technologies been used and their results compared with the DBYD plans?

03 Have the plans been marked up to reflect any new information/changes?

04 Has the safest plant suitable for the job been selected and ordered?

05 Has a spotter been allocated to this job to observe hand, mechanical or powered digging?

06 Is potholing included in the safe work procedure?

07 Has the job been assessed to use non-destructive digging?

08 Have overhead power lines been identified as a risk? If so, has this risk been managed as low as reasonably practicable?

09 Have all persons who may face/are affected by the risk of hitting underground utilities been consulted/made aware of the safe work procedures?

SAFETY EXCELLENCE

IN EMERGENCIES CALL 131 003

24 hours a day, 7 days a week

If you have any questions about what you should do to stay safe please call 131 081 or visit us at www.endeavourenergy.com.au

0611-ENE2352_BC

ELECTRICAL SAFETY

FOR PLUMBERS

WORKPLACE FACT SHEET

KNOW THE DANGERS

Plumbers run the risk of receiving an electric shock when cutting metallic water pipes or replacing water meters. This fact sheet has been developed to help you understand why you may be at risk and what you can do to work safely.

THINGS YOU SHOULD DO BEFORE STARTING WORK

- Complete a risk assessment. This will identify hazards (including work practices and procedures) and help you implement appropriate control measures.
- If appropriate, inform the customer and isolate the electrical supply. Locate the main switch/es and turn them off attaching a "Do not operate" tag. Remember, this may not isolate all stray voltage.
- Know the location of underground or overhead power lines and their proximity to your work site before commencing digging or climbing. Dial **1100** or visit **www.1100.com.au** before you begin any digging work.
- Test water pipes with a self-testing voltage indicator for stray voltage.
- If the earth wire needs to be moved or disconnected, or shows signs of being damaged, or where any existing metallic pipe is to be replaced in part or in it's entirety by plastic pipe or other non-metallic fittings or couplings, the work must not commence until the earthing requirements have been checked by an electrical contractor and modified, if necessary.

Call 131 081 and put safety first.
www.endeavourenergy.com.au

Endeavour Energy

THINGS YOU SHOULD DO BEFORE STARTING WORK

BRIDGE THE GAP, AVOID THE ZAP!

When cutting a water pipe, disconnecting a water heater or water meter it is important to provide an alternate circuit for electrical current to travel. Otherwise, it may travel through you!

5 STEPS TO SAVING YOUR LIFE

01 Test water pipes with an approved testing device to determine if there is any voltage in the pipes. If a voltage reading of 5 volts or above is detected, warn the customer and contact Endeavour Energy immediately as there is a problem with the electrical system.

02 Clean water pipe back to the bare metal on either side of the work area that you intend to cut/work on. This assists the bridging conductor to achieve a good connection.

03 Attach the bridging conductor to the cleaned pipe and secure it firmly ensuring both ends of it will not come loose during work. Do not work outside of the bridging conductor.

04 Complete the job whilst working inside the bridged area.

05 Remove the bridging conductor once all work inside the bridge has been completed including all joining work.

WHEN BRIDGING

- Every time, before using one, visually inspect the bridging conductor for any damage.
- Ensure bridging conductors have a current rating of no less than 70 amps.
- Ensure suitable bridging conductors with insulated screw type clamps are fitted for each end of the electrical bridging conductor.
- Ensure PPE is used, especially insulated electrical gloves (minimum 500 volts). Every time, prior to use, ensure gloves are checked for damage such as holes.
- Do not break or remove the bridge until all work on the bridged area is completed and continuity of the metallic service pipe is restored.
- Remember, the removal of a bridging conductor during work may result in electrocution.

OTHER WAYS TO MAKE YOUR WORKSITE "POWER SAFE"

- Find out about any work areas which may be hazardous for other reasons such as gas, water etc.
- Look for obvious signs of underground services such as conduits, pipes, warning tape, bricks or equipment.
- If required, arrange for the isolation of electricity supply or the application of insulating matting onto service and point of attachment by Endeavour Energy.
- If there are power lines near the worksite, install appropriate signage.

SAFETY EXCELLENCE

IN EMERGENCIES CALL 131 003

24 hours a day, 7 days a week

If you have any questions about what you should do to stay safe please call 131 081 or visit us at www.endeavourenergy.com.au

0611-ENE2352_PL

SAFETY PLAN FOR PLUMBERS

Purpose

This brochure outlines risks, and how to avoid receiving an electric shock from metallic water pipes due to faults within the electricity supply system.

Metallic water pipe systems are used extensively as a means of earthing the electricity supply system, even in properties built after 1976 that are required to have the main earth wire connected to an earthing electrode (rod) driven into the ground.

If an electrical fault occurs then the water pipe can become 'alive' – and therefore dangerous.

Bridge the gap

If there is a fault you may feel a tingle from pipes or taps. Stop work immediately and contact Endeavour Energy.

When cutting water pipes or removing a meter, ensure that you always use a bridging conductor across the cut/break before cutting and keep it in place until the pipe is permanently rejoined. Such work should only be undertaken by qualified people using the appropriate bridging conductor in accordance with AS/NZS 3500.1:2003 Part 5.2, Electrical Safety Precautions and Earthing.

Get a sparky

In circumstance where an earth wire needs to be disconnected from a pipe and/or reconnected to a pipe, an electrical contractor must be contacted to perform the task and ensure the system is safe. Similarly, when replacing part of a copper water system with plastic pipes or non-metallic fittings or couplings, an electrical contractor must be engaged to install an earthing electrode and ensure the system is effectively earthed.

Storm precautions

Lightning can also damage electrical equipment and can conduct through metallic pipes and fittings. To improve plumbing safety when lightning is about, you should cease contact with any metal pipes and fittings.

Check power points

If you plug your equipment into a faulty power point your whole machine could become 'alive'. That's why it is important to use a power point safety tester to check a customer's power point before you use it. For added protection against electric shock from damaged cords or faulty equipment, use a portable safety switch (Residual Current Device).

HOW CAN YOU HELP?

Be aware

When an electrical fault occurs, metallic water pipes can become 'alive' resulting in an electric shock which could be fatal.

The risks increase if you:

- Cut a water pipe
- Remove a water meter
- Disconnect the main earth wire from the water pipe.

Plan the job

01 Find the main switches for the premises and then turn them off. Attach 'Danger Tags'. Be aware this step alone will not guarantee your safety as other faults elsewhere could still make the water pipes 'alive'.

02 If you are replacing all or part of the metallic water system with a plastic pipe, ask a qualified electrician to check the installation to ensure the electricity system is still effectively earthed.

03 Contact an electrical contractor when an earth wire needs to be disconnected or reconnected to a water pipe or when replacing part of a copper water system with plastic pipes or non-metallic fittings or couplings.

04 Test power points and use a safety switch to reduce the risk of shock from your portable tools. Make sure you have your tool and extension leads tested regularly and tagged including bridging conductors.

05 Stop immediately if you feel a tingle or see electrical arcs. Contact Endeavour Energy immediately on **131 003**.

YOUR SAFETY IS OUR PRIORITY

The danger

Under normal operations electricity flows through the active conductor into a premises, whilst the neutral conductor provides the return path for electric current to the substation. If a fault occurs at the customer's or neighbouring premises or in the mains neutral in the street, the electricity may not be able to follow its normal course and flow along metallic water pipes instead. Such faults may remain undetected for prolonged periods of time, especially if nobody has received a shock or noticed a tingling sensation from taps or pipes. Under these conditions the pipe can be energised and cause dangerous shocks if safe work procedures are not applied prior to and during any work on the pipe.

DANGER IN THE PIPELINE

SAFETY EXCELLENCE

IN EMERGENCIES CALL 131 003

24 hours a day, 7 days a week

If you have any questions about what you should do to stay safe around damaged power lines and other electrical infrastructure please call 131 081 or visit us at www.endeavourenergy.com.au

0611-ENE2351-PLMB

51 Huntingwood Drive
Huntingwood NSW 2148
PO Box 6366 Blacktown NSW 2148
T: 131 081 • F: 61 2 9853 6000

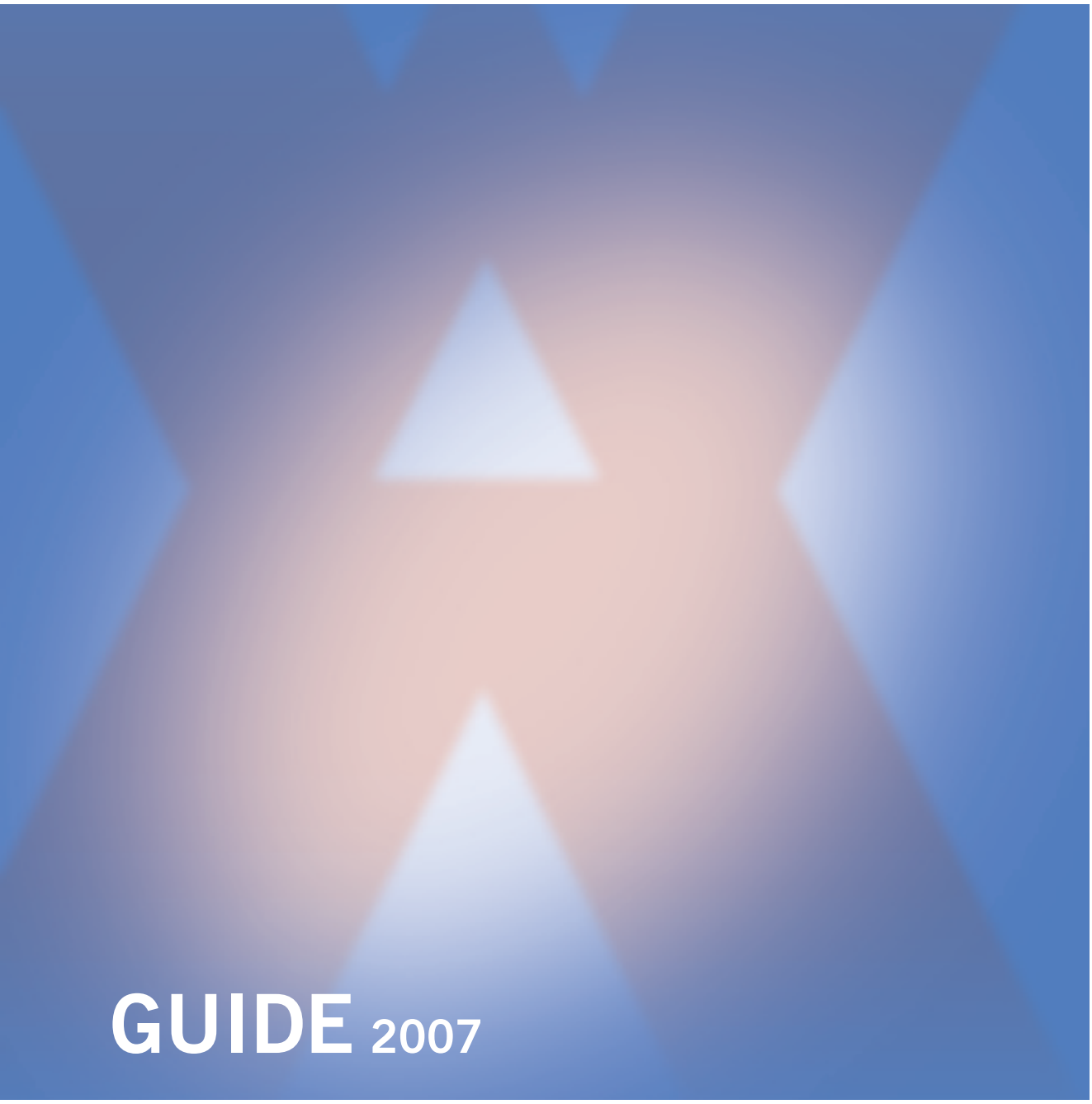
Endeavour Energy

Call 131 003 and put safety first.
www.endeavourenergy.com.au

Endeavour Energy

WorkCover
NEW SOUTH WALES

WORK NEAR
UNDERGROUND ASSETS



GUIDE 2007

making a difference

New South Wales Government

INDUSTRY REFERENCE GROUP
UTILITIES

This is a Utilities Industry Reference Group (IRG) project in partnership with WorkCover and Industry.

The Utilities IRG working party consisted of representatives from the following organisations:

- Alinta
- Australian Workers Union – Technical Administrative Professional Staff Branch
- Civil Contractors Federation
- Department Energy, Utilities and Sustainability
- EnergyAustralia
- Integral Energy
- Local Government Engineer's Association
- Local Government and Shires Association
- Roads and Traffic Authority
- Sydney Water
- Telstra
- WorkCover.

ACKNOWLEDGEMENT

The Working Party wishes to acknowledge that some references in this document are sourced from the WorkSafe Victoria *Guide for Undertaking Work Near Underground Assets,* the Utility Providers *Code of Practice for Western Australia* and the NSW Streets Opening Conference *Guide to Codes and Practices for Streets Opening.*

CONTENTS

PREFACE

This Guideline is for employers, employees, contractors, subcontractors and other parties involved in construction work near underground assets. Note: This Guideline is not designed to impact on mining legislation.

The aim of this Guideline is to assist employers in deciding appropriate measures to eliminate or control risks to workers and other people on construction sites. It provides practical advice on implementing the requirements of the *Occupational Health and Safety Act 2000* (OHS Act) and the *Occupational Health and Safety Regulation 2001* (OHS Regulation).

At times, construction work may be carried out near underground assets on greenfield construction sites as well as on or near public roads and pedestrians. Where construction and maintenance work is carried out on or near public roads, work should be carried out in accordance with the AS 1742 set of Standards – *Manual of uniform traffic control devices.* These Standards are supported by a set of field guides (HB 81) *Field guide for traffic control at works on roads.*

Use this Guideline to assess the effectiveness of your present arrangements for dealing with safety issues associated with working near underground assets, and to check that sources of risk have been identified and dealt with. If you are setting up a new business, this Guideline can serve as your step-by-step guide to establishing a program to manage the hazards arising from work near underground assets.

Work on, near or adjacent to gas and electricity services are deemed to be high risk construction work. Also water and sewerage assets may be deemed to be high risk construction work.

What do the symbols in the Guideline mean?

To help you work out what you require, a number of symbols are used to highlight things you need to take into account and tools to help you undertake the activity.

Assess the risks in your workplace

Processes of finding things that cause harm, work out how serious the problems are and then to fix them

Legal obligations that must be followed

The process of finding things that cause harm, working out how big a problem they are and fixing them

1. ESTABLISHMENT

1.1 TITLE

This is the Work Near Underground Assets Guideline.

1.2 PURPOSE

This Guideline provides practical guidance to prevent injury to people and damage to underground assets.

1.3 SCOPE

This Guideline informs asset owners, contractors, employers, workers and industry as to their obligations to:

- accurately install and record the location of the asset
- operate and maintain utility assets
- foster co-operation between underground utility owners and industry so as to eliminate or control the risk to individuals and the community, as well as damage to underground assets
- manage the risks involving underground assets at a workplace
- provide safe systems of work for individuals dealing with works near underground assets
- encourage the use of agreed practices for such work
- carry out JSA/Risk assessment and develop safe work method statements prior to commencing high risk construction work.

Note: This Guideline relates to underground utility assets on public land, within easements and on private property. While the principles may be similar, this Guideline does not specifically relate to underground assets on private property.

1.3.1 Encouraging compliance

All worksite controllers within NSW have a duty of care to persons within their worksite or those who may be affected by actions or omissions arising from their work activities.

The adoption of this Guideline when dealing with underground assets should help ensure that this duty of care is met.

All persons working near underground assets are encouraged to adopt this Guideline.

All asset owners must promote and encourage the adoption of this Guideline, not only within their own workplaces but to sub-contractors and all persons performing work near underground assets.

1.4 COMMENCEMENT

This Guideline takes effect on 05/07.

1.5 INTERPRETATION

1.5.1 Recommended practices

Words such as 'should' indicate recommended courses of action. 'Consider' indicates a possible course of action that the Guideline is indicating the duty holder should think about. However, you may choose an alternative method of achieving a safe system of work.

1.5.2 Legal requirements

Words such as 'must', 'requires' or 'mandatory' indicate that legal requirements exist which must be complied with.

1.6 DEFINITIONS

access authority — a written authorisation, issued by an asset owner, which allows persons to work within a specified proximity of the asset.

accredited person — a person who has successfully completed a recognised training course relating to the specific job, the training having been conducted by a registered or accredited training organisation.

approach distance — the minimum separation in air from an exposed conductor that shall be maintained by a person, or any object held by or in contact with that person.

approved — having appropriate endorsement in writing for a specific activity.

asset owner — the owner, controller or operator of an underground asset. For the purpose of this Guideline an underground asset includes electrical, water, sewage and drainage, gas, telecommunications, petrochemicals and hazardous substances.

authorised person — a person with technical knowledge or sufficient experience who has been approved, or has the delegated authority to act on behalf of the organisation, to perform the duty concerned.

cable — an insulated conductor or two or more such conductors laid together, whether with or without fillings, reinforcements or protective coverings.

competent person — a person who has acquired through training, qualification or experience, or a combination of them, the knowledge and skills to carry out the task.

confined space — confined space as defined in Australian Standard AS 2865 *Safe working in a confined space.*

construction work — means any of the following:

- excavation, including the excavation or filling of trenches, ditches, shafts, wells, tunnels and pier holes, and the use of caissons and cofferdams
- building, construction (including the manufacturing of prefabricated elements of a building at the place of work concerned), alteration, renovation, repair, maintenance and demolition of all types of buildings
- civil engineering, including the construction, structural alteration, repair, maintenance and demolition of – for example, airports, docks, harbours, inland waterways, dams, rivers, avalanche and sea defence works, roads and highways, railways, bridges and tunnels, viaducts – and works related to the provision of services such as communications, drainage, sewerage, water and energy supplies.

consumer services	the supply to individual houses or premises, as opposed to "mains" which form part of the utility's distribution system.
– water	the cold water supply pipework from the water main up to and including the outlet valves at fixtures and appliances. The water service is owned by the consumer.
– electricity	consumer services means the conductors from the supply authorities' distribution mains (overhead or underground) to the customers' premises.
– gas	the pipe used to supply gas to the property, which runs from the distribution main to the meter position.
	the Network Operator, also known as the Asset Owner, owns the section of the pipe between the distribution main and the property. The property owner owns the section of pipe between the property line and the meter.
– telecommunications	the conduit and cabling controlled by the Carrier from the Network Point of Presence to the Network Boundary Point (NBP). Cabling beyond the NBP is customer owned cabling.
contaminated ground	a contaminated site that poses a significant risk of harm to human health or the environment and is regulated by the EPA (NSW) under *Contaminated Land Management Act 1997.* Refer to http://www.epa.nsw.gov.au/clm/searchregister.aspx
control measures	measures taken to minimise a risk to the lowest level reasonably practicable.
crane	an appliance intended for raising or lowering a load and moving it horizontally. Includes the supporting structure of the crane and its foundations, but does not include industrial lift trucks, earth moving machinery, amusement devices, tractors, industrial robots, conveyors, building maintenance equipment, suspended scaffolds or lifts.
earthed	direct electrical connection to the general mass of earth so as to ensure and maintain the effective dissipation of electrical energy.
earth moving machinery	an operator controlled item of plant used to excavate, load or transport, compact or spread earth, overburden, rubble, spoil, aggregate or similar material, but does not include a tractor or industrial lift truck.
electrical apparatus	any electrical equipment, including overhead power lines and underground cables, the conductors of which are live or can be made live.
electricity network	transmission and distribution systems consisting of electrical apparatus which are used to convey or control the conveyance of electricity between generators' points of connection and customers' points of connection.
emergency work	work to rectify or prevent imminent danger to human life or physical injury.
	work to rectify or prevent imminent or continuing damage to, or destruction of, property or the environment.
	work to rectify or prevent an unscheduled outage which has or is likely to have a significant impact on the Distribution Network or the Carrier's network.
employee	an individual who works under a contract of employment or apprenticeship.
employer	a person who employs persons under contracts of employment or apprenticeship.
energised	connected to any source of energy.

excavating	the movement or placement of soil or other surface materials by removing, boring or forcing objects into the ground or surface of the earth.
exposed conductor	an electrical conductor, approach to which is not prevented by a barrier of rigid material or by insulation that is adequate under a relevant Australian Standard specification for the voltage concerned.
extra high voltage (EHV)	in NSW, means a transmission system cable with a nominal voltage of 132,000V a.c. (132kV) or above.
hazard	anything (including work practices and procedures) that has the potential to harm the health and safety of a person.
high pressure gas (HP)	210kPa – 1050kPa. **Note:** Transmission Pressure gas is equal to or greater than 1050kPa.
high-risk construction work	means any of the following construction work: • involving structural alterations that require temporary support • at a height above 3 metres • involving excavation to a depth greater than 1.5 metres • demolition work for which a licence is not required • in tunnels • involving the use of explosives • near traffic or mobile plant • in or around gas or electrical installations • over or adjacent to water where there is a risk of drowning.
high voltage (HV)	a nominal voltage exceeding 1000V a.c. or exceeding 1500V d.c.
insulated	separated from adjoining conducting material by a non-conducting substance which provides resistance to the passage of current, or to disruptive discharges through or over the surface of the substance at the operating voltage, and to mitigate the danger of shock or injurious leakage of current.
instructed person	a person adequately advised or supervised by an Authorised Person to enable them to avoid the dangers which electricity may create.
isolated	disconnected from all possible sources of energy by means that prevent unintentional energisation of the apparatus.
lancing	using water or air aided by vacuum extraction to achieve non-destructive excavation.
live	energised.
low pressure gas (LP)	pressure less than or equal to 7kPa.
low voltage (LV)	a nominal voltage exceeding 50V a.c. or 120V d.c. but not exceeding 1000V a.c. or 1500V d.c.
mains	part of the utility's distribution system as opposed to "services" which are the take-offs for individual properties.
– water/sewerage	a conduit or pipeline controlled and maintained by a network utility operator or water authority.
– electricity	aerial or underground wires or cables from 400/230V to 330kV a.c
– gas	a pipe installed in a street to convey gas to individual services.
– telecommunications	any facility owned by the carrier – typical underground plant consists of conduits, cables, pits and manholes linking exchanges, or exchanges to distribution points.

medium pressure gas (MP)	pressures greater than 7kPa and up to 210kPa.
mobile plant	includes plant that: • moves either under its own power or is pulled or pushed by other mobile plant • moves on or around the worksite, enters or leaves the site, or moves past the site • includes road vehicles operating at a worksite. **Note:** This definition has been adopted for the purposes of this Guideline. This includes items such as earthmoving machinery, concrete boom pumps and tipper trucks operating at a worksite.
network operator	also known as the asset owner.
nominal voltage (U)	the a.c. or d.c. voltage by which a system of supply is designated.
OHS act	the Occupational Health and Safety Act 2000.
OHS regulation	the Occupational Health and Safety Regulation 2001.
overhead power line	any bare or covered aerial conductors and other associated electrical parts that make up an aerial line for the distribution and transmission of electrical energy.
other cable systems	telecommunications cables, optic fibre cables, control cables, earth cables or electrolysis drainage cables.
personal protective equipment (PPE)	items that workers can use to protect themselves against hazards. PPE includes insulating gloves, mats or sheeting, glasses and face protection. **Note:** A number of items of PPE are made and tested to Australian Standards. PPE that is not designated as meeting a recognised Standard may be unreliable in service, as its performance is unknown.
place of work	premises where people work.
plant	any machinery, equipment or appliance. **Note:** For the purposes of this Guideline the definition includes a broad range of machinery and equipment, but not limited to, cranes, mobile plant, scaffolding, load shifting equipment, industrial lift trucks, earth moving machinery, amusement devices, tractors, rural machinery, vehicles, conveyors, building maintenance equipment, suspended scaffolds or lifts, implements or tools and any component or fitting of those things.
polymeric	made from polymers otherwise known as plastics.
pot-holing	excavating with hand tools to a pre-determined depth to establish if assets exist in the immediate location.
premises	includes any place, and particularly includes: • any land, building or part of a building • any vehicle, vessel or aircraft • any installation on land, on the bed of any waters or floating on any waters • any tent or movable structure.
permit conditions	permission conditions stipulated by asset owner.
pressurised	a constrained flow of a substance in a pipeline which may be of varying diameters and thicknesses, the flow of which may or may not be directly controlled by an asset owner.
procedure	the documentation of a systematic series of actions (or activities) directed to achieve a desired result.

property line	the boundary line between the road reserve and the adjacent property.
railway assets	electrical, signalling and communications infrastructure owned and maintained by the rail entity. Assets also included but are not limited to, drainage lines and compressed air line.
safety observer	a competent person who has been specifically assigned the duty of observing and warning against unsafe approach to the asset.
supervisor	a representative of the principal for a worksite, who has the delegated responsibility for a task or range of tasks being undertaken at the worksite.
underground assets	part of an underground network such as water/drainage/sewerage, electricity, gas or communications etc.
underground services	the supply to individual houses or premises as opposed to underground assets which form part of the utility's distribution system.
works planned or programmed	any work which has followed the normal planning process prior to work commencing ie where the worksite has been physically inspected and assessed in advance of the work crew arriving on site.

2. PLANNING AND PREPARATION

The OHS Act and the OHS Regulation require employers to address workplace health and safety through a process of risk management and consultation.

Under the OHS Act and the OHS Regulation, employers have an obligation to ensure the health, safety and welfare of employees at work and that other people are not exposed to risks to their health and safety. When contracting out work, employers must ensure that contractors are planning and carrying out work in a safe manner. The work should be conducted according to this Guideline.

To effectively implement this Guideline, employers need to be aware of these requirements and have procedures in place to apply them. Employees, self-employed persons, subcontractors and controllers of premises, plant and substances also have responsibilities under OHS legislation. Each individual should ensure that they work safely and that their work does not expose others to health and safety risks.

The way to systematically plan and manage health and safety in the workplace is to build risk management and consultation into all those activities that may have OHS implications. This will involve activities such as purchasing, work methods or procedures, using contractors, reporting OHS problems, investigating incidents and planning emergency procedures.

2.1 UNDERSTANDING RESPONSIBILITIES

2.1.1 Clients

The client's responsibilities under the OHS Act and OHS Regulation will depend on their role in the design and construction. They are usually a "controller of premises" at least to some extent and may also have other roles such as designer, principal contractor or an employer in relation to the project.

The client is also in the best position to influence others to consider that constructability and maintainability are included in the design and thus to reduce construction and ongoing maintenance risks at the design stage. Setting realistic timeframes for tendering, planning and project execution can also assist planning and execution of construction work.

However, the client is not always aware of all the complexities, such as the range of construction techniques, ground conditions and their effect on safety. It is therefore often appropriate for consultation between the client and other parties at an early stage to take advantage of the opportunity to identify the best concept design.

2.1.2 Controllers of work premises, plant or substances

Controllers of work premises, plant or substances also have health and safety legal responsibilities. They must make sure that the premises used as a place of work are safe and without risks to health and that the plant and substances used in the work process are safe and without risks to health when properly used. For persons who have only limited control of the premises, plant or substances, their responsibilities apply only to the matters over which they have control.

Designers should ensure that:

- to the extent that they have control over the design work, the structure (or plant) can be safely constructed, used, repaired, cleaned, maintained, and demolished, such that the health and safety of any person is not put at risk by the design
- information is provided to the client about the health and safety aspects of the design.

Designers should also ensure that, as far as practicable, hazards associated with the following are identified before commencement of the construction work:

- the design of the structure (whether permanent or temporary)
- systems of work required to construct, repair and maintain the structure
- the intended use of the structure
- materials required to be used in the construction of the structure
- the demolition (or abandonment) of the structure.

Note: In relation to the design of plant, the OHS Regulation contains more detailed risk control requirements on designers, manufacturers and suppliers.

Where there is more than one designer, critical aspects of the project should be documented and liaison should occur between the principal contractor and relevant designers so that the work can be coordinated to ensure the safe interaction of the different design aspects. When risks remain in the design work, information should be included with the design to alert others to the risks.

2.1.3 Principal contractors

The principal contractor, whether as an employer or as the person in control of the workplace, must provide and maintain in relation to those matters over which he or she has control, a workplace that is safe and without risks to health for their employees and other persons present at the workplace or affected by the work. To fulfil these obligations the principal contractor must plan for the work to be done safely.

The principal contractor must ensure that a site specific OHS management plan is prepared and documented for each place of work where construction work is to be carried out, before the work commences. This plan must be developed in consultation with the contractor/s and their employees or representatives. The plan must include safe work method statements (SWMS), provided by the contractors where they are used, for all work activities assessed as having risks. It must also include the following details:

- arrangements for OHS induction training
- arrangements for managing OHS incidents including response persons
- site safety rules and arrangements for informing persons affected
- details where persons have specific site OHS responsibilities.

The health and safety management plan must be monitored to ensure that work is carried out safely, according to that plan and that the plan is effective. The plan must be maintained and up to date during the course of the construction work and must be made available for inspection. The principal contractor must stop work immediately, or as soon as it is safe to do so, where there is a risk to the health or safety of a person.

2.1.4 Contractors

The contractor(s) doing the work, whether the principal contractor themselves or sub-contractors, must provide and maintain a workplace that is safe and without risks to health for their employees in relation to those matters over which they have control.

In addition to consultation with the principal contractor in the overall job planning, the contractor must develop written SWMS including an assessment of the risks and the controls used to carry out the work safely.

2.1.5 Employees

Employees must take reasonable care of the health and safety of themselves and others. Employees must cooperate with employers in their efforts to comply with OHS requirements. This means that employees must notify their employer of safety and security hazards, risks and incidents in line with the requirements of the OHS Act. These requirements should be outlined by the employer's OHS policy, procedures and safety related instructions.

Employees must not be required to pay for anything done or provided to meet specific requirements made under the OHS Act or OHS Regulation.

2.1.6 Self-employed persons

Self-employed persons must ensure that their undertakings do not expose others to health or safety risks.

2.2 COORDINATION OF RESPONSIBILITIES

There may be a number of parties involved in a project, such as:

- the client
- the principal contractor
- controllers of premises, plant or substances
- designers
- employers (contractor or subcontractors) who employ persons at the site, including labour hire agencies providing persons to the site
- self-employed persons
- suppliers of plant, materials or prefabricated components.

Where more than one party has responsibilities at a specific workplace, each party retains their legal responsibilities and must discharge their responsibilities in a coordinated manner.

3. CONSULTATION AND RISK MANAGEMENT

The OHS Act and the OHS Regulation require employers to address workplace health and safety through a process of risk management and consultation.

To effectively implement this Guideline, employers need to be aware of these requirements and have procedures in place to apply them.

Employers are advised to consult the OHS Act and the OHS Regulation as well as the *Code of Practice: Occupational Health and Safety Consultation* and the *Code of Practice: Risk Assessment* for details of these requirements and how they can be met. The following information is designed to provide an overview of legislative requirements.

3.1 CONSULTATION AT THE WORKPLACE

Employers must consult with employees when taking steps to assess and control workplace risks.

In order to consult with employees, employers are required to set up consultation arrangements and develop consultation procedures.

3.1.1 Consultation arrangements

The OHS Act provides three options for consultation arrangements:

Arrangement	Workplace	Requirement
OHS Committee	20 or more employees	requested by a majority of employees or direction by WorkCover
OHS Representative	any size	at least one employee requests an election or directed by WorkCover
Other agreed arrangements	any size	agreed to by both the employer and employees (in a small workplace it may be a regular safety meeting with employees)

Before using this Guideline, an employer should ensure that consultation arrangements are in place. An employer may initiate the establishment of an OHS Committee or the election of an OHS Representative if the employees have not made such a request. When the consultation arrangements have been decided, clause 27 of the OHS Regulation requires employers to record them and advise all existing and new employees.

3.1.2 Consultation procedures

After setting up the consultation arrangements employers need to consider when and how these consultation arrangements need to be applied.

3.1.3 When should consultation be undertaken?

Under section 13 of the OHS Act, employers have the general duty to consult employees when decisions are being considered that may affect their employees' health and safety. Therefore, employers are required to consult with their OHS Committee, OHS Representative or other agreed arrangement when such decisions are being considered. Decisions which could affect health and safety include:

- planning for new premises or modifying existing premises
- purchasing new plant, equipment or substances
- planning, designing or changing work tasks or jobs
- using contractors in the workplace
- investigating incidents or accidents
- developing emergency procedures
- determining or reviewing workplace amenities
- determining or reviewing consultation arrangements.

Note: Any procedures that are developed to encompass these activities should incorporate consultation.

It may not be practical or reasonable to involve the OHS Committee or the OHS Representative in every purchase decision or task change. However, the employers and committee or representative should agree on what process is needed to ensure that affected employees are consulted.

3.1.4 How should consultation be undertaken?

When engaged in consultation, the OHS Act requires employers to:

- **share all relevant information with employees.** For example, if an employer is going to change a work task, employees need to be told of any risk to health and safety that may arise and what will be done to eliminate or control these risks.
- **give employees reasonable time to express their views.** Employees need adequate time to assess the information given to them, obtain relevant safety information and consult with fellow employees to enable them to form their views.
- **value the views of employees and take them into account when the decision is made to resolve the matter.** In many cases, agreement will be reached on how the safety issues are to be addressed. When agreement cannot be reached, the employer should explain how the employees' concerns have been addressed.

3.2 RISK MANAGEMENT AT THE WORKPLACE

Employers and self-employed persons must identify any foreseeable hazards, assess their risks and take action to eliminate or control them.

When addressing health and safety issues, besides consulting employees, employers must adopt the process of risk management. This process requires employers to:

3.2.1 Identify hazards

To ensure a safe and healthy workplace, employers must identify all the foreseeable health and safety hazards, which could harm their employees or other persons in the workplace. Hazards may arise from the work process, the equipment and materials in use, the work environment, or other people involved.

3.2.2 Assess risks

Once hazards have been identified the risk they pose to health and safety needs to be assessed. Some hazards pose a greater risk than others do, and the frequency and duration of exposure can also affect the risk. Risk assessment involves considering the likelihood and severity of injury or illness being caused by exposure to the risk. Therefore the factors that need to be considered in a risk assessment should include the:

- harm that can be caused by exposure to the hazard
- number of people and the duration and frequency of exposure to the hazard
- capability, skill and experience of people exposed to the hazard.

The risk assessment process provides information on the factors which contribute to the risk. This information will assist in determining what needs to be done to eliminate or control the hazard.

3.2.3 Eliminate or control the risk

The first responsibility is to investigate how the risk can be eliminated. Before implementing the control measures described in this Guideline, an employer should investigate possible strategies for eliminating the hazard from the work system.

If it is not reasonably practicable to do so, the risks associated with the hazard must then be controlled. This Guideline has been developed to provide advice on the most effective control measures.

3.2.4 Review risk assessment and control measures

Control measures should be reviewed on a regular basis. The frequency of their review should be determined by considering the significance of the risks associated with the hazard. However, a review should be undertaken in the following circumstances:

- new information is made available about the risks associated with the hazard
- an accident or incident occurs
- significant changes are proposed to the workplace or work system.

3.2.5 When must employers undertake risk management?

The OHS Regulation requires employers to incorporate the process of risk management into procedures.

These are the same activities for which employers are required to consult with employees.

3.2.6 Strategies for developing effective risk management procedures

When risk management activities are undertaken the following strategies should be considered to inform the process:

- visual checks through workplace inspections
- analysing the types of work being performed and the way work is performed
- inspections of plant and equipment
- analysing workplace records on accidents, incidents or 'near misses'
- risk management information provided by suppliers or manufacturers of equipment or, in the case of hazardous substances, Material Safety Data Sheets (MSDS)
- industry codes of practice for particular hazards or work processes
- Australian Standards, which set safety standards for a range of equipment products and materials
- guidance material from WorkCover NSW or industry or professional organisations.

Further advice is provided in the *Code of Practice: Risk Assessment.*

3.2.7 Personal protective equipment (PPE)

The use of PPE to control risks is lowest on the hierarchy of control measures. The measures at the lower levels are less effective and they require more frequent reviews of the hazards and systems of work. They should only be used when other control measures are impracticable or when, after implementing other controls, a residual risk remains.

- *PPE selection and suitability*

  Where PPE is to be used it should be appropriate for the risk and comply with the relevant Australian Standard or WorkCover approval. Employees should be competent in the proper selection, use and maintenance of the PPE. There should be sufficient supervision and monitoring conducted to ensure PPE is used and employees are competent in its use. PPE should be regularly inspected, maintained and replaced as necessary.

- *Eye protection*

  Dust, flying objects and sunlight are the most common sources of eye damage in excavation work.

  Where persons are carrying out cutting, grinding or chipping of concrete or metal, or welding they must be provided with eye protection complying with AS/NZS 1337:1992 – *Eye protectors for industrial applications.* Eye protection complying with AS/NZS 1337 should also be provided where persons carry out other work, such as carpentry or handling of chemicals, where there is a risk of eye injury. Selection, use and management systems should comply with AS/NZS 1336:1997 – *Recommended practices for occupational eye protection.*

- *Hearing protection*

  Where personal hearing protection is provided it should conform with AS 1270:1988 – *Acoustics – Hearing protectors.* Control measures including training should comply with AS/NZS 1269.3:1998 – *Occupational noise management – Hearing protector program.*

- *High visibility garments/safety reflective vests*

  Persons working underground or near traffic, mobile plant or equipment under operator control, should be provided with and use high visibility garments. Such garments should be selected, used and maintained in accordance with AS/NZS 4602:1999 – *High Visibility Safety Garments.* Other clothing not covered by the high visibility garment should be light coloured and all garments should be selected for best contrast with the surrounding background.

- *Safety helmets*

  The use of safety helmets may prevent or lessen a head injury from falling objects or a person hitting their head against something. Where there is a likelihood of persons being injured by falling objects and overhead protection is not provided, persons must be provided with and must use an appropriate safety helmet. Appropriate safety helmets should also be provided and used where a person may strike their head against a fixed or protruding object or where there is a risk of accidental head contact with electrical hazards.

  All persons on excavation sites should wear head protection that conforms to AS/NZS 1801:1997 – *Occupational protective helmets* and be used in accordance with AS/NZS 1800:1998 – *Occupational protective helmets – Selection, care and use.*

- *Safety gloves*

  Where there is a risk of hand injury, such as exposure to a harmful substance, excessive heat or cold, or to a mechanical device, hand protection appropriate to the risk and that complies with AS/NZS 2161:1998 – *Occupational protective gloves* should be provided and used.

- *Waterproof clothing*

  Waterproof clothing provided as a system of work relating to weather or site conditions should be effective and suitable for the task. Waterproof clothing should also incorporate light reflective features in accordance with the requirements of the section above.

3.2.8 Incident reporting

Hazards and OHS problems should be reported as soon as they are noticed so that the risks can be assessed and addressed as quickly as possible. Records of reported hazards should be kept and should include details of the action taken to remove the hazard or control the risk arising from the hazard.

The OHS Regulation also prescribes a number of workers compensation and OHS legal requirements concerning incident and injury reporting.

3.2.9 First aid

The OHS Regulation requires that employers must provide first aid facilities that are adequate for the immediate treatment of injuries and illnesses that may arise at the place of work and, if more than 25 people are employed, trained first aid personnel.

To ensure adequate first aid provisions, employers must identify their potential problems, assess their requirements and consult with employees in the process.

When determining the nature, number and location of first aid facilities and the number of trained first aid personnel, employers must take into account the location and type of work being undertaken. The type of work performed will influence the hazards and the possible harmful consequences for employees. For example, office workers will have different first aid requirements from construction workers. Workplaces using hazardous substances may require specialised first aid facilities, such as eyewash stations and emergency showers. The risk assessment process will assist in identifying the particular needs of the workplace.

Further information regarding such matters as contents of first aid kits, who qualifies as 'trained first aid personnel', and other requirements relating to first aid rooms, consult the OHS Regulation or the *First Aid in the Workplace Guide.*

3.2.10 Emergency response

The OHS Regulation specifies that an employer must ensure that, in the event of an emergency at the workplace, arrangements have been made for:

- the safe and rapid evacuation of persons from the place of work
- emergency communications
- appropriate medical treatment of injured persons
- appointment of appropriately trained persons to oversee any such evacuation and, if appropriate, the use of on-site fire fighting equipment.

3.2.11 Record keeping

The OHS Regulation requires records to be kept in the following areas:

- induction training
- hazardous substances
- confined spaces
- plant
- electricity
- asbestos
- atmospheric monitoring
- notification of accidents.

Refer to the relevant chapters of the OHS Regulation for further information.

DON'T RISK IT

www.dialbeforeyoudig.com.au

DIAL 1100
BEFORE YOU DIG

- Dial Before You Dig is a free referral service for receiving information on underground pipes and cables before you start work.
- All major utilities are members including Energy Australia, Integral Energy, Telstra, Optus, Alinta and Sydney Water.
- Digging without maps means exposing yourself and your contractors to danger.
- Unexpected cable strikes can slow your job down.
- Damage to underground utilities can affect your insurance.

Visit www.dialbeforeyoudig.com.au any time

Dial 1100 between 8am and 5pm on working days

Fax 1300 652 077 anytime

THIS IS A FREE SERVICE

4. ACCURATE INSTALLATION AND INFORMATION

4.1 INTRODUCTION

Asset owners are required to capture and maintain accurate and up-to-date (as built) records of their underground assets.

When planning a job requiring excavation, a complete record search must be undertaken by lodging an enquiry with the central call service 'Dial Before You Dig'. Asset owners who are not members of this service must also be contacted. When an asset location is requested, asset owners may provide information on the recommended practices for work near that location or asset.

Lodging an enquiry with 'Dial Before You Dig' is as simple as visiting www.dialbeforeyoudig.com.au, phoning 1100 or faxing an enquiry to 1300 652 077. Once the records are obtained, they should remain in the work area and be accessible to all. When carrying out emergency work, every effort should be made to obtain records as soon as possible. If work must commence prior to the records being obtained, it should be carried out on the basis that underground assets are present even if an Electronic Service Detector gives the 'all clear'.

It should be also remembered that as technologies and work practices change over time, features such as the presence of warning tape may not be where you expect (see Table A). For example, the majority of telecommunication assets at joint locations are now housed in pits or manholes. However, the line between these may not be straight if obstructions were encountered during installation. Direct buried cable in rural areas may be identified by pits/manholes and marker posts. However, it cannot be assumed that a cable follows a direct path between these items.

WARNING: Asset owners' plans may not show the presence of all cables, pipes and plant. They may only show their position relative to road boundaries, property fences etc at the time of installation and the asset owners do not guarantee that such plans are accurate thereafter due to changes that may occur over time.

Do not assume depth or alignment of cables as these vary significantly. For example, road and building alignments and levels may change.

4.2 ENSURING ACCURACY OF PLANS AND RECORDS

Asset owners shall have a system of work which ensures the accuracy of plans. The system of work should be included in the asset owners' audit processes.

Improving the accuracy of existing asset plans relies on cooperation between asset owners and contractors. If during work activities, underground assets are found to be not on the plans or are in a different location, contact should be made with the source of the plans to notify of the missing information.

4.3 UNDERGROUND ASSET OWNERS INCLUDE:

- electricity generation, transmission and distribution
- rail
- Roads and Traffic Authority
- local authorities
- telecommunications
- private (eg privately owned water pipelines)
- gas transmission and distribution
- petrochemical (oil, petrol, LPG etc)
- oil
- water
- drainage
- sewerage.

(See Table A).

4.4 ELECTRICITY CABLES

4.4.1 Cable records

Cable records are in the form of plans drawn to scale or on computer based Geographic Information Systems (GIS).

The detail of the records will vary with the type of installation. For cable installed in a standard allocation, the records may provide only general cross sectional arrangements of cable and conduits together with road crossing and street lighting information.

It is common practice to negotiate a special alignment on the roadway for high voltage transmission cables. For this type of installation, the records are more detailed with reduced level and offset information provided. The details of local area distribution and of transmission cables are typically shown on separate plans.

Older installations may not be accurately recorded or reference details may have changed.

4.4.2 Cable installation

The cover for underground electricity cables and underground control cables may vary in depth. Always assume a cable may be present. See Table B.

Note: Underground electrical cables are not necessarily covered with slabs, marker tapes or other indicators of their presence and are frequently not enclosed in conduits. Some underground electrical cables may have been encased in bitumen. Hence a full risk assessment must be undertaken prior to carrying out any excavation work so as to accurately establish the exact locations of underground electrical cables.

4.4.3 Cable ancillary equipment

Associated with many cable installations are ancillary assets and pits. These may include cable joint pits, cable link pits, oil or gas pits, inspection pits and other ancillary pits. These pits will have cables or pipes that connect them to the main cables and care should be exercised when excavating between the cables and the ancillary pits. The presence of ancillary pits shall be confirmed with the electricity asset owner prior to any work.

4.5 GAS PIPES

4.5.1 Gas reticulation systems

Several methods of gas reticulation are used, from low-pressure services through to transmission systems. These systems have been constructed from materials including coated welded steel, cast iron, and a variety of plastics. In most areas, the systems are buried directly in a suitable stone-free backfill. The systems are not designed to resist the impact of tools or mechanical plant or to be left unsupported over any great distance. The operating pressures range from as low as 2kPa up to as high as 15MPa for a transmission pipeline system.

4.5.2 Pipe records

The records for all high and low pressure gas distribution mains are maintained in the form of plans drawn using Computer Aided Design system (CAD). The detail of the records will show the size of pipe and the type of material, changes in direction. Please note gas consumer services are generally not shown on plans. High-pressure transmission pipelines are generally located within a pipeline easement, therefore records of these pipelines are in the form of alignment sheets specific to the individual pipeline.

The location of high and low-pressure distribution mains on the plans are shown at a nominal distance from the building line. The actual pipe alignment will be shown in text as an offset distance in metres from the Building Line (MBL) – also could be known as the ‘property boundary’. When locating gas distribution pipes always reference the offset distance from the building line as minor changes in alignment will not be shown graphically.

4.5.3 Pipe installation

Most pipes laid in recent years may have a marking tape or polymeric plastic slab laid above the pipes for identification when excavating. However, these tapes or slabs may have been damaged by other excavations in the area since the initial construction and not replaced. For location purposes, plastic pipe may have been laid with a trace wire to enable the main to be located using a cable locator. Again, it is important these tracer wires are not interfered with or broken, as it makes future location of these pipes very difficult. If you do break the trace wire, please ensure that the wire is rejoined and coated with electrical tape. Steel mains and pipelines will not have a trace wire as they are metallic and can be detected. Other structures, such as siphon points, valve pits, regulator pits and other varied components may be installed in the pipeline. Care needs to be taken to locate these before excavation.

While the plans may show the expected location of underground distribution mains, consumer services are not shown. Properties should be checked to ascertain whether gas meters are present. If so, the services normally run at right angles to the distribution main to the service connection at the meter. However, it cannot be assumed that a pipe follows a direct path between these items. Be aware the consumer service may receive its supply from a distribution main on the opposite side of the road. The installed depth of consumer services varies – refer to Table B. In circumstances where the correct depth of cover has not been achievable, mains and services may be encased in concrete or laid in copper pipe.

All high-pressure steel distribution mains and transmission pipelines have corrosion protection systems. These systems form part of the pipeline and incorporate the protective coating, test points and galvanic anodes at various points along its length. If these are broken or damaged, it should be reported to the gas utility immediately. They are easily rectified but can be extremely difficult to locate if the damage is not reported.

4.6 WATER AND SEWER PIPES

4.6.1 Pipeline types

Cast iron and steel pipes are often joined with lead. These and asbestos pipes are easily disturbed and brittle. Mild steel and ductile cast iron pipes have external protective coatings which, when damaged, significantly reduce the life of the pipes. Copper pipes are very soft and easily compressed or bent without necessarily breaking, but their flow capacity can be significantly reduced. Recycled water areas have dual pipe and service systems.

The water supply system in residential areas has traditionally formed part of the multiple earth neutral (MEN) system of the electricity distribution network. More recent use of PVC and polypropylene materials may adversely impact the MEN system. Refer to Section 5 for more information.

4.6.2 Depth and location

Water authorities, developers and local councils maintain records of pipeline locations.

As with other assets, there can be great variations in pipeline depths, depending on their age and the amount of surface reconstruction over the years. More recently, some water assets have been co-located with other assets in shared trenches. This raises the potential problem of simultaneous damage to several assets.

Some pipes may be encased in concrete to provide added support and protection.

4.7 TELECOMMUNICATION CABLES

Telecommunications cables developed for underground installations have changed in line with technology requirements.

Plans provided by Telstra are circuit diagrams only and indicate the presence of telecommunications plant in the general vicinity of the area shown. Due to the nature of the Telstra plant and the age of some cables and records, it is impossible to ascertain the location of all Telstra plant from plans. Telecommunications plant seldom follow straight lines and careful on site investigation is essential to uncover and reveal its exact position.

4.8 ABANDONED AND RETIRED UNDERGROUND ASSETS LEFT IN-SITU

In cases where assets are no longer to be utilised and are to be left in-situ, they are to be disconnected and/or filled, capped, plugged or otherwise rendered safe to avoid any future problems.

All such assets shall be consistent with the following points:

- treated as in-service unless otherwise positively proven out of service
- marked accordingly on the appropriate asset record
- if out of service retired or abandoned assets etc are to be interfered with, the owner of the asset should be contacted and arrangements made to locate the asset
- an asset shall not be used by others without prior agreement with the asset owner. This is so that both organisations' records can be updated
- where an asset is inserted inside an out of service, retired or abandoned conduit, pipe or duct, the records shall show this information
- if assets are sold or disposed of to another owner, then both organisations records should show such information.

4.9 TABLE A: THE INSTALLATION OF VARIOUS TYPES OF UNDERGROUND ASSETS

Assets have been installed underground over the last 150 years. Therefore you may come across a large range of pipe and cable materials, their installation technologies and protection barrier methods. The table below gives an overview of these different techniques. It is not a complete list and it should be remembered that you may come across underground assets that have no barrier protection or other indication of their presence, for example underbores.

Utility/Industry	Asset	Traditional Techniques	Current Techniques	New Technologies
Electrical cables (power, rail and tram)	Transmission: Extra High Voltage (EHV) Distribution: High Voltage (HV) and Low Voltage (LV) Supervisory and signalling cables	Buried direct, conduits (orange PVC), ductlines, concrete encased, fibro asbestos cement, steel, earthenware or encased in bitumen Protective covers bricks/tiles, terracotta, concrete, polymeric Marker tapes – polymeric	Direct burial in trench, ducts Some thrust boring across roads Marker tape – polymeric Protective covers – polymeric and concrete Surface markers	Trench-less technology including directional drilling Conduits installed by directional drilling. Variations in alignment and depth may occur. Multiple conduits can be installed using this method
	Cathodic protection	May be direct buried	Nil	
	Earthing rods and conductors	Direct buried	Direct buried	
	Conduits and ducts	Orange PVC	Orange PVC	
	Power poles and lattice towers	Risk assess to ensure that 1) structure will not be undermined and 2) cable is not coiled around base of pole		
Gas pipelines	Transmission	Coal tar enamel (warning contains asbestos) coated steel pipe Blue polyethylene coated steel pipe	Yellow polyethylene coated steel pipe Red fusion bonded epoxy coated steel pipe Construction techniques included trenching, cased boring, horizontal directional drilling	

Utility/Industry	Asset	Traditional Techniques	Current Techniques	New Technologies
	Distribution High Pressure	Blue polyethylene coated steel pipe Yellow polyethylene coated steel pipe	Yellow polyethylene coated steel pipe Construction techniques included trenching, cased boring, horizontal directional drilling	High density polyethylene yellow stripe/black pipe
	Distribution Low Pressure	Tar coated wooden pipe Cast iron pipe Blue PVC pipe	Yellow nylon pipe Medium density yellow polyethylene pipe High density polyethylene black and yellow stripe pipe Insertion of disused cast iron pipe with nylon or polyethylene pipe Construction techniques included trenching, cased boring, horizontal directional drilling	
	Consumer services	Cast iron pipe Galvanised steel pipe	Yellow nylon pipe Medium density yellow polyethylene pipe High density polyethylene yellow stripe/black pipe Insertion of disused cast iron or galvernised pipe with nylon or polyethylene pipe Construction techniques included trenching, grundamat boring, horizontal directional drilling	

Utility/Industry	Asset	Traditional Techniques	Current Techniques	New Technologies
Water mains and services	Pipes 15 mm to 3000 mm, valves, hydrants, chambers	Cast iron, steel, cement coated steel, asbestos cement, copper, glass reinforced plastic ductile iron, polyethylene, PVC or concrete encased steel or ductile iron	Pipes usually installed by trenching Pipe cracking and slip lining renewal technique also used Some directional drilling Some thrust boring across roads Surface fittings for access and operation Chambers for valve access	Dual supply mains and services in recycled water areas
	Property connections	Service connections to properties are usually copper in smaller sizes and iron or steel in larger sizes (fire services and industrial)		Dual supply mains and services in recycled water areas
Sewerage mains and services	Pits pipes 15 mm to 1800 mm, tunnels, valves, connections	Cast iron, mild steel, cement lined steel, asbestos cement, copper, glass reinforced plastic, ductile cast iron or PVC, vitreous clay	Pipes installed by trenching Sewer re-lining or replacement using trenchless technologies (eg pipe cracking and slip lining)	On site treatment and reuse systems Jointless systems
Stormwater, grey water and drainage pipelines and services	Pits pipes 15 mm to 1800 mm, tunnels, shafts	Cast iron, mild steel, cement lined steel, asbestos cement, copper, ductile cast iron or PVC reinforced concrete	Installation generally by trenching	

Utility/Industry	Asset	Traditional Techniques	Current Techniques	New Technologies
Communications cables	Phone lines	Fibro asbestos cement (FAC) pipes and ducting. Galvanised iron (GI) pipe – various diameters Rocla concrete pipes Earthenware pipe Tunnels – Sydney CBD and servicing some other major telephone exchanges White PVC pipe 10 mm to 100 mm internal diameter Black PVC Directly buried cables PVC or armored steel sheath Polyethylene	Because of the long operational life of conduits, cables providing new technology services are often hauled into existing conduits All new standard conduit installations are white PVC of internal diameter 20 mm – 100 mm. Galvanised iron (GI) conduits are used for special purpose applications Conduits installed by directional drilling. Variations in alignment and depth may occur. Multiple conduits can be installed using this method Direct drilling technologies	Conduits installed by directional drilling. Variations in alignment and depth may occur. Multiple ducts can be installed using this method
	Co-axial, data and signalling cables	As above	As above	
	Broadband, copper and fibre optic cables	As above	As above Directly buried fibre optic cables will generally have been installed with marker tape above the cable containing a metallic wire Fibre Optic cables in conduits are installed by directional drilling technologies. They do not have marking tapes installed above the cable. In this case there may be no metal marking tapes installed	

Utility/Industry	Asset	Traditional Techniques	Current Techniques	New Technologies
	Conduits and ducts	As above	As above	
Oil transmission pipelines and valves	High Pressure (above 1050 kPa) Regularly signposted	Coal tar enamel (warning contains asbestos) coated steel pipe AS 2885-1997. *Pipelines for Gas & Liquefied Petroleum*	Yellow polyethylene coated steel pipe	
Privately owned pipelines	Chemical	Mostly similar to oil and gas transmission pipelines above (WorkCover Dangerous goods pipelines) Regularly signposted.		

Note: It is essential to treat a cable or pipe as high voltage or high pressure until it has been positively identified as being otherwise.

5. HAZARD IDENTIFICATION

5.1 SAFETY INFORMATION

Consideration must be given to the safety of individuals and the community, especially to provide adequate safety barriers and safe pedestrian access around the worksite. Additionally, PPE applicable to the particular operation must be used.

Excavation within the zone of influence may destabilise the underground asset or supporting structures resulting in damage to the asset.

5.1.1 Some of the dangers when working near underground assets

- *Gas*

  Damage to gas assets can cause gas escapes which may lead to fires or explosions if an ignition source is present. There are two types of leaks following damage to the asset:

  - damage which causes an immediate escape. In this case, there is a risk to those working at the site
  - damage which causes an escape some time after the incident. This may be through damage which weakens the asset casing or the result of poor reinstatement practice. In this instance, the public is mainly at risk.

- *Electricity*

  - an injury resulting from damage to live electricity cables is usually caused by electric shock or the explosive effects of arcing current and by the fire or flames which may follow when the sheath of a cable is penetrated by an object. Damage and injury may also occur if the cable is crushed or contact is made between the individual phases of a cable. The presence of gas or a mixture of gases in a trench could be ignited by an electrical charge or an electrical arc resulting in a fire or explosion, the severity of which depends on the gaseous mixture
  - gas can be present in the ground due to gas pipe damage or leakage, sewage pits, chemical reactions or leaching and the accumulation of airborne gases in low lying areas. Gas can also be introduced by the nature of the work being undertaken such as oxy-acetylene cutting or chemical grouting
  - consideration should be given to conducting a risk assessment to determine if a trench or the work constitutes a confined space.

- *Petroleum or oil pipelines*

  - the result of damaging these assets is similar to that of gas assets. However, there is the additional risk of significant environmental issues such as contamination of waterways.

- *Water pipes and sewers*

  - some pipelines transport water under high pressure. Some older water pipes are also made from asbestos cement. Damaged water pipes have great potential to affect other assets and structures, either directly or by washing away their supports ie thrust blocks

- the main danger from sewer damage is the contamination of a broken water main or asset, damage to the environment or disease from exposure to sewage. Some sewer lines are high pressure. Toxic and explosive gases may also be present in both sewer lines and stormwater drains
- persons working on metallic water pipes are at risk of electric shock due to an electrical fault near a customer's premises or a mains neutral fault in the street. Metallic water pipes are usually bonded to the electrical earthing system and are a path of low resistance. Stray electrical current will often flow through the bonded metallic water pipe. When the pipe is cut or disconnected, either side of the pipe could become live causing a person to receive a serious or fatal electric shock. The consumer is also at risk of an electric shock under the same circumstances.

- *Telecommunications*
  - consequences could be the isolation of whole communities, disruption of interstate and international telecommunications, inability to contact emergency services, loss of telephone, mobile phone, data and television services
  - cables containing optical fibres carry light signals generated by Class 3B lasers that can cause injury to the eye. This infra-red beam is invisible to the naked eye and exposure to it should be avoided. Small optic fibre particles are capable of entering the bloodstream causing injury or death.
- *Pipelines containing hazardous substances and dangerous goods.*

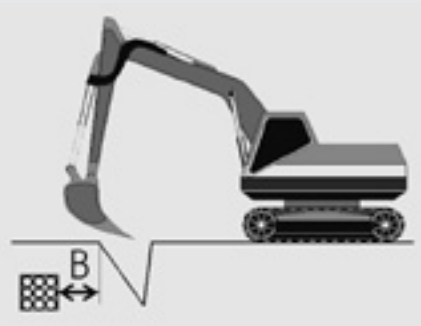
5.1.2 Safety considerations for Low, High or Extra High Voltage electrical cables

- High voltage (HV): same as for low voltage except the approach distances are variable. For more information refer to Table B.
- Extra high voltage cables (EHV): all work in the vicinity of extra high voltage cables must be undertaken with the consent and under the supervision of the asset owner. Contact with extra high voltage electric current will result in serious burns and/or death. For more information refer to Table B.
- Notwithstanding any guidance on the use of blasting as a means of excavation, where blasting is to take place within 200 m of an underground asset, the asset owner should be contacted for any special requirements.

5.1.3 Electrical earthing of metallic pipes

Prior to the removal or the repair/replacement of metallic piping, workers must ensure that an effective electrical bond across the break is maintained at all times.

5.2 TABLE B: TYPES OF ASSETS AND LIMITS OF UNDERGROUND APPROACH

Assets	Clearances	No Go Zone For Powered Excavation	Controls	Typical Depths
Types of underground assets **(Note:** The owners of assets registered with the Dial Before You Dig service and covered by this Guideline require an enquiry through this free service and the compliance with any directive issued with information regarding the asset)	The minimum approach distance for individuals carrying out work near underground assets	Distance 'B' is the minimum approach distance for powered excavating machines  For directional boring across the line of an asset a minimum clearance of **300 mm** from the asset shall be maintained For directional boring parallel to the asset and at the level of the asset, a clearance of **500 mm** shall be maintained from the edge of the nearest asset. It may be necessary to dig trial holes to prove the location of the nearest asset at points along the route. See Section 6.10	If the risk assessment identifies a potential risk of making contact with both underground and overhead assets, two safety observers would be required. One observer to ensure that the machinery maintains a safe distance from underground assets, the other observer to ensure a safe distance from the overhead powerlines In the case of gas or electricity assets, an appropriate fire extinguishing system must be at the worksite If the width and/or depth of the excavation will expose the asset, the asset owner must be contacted prior to commencing work	

Assets	Clearances	No Go Zone For Powered Excavation	Controls	Typical Depths
Low and Medium Pressure services and Low pressure mains	N/A	**300 mm**	Pot-hole to confirm location of service The position of the asset will not appear on the maps	**300 – 450 mm**
Medium Pressure mains	N/A	**300 mm**	Pot-hole to confirm location of asset The code of practice for shafts, tunnels and trenches, and the guide to dangers of poorly ventilated workplaces Only one individual at a time should be excavating if hand excavation is being undertaken in a confined space. Another should act as an observer and be able to operate any breathing, escape or fire equipment required The elimination of an ignition source in the event of an escape Excavation below underground assets should not be undertaken within a distance of **300 mm** below the asset located at the lowest level **Note:** All transmission pipelines involving gas, oil and petrochemical have separate requirements and the asset owners should be contacted.	**450 – 750 mm**

Assets	Clearances	No Go Zone For Powered Excavation	Controls	Typical Depths
High Pressure services, mains and pipelines	**300 mm** with hand tools and supervision from Network Authority	**1000 mm**	Powered excavation within 300 – 1000 mm is only permitted under supervision and with a Permit to Work from Asset Owner Also see **Controls** for medium pressure mains immediately above	**750 – 1200 mm**
Low Voltage Electricity cables – voltages less than or equal to 1000V (1kV)	Close proximity with use of hand tools	**300 mm**	Must contact asset owner for specific conditions	**450 – 750 mm**
Electricity conductors from 11,000V (11kV) up to 33,000V (33kV)	Close proximity with use of hand tools	**600 mm**	Must contact asset owner for specific conditions	**900 mm**
Underground sub-transmission cables 33,000V up to 132,000V (132kV)	Must contact asset owner	Must contact asset owner	Must be carried out under the supervision of the asset owner	**900 mm**
High Voltage Electricity cables – voltages from 1000V (1kV) up to 33kV	Close proximity with use of hand tools	Must contact asset owner	Must contact asset owner for specific conditions	**600 – 1000 mm**
Extra High Voltage Electricity Transmission cables – voltages above (132kV) and 330,000V (330kV)	Must contact asset owner	Must contact asset owner	Work must be carried out under the supervision of the asset owner	**800 – 1200 mm**
Telecommunications cables	Contact asset owner for specific conditions	Contact asset owner for specific conditions	Must contact the asset owner for specific conditions	Typically **450 – 600 mm**, other assets to **1200 mm**
Water pipelines	N/A	**300 mm** (if pipeline is **200 mm** or greater in diameter)	Pot-hole to confirm location of asset	Min **450 mm**
Sewerage pipelines	N/A	**300 mm** (if pipeline is **200 mm** or greater in diameter)	Pot-hole to confirm location of asset	Between **600 mm** to **10 (ten) metres**

5.3 ON-SITE CHECKING

Prior to any excavation work, check at least 100 m along the footpath in each direction and around nearby corners for indications of existing assets. These include:

- indicators or markers for underground assets, drainage pits and manhole covers
- damaged footpaths, driveways or depressions which may indicate the presence of a trench
- cables running up a pole
- overhead cables near the worksite
- control cabinets
- no overhead wires to a building or premise
- above ground connection cabinets
- transformers for cathodic protection on power poles
- light poles without an overhead service
- service pits for gas, water, electricity, communications, sewerage and drainage connections
- down pipes or vent poles
- underground storage tank fill points and venting systems
- kerb markings
- water valves
- fire hydrants and plugs
- sprinkler systems
- road repairs
- trap doors or access-covers for:
    - access to underground electricity substations
    - access to cable jointing pits or tunnels
    - access to sewerage or stormwater trunks
    - access underground gas regulators, siphons and valve assemblies
    - access to shafts
    - link box pits, oil tank pits and other ancillary underground pits.
- domestic service pits
- gas or water meters
- electricity pillars and meter boxes
- any other signs out of character with the surrounding area such as a clearing for an easement.

If such indications exist, the asset must be located by hand or another approved method.

5.4 PLAN OR DRAWING READING

Although each asset owner may have their own type of plan, with special notations and legends, the basic principle of map reading can be applied.

Telecommunications plans, and in some cases electrical plans, may provide a detailed representation of the asset or network. When reviewing the information:

- identify the streets or buildings nearby and position yourself so the streets correspond with the plan/s
- use the scale and measurements indicated on the plan/s to pinpoint your exact location
- remember, drawings may NOT be to scale
- many plans reference the asset location from an adjacent property alignment
- determine if measurements are metric or imperial, or a combination of both
- identify nearby pipes or cables and mark their recorded location
- cross-reference any supplementary plans or details
- identify any of the items listed below and assess their relationship to each other to determine if a measurement has altered:
    - building lines
    - pits and poles
    - offsets
    - turning points.

Note: Inaccuracies can and do occur, both on plans and in the ground. If in doubt, check with the asset owner. Never guess or assume!

Asset owners' plans show only the presence of some cables, pipes and plant. They only show their position relative to road boundaries, property fences etc at the time of installation and the utilities do not warrant or hold out that such plans are accurate thereafter due to changes that may occur over time. DO NOT ASSUME DEPTH OR ALIGNMENT of cables or pipes as these vary significantly. For example, road and building alignments and levels may change.

6. MANAGING THE RISKS

6.1 MANAGING RISKS IN THE WORKPLACE

Employers and self-employed persons must identify any foreseeable hazards, assess their risks and take action to eliminate or control them.

A hazard identification and risk assessment process must be carried out at the planning and preparation stage by the employer/contractor doing the work to determine what risks may arise when the work is being carried out. Safe systems of work must then be put in place to eliminate or control these risks. For tunnel construction work the safe system of work must also be documented in a Safe Work Method Statement (SWMS).

6.1.1 Monitor and review risk assessments and control measures

The OHS Regulation states that employers must review risk assessments and measures adopted to control risks whenever:

- there is evidence that the risk assessment is no longer valid
- an injury or illness results from exposure to a hazard to which the risk assessment relates
- a significant change is planned to the place of work, work practices or work procedures.

6.1.2 Safe work method statements (SWMS)

The OHS Regulation requires SWMS where the cost of the work undertaken exceeds $250,000 or for defined high risk construction work. Construction work in tunnels is defined as high risk construction work, so tunnelling work requires a SWMS.

The SWMS:

- describes how the work is to be carried out
- identifies the work activities assessed as having safety risks
- identifies the safety risks
- describes the control measures that will be applied to the work activities. It also includes a description of the equipment used in the work, the standards or codes to be complied with, the qualifications of the personnel doing the work and the training required to do the work.

A SWMS requires the work method to be presented in a logical sequence. The hazards associated with each process are to be identified and the measures for controlling these hazards specified.

Break down each job into a series of basic job steps to identify the hazards and potential accidents in each part of the job. The description of the process should not be so broad that it leaves out activities with the potential to cause accidents and prevents proper identification of the hazards.

Employees of the workforce should be involved/consulted in the development and implementation of any SWMS.

All persons involved in carrying out the work should understand the SWMS before commencing the work.

6.1.3 Consultation with relevant parties prior to commencing work

The planning before the start of work, which may affect a utility asset, must include but not limited to:

- consultation with local councils
- consultation with asset owners to obtain agreement on the use of out of service, retired or unused assets
- advising affected residents/occupants
- obtaining permit requirements and conditions for undertaking the works
- identifying and determining exact location of assets
- establishing methods to be adopted to protect existing assets
- further consultation as required by the scope of works
- consultation with 'Dial Before You Dig' and the asset registers of other infrastructure owners not registered with 'Dial Before You Dig'
- consultation with roads authority (eg RTA, local council or private body)
- consultation with local councils in terms of storm water assets and work in council owned roads.

Where underground assets exist, the precise location of the assets shall be established in conjunction with the asset owner by pot-holing (or equivalent non-destructive asset location techniques) prior to the principal excavation commencing.

Consideration must be given to the presence of private property assets eg telecommunications, gas, stormwater, sewerage and water assets. These private property assets are unlikely to be found on any plans and are best identified by a visual on-site inspection.

The use of an Electronic Service Detection Device to survey the ground for buried pipes and cables, before commencing excavation, should be considered.

The close out process of the project or scope of work may typically involve recording the 'as constructed' diagram of the asset and providing this record to the appropriate agency with details of:

- finished surface level
- depth of asset
- alignments from property boundary and/or kerb etc
- type of cover or warning device installed eg warning tape, concrete slab, mechanical polymeric protection strip etc
- new ownership details of the asset
- assets retired, removed, declared out of service etc
- type, size, location and installation method of assets

- surface and underground markings installed
- advice to any authorities, agencies etc on the completion of the project or scope of works
- cancellation of any permits, authorities etc
- the provision of a copy of the asset plans to the new owner.

For more information on how to safely dig near an asset, specific information is provided on the Telstra website via the following link www.telstra.com.au/dialb4udig/digging.htm Excavation with hand tools shall be carried out carefully up to but not closer than the minimum distances specified in Table B.

6.1.4 Planning and liaising with other authorities

When planning, it is important to discuss and consider the following areas:

- existing utility assets
- duration of the project and scope of works
- future planned assets
- opportunities for coordination of works
- shared trenching opportunities
- thermal impacts on EHV electricity assets
- changing ground surface levels
- installing heat sources (eg other electricity assets)
- creating underground voids (eg stormwater assets)
- changing backfill materials
- possible limitations in information available
- opportunities to improve information availability
- effect on traffic
- opportunities to isolate or relocate existing assets
- provision of visual identification devices
- asset owner and other authorities' concerns, conditions and expected working procedures
- any requirement/s for the worksite involving:
    - access to assets
    - permit conditions
    - recording of infrastructure, assets locations or relocations
    - financial costs
    - individual, asset or community safety
    - worksite and traffic management requirements and railway safety management requirements
    - reinstatement requirements (this liaison is in addition to the statutory notification required by legislation).

Consideration must be given to the operation of heavy plant over potentially fragile underground assets.

6.2 RAILWAY ASSETS

Rail easements have numerous electrical power, signalling, communication cables, compressed air and drainage lines that are owned and maintained by the Rail Authority. These assets vary in type of construction and are documented to various degrees of accuracy.

Numerous utility service providers and other private parties also jointly use the rail easement. Access to the rail easement is strictly regulated by the requirements of AS 4292.1: 2006 and AS 4799: 2000.

Access to information relating to the location of the various rail assets is issued on application.

6.3 SERVICE TUNNELS

Many utilities own or share service tunnels. These will have shafts plus manholes at the surface or other surface infrastructure supporting the tunnel environment.

6.4 EXCAVATION AND TRENCHING

To maintain essential structural support and the protection of other existing assets, excavations in the vicinity must not disturb the embedment around each asset (see Table B for minimum approach distances and to identify if the asset owner must be contacted for specific approach conditions). This information should be supplied by the asset owner through a 'Dial Before You Dig' request. Where this is not possible, the relevant asset owners must be consulted and their permission first obtained.

- If a cable or pipe is exposed, the contractor must ensure that any angular material such as rock or gravel does not mix into the embedment material
- Excavations in any easement must be backfilled, compacted and re-sealed to the appropriate Authority's standard at the completion of excavation
- Temporary restorations in roads and footways must be of sufficient quality to ensure the safety of pedestrians and vehicles until the final restoration is undertaken. Temporary restorations must be regularly checked by the responsible party to confirm their integrity
- Refer to NSW Code of Practice, *Excavation*
- Refer to:

  AUS-SPEC 306U *Road Openings and Restoration* (2004 and earlier additions)

  AUS-SPEC 7200 C0219 *Construction – Roadways – Road openings and restorations for utilities* (2007).

6.5 ASSETS NEAR BRIDGE APPROACHES

Often underground assets will be congested at the approach to bridges. Assets' typical depths may vary substantially, rising and falling sharply and at much shallower depths than elsewhere as they are channelled into shared allocated spaces on the bridge. Road safety barriers are often very close to heavily congested services at the approaches to bridges. Construction staging and footing design for such barriers should consider impacts on assets and, where possible, construct barriers prior to constructing the assets.

6.6 ASSETS AROUND POLES

Unless otherwise agreed, underground assets and other obstructions around poles are to be kept a minimum distance of 300 mm from the periphery of the pole, to allow inspections by asset owner staff.

No excavation within 10 metres of a Single Wire Earth Return (SWER) transformer pole is to occur without the approval of the local electricity asset owner.

It should be noted that the NSW Service and Installation Rules require a sketch of the underground service/consumers mains to be marked inside the switchboard.

6.7 TRAFFIC CONTROLS

All work carried out on RTA NSW controlled roads must be done in accordance with the RTA's *Traffic Control at Work Sites Manual.* As this manual is considered to be the benchmark for traffic control in NSW, **all** works carried out within the road corridor or on adjacent pathways should be conducted in accordance with this manual.

6.8 EMERGENCY WORK

While there will be times when, due to pressing requirements, the timeframe for starting work will prevent some of the normal controls from being completed, this will not diminish the responsibility of worksite controllers to do everything that is reasonable and practical that is within their power to ensure the health, safety and welfare of persons affected by their actions.

6.9 VERTICAL BORING

For any boring within 500 mm of an underground asset, the location of the asset/s shall first be proved by careful hand digging (pot-holing) or equivalent asset location techniques and:

- a minimum clearance of 300 mm from the edge of the underground asset shall be maintained for pole hole boring
- lead in excavations shall be used.

Note: All transmission assets including EHV electricity cables, pipelines involving gas, oil and petrochemicals have separate requirements and the asset owners should be contacted.

6.10 DIRECTIONAL BORING

- When boring across the line of an underground asset, the location of the asset/s shall be positively proven by hand digging (pot-holing) or proven by another approved method.
- All transmission pipelines involving gas, oil and petrochemicals have separate requirements and the asset owners should be contacted.
- For boring under electricity cables, it is necessary to excavate a slit trench beside the cables to confirm the depth of the cables and ensure the drill is not within the minimum approach distance of the cable specified in Table B.

- Additional precautions and clearances are required for directional boring near or beneath sub-transmission cables, normally located in roadways. If the bore is to pass within 2 metres of any electrical cable or conduit the asset owner must be notified as the clearances for HV and EHV may be significantly greater.

  See Table B for further information on clearances.

6.11 MECHANICAL EXCAVATING PLANT

Reference should be made to WorkCover's *Moving Plant on Construction* Sites code of practice.

Mechanical excavating plant may be used with care up to, but not closer than, the minimum distances as specified in Table B.

- Where the excavation is being carried out parallel to or across underground asset/s, location of the asset/s must be proven by careful hand tool excavation (pot-holing) or another endorsed method used to positively locate the asset prior to mechanical excavation.
- If an excavation must exceed the depth of the asset and will disturb the protective cover, slab, other asset/s or the bedding material around the asset/s, the asset owner/s must be contacted to determine if the asset/s is to be relocated.
- Excavations must be reinstated to comply with the asset owner's requirements.
- **Where plant is required to operate over underground assets, such as in major road reconstruction, the clearances as specified in Table B must be maintained. Alternatively, if Table B cannot be complied with, the asset can be mechanically protected by an engineered structure agreed to by the asset owner.**

Note: All transmission cables, pipelines and petrochemical networks may have separate requirements and the asset owners should be contacted before commencing work.

6.12 EXPLOSIVES

The use of explosives by licensed operators must only be used after a comprehensive risk assessment has been undertaken in consultation with all owners of assets in the vicinity and must be consistent with the requirements of the *Explosives Regulation 2005.*

6.13 PILE DRIVING

Pile driving adjacent to underground assets must not take place without authority from the owner of the assets. The exact location and depth of all adjacent assets shall be physically proved by hand digging (pot-holing) or equivalent asset location techniques prior to commencement of work.

The effects of vibration on the asset must be considered when planning the work.

6.14 IDENTIFICATION OF ASSETS NOT ON PLANS

Where an asset that is not identified on any plans etc is located in the field, work should be suspended until the asset is positively identified and any remedial controls put in place. Depending on the nature of the risk, it may be necessary to notify the asset owner and obtain a revised plan.

6.15 ASSET SEPARATION DISTANCES

To avoid safety and operational conflicts resulting from space infringement issues, refer to the Street Allocation Diagrams in Section 13.

7. SAFE SYSTEMS OF WORK

A critical part of planning safe systems of work is making sure that the plans are accurate. With some assets installed over 60 years ago, it is likely that changes would have been made to the surface of the land at some stage. Road widening and regrading of surfaces are common causes for inaccuracies in records. For this reason, when working from old records, pot-holing and/or pipe and cable locating devices should be used. The relevant authority or asset owner should be told of any inaccuracies in records.

Asset owners typically require notification of a major project or where the project may require supply of a service or product outside normal residential demand.

A safe system of work should be sufficiently robust to include site controls that will ensure assets on construction sites are not damaged. All those who dig the ground should be aware of the assets in the area before they dig and have appropriate controls in place. Particular attention needs to be given to relocated assets and persons new to the site to ensure they are aware of the assets and their locations.

At the project planning stage it is important to consider minimising damage to surface infrastructure and disruption of services to residents, pedestrians and traffic. Any construction or maintenance technique should ensure adequate clearances are maintained between assets and that other assets crossings are identified.

Access to assets must be maintained at all times to ensure emergency and scheduled maintenance activities can be carried out by the asset owner. Contractors should also give consideration at the planning stage for site storage of material and traffic areas associated with construction activities so these do not impede access to or damage assets.

Consideration should also be given to the appropriate level of supervision and training, including specific industry awareness training, for an individual undertaking work near any gas or electrical assets.

7.1 EXCAVATION USING NON-POWERED HAND TOOLS

For more information on how to safely dig near an asset, specific information is provided on the Telstra website via the following link www.telstra.com.au/dialb4udig/digging.htm Excavation with hand tools shall be carried out carefully up to, but not closer than, the minimum distances specified in Table B.

There is a duty of care when excavating near cables, pipes and plant. Before using machines to excavate, **underground assets must first be exposed by pot-holing** with **non-conductive** tools to identify its location. Damage can also result in serious injury or death to workers and widespread disruption to services and traffic.

7.1.1 Work on top of or below an underground asset

No disturbance of the underground assets, including any mechanical cover (eg concrete or polymeric cover slab), should occur without prior notification to the asset owner.

Excavation must not be carried out below an underground asset unless steps are taken to ensure that:

- the asset/s or the integrity of the asset and support material is not damaged

- under-crossing shall be at right angles whenever possible
- such excavation below the asset/s should not come within the distance specified in Table B.

  Note: all transmission cables, pipelines and petrochemical networks may have separate requirements and the asset owners should be contacted before commencing work
- steps must be taken in consultation with the asset owners to ensure the asset is adequately supported.

  Note: Also see Section 6.10 Directional Boring.

7.1.2 Work beside an underground asset

If any excavation beside underground assets comes within the clearances specified in Table B, then the asset owner must be notified prior to work commencing. Measures should be agreed upon to ensure the stability of the surrounding soil or material.

7.2 ACCIDENTAL CONTACT WITH UNDERGROUND ASSETS

In the event of an inadvertent contact with an underground asset, it is essential to notify the asset owner and comply with the reporting requirements under the OHS Regulation (Chapter 12).

7.2.1 Electrical assets

Should contact be made with a live overhead power line or a flash-over occur between a live overhead power line and a crane or an item of mobile plant, the following actions shall be taken:

- an attempt should be made to break the machinery's contact with the live overhead power line by moving the jib or driving the machine clear
- if it is not possible to break the contact with the live overhead power line, the operator of the crane or mobile plant should remain inside the cabin of the crane or on the plant item. The network operator should be called immediately to isolate power to the live overhead power line. The operator must remain in place until the power has been isolated and the 'all clear' given by the network operator

When a crane or item of plant inadvertently contacts overhead power lines, circuit protective devices may operate to automatically turn the power off. However, some protection devices are designed to automatically reclose thereby re-energising the power lines after a short period of time, typically 1–4 seconds.

- if it is essential to leave the cabin or the operator's position due to fire or other life threatening reason, then jump clear of the equipment. Do not touch the equipment and the ground at the same time. When moving away from the equipment, the operator should hop or shuffle away from the plant item (with both feet together) until at least 8 metres from the nearest part of the crane or plant. **Under no circumstances run or walk from the crane or item of plant as voltage gradients passing through the ground may cause electricity to pass through the body resulting in an electric shock**

- warn all other personnel and members of the public to keep 8 metres clear from the crane or item of plant. Do not touch or allow persons to touch any part of the crane or plant item and do not allow persons to approach or re-enter the vehicle until the network operator has determined the site safe. Remember electricity flows through the ground, so an electric shock could be received from walking close to the scene. If the crane or plant operator is immobilised, ensure the power supply has been isolated and the site made safe before giving assistance
- untrained, unequipped persons should not attempt to rescue a person receiving an electric shock. All too often secondary deaths occur because others get electrocuted trying to help earlier victims. If the crane or plant operator is immobilised, ensure the power supply has been isolated and the site has been made safe before giving assistance.

7.2.2 Gas assets

Should an incident involving gas assets occur, the following actions should be taken:

- all work should cease immediately
- operator is to shut down the plant or equipment UNLESS this process may provide an ignition source for any escaping gas
- it is essential to leave the cab or operator station, trench or enclosure and maintain an exclusion perimeter due to the risk of explosion or fire. Do not attempt to use any instrument which may provide an ignition source near the gas escape. This may include mobile phones, two way radios, etc
- warn all other personnel and/or public to keep clear from the worksite and equipment. DO NOT attempt to approach, re-enter or start the vehicle until the relevant authorities have determined the site is safe
- contact the fire brigade on 000 if life and/or property are threatened
- facilitate First Aid treatment and seek medical aid as required
- advise your organisation's emergency contact and request they immediately notify the relevant authorities, including the relevant asset owner
- initiate the emergency management plan and incident investigation process.

7.2.3 Sewerage assets

Should an incident involving sewerage assets occur, the following actions should be taken:

- cease work, make the site safe and contact the sewerage asset owner as soon as possible. Local circumstances and/or ownership should be considered
- if contaminated, shower or wash down with copious amounts of water. Remove any contaminated clothing as soon as practical
- there is a risk of infection from ingestion or eye contact. If eyes are contaminated, flush with copious amounts fresh potable water. If ingested, seek medical advice
- for skin contact, wash with soap and water. For broken skin and abrasions, also seek medical advice
- protect the public and watercourses from exposure to raw or untreated sewage
- if damage to a sewer pipe occurs during construction works, take appropriate steps to prevent surrounding material entering the pipe.

7.2.4 Water assets

- Cease work, make the site safe and contact the asset owner.

7.2.5 Telecommunications assets

- Report any damage to Telstra assets by phoning **13 22 03**.
- Contact specific asset owner if not owned by Telstra.

7.3 COOPERATION WITH AUTHORITIES

Constructing authorities and others operating in a public road reserve, rail reserve or private property have a duty of care to protect the existing assets of utility providers. It is essential to determine the location of existing assets by obtaining plans and proving the exact location before excavating.

Asset owners may have formal agreements in place describing how work shall be undertaken near each other's assets and these shall be complied with.

7.3.1 Obligations of asset owners and contractors

There is an obligation for all asset owners, contractors and service providers to observe the specifications and separation distances indicated in the Streets Opening Conference diagrams (see Section 13) or those agreed through consultation between asset owners.

All contractors should notify the relevant asset owners if they locate any asset that is not shown accurately on the plans. At no time may an asset be relocated or moved without the prior authority of the asset owner.

7.4 DOCUMENTED SYSTEMS OF WORK

A documented **risk assessment** developed in consultation with those supervising and undertaking the activity is necessary for all activities where excavation and inadvertent contact with underground assets may occur.

A **SWMS** is to be developed in accordance with the OHS Regulation which captures details of the risk assessment and the required training/qualification. All those workers undertaking the activities identified in the SWMS should be made aware prior to commencement of work (eg toolbox talk).

An **excavation permit** is an excellent method of managing the investigation and approval process leading up to the commencement of the excavation. A properly constructed permit will produce a rigorous process that must be followed and completed prior to excavation activities and includes the positive identification of underground assets.

Verification activities such as **audit and inspection** are an excellent means of ensuring that the process has been correctly implemented at a systems level and on the ground before and during the excavation activity.

7.5 TRAINING OF MANAGERS AND EMPLOYEES

Training is an integral component of reducing the risk of inadvertent contact with underground assets.

Managers and supervisors need to be made aware of the hazards and overarching requirements regarding inadvertent contact with underground assets such that they are able to implement safe systems of work and properly plan for and oversee the activities.

Both managers/supervisors and employees will benefit from information and training regarding the use of electronic detection devices, how to use the 'Dial Before You Dig' service and how to read plans supplied by the asset owners and/or 'Dial Before You Dig'.

Employees need to be made aware of the systems in place to minimise the risk of inadvertent contact with underground assets and also the hazards facing them if these systems are not employed.

Site-specific induction systems should include details such as the known location of assets, the site safety rules in relation to excavations (eg no excavations without a permit) and provide inductees access to, or a copy of, the utilities location plan for the work zone.

7.6 ASSET OWNER PLANS AND 'DIAL BEFORE YOU DIG'

A site meeting with the asset owners may be required to determine location/s and procedures for dealing with assets within the scope of work. This issue should be addressed during initial project development to provide time to establish a regime to manage any risks.

Before commencing any excavation work, reference shall be made to the details or plans of the utility or private assets in the proposed excavation area as well as a site inspection to identify any unmarked assets. Plans illustrating the location of known underground assets can be obtained from individual asset owners or the 'Dial Before You Dig' service.

As mentioned, the location of underground assets provided by a service or utility provider may not be accurate for many reasons. As complete accuracy cannot be guaranteed, the position of underground assets must be proven by hand excavation, pot-holing or other approved techniques.

For work in the vicinity of EHV electricity transmission cables it is mandatory to have a meeting with the asset owner prior to any work commencing.

7.7 CABLE/PIPE IDENTIFICATION DEVICES

An electronic pipe or cable locator should be used to more accurately identify the location of the underground asset – as asset owners' plans will not provide exact locations.

Once identified using such electronic device, care should be taken to mark the location of the underground asset on the ground's surface.

7.8 GROUND PENETRATING RADAR (GPR)

Ground penetrating radar (GPR) is emerging within the civil construction industry as an excellent tool for identifying underground assets and mapping assets on a wider scale.

GPR is a non destructive and non invasive technique for rapidly imaging the shallow surface (up to 10 m) and produces high resolution colour section in real time. Parallel images can be used to create a 3D image.

7.9 POT-HOLING

Pot-holing is the use of hand tools to excavate to a pre-determined depth to establish if assets exist in the immediate location. Pot-holing is a proven method of identifying assets.

Never assume that underground assets are positioned in the location as depicted on the plans or in the depth suggested. All underground assets should be positively identified prior to commencing excavation.

Pot-holing should be undertaken along the length of the proposed excavation to identify the path of underground assets and their depth. The information contained on the asset owner's plans and gathered during electronic identification methods helps in this process.

- careful digging (ie pot-holing) is the only sure way to identify the depth and alignment of underground pipes and cables
- pot-holing must be undertaken with reference to plans and other information provided by pipe and cable owners.

The amount of pot-holing should be determined with reference to the risk assessment for the site. Excavators should also pay attention to pot-holing requirements included in work practices provided with the network plans and onsite by a representative of the pipe and cable owner.

7.10 AIR AND WATER LANCING

Air/water lancing techniques may be used in some circumstances, but the advantage of these needs to be assessed against any inherent safety and environmental risks, eg dust generation, contaminated water runoff and possible damage to underground assets.

7.11 TRENCHLESS TECHNIQUES

Pot-holing must be used to locate existing underground assets to ensure adequate clearances are maintained between assets and to locate other asset crossings. Pot-holing at each asset crossing and at regular spacing along assets is recommended.

Where high risk assets are identified, consultation with the asset owner is required. Consultation is also required when using directional boring across existing utility lines. Where clearances required by other assets cannot be achieved at the proposed depth of asset installation, alternative solutions should be sought in consultation with the relevant parties.

It is crucial to provide the "as constructed" details on this type of installation for future reference because:

- the ground above the bore is typically undisturbed, not offering any indication of previous works
- of the inability of directionally-bored installations to provide warning tape or mechanical protection above the asset
- the bore may not follow a direct route.

7.12 SAFETY OBSERVERS

Excavation work around underground assets should only be undertaken with the assistance of a competent safety observer.

The safety observer/s should be given sufficient control of the activity to call for a cessation of work in the event of system failure or observation of unsafe practice which may give rise to an inadvertent contact with an underground or overhead asset.

When excavating near or adjacent to underground assets it is important to be aware of overhead hazards such as overhead powerlines. Risk assessment may dictate a requirement for more than one safety observer for such activity, eg one observer to mitigate inadvertent contact with underground hazards and the other to mitigate inadvertent contact with overhead hazards.

7.13 CONFINED SPACES

Excavations are generally not confined spaces. However, confined space provisions may apply to certain excavations where the excavation enters foul or contaminated ground or opens a live sewer. Also, where the atmosphere can be altered by exhaust gases or other contaminants, the excavation is to be treated as a confined space. Further information is given in WorkCover's *Code of Practice: Excavation,* Section 4.

7.14 GLOBAL POSITIONING SYSTEM (GPS)

GPS technology provides an excellent opportunity to plot the location of underground assets and maintain that information for the duration of the project. This is especially important in maintenance and long term projects.

GPS locations, when captured, should be noted on relevant plans. This information should also be provided to asset owners for any as built/modified infrastructure or previously unidentified underground assets.

7.15 ABOVE GROUND IDENTIFICATION DEVICES

Previously in this document, many above ground identification devices have been discussed that may assist identifying underground assets.

The Western Sydney Orbital Project (M7) successfully implemented a process where different coloured conduits (according to the nature of the asset) were temporarily inserted into the pot-hole directly onto the underground asset. These conduits, when back filled, extended approximately 1-1.5 metres above the ground and were plugged on top to prevent dirt and debris entering the conduit. These above ground locators enabled easy visual identification of the path of known underground assets and, when a measuring tape was inserted into the conduit, provided the exact depth of the asset.

8. TRAINING, INSTRUCTION AND INFORMATION

The OHS Act requires employers to provide such information, instruction, training and supervision as may be necessary to ensure the health, safety and welfare of their employees while at work.

In addition, some activities are restricted to persons holding the relevant certificate of competency, for example scaffolding and operation of cranes and some load shifting equipment. See the OHS Regulation or the *Industrial Certification Manual* for a full list of such activities.

8.1 TRAINING REQUIREMENTS

In addition to the requirements of construction training, all persons undertaking work involving underground assets must be instructed, trained and assessed as competent for the tasks they are undertaking.

Training includes but is not limited to:

- induction
- general health and safety induction training
- work activity health and safety induction training
- site specific health and safety induction training (Clause 216 OHS Regulation)
- risk assessment methodology
- training in the use of SWMS
- plan/map reading
- utility specific statutory training.

8.2 INDUCTION TRAINING

The OHS Regulation requires that employees receive OHS induction training, including general health and safety induction training, work activity based induction training and site specific induction training, and that this training covers the topics set out in the *Code of Practice: Occupational Health and Safety Induction Training for Construction Work 1998.* The training must cover the following points:

- arrangements for the management of OHS, including arrangements for reporting hazards to management
- health and safety procedures relevant to the work of the employee, including the use and maintenance of risk control measures
- how to access any health and safety information that the employer is required to make available to each employee
- any other induction training relevant to the place of work (eg confined spaces entry training), having regard to the competence, experience and age of the new employee.

8.3 TRAINING TOPICS

Training should draw on knowledge of the known hazards and risks in your operations, including matters described in this Guideline. The source of risks should be pointed out and the adverse outcomes that have been experienced by others should be used to stress the importance of safety.

The training provided and the instruction given should at least include all safe work methods to be used on the job and matters described in this Guideline, that is, all hazards, risks and control measures for control of hazards.

8.4 WHO SHOULD RECEIVE TRAINING?

The target groups for training at a workplace include but are not limited to:

- managers and supervisors of employees and/or other persons undertaking work considered at risk of injury and/or who have responsibility for implementing safe operating procedures
- OHS committees and OHS representative/s
- staff responsible for the purchasing and maintenance of plant, PPE and for designing, scheduling and organisation of work activities
- persons undertaking risk assessments or preparing SWMS
- employees and subcontractors undertaking the work, including employees of labour hire organisations.

As the needs of each target group are different, the content and methods of presenting training material should be tailored to meet the specific needs of each group.

8.5 PROVISION OF INFORMATION AND INSTRUCTION

Information may include:

- the results of any applicable risk assessment
- SWMS
- a review of such a risk assessment and/or SWMS or operating procedure
- any other relevant OHS information.

Employers should brief each employee as to the contents of risk assessments and SWMS when each employee and/or other person first begins to perform tunnelling work, at regular intervals thereafter, and whenever there are changes to risk assessments or new information about health and safety risks becomes available.

Employees and other workers should have, on request, ready access to risk assessments and SWMS.

9. CASE STUDIES AND CHECK LISTS

9.1 REPAIRING SEWERAGE PIPES

A reactive dig and repair job was commenced by a work crew of a sewage and drainage authority following the internal surcharge of a sewer line at a preschool adjacent to the worksite. CCTV was used to identify the repair location of the sewer. Damage to the sewer pipes apparently occurred during the laying of electrical conduits approximately 20 years ago and a contractor had carried out a repair of that damage. The repairs appear not to have been referred back to the responsible sewerage authority and eventually resulted in the internal surcharge at the preschool.

The work crew did not find indicator plates or markers identifying underground power in the immediate area, and, because locating equipment was not readily available, made a decision not to delay the work and to commence excavating with a mechanical excavator. The excavator uncovered bricks marking an electricity asset directly over a conduit. Marker tape was found but was not immediately obvious.

An incident was declared by the work crew and work stopped when the conduits were uncovered. The asset owner was called to the site and supervised the remainder of the repairs. An insulated spud bar was used to break up concrete that was placed around the pipe in the original repair. The pipe was replaced, work completed and the excavation backfilled. The incident was reported as a near miss.

The hazards shown here include a broken sewer pipe and high voltage cables.

The risks were electric shock, contaminated and hazardous atmosphere (from sewer gases) and possible infection.

Failure to identify the presence of these cables before work commenced exposed the workers to the risk to health and safety.

Once the risk was identified, the controls included the use of insulated tools to excavate under the supervision of an authorised person from the asset owner.

9.2 COUNTRY TELECOMMUNICATIONS CABLE DAMAGE CASE STUDY

At this location, a contractor working for a telecommunication carrier performing combined pre-ripping and plough operation to install new optic fibre cable, damaged the Telstra major interstate fibre cables.

The new route was being installed through rural paddocks and properties by D7 dozer and trenching machinery. The route was being installed parallel to the existing Telstra major fibre route.

At the manhole, approx 20 metres from the damage location, a 30 fibre cable, 16 fibre cable and a 30 pair copper cable left the manhole at right angles following the fence line. The contractor failed to identify the break off from the manhole shown on the plans. These cables were subsequently damaged during the pre-ripping procedure near the fence line.

The contractor believed the main cables where in another location, the one they had been following, and they had not noticed the manhole (located approximately 20-30 metres from the pre-ripping process) until after the damage had occurred. Two markers on either side of the manhole were clearly visible from a distance.

Site observations

- The Telstra fibre cable route was clearly marked with Telstra yellow concrete markers, which was easily visible.
- The manhole was marked with a yellow concrete marker post at either end of the manhole.
- The cable route was clearly shown on Telstra plans that the contractor obtained from the 'Dial Before You Dig' service.
- There was no visible sign of asset location (pot-holing) on the ground such as markers, paint, peg lines, markings on the ground etc.
- There were deficiencies with the safe system of work used on the project.

9.3 CITY TELECOMMUNICATIONS CABLE DAMAGE CASE STUDY

A contractor in the west of Sydney drilling pier holes for the construction of townhouses caused significant damage to telecommunication cables resulting in severe disruption to telecommunication services in country NSW.

An auger operated by an excavation contractor made a direct hit on a telecommunications cable route. Thousands of telephone lines, mobile phone towers, EFTPOS terminals and data lines went dead all over NSW instantly.

The auger, a giant drill, severed six fibre optic cables running between 12 and 60 fibres each and a 2400 copper pair cable, about seven kilometres from the Parramatta exchange.

Physical cable damage was not confined to the one hole in the ground – it wrenched and ripped cables clean out of manholes for hundreds of metres on either side.

One of the cables was the main feed to the Bathurst and Orange area, others carried mobile phone traffic. Almost all the copper lines were in use by local households and businesses and, not least of all, the main ATM (asynchronous transfer mode) internet backbone running to the south and west out of Sydney. At one ISP alone, more than 100,000 customers across four states were unable to log on to the internet for hours. Also 250,000 Foxtel service subscribers were disconnected, some for nearly 12 hours.

It was not just the phone services that went down. EFTPOS services died, and staff from a Bathurst supermarket were reduced to hunting around other businesses for manual transfer forms for more than a day so customers could buy groceries and debit their bank accounts. E-mail access in Bathurst was out too.

Had the 'Dial Before You Dig' service been contacted on 1100 and the appropriate plans used, the damage could have been avoided.

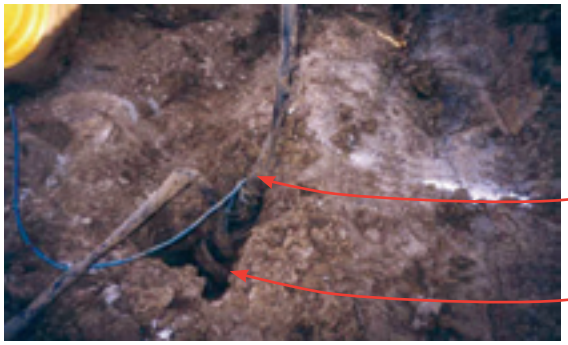
If there is any doubt at all about cable location, Telstra will send staff to show contractors and property owners how to check for stray lines. However, there was no call placed to the 1100 service for this damage.

When people in west Sydney picked up their phones and found no signal, they might have expected their mobiles or other carrier services to fill the gap. But Telstra, Optus, AAPT, Vodafone and Primus were all affected to some extent.

This incident was the cable cut of all cable cuts, but cut and flooded cables take down parts of the telephone and data network every day.

It took 50 technicians until 11.00 that night just to restore all the services, and two-and-a half days to finish all the work.

Sub-ducts and cables laying on the construction site, pulled out by an auger.



Twisted sub-ducts and optical fibre.

One of the bored holes where the cables and conduits had been pulled out.

Twisted sub-ducts and optical fibre.

Through these bored holes large amounts of cables and sub-ducts had been pulled out. Thus, causing major damage to cables and joints in the Telstra Network.

9.4 EXAMPLE OF AN INCIDENT REPORT USED BY AN ELECTRICITY ASSET OWNER

'Excavator operator injured when hitting 11,000 volt underground cable'

Date:	07/10/05
Incident occurred at a place of work (refer OHS Act 2000)	[✗] (Construction site)
System voltage involved:	11,000 kV
Address:	Northumberland Road
Work being done for:	[✗] Contestable work done for customer
Category:	[✗] General public (workers – non networks worker)
Category type:	[✗] Electric shock
Treatment:	[✗] Medical treatment given (Hospital)
Description of injuries:	Excavating for ASP to relocate 11,000 volt UG cables, excavator hit cable causing explosion and feeder trip. Victim received shock from excavator and was taken to hospital for check up. No permanent injuries
Network element involved in incident:	[✗] Underground mains
Object involved in incident:	[✗] Excavator
Location of incident:	[✗] Urban
Location type:	[✗] Public Roadway (including footpaths to property boundary)
	[✗] Accident area exposed to weather (ie outdoors)
Possible causes of incident:	[✗] Failure to follow written procedures
Briefly describe possible causes of incident in more detail:	Workers had located cable via searches but proceeded to dig with excavator beyond marker tape and hit cable
Initial corrective action:	ASP and excavator operator advised of the dangers associated with excavation near cables. Advised that any work beyond covers or marker tapes can only be done using hand tools
Corrective action taken:	• excavator operator advised of his responsibilities when working near underground assets • ASP reminded of his responsibilities in regard to site supervision and the need to consult plans before commencing any excavation work
Follow up:	Cable isolated and repaired by IE. 50 customers interrupted for 5.2 hours

9.5 CASE STUDY: CONSTRUCTION OF THE M7 MOTORWAY

The Abi Leighton Joint Venture (ALJV) conducted an extensive risk assessment before commencing on the project and services both above and below the ground were identified as a major risk.

The ALJV consulted with the asset owners who identified an extensive number of assets in the M7 corridor and local road upgrades.

Plans were obtained from 'Dial Before You Dig' and from the asset owner. Electronic services detection was also conducted. These assets were then surveyed and non-destructive digging conducted to positively identify each asset. Colour coded conduits were then placed on top of the assets.

The ALJV still recorded hits to the assets as not all assets were identified on the plans or by 'Dial Before You Dig'.

Meetings were arranged by the ALJV with management and field staff, asset owners, subcontractors and 'Dial Before You Dig'. From these meetings the ALJV developed the following procedures through consultation to reduce the possibility of impacting on these assets:

- a request to de-energize high risk electrical assets where possible was made to the asset owner. A training course was developed and delivered by the ALJV and Integral Energy to approximately 500 ALJV and subcontractor employees on the project
- permits to excavate and work around assets were reviewed and developed with input from all stakeholders. The mandatory exclusion zones for underground assets were doubled
- colour coded conduits were used to identify the type of asset, location and depth
- when working in the asset zones, only toothless buckets were permitted to be used on plant
- banners, posters, stickers and signage were extensively used to remind all personnel of the procedures.

The ALJV, in consultation with a manufacturer, developed a GPS backpack to identify a known asset by comparing it to the ALJV survey database. This allows the ALJV to mark out existing assets and make this information more accessible and easier to understand.

By consulting and training all stakeholders, the ALJV was able to implement safe work methods and dramatically reduce the number of incidents impacting on assets.

Colour Coded Conduits used to identify assets

Manufacturer's backpack being used by ALJV survey staff

The manufacturer's pocket PC allows quick recognition of underground assets by touch screen technology. This identifies the type of asset and its approximate location.

10. FURTHER INFORMATION

10.1 AUSTRALIAN STANDARDS

- AS 2648.1 *Underground marking tape*
- AS 4026 *Electrical cables for underground residential systems*
- AS 1345 *Identification of the contents of pipes, conduits and ducts*
- AS 2566.2 *Buried flexible pipelines*
- AS 4271 *Interim – Geographic information data dictionary*
- AS 1742.3 *Traffic control devices for works on roads*
- AS/NZS 4360 *Risk management*
- AS 4799 *Installation of underground utility services and pipelines within railway boundaries*
- AS 4292.1 *Railway safety management*
- AS 2865:2001 *Safe working in a confined space*
- AS 1165 *Traffic hazard warning lamps*
- AS 1345:1995 *Identification of the contents of pipes, conduits and ducts*
- AS 1742.3 *Traffic control devices for works on roads*
- AS 1743 *Road signs – specifications*
- AS 1744 *Forms of letters and numerals for road signs*
- AS 1906 *Retroreflective materials and devices for road traffic control purposes*
- AS HB81 *Field guide for traffic control at works on roads:*

  (HB81.1 Short term urban works – daytime only

  HB81.2 Short term rural works – daytime only

  HB81.3 Mobile works

  HB81.4 Short term night works

  HB81.5 Works on unsealed roads

  HB81.6 Bituminous surfacing)

Australian Standards are available from SAI Global **www.saiglobal.com/shop**
email sales@sai-global.com or phone 13 12 42.

10.2 WORKCOVER NSW CODES OF PRACTICE

- *Code of Practice: Work Near Overhead Power Lines*
- *Code of Practice: Excavation*
- *Code of Practice: Moving Plant on Construction Sites.*

10.3 OTHER STANDARDS AND REFERENCES

- Streets Opening Conference (2007) *Guide To Codes and Practices for Streets Opening*
- Streets Opening Conference (1999) *Model Agreement for Local Councils and Utility Service Providers*
- *Service and Installation Rules of New South Wales* (2006)
- AUS-SPEC 306U AUS-SPEC *Road Openings and Restoration* (2004 and earlier additions)
- AUS – SPEC 7200 C0219 *Construction – Roadways – Road openings and restorations for utilities* (2007).

  For Streets Opening Conference enquiries, contact The Secretariat, Institute of Public Works, Engineering Australia (NSW Division)
  Phone 02 9267 6677 Fax 02 9283 5255 email ipwea@ipwea.org.au

  For AUS–SPEC enquiries contact: Manager Specifications, Standards Australia,
  286 Sussex Street Sydney NSW 2000. GPO Box 476 Sydney NSW 2001
  Phone 02 8206 6713 Fax 02 8206 6021 email aus-spec@standards.org.au

10.4 LEGISLATION

- *Electricity Supply Act 1995*
- *Electricity (Consumer Safety) Act 2004*
- *Gas Supply Act 1996*
- *Occupational Health and Safety Act 2000*
- *Pipelines Act 1967*
- *Sydney Water Act 1994*
- *Hunter Water Act 1991*
- *Roads Act 1993* and *Road Regulations 1994 (as amended)*
- *Local Government Act 1993*
- *Contaminated Land Management Act 1997*
- *Telecommunications Act 1997.*

11. APPENDIX A – UNDERGROUND ASSET LOCATION CHECKLIST

Worksite location: _____

(street name, cross street, landmarks)

_____

Plans provided by: Dial Before You Dig ☐ Yes ☐ No Contractor ☐ Yes ☐ No
Asset owner ☐ Yes ☐ No

Underground assets located:

Utility (Note Utility from which plans were obtained)	Plans received as per dial before you dig information	Plans current Check dates	Plans indicate assets in vicinity	Assets checked	Pot-holing req'd	Pot-holing done	Stand-by req'd	Site marking completed	(sketch on rear of sheet)
	✓	✓	✓	Y/N	Y/N	Y/N	✓	Y/N	Y/N
Communications									
Electrical									
Water									
Sewerage									
Gas									
Other									
Other									

Sketch worksite and Utility locations on reverse side of page

Additional Comments:

_____

_____

_____

_____

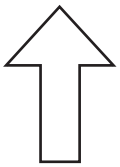
Plans verified and confirm all assets as located? ☐ Yes ☐ No

Person locating asset	**Person carrying out work**
Signed	Signed
Name (Print) ..... Business Name	Name (Print) .....
Date completed checks ...../...../.....	Date received checked results ...../...../..... Completed Checklist and Utility Plans included in job-pack. ☐ **Yes** ☐ **No**

Underground Asset Location Checklist – SAMPLE ONLY

Diagram of UG Assets as located on site

Indicate the north point with an arrow



Drawn by

Name _____

Sign _____

Date _____ / _____ / _____

The above sketch should contain the following details:

- street alignments (where applicable)
- lot boundaries (where applicable)
- name of street and suburb
- north point
- nearest cross street
- distances from relevant assets/boundaries
- depth of cover (only if available)
- signature and name (drawn by).

12. APPENDIX B – WORKERS COMPENSATION INSURANCE

Anyone who employs workers, and in some cases engages contractors, must maintain a current workers compensation insurance policy. Penalties apply for failing to have a current policy in place.

All employers have a legal liability to pay workers compensation to workers who are injured in the course of their work, and employers are required by law to hold a workers compensation insurance policy from a licensed WorkCover insurer to cover that liability.

For workers compensation insurance purposes the *Workplace Injury Management and Workers Compensation Act 1998* (the Act) defines a worker, subject to certain specified exceptions, to mean:

A person who has entered into or works under a contract of service or a training contract with an employer (whether by way of manual labour, clerical work or otherwise, and whether the contract is expressed or implied, and whether the contract is oral or in writing).

In addition, the Act deems certain other persons to be workers for workers compensation purposes, eg some types of contractors.

For assistance in clarifying your obligation, contact your insurer or the WorkCover Assistance Service on **13 10 50**.

13. APPENDIX C – TYPICAL FOOTWAY ALLOCATIONS FOR UTILITY SERVICES AND DEPTH OF COVER IN ROAD RESERVES

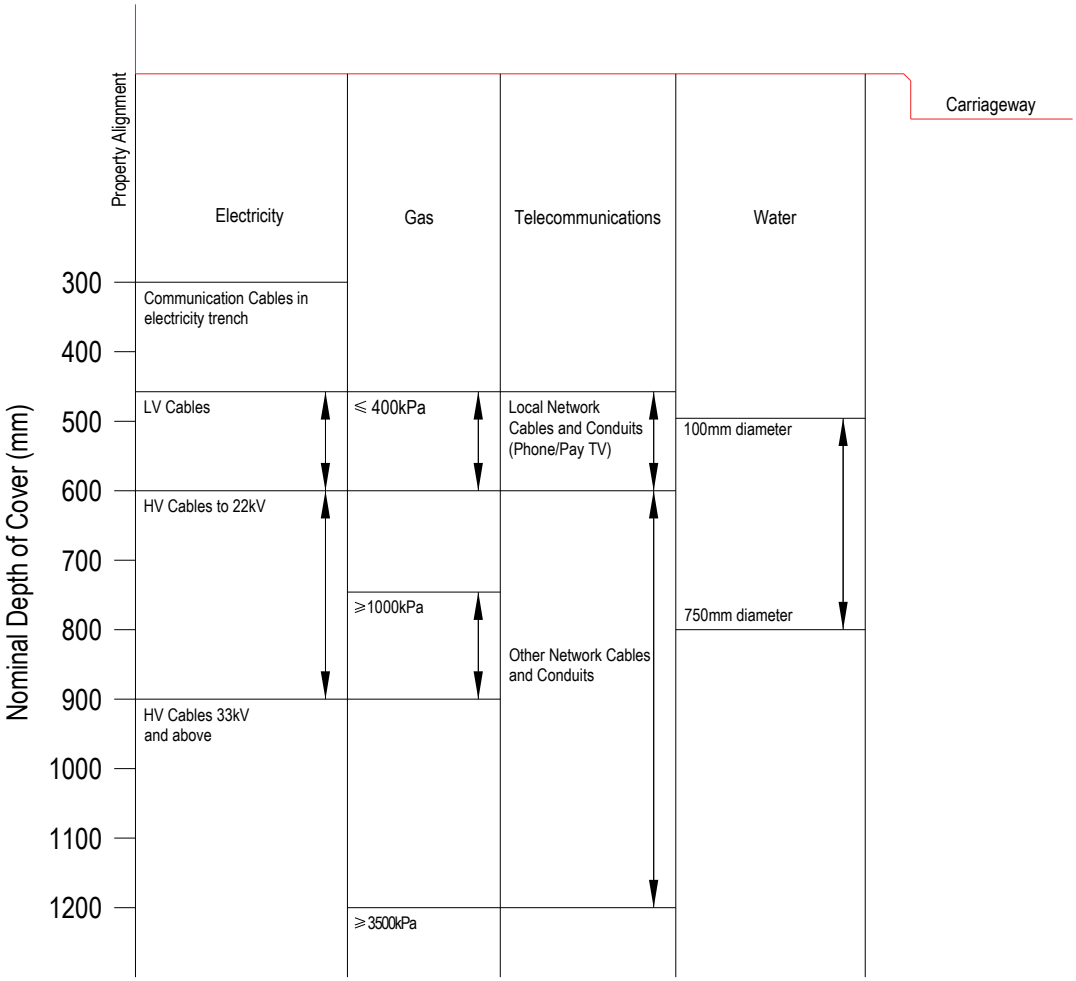
The diagrams in this section have been sourced from the publication entitled *Guide to Codes and Practices for Streets Opening 2007* published by the NSW Streets Opening Conference (SOC). These diagrams are typical examples only, and may not be up-to-date. The current edition of the SOC document should always be consulted prior to undertaking work that impacts on underground services to ensure that the information used is up-to-date.

Source: NSW Streets Opening Conference: Guide to Codes and Practices for Streets Opening 2007

For the purpose of this section, note that sewer lines have not been specifically identified.

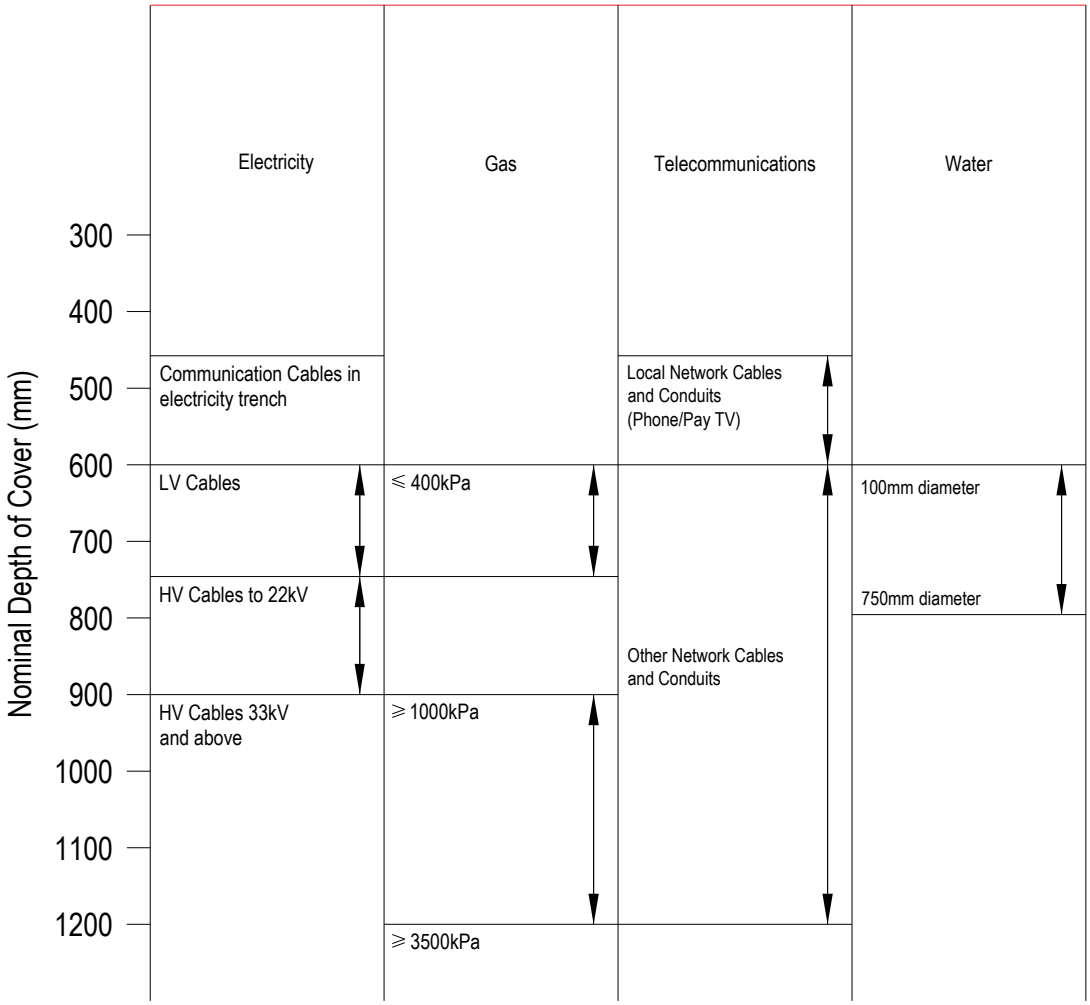
13.1 NOMINAL DEPTH OF COVER OF UTILITY SERVICES IN ROAD RESERVES

13.1.1 In footways



Source: NSW Streets Opening Conference: Guide to Codes and Practices for Streets Opening 2007

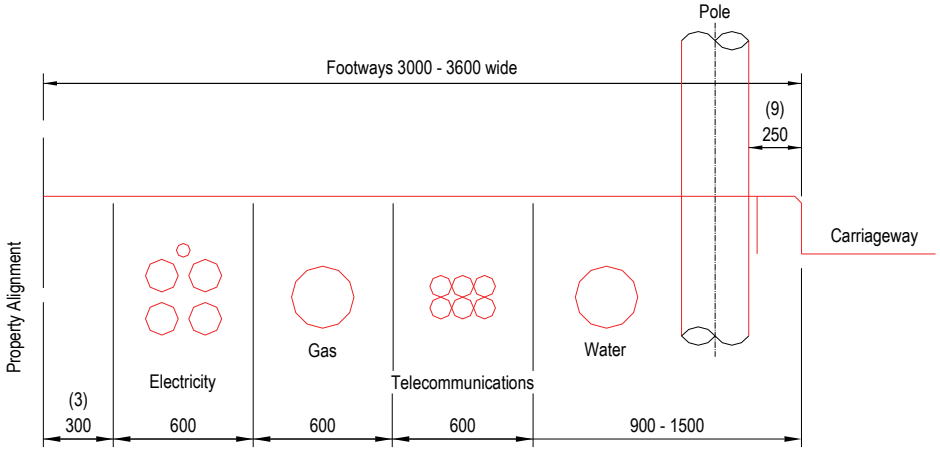
13.1.2 In carriageways

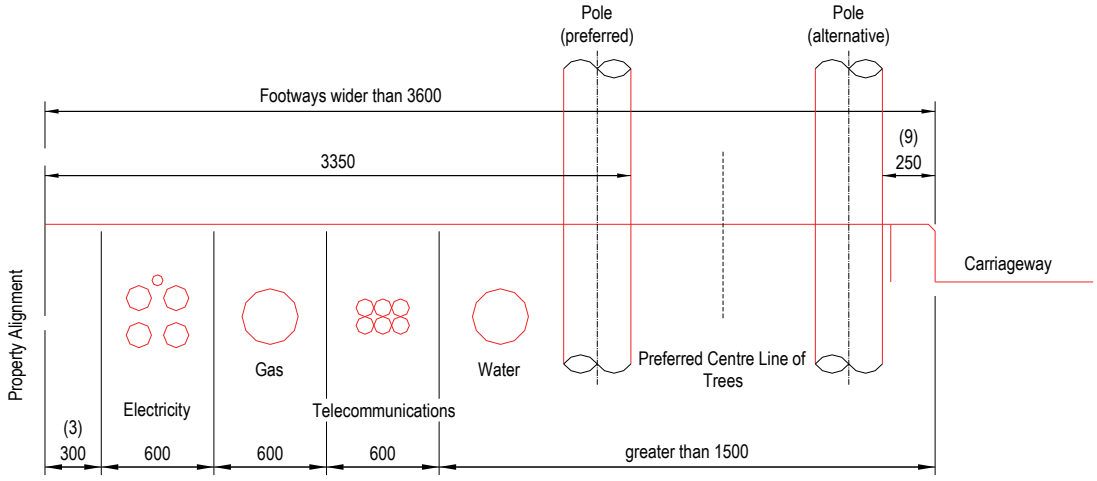


Source: NSW Streets Opening Conference: Guide to Codes and Practices for Streets Opening 2007

13.2 UTILITY/SERVICE PROVIDER ALLOCATION OF SPACE IN FOOTWAYS

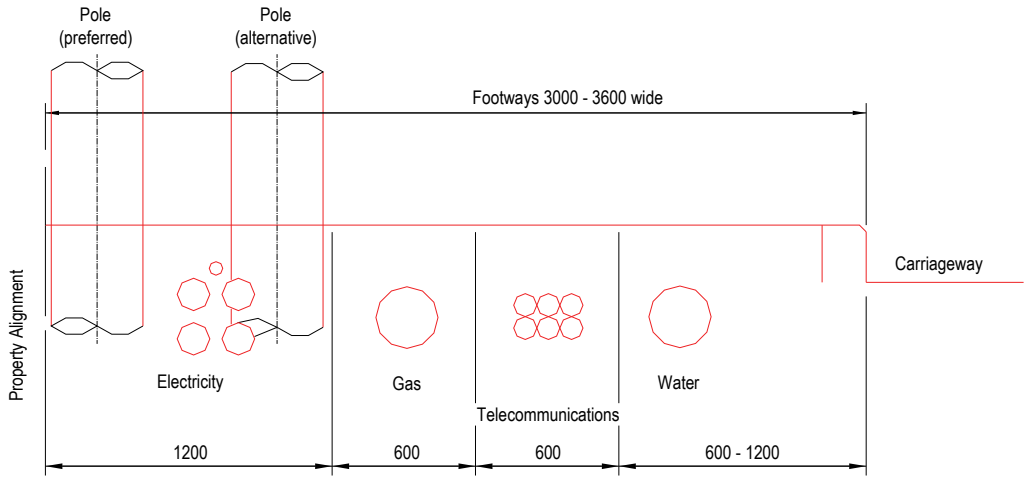
13.2.1 Streets dedicated prior to 1 January 1991

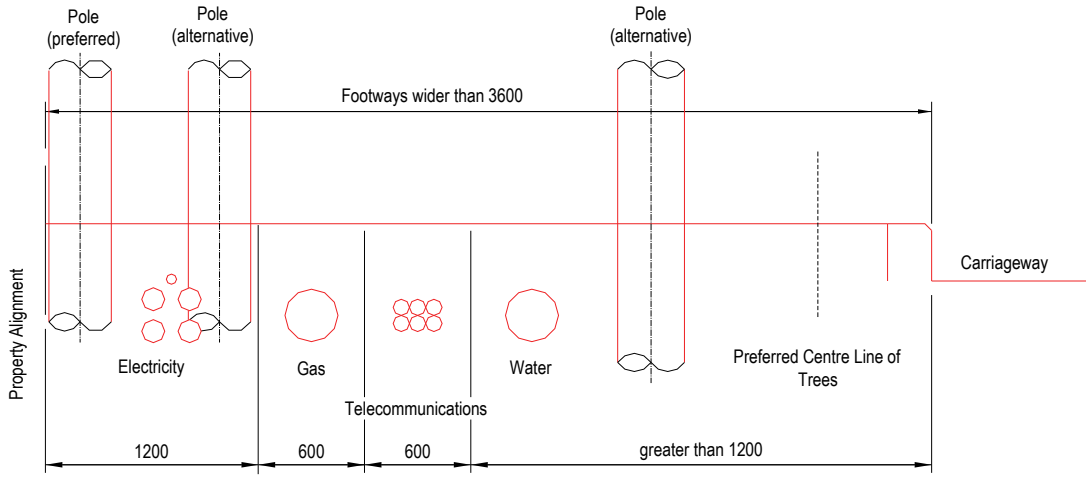




Source: NSW Streets Opening Conference: Guide to Codes and Practices for Streets Opening 2007

13.2.2 Streets dedicated after 1 January 1991





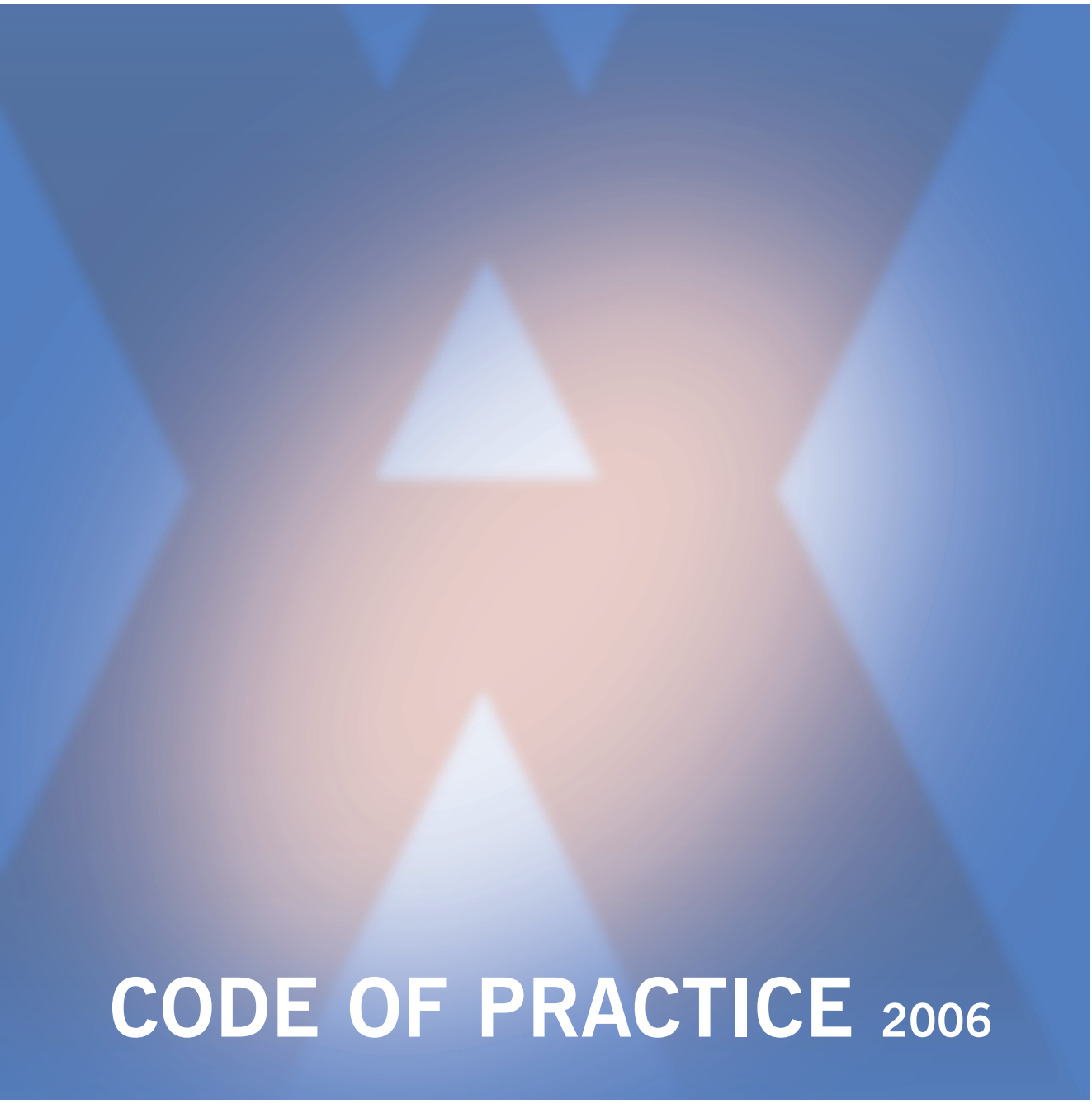
Source: NSW Streets Opening Conference: Guide to Codes and Practices for Streets Opening 2007

Catalogue No. **WC01419** WorkCover Publications Hotline **1300 799 003**

WorkCover NSW 92-100 Donnison Street Gosford NSW 2250
Locked Bag 2906 Lisarow NSW 2252 WorkCover Assistance Service **13 10 50**
Website **www.workcover.nsw.gov.au**

WorkCover
NEW SOUTH WALES

WORK NEAR
OVERHEAD POWER LINES



CODE OF PRACTICE 2006

WorkCover. **Watching out for you.**

New South Wales Government

CONTENTS

WHAT IS AN INDUSTRY CODE OF PRACTICE?

An approved industry code of practice is a practical guide to employers and others who have duties under the *Occupational Health and Safety Act 2000* (OHS Act) and the *Occupational Health and Safety Regulation 2001* (OHS Regulation) with respect to occupational health, safety and welfare.

An industry code of practice is approved by the Minister administering the OHS Act. It comes into force on the day specified in the code or, if no day is specified, on the day it is published in the NSW Government Gazette. An approved industry code of practice may be amended from time to time (or it may be revoked) by publication in the Gazette.

An approved industry code of practice should be observed unless an alternative course of action that achieves the same or a better level of health, safety and welfare at work is being followed.

An approved industry code of practice is intended to be used in conjunction with the requirements of the OHS Act and the OHS Regulation but does not have the same legal force. An approved industry code of practice is advisory rather than mandatory. However, in legal proceedings under the OHS Act or OHS Regulation, failure to observe a relevant approved industry code of practice is admissible in evidence to establish an offence under the OHS Act or OHS Regulation.

A WorkCover Authority inspector can draw attention to an approved industry code of practice in an improvement or prohibition notice as a way of indicating the measures that could be taken to remedy an alleged contravention or non-compliance with the OHS Act or OHS Regulation. Failure to comply with an improvement or prohibition notice without reasonable excuse is an offence.

In summary an approved **INDUSTRY CODE OF PRACTICE**:

- ✓ gives practical guidance on how health, safety and welfare at work can be achieved;
- ✓ should be observed unless an alternative course of action that achieves the same or a better level of health, safety and welfare in the workplace is being followed;
- ✓ can be used in support of the preventive enforcement provisions of the *Occupational Health and Safety Act*;
- ✓ can be used to support prosecutions for failing to comply with or contravening the OHS Act or OHS Regulation.

PREFACE

The aim of this code of practice is to protect the health and safety of persons from the risks arising when they are working near overhead power lines and associated electrical apparatus. It provides practical advice on implementing the requirements of the *Occupational Health and Safety Act 2000* and the *Occupational Health and Safety Regulation 2001*.

This code of practice provides practical guidance on the risk control measures, competency requirements and approach distances for workers working near overhead power lines. It applies to people with varying levels of qualification, training or knowledge.

This code of practice will assist employers, self-employed persons, employees, contractors and other parties involved in managing electrical risks associated with work near overhead power lines.

Use this code of practice to assess the effectiveness of your present arrangements when working near overhead power lines, and to check that all risks have been identified, assessed and eliminated or controlled.

This code of practice has been developed in consultation with members of the NSW electricity supply industry, including relevant unions and employer bodies. It is based on the earlier Electricity Association of N.S.W publication, *Interim Guide for Operating Cranes & Plant in Proximity to Overhead Power Lines*, and the Australian Standard *AS 2550.5 – 2002 Cranes, hoists and winches – Safe use Part 5: Mobile and Vehicle Loading Cranes*, which was gazetted as an approved industry code of practice on 21 September 2001 in the *Code of Practice: Technical Guidance*. In the event of any inconsistencies between the Standard and this code, the code shall prevail.

WHAT IS WORK NEAR OVERHEAD POWER LINES?

There are legislative obligations on employers, self-employed persons and controllers of premises in regard to undertaking work in close proximity, or at an unsafe distance, to overhead power lines. The term ‘near’ is utilised as a reference point for persons planning and undertaking this work.

Work ‘near’ overhead power lines means a situation where there is a reasonable possibility of a person, either directly or through any conducting medium, coming closer than the approach distances specified in this code. For the purposes of this code the term ‘near’ can be interchanged with other legislative or commonly used industry terms ie ‘close proximity’, ‘unsafe distance’ or ‘in the vicinity of’.

PERSONNEL WORKING NEAR OVERHEAD POWER LINES

This code of practice is based on the assumption that without appropriate technical knowledge and experience of electricity distribution networks and associated electrical apparatus, untrained personnel working or operating cranes or plant near overhead power lines will not be able to identify the operating voltage concerned, and will therefore not be able to recognise and avoid the inherent dangers of live overhead power lines. These personnel are termed ***ordinary persons***.

The approach distances specified in this code of practice take account of differing levels of technical knowledge, and are substantially greater for ordinary persons than for personnel who have been trained and assessed as having the necessary technical knowledge. These personnel are termed **accredited persons**.

HOW CAN WORKING NEAR LIVE OVERHEAD POWER LINES BE DANGEROUS?

Overhead power line contact is one of the largest single causes of fatalities associated with mobile plant and equipment.

Contact with live overhead power lines is a serious risk because any voltage that causes sufficient current to pass through the heart is potentially injurious or even fatal.

Contact with live electricity can also cause serious burns arising from the discharge of electrical energy. Other risks include fires and explosions that may immobilise the equipment involved.

You don't have to have a direct contact with a high voltage overhead power line to receive a fatal electric shock. ***Simply being too close can kill***.

WHAT DO THE SYMBOLS IN THE CODE OF PRACTICE MEAN?

To help you work out what you require, a number of symbols are used to highlight things you need to take into account and tools to help you do the job.

Consult and communicate with employers

Legal obligations that must be followed

The process of finding things that cause harm, working out how big a problem they are and fixing them.

Assess the risks in your workplace

Tools that can help you work out your plan

ACKNOWLEDGEMENT

In developing this code of practice WorkCover NSW has drawn on information contained in a number of codes of practice and industry guidelines issued by other State regulators or organisations. WorkCover NSW acknowledges the following publications, which have been incorporated in parts of this code.

- *Code of practice – Working near exposed live parts* – Queensland, Department of Industrial Relations, and
- *Framework for undertaking work near overhead and underground assets* – WorkSafe, Victoria, and
- *NENS 04-2003 National guidelines for safe approach distances to electrical apparatus* – Energy Networks Association.

CHAPTER 1 – ESTABLISHMENT

1.1 Title

This is the Code of Practice – Work near Overhead Power Lines.

1.2 Purpose

This code of practice provides practical guidance in order to protect the health and safety of persons working near overhead power lines and associated electrical apparatus. It provides guidance on the risk control measures, competency requirements and approach distances to live electrical conductors, including no go zones for cranes and plant (and their loads), as well as for vehicles, individuals and hand-held tools. It applies to persons with varying levels of qualification, training or knowledge.

This code of practice should be used instead of the *Interim Guide for Operating Cranes and Plant in Proximity to Overhead Power Lines – ISSC 26* issued by the Electricity Association of NSW in September 2001.

1.3 Scope

This code of practice applies to work, which is carried out near overhead power lines and associated electrical apparatus excluding:

- work on electricity network assets where the work is carried out in accordance with the requirements of the *Electricity Supply (Safety and Network Management) Regulation 2002* and the work is either:
    - by or for an electricity network operator, or
    - by an accredited service provider, or
    - by a telecommunications network operator.
- mobile plant or vehicles operating on a public road where the design envelope is not greater than the transit envelope and is in any case not greater than 4.6 metres in height (eg a side loading waste collection vehicle collecting waste bins from the side of a public road under overhead power lines);
- when the crane or item of plant is correctly stowed for travelling on a public road;
- work on a mine site;
- work involving low flying aircraft (eg crop dusting, pesticide or herbicide spraying, etc);
- work carried out by emergency services personnel, including state emergency service, fire, police, volunteer rescue association and ambulance personnel during a declared emergency or other local emergency incident. In this situation the agency should advise the network operator of the circumstances of the emergency work and ensure a safe system of work is applied by those emergency services personnel undertaking the work.

This Chapter 1 is introductory, describes the purpose of this code, and provides definitions. Chapter 2 explains the regulatory principles in the occupational health and safety legislation, which this code is intended to complement. Chapter 3 describes a framework for work near overhead power lines by outlining general risk management principles, competency requirements and approach distances for the work. More detailed risk management requirements for specific workplace activity are set out in Chapters 4 to 9 inclusive.

1.4 Authority

This is an industry code of practice approved by the Minister for Commerce, under section 43 of the *Occupational Health and Safety Act 2000*, on the recommendation of the WorkCover Authority of New South Wales ('WorkCover NSW').

1.5 Commencement

This code takes effect on [Gazettal /date]

1.6 Interpretation

1.6.1 Recommended practices

Words such as 'should' indicate recommended courses of action. 'May' or 'consider' indicate a possible course of action the duty holder should consider. However, you may choose an alternative method of achieving a safe system of work. For a further explanation, see 'What is an industry code of practice'.

1.6.2 Legal obligations

Words such as 'must', 'requires' and 'mandatory' indicate obligations, which must be complied with. Failure to comply with the code can be used as evidence in proceedings for an offence against the OHS Act or OHS Regulation (where the code is relevant to any matter, which it is necessary for the prosecution to prove to establish the commission of the offence).

1.7 Applicable legislation

Consult the OHS Act and the OHS Regulation for the specific legal requirements regarding occupational, health and safety responsibilities for work near overhead power lines.

Specific responsibilities:

Clause 41(4) of the OHS Regulation requires a controller of premises to ensure that persons working in, or undertaking maintenance on, the premises (apart from those undertaking electrical work) are prevented from coming within an unsafe distance from any overhead power lines or live electrical installations unless a risk assessment determines otherwise.

Clause 64(2)(e) of the OHS Regulation requires employers to ensure that persons at work, their plant, tools or other equipment and any materials used in or arising from the work do not come into close proximity with overhead electrical power lines (except if the work is done in accordance with a written risk assessment and safe system of work and the requirements of the relevant electricity supply authority).

Other significant legislation:

The *Electricity Supply (Safety and Network Management) Regulation 2002*, which is administered by the Department of Energy, Utilities and Sustainability, requires that a person must not carry out work on or near a network operator's transmission or distribution system and a network operator must not allow a person to carry out work on or near its transmission or distribution system unless the person is qualified under the relevant requirements of the network operator's network management plan, to carry out the work; and the work is carried out in accordance with the relevant requirements of that plan.

1.8 Definitions

The following definitions are used for the purposes of this code of practice:

access authority means a written authorisation, issued by a network operator, which allows persons to work within the no-go zone.

accredited person means a person who has successfully completed a recognised training course relating to work near overhead power lines that has been conducted by a registered training organisation.

accredited service provider means a person who has been accredited by the Department of Energy, Utilities and Sustainability to undertake work on the electricity network.

approach distance means the minimum separation in air from an exposed overhead conductor that must be maintained by a person, or any object held by or in contact with that person. **Note:** Refer to Chapter 3 for relevant approach distances.

approved means approved in writing. This can be achieved by any, or a combination, of the following:

- providing a paper document;
- sending a facsimile;
- other equivalent means (eg e-mail).

authorised person means a person with technical knowledge or sufficient experience who has been approved by the network operator.

authorised representative of an industrial organisation of employees means an officer of that organisation who is authorised under the *Industrial Relations Act 1996*.

competent person for any task means a person who has acquired through training, qualification, experience, or a combination of them, the knowledge and skills to carry out the task.

conductor means a wire, cable or form of metal designed for carrying electric current.

construction work means any of the following:

(a) excavation, including the excavation or filling of trenches, ditches, shafts, wells, tunnels and pier holes, and the use of caissons and cofferdams,

(b) building, including the construction (including the manufacturing of prefabricated elements of a building at the place of work concerned), alteration, renovation, repair, maintenance and demolition of all types of buildings,

(c) civil engineering, including the construction, structural alteration, repair, maintenance and demolition of, for example, airports, docks, harbours, inland waterways, dams, river and avalanche and sea defence works, roads and highways, railways, bridges and tunnels, viaducts, and works related to the provision of services such as communications, drainage, sewerage, water and energy supplies.

control measures measures taken to minimise a risk to the lowest level reasonably practicable.

crane	means an appliance intended for raising or lowering a load and moving it horizontally, and includes the supporting structure of the crane and its foundations, but does not include industrial lift trucks, earth moving machinery, amusement devices, tractors, industrial robots, conveyors, building maintenance equipment, suspended scaffolds or lifts.
de-energised	means not connected to any source of electrical supply but not necessarily isolated.
earthed	means directly electrically connected to the general mass of earth so as to ensure and maintain the effective dissipation of electrical energy.
earth moving machinery	means an operator controlled item of plant used to excavate, load or transport, compact or spread earth, overburden, rubble, spoil, aggregate or similar material, but does not include a tractor or industrial lift truck.
electrical apparatus	means any electrical equipment, including overhead power lines and cables, the conductors of which are live or can be made live.
electricity network	means transmission and distribution systems consisting of electrical apparatus which are used to convey or control the conveyance of electricity between generators' points of connection and customers' points of connection. **Note:** Overhead power lines on private property come under the control of the controller of the premises.
elevating work platform	means a telescoping device, scissor device or articulating device, or any combination of those devices, used to move personnel, equipment or materials to and from work locations above the support surface.
envelope	means the space encapsulating a plant item, including attachments such as rotating / flashing lights or radio aerials and is categorised as: **Design:** the space encapsulating all possible movements of the plant and any load attached under maximum reach. **Transit:** the area encompassing the normal height and width of a vehicle or plant when traveling to or from a worksite.
employee	means an individual who works under a contract of employment or apprenticeship.
employer	means a person who employs persons under contracts of employment or apprenticeship. **Note:** In some chapters of the OHS Regulation, the term 'employer' includes a self-employed person in relation to duties to other persons. See the definition of 'employer' in clause 3 of the OHS Regulation.
energised	means connected to a source of electrical supply.
exposed conductor	an electrical conductor that is hazardous because it has not been protected by a barrier of rigid material or by insulation that is adequate for the voltage concerned, under a relevant Australian Standard specification.
hazard	means anything (including work practices and procedures) that has the potential to harm the health or safety of a person.

high-risk construction work	means any of the following construction work, • involving structural alterations that require temporary support • at a height above 3 metres • involving excavation to a depth greater than 1.5 metres • demolition work for which a licence is not required • in tunnels • involving the use of explosives • near traffic or mobile plant • in or around gas or electrical installations • over or adjacent to water where there is a risk of drowning.
high voltage (HV)	means a nominal voltage exceeding 1,000 V a.c. or exceeding 1,500 V d.c.
hoarding	for the purposes of this code is containment sheeting positioned on the external face of a scaffold that serves as a physical barrier between a worker and live overhead power lines and associated electrical apparatus.
insulated	means separated from adjoining conducting material by a non-conducting substance which provides resistance to the passage of current, or to disruptive discharges through or over the surface of the substance at the operating voltage, and to mitigate the danger of shock or injurious leakage of current.
Interim Guide	means the *Interim Guide for Operating Cranes and Plant in Proximity to Overhead Power Lines – ISSC 26* issued by the Electricity Association of NSW.
isolated	means disconnected from all possible sources of electricity supply by means which will prevent unintentional energisation of the apparatus and which is assessed as a suitable step in the process of making safe for access purposes.
live	means connected to any source of electrical supply or subject to hazardous induced or capacitive voltages.
low voltage (LV)	means a nominal voltage exceeding 50 V a.c. or 120 V d.c. but not exceeding 1000 V a.c. or 1500 V d.c.
LV – ABC (Aerial Bundled Cable)	means an insulated cable system used for low voltage overhead distribution of electricity that is manufactured in accordance with the Australian Standard, AS/NZS 3560.
mobile crane	means a crane capable of travelling over a supporting surface without the need for fixed runways (including railway tracks) and relying only on gravity for stability, that is, with no vertical restraining connection between itself and the supporting surface and no horizontal restraining connection (other than frictional forces at supporting-surface level) that may act as an aid to stability.

mobile plant	includes plant that: (a) moves either under its own power, or is pulled or pushed by other mobile plant (b) moves on or around the work site, enters or leaves the site, or moves past the site (c) includes road vehicles operating at a worksite **Note:** This definition has been adopted for the purposes of this code of practice. This includes items such as earthmoving machinery, concrete boom pumps and tipper trucks operating at a worksite.
near	means a situation where there is a reasonable possibility of a person, either directly or through any conducting medium, coming closer than the relevant approach distances specified in this code.
network operator	means the owner, controller or operator of an electricity network also known as an electricity supply authority.
no go zone	means the area around overhead power lines into which no part of a person or material or cranes or vehicles or items of mobile plant may encroach without the approval of the network operator. **Note:** • person includes hand tools, equipment or any other material held by a person. • plant includes the load, controlling ropes and any other accessories.
occupier	of premises includes: (a) a person who, for the time being, has (or appears to have) the charge, management or control of the premises, or (b) a person who, for the time being, is in charge (or appears to be in charge) of any operation being conducted on the premises.
operating voltage	means the a.c. voltage (phase to phase RMS) or d.c. voltage by which a system of supply is designated.
ordinary person	means a person without sufficient training or experience to enable them to avoid the dangers which overhead power lines and associated electrical apparatus may create.
overhead power line	means any bare or covered aerial conductors and other associated electrical parts that make up an aerial line for the distribution and transmission of electrical energy.
personal protective equipment (PPE)	items that workers can use to protect themselves against hazards. PPE includes insulating gloves, mats or sheeting, glasses and face protection. **Note:** A number of items of PPE are made and tested to Australian Standards. PPE that is not designated as meeting a recognised Standard may be unreliable in service, as its performance is unknown.

place of work	means premises where persons work.
plant	includes any machinery, equipment or appliance. **Note:** For the purposes of this code the definition includes a broad range of machinery and equipment, but not limited to, cranes, mobile plant, scaffolding, load shifting equipment, industrial lift trucks, earth moving machinery, amusement devices, tractors, rural machinery, vehicles, conveyors, building maintenance equipment, suspended scaffolds or lifts, implements or tools and any component or fitting of those things.
premises	includes any place, and particularly includes: • any land, building or part of a building • any vehicle, vessel or aircraft, or • any installation on land, on the bed of any waters or floating on any waters, or • any tent or movable structure.
OHS Act	means the *Occupational Health and Safety Act 2000*.
OHS Regulation	means the *Occupational Health and Safety Regulation 2001*.
safety observer	means an accredited person specifically assigned the duty of observing and warning against unsafe approach to overhead power lines and associated electrical apparatus, or other unsafe conditions.
safe work method statement (SWMS)	means a statement that: • describes how the work is to be carried out • identifies the work activities assessed as having safety risks • identifies the safety risks; and • describes the control measures that will be applied to the work activities, and includes a description of the equipment used in the work, the standards or codes to be complied with, the qualifications of the personnel doing the work and the training required to do the work.
self-employed person	means a person who works for gain or reward otherwise than under a contract of employment or apprenticeship, whether or not they employ others.
tiger tails	means pipe type cable covers, used as a warning to visually indicate the position of overhead power lines. **Note:** A tiger tail is also known as a torapoli pipe.
vehicle	means a truck (non tipping), car or utility, or other general purpose conveyance used for the carriage of persons, materials or goods.
voltage	means a potential difference between conductors or between conductors and earth.
work	means work as an employee or as a self-employed person.

CHAPTER 2 – CONSULTATION AND RISK MANAGEMENT

The OHS Act and the OHS Regulation require employers to address workplace health and safety through a process of risk management and consultation.

To effectively implement this code, employers need to be aware of these requirements and have procedures in place to apply them. Employers are advised to consult the OHS Act and the OHS Regulation as well as the *Code of Practice: Occupational Health and Safety Consultation* and the *Code of Practice: Risk Assessment* for details of these requirements and how they can be met. The following information is designed to provide an overview of legislative requirements.

The OHS Regulation requires employers (and self-employed persons) to identify hazards and to ensure that any risk of injury from electricity at a place of work is eliminated, or if elimination is not reasonably practicable, the risk is controlled.

Other legislative requirements particularly relevant to this code are clause 64 of the OHS Regulation, which requires that employers must ensure that persons at work, their plant, tools or other equipment and any materials used in or arising from the work do not come into close proximity with overhead power lines.

Controllers of premises also have obligations under section 10 of the OHS Act and clause 41 of the OHS Regulation for work that is carried out near overhead power lines.

This code of practice provides guidance on ensuring these requirements are met and should be implemented within a risk management framework. Risk management is a way of organising your efforts to determine safe systems of work. Following this procedure will help you identify the safety issues for work that is to be carried out near overhead power lines.

The following information is designed to provide an overview of:

- consultation
- risk management
- information, instruction, training and supervision

2.1 Consultation at the workplace

Employers must consult with employees when taking steps to assess and control workplace risks.

In order to consult with employees, employers are required to set up consultation arrangements and develop consultation procedures.

2.1.1 Consultation arrangements

The OHS Act provides three options for consultation arrangements under sections 16 and 17:

Arrangement	Number of employees	Requirement
OHS committee	20 or more employees	• requested by a majority of employees, or • directed by WorkCover
OHS representative	any size	• at least one employee requests an election, or • directed by WorkCover
Other agreed arrangements	any size	agreed to by both the employer and employees (in a small workplace it may be a regular safety meeting with employees)

Before using this code, an employer should ensure that consultation arrangements are in place. An employer may initiate the establishment of an OHS Committee or the election of an OHS Representative if the employees have not made such a request. When the consultation arrangements have been decided, clause 27 of the OHS Regulation requires employers to record them and advise all existing and new employees.

2.1.2 Consultation procedures

After setting up the consultation arrangements, employers need to consider when and how these consultation arrangements need to be applied.

2.1.3 When should consultation be undertaken?

Under section 13 of the OHS Act, employers have a general duty to consult employees when decisions are being considered that may affect their health, safety and welfare at work. Therefore, employers are required to consult with their OHS Committee, OHS representative or other agreed arrangement when such decisions are being considered. Decisions, which could affect health, safety and welfare for work near overhead power lines include:

- eliminating or controlling risks to health and safety from work
- assessing, reviewing and monitoring risks to health and safety from work
- planning, designing or changing work tasks or jobs
- purchasing new plant and equipment or substances
- using contractors at the workplace
- investigating incidents or accidents
- developing emergency procedures
- determining or reviewing consultation arrangements

Note: Any procedures that are developed to encompass these activities should incorporate consultation.

It may not be practical or reasonable to involve the OHS committee or the OHS representative in every decision. However, the employers or committee or representatives should agree on what process is needed to ensure that affected employees are consulted.

2.1.4 How should consultation be undertaken?

When engaged in consultation, section 14 of the OHS Act requires employers to:

- Share all relevant information with employees – for example, if an employer is going to change a work task, employees need to be told of any risk to health and safety that may arise and what will be done to eliminate or control these risks.
- Give employees reasonable time to express their views – employees need adequate time to assess the information given to them, obtain relevant safety information and consult with fellow employees to enable them to form their views.
- Value the views of employees and take into account when the decision is made to resolve the matter – in many cases, agreement will be reached on how the safety issues are to be addressed. When agreement cannot be reached, the employer should explain how the employee's concerns have been addressed.

2.2 Risk management at the workplace

Employers and self-employed persons must identify any foreseeable hazards, assess their risks and take action to eliminate or control them. Employees must be consulted as part of this process.

A hazard identification and risk assessment process must be carried out at the planning and preparation stage by the employer/contractor, in consultation with the persons doing the work near overhead power lines to determine what risks may arise when the work is being carried out. Safe systems of work must then be put in place to eliminate or control these risks. **Note:** For some work activities carried out near overhead power lines the safe system of work must also be documented in a safe work method statement. Refer to section 2.4.1.

The process of risk assessment and control is made up of the following steps:

- identify the hazards
- assess the risk(s) to the health and safety of persons arising from the hazards
- use appropriate control measures to eliminate or control the risk(s)
- monitor and review the control measures to ensure on-going safety.

2.2.1 Identify hazards

To ensure a safe and healthy workplace, employers must take reasonable care to identify all the foreseeable health and safety hazards, which could harm their employees or other persons in the workplace. Hazards may arise from the work process, the equipment and materials in use, the work environment, or other people involved.

Live overhead power lines are a potential hazard posing substantial risk of death or serious injury. In addition to electrical shock and electrocution, contact with overhead power lines, can result in:

- the electrifying of other objects such materials, tools and items of plant, with the potential for electric shock or electrocution;
- a rain of molten metal caused by contact between an energised conductor and another conducting medium;
- fire;

- explosion; or
- swift, unpredictable power line whiplash.

2.2.2 Assess risks

Once hazards have been identified, the risk they pose to health and safety needs to be assessed. Some hazards pose a greater risk than others do, and the frequency and duration of exposure can also affect the risk. Risk assessment involves considering the likelihood and severity of injury or illness being caused by exposure to the risk. Therefore the factors that need to be considered in a risk assessment should include the:

- harm that can be caused by exposure to the hazard
- number of people and the duration and frequency of exposure to the hazard
- capability, skill and experience of people exposed to the hazard.

The risk assessment process provides information on the factors, which contribute to the risk. This information will assist in determining what needs to be done to eliminate or control the hazard.

2.2.3 Eliminate or control the risk

The OHS Regulation prescribes the following hierarchy of controls that must be used to eliminate or control a risk to health and safety in the workplace. Refer to the following chapters of this code of practice to see how this must be applied to work near overhead power lines. In particular, consider the following:

Level 1: Eliminate the hazard by:

- discontinuing the work activity or arranging for the de-energising of the overhead power lines during the work or re-routing the overhead power lines away from the work activity.

Level 2: Minimise the risk by:

- substituting the system of work or plant (with something safer that does not come near the overhead power lines). This could mean using an alternate crane or mobile plant, which cannot encroach the approach distances specified in this code.
- separating the hazard. This could mean erecting a physical barrier to prevent a person or anything held by a person, or attached to the person, coming near the overhead power lines.
- introducing engineering means. This could mean substituting with a less hazardous process or modifying an item of plant or equipment to ensure it does not come near the overhead power lines.
- adopting administrative controls, by example, signage, warning barriers marking the worksite, safe work procedures such as maintaining a safe distance from overhead power lines and using a safety observer to warn people before they encroach the approach distances specified in this code.
- using personal protective equipment (PPE). (eg insulating gloves, safety helmets, eye protection).

The control measures at Level 1 give the best results and should be adopted where possible. The Level 2 measures apply in descending order of effectiveness and require more frequent reviews of the hazards and systems of work. In some situations a combination of control measures may be used such as engineering means and administrative controls.

2.2.4 Review risk assessment and control measures

Control measures should be reviewed on a regular basis. The frequency of their review should be determined by considering the significance of the risks associated with the hazard. However, a review should be undertaken in the following circumstances:

- new information is made available about the risks associated with the hazard
- an accident or incident occurs
- significant changes are proposed to the workplace or work system.

2.3 Information, instruction, training, and supervision

The OHS Act requires employers to provide such information, instruction, training and supervision as may be necessary to ensure the health, safety and welfare of their employees while at work.

Work near overhead power lines should not be performed unless those performing the work have received appropriate instruction and training. For example, the operator of any crane or mobile plant and the safety observer who carry out work within the accredited person zone specified in this code must have received training for work near overhead power lines conducted by a Registered Training Organisation. Refer to Appendix 4.

Employers must provide appropriate supervision and should recognise their supervisor's role in the management of the risks and the protection of employees. Close liaison between supervisors and employees is vital in ensuring the work is carried out in a safe manner.

Supervision of crane and plant operators working near overhead power lines should ensure that the control measures are fully implemented and followed at all times by employees. If you are supervising, it is your responsibility to ensure that the situation is safe for everyone.

The level and extent of supervision required will vary according to the safety aspects of each task and the skills of the worker. In determining the necessary level of supervision, an employer should consider:

- the complexity of the job environment in which the job is being done;
- the hazards at each work site;
- the worker's level of competence, experience and age.

The levels of supervision required for various tasks need to be described in policies and procedures.

2.4 Provision of information

Health and safety information may include:

- the results of any applicable written risk assessment;
- requirements of safe work method statements;
- a review of the written risk assessment and/or safe work method statements and standard operating procedures;
- any other relevant OHS information, such as type test information, documentation and signage.

Persons working near overhead power lines should always have, on request, access to written risk assessments and safe work method statements at the work site. Employers should brief employees and other workers as to the contents of written risk assessments and safe work method statements when work begins near overhead power lines, at regular intervals thereafter, and whenever there are changes to written risk assessments or new information about health and safety risks becomes available.

The employer should consult with their employees to ensure that such information and training is in a form that is accessible and easily understood. This is important where employees are from a non-English speaking background and/or have special needs or disabilities, and may have specific language or literacy requirements.

2.4.1 Safe work method statements

Chapter 8 of the OHS Regulation requires that safe work method statements (SWMS) be used for high risk construction work.

High-risk construction work may include, for example the following activities that may occur near overhead power lines:

- construction work involving structural alterations that require temporary support;
- construction work at a height above 3 metres;
- construction work involving excavation to a depth greater than 1.5 metres;
- demolition work for which a licence is not required;
- construction work involving the use of explosives;
- construction work near traffic or mobile plant;
- construction work in or around gas or electrical installations.

An example of a safe work method statement is included at Appendix 3 to assist in this.

2.5 Preparation for work to commence

Careful planning and preparation is an essential step to ensure that work is done safely. When preparing for the commencement of work all controls indicated by the risk assessment(s) and safe work method statement(s) as applicable must have been put in place and that no new hazards exist, or have been created.

Preparation should include:

- nature of the work planned and ways of dealing with changes as the work proceeds;
- the possible hazards and risks associated with the work;
- consultation with the network operator;
- communication and interaction between workers at the site;
- training, qualifications and competency of workers;
- checking the operation of plant and equipment, including the operation of limiting devices;
- proximity of persons, cranes, mobile plant, material and tools to overhead powerlines;
- proximity of persons to cranes and mobile plant;
- specific instructions for employees;
- workplace access and egress;
- emergency procedures, including first aid, evacuation and rescue; and
- environmental factors.

CHAPTER 3 – APPROACH DISTANCES WHEN WORKING NEAR OVERHEAD POWER LINES

3.1 Scope

This Chapter introduces a framework for work near overhead power lines. It provides guidance on general risk management principles, competency requirements and approach distances to live electrical conductors, including no go zones for cranes and plant (and their loads), as well as for vehicles, individuals and hand-held tools. It applies to persons with varying levels of qualification, training or knowledge.

This Chapter should be read in conjunction with the following Chapters, which provide risk management requirements for various types of workplace activity, including scaffolding (Chapter 6) and work near low voltage overhead service lines (Chapter 8), which specify a different set of approach distances to those described in this Chapter.

3.2 Basis of approach distances

This code is based on the assumption that without appropriate technical knowledge and experience of electricity distribution networks, workers that have not received training in overhead power line electrical hazards (ordinary persons) will not be able to identify the operating voltage of the live overhead power lines. When working near or operating cranes or plant near live overhead power lines such persons will not be able to recognise and avoid the inherent electrical hazards.

The approach distances specified in this Chapter take account of differing levels of technical knowledge and items of plant, and are substantially greater for ordinary persons than for personnel who are accredited. The approach distances for ordinary persons and accredited persons are based on those specified in the *National Guidelines for Safe Approach Distances to Electrical Apparatus*. In the National Guidelines, the approach distances were derived by –

- determining a distance to avoid electrical flashover; and
- providing additional allowance for inadvertent movements of the person, crane or plant relative to the overhead power lines, or the movement of the overhead power lines relative to the person, crane or plant.

3.2.1 Assessing the relevant approach distance

Prior to the start of any work near overhead power lines it is essential that the height and voltage of the overhead power lines (and if applicable the horizontal safety clearance) be assessed at the worksite. When assessing the relevant approach distances for the work a number of factors must be taken into account including,

- the possibility of errors in estimating distances, especially at higher voltages, where the approach distance is large. It may be necessary either to allow more clearance or to use methods that provide more accurate estimation of distances, for example, an ultrasonic cable height indicator, which provides a safe and accurate method of estimating distances near overhead power lines. If the height or voltage of the overhead power lines cannot be accurately determined consult the network operator.

WARNING

Do not attempt to directly measure the height of overhead power lines. Do not use conductive metallic objects or measuring devices such as metal tape measures for estimating the height of overhead power lines.

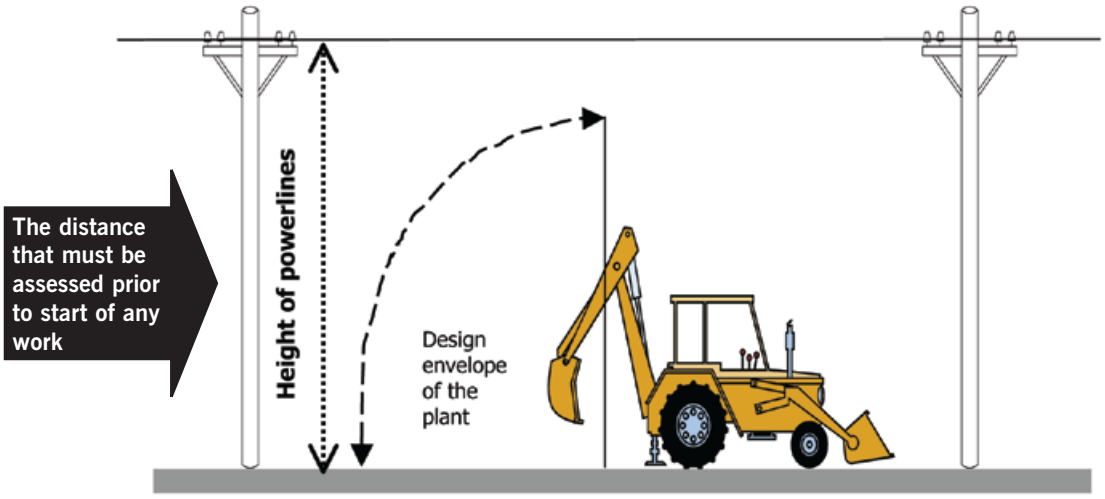


Figure 1: Distance that must be assessed for each worksite

- overhead power lines are made of metal and are therefore subject to expansion and contraction when heated and cooled. This can be a direct result of high ambient air temperature and/or excessive electrical load current passing through the conductors. Regardless of the cause, any expansion will result in gravity causing the power lines to sag downwards. Wind can also cause the power lines to swing from side to side. For this reason the approach distances must be increased either vertically or horizontally by the amount of conductor sag or swing at the point of work. Refer to Figure 2.

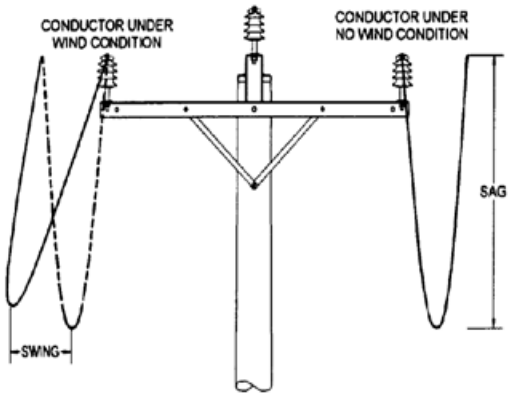


Figure 2: Illustration of overhead power line 'sag or swing'

- where more than one voltage is present, eg overhead power lines where two or more circuits operating at different voltages are supported on the same poles, the approach distance appropriate to each voltage must be maintained independently.
- increased clearances must be allowed where a risk assessment identifies a reasonable possibility of the load or lifting gear (crane hook, chains, slings, etc) moving or swinging towards the overhead power lines or associated electrical apparatus when the crane or item of mobile plant is operated.

3.2.2 Increases to approach distances

It is recognised that certain Australian Standards and industry practice in some States require greater approach distances than those described in this code. For certain types of work or classes of authorisation and competency, greater distances than that described in this code may be appropriate.

For example, the approach distances shown in Table 1 are less than those described in the Australian Standard AS 2550.5 Cranes, hoists and winches – Safe use Part 5: Mobile and Vehicle Loading Cranes, which is also gazetted as an approved industry code of practice. In the event of any inconsistencies between the Australian Standard and this code the approach distances specified in this code shall prevail.

Employers, self-employed persons and controllers of premises should determine the applicability of the approach distances described in this code for particular work circumstances and, if considered appropriate, specify greater approach distances for the work.

3.2.3 How close can I go to overhead power lines?

Once an assessment has been carried out of the worksite and the overhead power lines, a decision can be made on the approach distance for the proposed work. The approach distances and work zones described in this Chapter and illustrated in Figure 3 vary with the voltage of the overhead power lines and the level of accreditation of the person/s performing the work. The relevant approach distances are set out in the following tables:

- Table 1 provides the approach distances for ordinary persons. These are workers who have not received training in overhead power line electrical hazards and are restricted to work in the ordinary person zone. Refer to Section 3.3 and Figure 3.
- Table 2 provides reduced approach distances for accredited persons. These are workers who have successfully completed a recognised training course in overhead power line electrical hazards and are therefore permitted to work closer to the overhead power lines in the accredited person zone. Refer to Section 3.4 and Figure 3.
- Table 3 provides the approach distances for vehicles that are driven under overhead power lines. Refer to Section 3.6.

The approach distances vary with the voltage. They apply to:

- any part of a crane or item of mobile plant, including vehicles,
- any load being moved, including the slings, chains and other lifting gear,
- any person working at heights eg from an elevating work platform, scaffold, or other structure, or
- any hand tools, hand control lines, equipment or other material held by a person.

Note: Special approach distances apply for scaffolding work (Chapter 6) and work near low voltage overhead service lines (Chapter 8).

3.3 Ordinary Person Zone

Table 1 provides approach distances for:

- ordinary persons performing work near overhead power lines, (including plant, hand tools, equipment or any other material held by a person); or
- cranes (and their loads) and items of mobile plant operated by an ordinary person near overhead power lines.

Note: Where a written risk assessment determines it necessary, the use of a safety observer should also be considered for work performed by ordinary persons working outside but up to the approach distances specified in Table 1. The duties of the safety observer are described in Section 3.8.

TABLE 1

Approach distances for work performed by Ordinary Persons

Nominal phase to phase a.c. voltage (volts)	**Approach distance (m)**
Up to and including 132,000	3.0
Above 132,000 up to and including 330,000	6.0
Above 330,000	8.0
Nominal pole to earth d.c. voltage (volts)	**Approach distance (m)**
Up to and including +/- 1500 Volts	3.0

Note: Special approach distances apply for scaffolding work (Chapter 6) and work near low voltage overhead service lines (Chapter 8).

3.4 Accredited Person Zone

Table 2 provides approach distances for:

- accredited persons, with a safety observer who are performing work near overhead power lines (including plant, hand tools, equipment or any other material held by a person); or
- cranes (and their loads) and items of mobile plant operated by an accredited person with a safety observer near overhead power lines.

The approach distances in Table 2 are based on

- completion of a written risk assessment prior to the commencement of work,
- application of a safe system of work, which includes the use of a safety observer, and
- if determined by the written risk assessment, consultation with the network operator regarding the proposed work and compliance with any conditions imposed by the network operator for the work.

TABLE 2

Approach Distances for work performed by Accredited Persons, with a Safety Observer

Nominal phase to phase a.c. voltage (volts)	**Approach distance (m)**
Insulated low voltage cables up to 1000, including LV ABC	0.5
Un-insulated low voltage conductors up to 1000	1.0
Above 1000 up to and including 33,000	1.2
Above 33,000 up to and including 66,000	1.4
Above 66,000 up to and including 132,000	1.8
Above 132,000 up to and including 220,000	2.4
330,000	3.7
500,000	4.6
Nominal pole to earth d.c. voltage (volts)	**Approach distance (m)**
Up to +/- 1,500	1.0

Note: Special approach distances apply for scaffolding work (Chapter 6) and work near low voltage overhead service lines (Chapter 8).

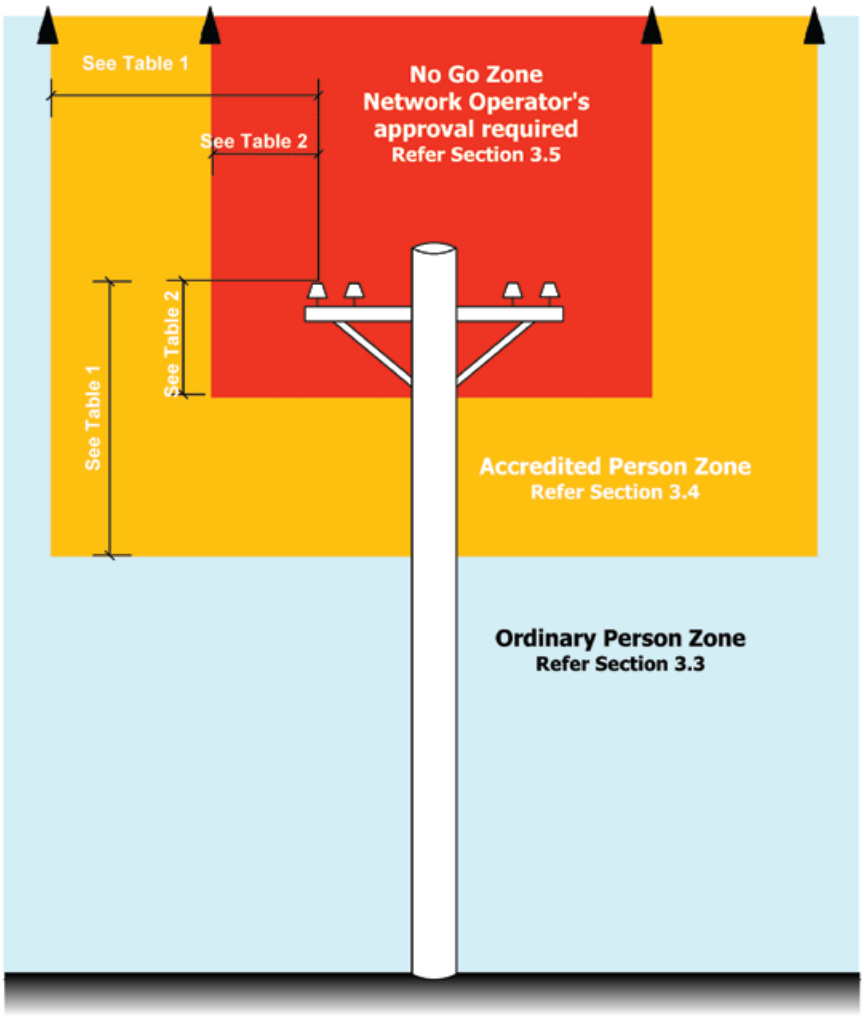


Figure 3 – Approach distances and work zones near overhead power lines

3.5 Work inside the No Go Zone – Approval of the network operator

The no go zone is the area around overhead power lines into which no part of a person or material or cranes or vehicles or items of mobile plant may encroach without the approval of the network operator.

Note:

- person includes hand tools, equipment or any other material held by a person.
- plant includes the load, controlling ropes and any other accessories associated with the plant.

If the work cannot be carried out without coming inside the no-go zone (closer than the approach distances listed in Table 2 or above the overhead power lines), prior to commencing work the employer must consult with and obtain the written approval of the network operator.

Note: The written approval should be available at the worksite and be able to be produced to a WorkCover Inspector, Principal Contractor, elected OHS representative, authorised representative or network operator.

3.6 Approach Distances for Vehicles

Table 3 provides approach distances for vehicles, mobile plant stowed for transit or with a design envelope up to an including 4.6 metres in height, which are driven by or operated by persons under overhead power lines.

When assessing the approach distance for a vehicle driven under overhead power lines a number of factors should be taken into account including:

- the approach distances specified in Table 3 are based on the fact that the design or transit envelope of the vehicle does not allow any part of the vehicle to come closer than the approach distances specified. This includes the load, exhaust pipe and attachments such as rotating/flashing lights or radio aerials. Refer to Figure 5 below.

Figure 5: Transit envelope – The maximum overall height of the vehicle

- where a work activity involves a person working from, standing on or walking across the top of a vehicle the relevant approach distance specified in either Table 1 or Table 2 must be maintained. This may include for example the driver of a livestock transporter who may need to access the top of the vehicle to check livestock.
- where, as a result of the work being performed the distance between the conductors and the ground may decrease (for example when constructing a road or levee bank beneath overhead power lines or where the ground level is raised during the work), then the distance between the vehicle must be continually re-assessed to ensure that the relevant approach distances are being maintained.
- any additional assessment factors that may be relevant for the operation of the vehicle as described in section 3.2.1.

TABLE 3

Approach Distances for Vehicles

Nominal phase to phase a.c. voltage (volts)	**Approach distance (m)**
Low voltage conductors up to 1000	0.6
Above LV, up to and including 33,000	0.9
Above 33,000 up to and including 132,000	2.1
Above 132,000 up to and including 220,000	2.9
330,000	3.4
500,000	4.4
Nominal pole to earth d.c. voltage (volts)	**Approach distance (m)**
Up to and including +/- 1500 Volts	0.9

3.7 Work near overhead power lines – General risk management principles

The approach distances set out in this Chapter are only part of an overall safe system of work, which must be implemented by employers and self-employed persons working near overhead power lines and associated electrical apparatus. In implementing a safe system of work consideration should be given to the following risk control measures:

- The employer has in place an effective risk management process, as part of a systematic occupational health and safety management system.
- Appropriate workplace hazard identification and written risk assessments are carried out as required by the OHS Regulation in consultation with the workers performing the work.
- Consultation with the network operator regarding the proposed work and compliance with any conditions imposed by the network operator for the work.
- The approach distances used are appropriate for the levels of accreditation of the workers performing the work. Refer to Sections 3.3 and 3.4
- Operators and other workers are provided with information and instruction about the safety precautions needed and the requirements of this code, as well as appropriate training, supervision and safe work practices and procedures.
- An essential requirement of a safe system of work is that workers are competent to carry out the work concerned. This code specifies the competency requirements (in respect of overhead power line electrical safety awareness) for crane and mobile plant operators and safety observers. Refer to Sections 3.8 and 3.9.
- An effective communication system is in place for the personnel performing the work.
- An effective process is in place to monitor compliance with the adopted risk control measures, safe work practices and procedures for work carried out near overhead power lines and associated electrical apparatus.

3.8 Competence and knowledge of this code

In order to carry out work at distances less than the approach distances specified in Table 1 the following workers must be accredited in accordance with Section 3.9 of this code,

- the operator of a crane,
- the operator of mobile plant (including an elevating work platform),
- a safety observer.

3.8.1 Training and Competence – Accredited Person

Accredited persons such as operators of cranes, mobile plant and elevating work platforms who carry out work closer than the approach distances specified in Table 1 and safety observers who observe the work must have successfully completed an appropriate training course (eg Crane and Plant Electrical Safety Course) relating to work near overhead power lines that has been conducted by a registered training organisation. Refer to Appendix 4 of this code for a training course framework, which is recognised by WorkCover NSW and network operators.

Note: 'Successful completion' includes a satisfactory competency assessment.

The registered training organisation, which provides the training and competency assessment required by this code must provide the person concerned with a statement of attainment or written certification of his/her successful completion of assessment, that has an identifying number particular to that person.

Employers should maintain appropriate training and assessment records for 'accredited persons' and other employees who carry out work near overhead power lines.

3.8.2 Maintenance of competency

The employer of accredited persons must ensure that those persons are either re-assessed or re-trained annually to ensure their on-going competency to perform activities associated with work near overhead power lines.

Re-assessment or re-training must cover as a minimum the knowledge and skills necessary to ensure safe work practices near overhead power lines, approved resuscitation procedures and emergency procedures to be followed in the event of an accident.

Following re-assessment, persons who have failed to maintain competency through the regular on the job application of learnt skills and knowledge must undertake refresher training and competency assessment.

3.9 Safety Observer – General requirements

The safety observer is a person specifically assigned the duty of observing the work near live overhead power lines and associated electrical apparatus in order to –

- warn personnel or the crane or plant operator so as to ensure the approach distances are being maintained, and
- warn of any other unsafe conditions.

The safety observer must –

- be used whenever the work activity is likely to be performed in the Accredited Person Zone.

Note: Where a written risk assessment determines it necessary, the use of a safety observer should also be considered for work outside but up to the Accredited Person Zone.

- be positioned at a suitable location to effectively observe both the overhead power lines and plant;
- be able to immediately and effectively communicate with the operator of the crane or mobile plant, or other personnel if required;
- ensure that all personnel stay outside the specified approach distance (unless performing a rescue in accordance with approved procedures or carrying out a specific task that is described in the safe work method statement eg a crane dogman holding a non-conductive tag line attached to a load suspended from a mobile crane);
- not carry out any other work while acting as a safety observer, which includes the passing of tools, equipment or materials directly to the personnel performing the work;
- not observe more than one work activity at a time; and
- continue to monitor the work activity being carried out and have the authority to suspend the work at any time.

CHAPTER 4 – OPERATING CRANES AND MOBILE PLANT NEAR OVERHEAD POWER LINES

4.1 Scope

In addition to the general requirements described in Chapter 3, this chapter details any variations applicable where a person operates a crane or an item of mobile plant near overhead power lines, including, but not limited to the following items of mobile plant:

- cranes (including mobile cranes and vehicle loading cranes);
- concrete placing booms;
- elevating work platforms (EWPs);
- mobile plant (including truck operators engaged in tipping loads, restraining loads or other associated work);
- load shifting equipment (including forklifts).
- excavation and earthmoving equipment
- high load transportation vehicles

However, the application of this Chapter is not limited to any particular type or class of mobile plant or equipment.

Note: This chapter is not intended to cover cranes and mobile plant when they are retracted and correctly stowed when travelling on a public road or where the design envelope of the crane or item of mobile plant is less than 4.6 metres in height.

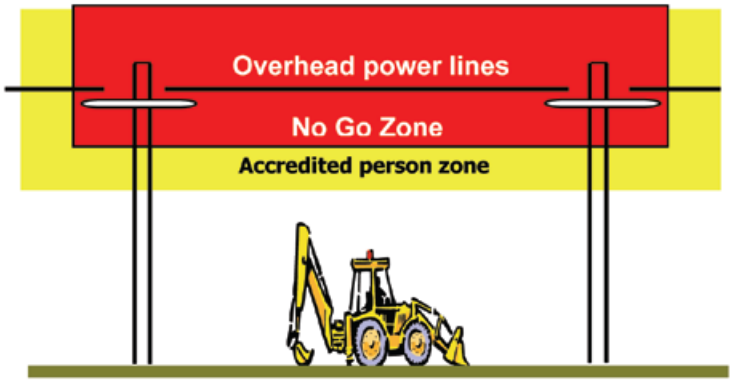
WARNING

For the operation of cranes, mobile plant and other types of load shifting equipment the approach distances specified in this code of practice are greater than those described in the National Certificate of Competency – Assessment Instruments. Where any discrepancy exists between the National Assessment Instruments and this code, the code shall prevail.

4.2 Hazard identification

Before operating a crane or item of mobile plant, the operator or other person in control of the work must take reasonable care to inspect the workplace to identify potential hazards, including any live overhead power lines or other associated electrical apparatus in the vicinity of the workplace.

All overhead power lines should be treated as live unless the operator of the crane or mobile plant has received an access authority or other form of written documentation from the network operator.



Mobile plant including cranes, excavators, EWPs, earth moving machinery, tipper trucks and concrete placing booms whose design envelope is within the approach distances specified in Table 1 must be controlled by safe systems of work as described in this chapter.

Figure 6: Cranes and mobile plant working near overhead power lines

4.3 Risk assessment

Risk assessment involves looking at the:

- likelihood (which is a combination of length of time and frequency of exposure); and the
- likely severity, of any injury or illness that may occur.

If you have identified a hazard involving overhead power lines where it is foreseeable that the work activity, crane or item of mobile plant will be required to or might inadvertently encroach on the approach distances specified for ordinary persons set out in Table 1, a written risk assessment must be completed which considers the following factors:

- consulting the network operator regarding the proposed work;
- can the electricity supply be de-energised?
- the location and voltage of the overhead power lines;
- the number of people involved and their individual needs;
- the nature of work undertaken;
- the nature, size and shape of the load to be moved, eg dimensions, surface area and whether the load is conductive;
- the setting up and packing up processes;
- the safe work practices and procedures in use;
- the type of crane, mobile plant, machinery and equipment to be used and its design envelope;
- site conditions, stability of crane or mobile plant and suspended loads;
- the potential for inadvertent movement of the crane or mobile plant, the load, persons and electrical equipment in the area;
- the qualifications, competency, skill and experience of people doing the work;
- vehicular traffic, pedestrians, or livestock that could interfere with the work;
- prevailing or unexpected wind strength and direction and weather conditions;
- foreseeable abnormal conditions that may exist at the worksite.

Having assessed the risks, action must now be taken to ensure that the risks are eliminated or controlled. Employers need to ensure adequate supervision of workers to make sure that control measures are applied.

Listed below in section 4.4 are steps to consider. Every workplace is different, so select the controls that are the right ones for you.

4.4 Control measures for cranes and mobile plant operating near overhead power lines

The highest practical level of control should be used. This does not preclude the additional use of appropriate lower level controls. In determining the control measures appropriate for a particular task consideration must be given to the terrain and ground conditions, weather conditions, lighting, and other work in the vicinity as well as the nature of the actual task to be carried out.

4.4.1 Elimination

Eliminate the risk of electrocution, electric shock or burns by arranging for the network operator to isolate the electricity supply for the duration of the work. Consideration may also be given, following consultation and agreement of the network operator, to re-route the overhead power lines away from the crane or mobile plant or replace existing overhead powerlines with underground cables.

WARNING

Even if it is believed that the supply has been isolated, it must be assumed that all conductors and components are live until an access authority or other form of written documentation has been received from the network operator.

The employer, self-employed person or operator of the crane or mobile plant should:

(a) discuss options for de-energising or re-routing the electricity supply with the network operator or in the case of work involving private overhead power lines, the person in control of the premises;

(b) consider working at another time when the electricity supply can be isolated; and

(c) investigate whether the section of the overhead power lines that needs to be de-energised can be isolated, while leaving the remainder connected.

4.4.2 Separation

If the risk cannot be eliminated, then separate the hazard from the crane or mobile plant and the personnel by:

(a) using an alternative crane or mobile plant which cannot encroach on the approach distances;

(b) limiting the hoisting, slewing or other movements of the crane or mobile plant such as:

- mechanical stops or interlocking of the motion of the crane or mobile plant to prevent it from being moved by power within the approach distance;
- mechanical constraints on the jib, boom, or other part of the crane or mobile plant likely to contact live overhead power lines or associated electrical apparatus as a result of surge or backlash;
- using cranes or mobile plant fitted with programmable zone limiting devices.

(c) setting up the crane or mobile plant in a position that keeps the design envelope outside the approach distance.

Note: Consideration should be given to any loads suspended by the crane or mobile plant or when being moved by load shifting equipment.

(d) minimising unexpected movement of the crane or mobile plant through:

- additional outriggers, supports or packing to increase the stability of the crane or mobile plant;
- preparation of the ground or surface, or adjustment or servicing of the crane or mobile plant, to minimise surge or backlash;

Increased clearances must also be allowed where there is a reasonable possibility the load or lifting gear (crane hook, chains, slings, etc) moving or swinging towards the overhead power lines or associated electrical apparatus when the crane or item of mobile plant is operated.

(e) providing marking barriers to define areas that the crane or mobile plant should not enter such as by:

- using rigid or tape barriers to mark off areas under overhead power lines;
- arranging for the network operator to mark the limit of the approach distance with high visibility 'bunting' or similar. Refer to Figure 7 below.

Figure 7: Illustration of a visual tape bunting fitted under overhead power lines.

(f) providing electrical separation between the people and hazard in accordance with the guidance outlined in Section 4.5 – Workers in contact with the crane, load or mobile plant.

4.4.3 Administrative controls

Support elimination and separation controls by taking the following precautions:

(a) managing and supervising the work to ensure that:

- the work is done very carefully and in an un-hurried, considered manner (haste can be dangerous);
- the employer's safe work method statements are rigorously followed;
- the appropriate persons involved in the work are accredited in accordance with the requirements of Section 3.8 of this code.

(b) making the hazard visible by arranging for the network operator to effectively identify exposed live low voltage conductors (up to an including 1000 volts) by using approved visual indicators such as sheeting or sleeves eg 'tiger tails'. In this situation the 'tiger tails' should extend a minimum distance of 5 metres beyond the extremities of where the crane or item of mobile plant will be operating. A competent person should visually inspect the tiger tails each day prior to commencing the crane, or mobile plant operations. If they have moved or been damaged the network operator should be contacted to ensure the tiger tails are replaced or located in the correct position. Refer to Section 9.1 of this code.

(c) planning for emergencies including:

- having fire-fighting equipment that is suitable for electrical fires at the site and readily accessible;
- having an appropriate first aid kit available at the worksite.

(d) ensuring that a safety observer is used whenever a crane, mobile plant or load is in motion and is likely to come closer than the approach distances listed in Table 1 and illustrated in Figure 3. The duties of the safety observer for work involving cranes and mobile plant is described in Section 3.9 of this code.

(e) considering the fitting of a warning device to the crane or mobile plant that alerts the operator when the crane or mobile plant has entered energised high voltage overhead power line zones. Warning: These devices are not a substitute for the proper management of safe work practices and procedures.

(f) using warning signs to indicate the location of overhead power lines and/or defined work areas. Refer to Figure 8 below.

Figure 8: Overhead power lines warning sign

4.5 Workers in contact with the crane, load or mobile plant

No-one may remain in contact with any part of a crane, load or mobile plant and the ground or other earthed situation while the crane or mobile plant is being operated closer than the approach distances listed for ordinary persons in Table 1 of this code, unless additional precautions are taken to prevent electric shock, as follows.

4.5.1 Operators

The operator may handle the controls of a crane or item of mobile plant while standing on the ground or while in an earthed situation only if -

- the controls are effectively insulated (consultation with the network operator will be necessary to verify effective insulation); or
- are wireless remote control; or
- the operator wears low voltage insulating gloves – provided that the live electrical apparatus is low voltage; or
- for low voltage, the operator stands on a rubber insulating mat 900mm x 900mm x 6 mm thick that is clean and dry; or
- the operator stands on an 'equipotential conductive mat' which is electrically connected to all metalwork associated with the controls.

4.5.2 Other workers

Other workers at the workplace may contact the crane, mobile plant or load while standing on the ground or while in an earthed situation only if one of the following control measures is observed -

- they wear low voltage insulating gloves – provided that the overhead power lines or electrical apparatus is low voltage; **or**
- effective insulation is provided on the overhead powerlines or electrical apparatus, or the crane, load or mobile plant or it's parts to ensure that even if it contacts the overhead powerlines or electrical apparatus, no–one would receive an electric shock; **or**
- control of the load by non-conductive tail ropes whenever uncontrolled motion could allow it to come within the approach distance (as long as the insulating properties of the rope are appropriate to the operating voltage), **or**
- they are positioning or removing lifting gear from a crane hook or the load while it is stationary; **or**
- they are adjusting outriggers, jacks, packing's, chocks or similar, as long as the crane, load or mobile plant is not being moved.

4.6 Competency requirements

In order to carry out crane and mobile plant operations closer than the approach distances specified in Table 1, the following personnel must be accredited as described in section 3.8 of this code,

- the operator of a crane,
- the operator of mobile plant (including an elevating work platform),
- a safety observer.

4.7 Safety observer for crane and mobile plant operations

A safety observer as described in Section 3.9 must be assigned the duty of observing the approach of a crane or mobile plant (and its load) to the live overhead power lines and associated electrical apparatus.

The safety observer must –

- be used whenever the crane, load, mobile plant or persons working from the plant are in motion and are likely to come closer than the approach distances specified in Table 1;

Note: Where a written risk assessment determines it necessary, the use of a safety observer should also be considered for work performed by ordinary persons working outside the approach distances specified in Table 1.

- be positioned at a suitable location to effectively observe both the overhead power lines and plant;
- be able to immediately and effectively communicate with the operator of the crane or mobile plant, or other personnel if required;
- ensure that all personnel stay outside the specified approach distance (unless performing a rescue in accordance with approved procedures or carrying out a specific task that is described in the safe work method statement eg a crane dogman holding a non-conductive tag line attached to a load suspended from a mobile crane);
- not carry out any other work while acting as a safety observer, which includes the passing of tools, equipment or materials directly to the personnel performing the work;
- not observe more than one crane or item of mobile plant at a time; and

- continue to monitor the work activity being carried out and have the authority to suspend the work at any time,

In addition to the above requirements, the safety observer must not be located on the workbasket of an elevating work platform while observing the work being undertaken from that workbasket.

A safety observer is not necessary in the following circumstances –

- for an item of stationary plant, once completely erected, if it is not located below the overhead power lines or electrical apparatus and is located horizontally outside the approach distances specified in Table 2;
- if an effective limiting device has been set to prevent any component of a crane, mobile plant or load coming closer than the approach distances in Table 2, as long as the limiting device is effective under stress conditions and is regularly inspected and tested by a competent person; or
- where, the design of the crane or mobile plant limits movement so that no part of the crane, mobile plant or load can come closer than the approach distances specified in Table 2.

4.8 Earthing systems for cranes and mobile plant

The chassis of a crane or item of mobile plant may, where practical, be earthed and bonded. A system of work must be adopted that ensures workers are kept clear of cranes and mobile plant when work is carried out near live overhead power lines and workers be advised of the effectiveness of the earthing system.

For specific advice and guidance about the earthing of a crane or item of mobile plant consult with the network operator.

4.9 Notices to be fixed to cranes and mobile plant

Cranes or items of mobile plant intended for use, or used, near live overhead power lines must be fitted with a warning notice or label, conforming to Appendix 1 of this code, listing the approach distances for ordinary persons as set out in Table 1.

The notice or label must be maintained in a legible condition and be displayed at each set of controls and must be readily visible to the operator.

Note: Where a crane or item of mobile plant is fitted with notices in accordance with the Interim Guide, the existing notices may be retained provided the plant is operated to the distances shown on the notice. Only columns described in the Table A notice for 'non-electrical work' or Table B for 'unqualified personnel' must be applied in relation to work under this code.

CHAPTER 5 – TREE AND VEGETATION MANAGEMENT NEAR OVERHEAD POWER LINES

5.1 Scope

In addition to the general requirements described in Chapter 3, this chapter details any variations applicable where a person works on trees such as, cutting, trimming, treating with chemicals or other processes, trees and other foliage near live overhead power lines where:

- a person or something the person is holding or is in contact with or could come closer than the relevant approach distance specified in either Table 1 or Table 2 of this code or;
- the work creates risk of damage to overhead power lines or electrical apparatus.

Tree and vegetation management carried out by or for network operators is excluded from this section as it is covered by the requirements of the *Electricity Supply (Safety and Network Management) Regulation 2002*.

5.2 Hazard identification and risk assessment

When carrying out the work, live overhead power lines are a potential hazard posing substantial risk of death or serious injury.

During tree and vegetation management electrical hazards can be encountered through a variety of circumstances. These include but are not limited to:

- branches or other vegetation falling onto power lines during trimming operations
- tools such as power saws or power trimmers coming into direct contact with power lines or other associated electrical apparatus
- mobile plant, for example an elevating work platform (EWP), coming into contact with overhead power lines or other associated electrical apparatus
- power lines becoming broken and falling on the ground, footpath or road
- wind blowing branches or limbs against overhead power lines
- high winds resulting in the loss of control while lowering materials
- unexpected movement of the worker, mobile plant or the vegetation relative to the worker.

If a hazard involving tree management work near overhead power lines has been identified, a written risk assessment must be undertaken by the employer to determine the risk to persons encroaching within the relevant approach distances. This step will help determine the level of risk associated with the identified hazards and establish a priority list based on the level of risk.

5.3 Eliminating or controlling risks – General risk factors

The risks associated with electrical hazards arise from coming near live conductors. The best means of eliminating the risks is to prevent people, their plant and equipment, as well as any materials from coming close enough to live conductors for direct contact or flash over to occur.

Care needs to be taken in planning the work to identify the ways in which people may be exposed to electrical hazards when the work is undertaken and determine the most effective means to ensure the approach distances are maintained from the live overhead power lines.

In addition to ensuring that the work near overhead powerlines is avoided, other factors should be considered:

- always assume an overhead power line or associated electrical apparatus to be energised or 'live' unless an access authority or other written documentation is received from the network operator.
- if a telecommunication cable is encountered, never assume that the operating voltage is harmless.
- a tree or branch of a tree can conduct electricity even in dry conditions. Never assume that a tree branch can safely rest on or against overhead power lines. If the tree or branch has the potential during the felling or cutting process to come closer than the approach distances specified in Table 1 the overhead power lines should be de-energised.
- trees that have grown into contact with live overhead power lines must not be cut by a person who is in an earthed situation (such as a standing on the ground or working from within the tree) unless a safe system of work is used that meets the requirements of the network operator.
- plant that comes near an overhead power line may become energised and pose a serious danger to the operator and any bystanders. Ensure that when operating plant (ie any machines (including chain saws), tools or equipment) near live overhead powerlines that the relevant approach distances are maintained. Operations should cease where trees or persons are in danger of coming closer than the relevant approach distances.
- manage traffic and pedestrians at the worksite to ensure approach distances are maintained and that members of the public are kept at a safe distance. If the work near overhead power lines requires a change in traffic direction or vehicle speed limits, full traffic control is required in accordance with the Roads and Traffic Authority's requirements.
- assess the weather conditions, including electrical storms, significant rain or excessive wind velocities that could impact on the proposed work.

5.4 Requirements for Ordinary Persons carrying out tree and vegetation management

An ordinary person must not:

- climb a tree closer than 3 metres to live overhead power lines, or cut any branch that may come closer than 3 metres to live overhead power lines as a result of the work, or
- allow any part of their body or anything they are holding or that is attached to their body, or anything they are using, to come closer than the approach distances specified in Table 1 of this code when carrying out the work near live overhead power lines.

Ensure the work is not carried out above overhead power lines or where any part of the tree or vegetation could fall or otherwise be carried closer than the approach distances specified in Table 1.

If there is a reasonable possibility of the work being carried out above overhead power lines or coming closer than the approach distances specified in Table 1 the work must be carried out by accredited persons who have been trained and have current competency to carry out 'tree and vegetation management' near live overhead power lines. See Section 5.5 of this code.

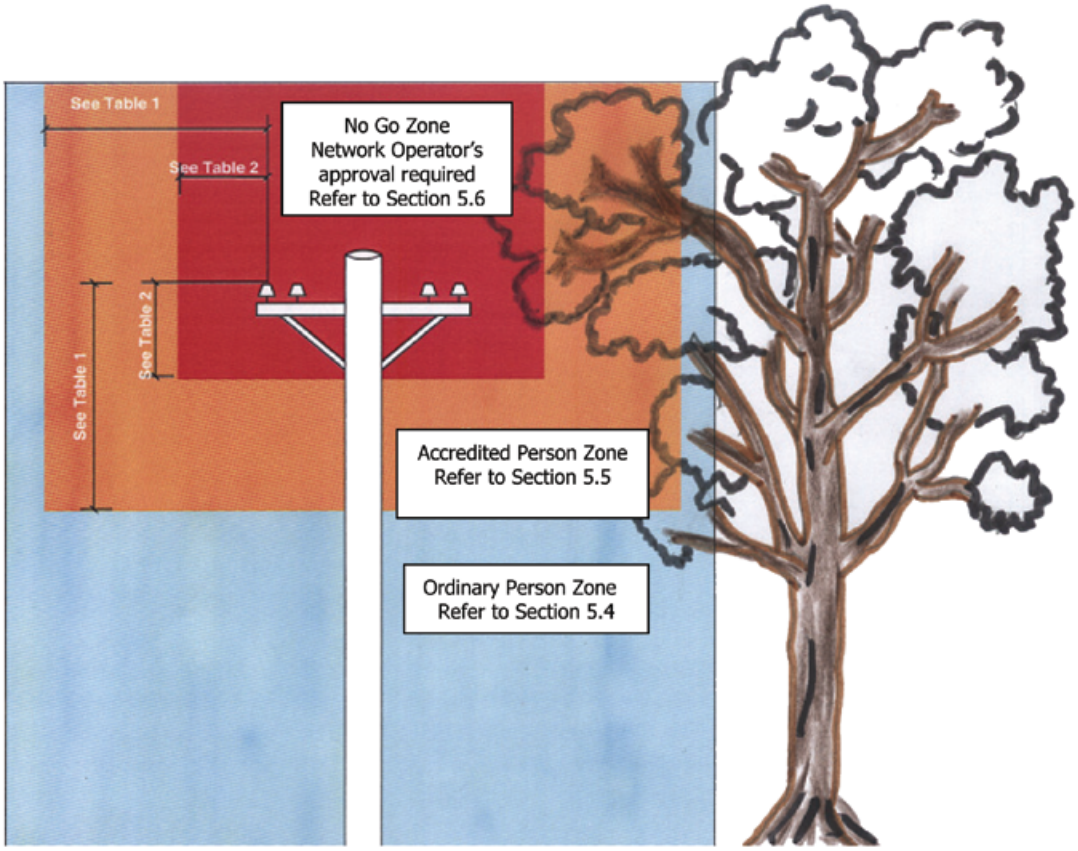


Figure 9 – Work zones for tree management near overhead power lines

5.5 Requirements for Accredited Persons carrying out tree and vegetation management

Accredited persons who have current competency to carry out 'tree and vegetation management' near live overhead power lines may carry out the work in accordance with the approach distances specified in Table 2 of this code provided the following requirements are observed,

- a written risk assessment is completed for the work and a safe system of work is implemented, which includes a safety observer, and
- if determined by the written risk assessment, consultation with the network operator regarding the proposed work and compliance with any conditions imposed by the network operator for the work.

Note: Training and assessment requirements for accredited persons, which include safety observers are described in Sections 3.8 and 3.9 of this code.

5.6 Tree management inside the No Go Zone – Approval of the network operator

The no go zone is the area around overhead power lines into which no part of a person or material or cranes or vehicles or items of mobile plant may encroach without the written approval of the network operator.

- person includes hand tools, equipment or any other material held by a person.
- plant includes the load, controlling ropes and any other accessories associated with the plant.

Work required on tree and vegetation that is inside the no-go zone (closer to live overhead power lines than the approach distances specified in Table 2 of this code) must only be performed by authorised persons approved by the network operator.

5.7 Trees or branches contacting live overhead power lines

While it is not permitted to work on trees where they (or their branches) may fall on overhead power lines, it is important to know what action to take if a branch or tree comes into contact with a live overhead power line, whether through pruning, wind, storm or other damage.

When this situation arises, *do not touch any part of the branch or tree*. If any part of a branch is touching live power lines, the entire branch may be 'live', including the leaves. Contact with any part of it may result in electric shock, burns or electrocution.

Immediately contact the network operator and keep all persons clear of the area while waiting for assistance.

Other aspects of tree and vegetation management safe work practices and procedures can be found in the *Code of Practice – Amenity Tree Industry.*

CHAPTER 6 – WORK INVOLVING SCAFFOLDING NEAR OVERHEAD POWER LINES

6.1 Scope

In addition to the general requirements described in Chapter 3, this chapter details any variations applicable where the work involves the erection, dismantling and use of fixed scaffolding near overhead power lines and associated electrical apparatus with an operating voltage up to and including 33 kV a.c. For scaffolding work above this voltage the network operator must be consulted and any special conditions imposed by the network operator complied with.

The guidance provided in this Chapter should be read in conjunction with AS/NZS 4576 – Guidelines for Scaffolding, which is an approved industry code of practice. In the Standard a 4 metre approach distance is provided for metallic scaffolding used near overhead power lines. This approach distance is used as a reference point for persons planning and undertaking scaffolding work as described in this Chapter.

For work involving the use of mobile aluminium scaffolding refer to the risk control measures for mobile plant that are described in Chapter 4 of this code.

6.2 Hazard identification

Before undertaking any scaffolding work where the work might come closer than the 4 metre approach distance specified in AS/NZS 4576 – Guidelines for Scaffolding, an inspection must be carried out at the worksite and reasonable care taken to identify any potential hazards.

Hazards may include:

- live overhead power lines and associated electrical apparatus;
- deteriorated or broken down insulation on the conductors or electrical apparatus;
- scaffolding coming into contact with overhead power lines; and
- possibility of hand held tools, equipment or materials coming into contact with overhead power lines.

6.3 Risk assessment

If a hazard involving overhead power lines has been identified, a written risk assessment must be undertaken by the employer to determine the risk to persons encroaching within the 4 metre approach distance. This step will help determine the level of risk associated with the identified hazards and establish a priority list based on the level of risk. If the scaffolding work is above 3 metres in height it must also be supported by a safe work method statement for the work. Refer to Appendices 2 and 3 of this code.

The following factors may be included in the risk assessment:

- the type of work activities being undertaken, tools, equipment, scaffolding and materials being used;
- proximity of the work activity or scaffolding to the overhead power lines;
- environmental conditions, such as rain, wind or uneven terrain, which may be bring a risk of unexpected movement of tools, equipment, scaffolding or material held by workers.

6.4 Eliminating or controlling risks – general risk factors

Once the hazards associated with scaffolding work near the overhead power lines have been identified and assessed, then control measures must be implemented to eliminate the risk. If it is not practicable to do so, the risks associated with the hazard must then be controlled.

The use of specific control measures to eliminate or control identified risks should be done on the basis of the risk assessment. In particular, consider the following:

1. Eliminating the hazard. This could involve de-energising the overhead power lines during the work. Consideration may also be given, following consultation and agreement of the network operator, to re-route the overhead power lines away from the scaffolding or replace existing overhead powerlines with underground cables.
2. Separating the hazard. This could mean erecting a physical barrier on the scaffold to prevent a person or anything held by a person, or attached to the person, encroaching with the 4 metre approach distance.
3. Minimising the risk by engineering means. This could mean substituting the scaffold with another means of access and egress, such as an elevated work platform or using an insulated fibreglass extension handle on a paint roller, instead of a conductive aluminium extension handle.
4. Introduce administrative controls. This may include planning and where relevant documenting the safe work method statements before starting work or using a safety observer to warn people before they encroach within the 4 metre approach distance. The duties of a safety observer are outlined in Section 3.9 of this code. Making the hazard visible by arranging for the network operator to effectively identify exposed live low voltage conductors (up to an including 1000 volts a.c.) by using approved visual indicators eg 'tiger tails'. Refer Section 9.1 of this code.
5. Use appropriate personal protective equipment. This includes the use of electrically tested insulating gloves by anyone who may be at risk of coming closer than the 4 metre approach distance.

A combination of the above control measures is required to be taken to minimise the risk to the lowest level reasonably practicable if no single measure is sufficient for that purpose.

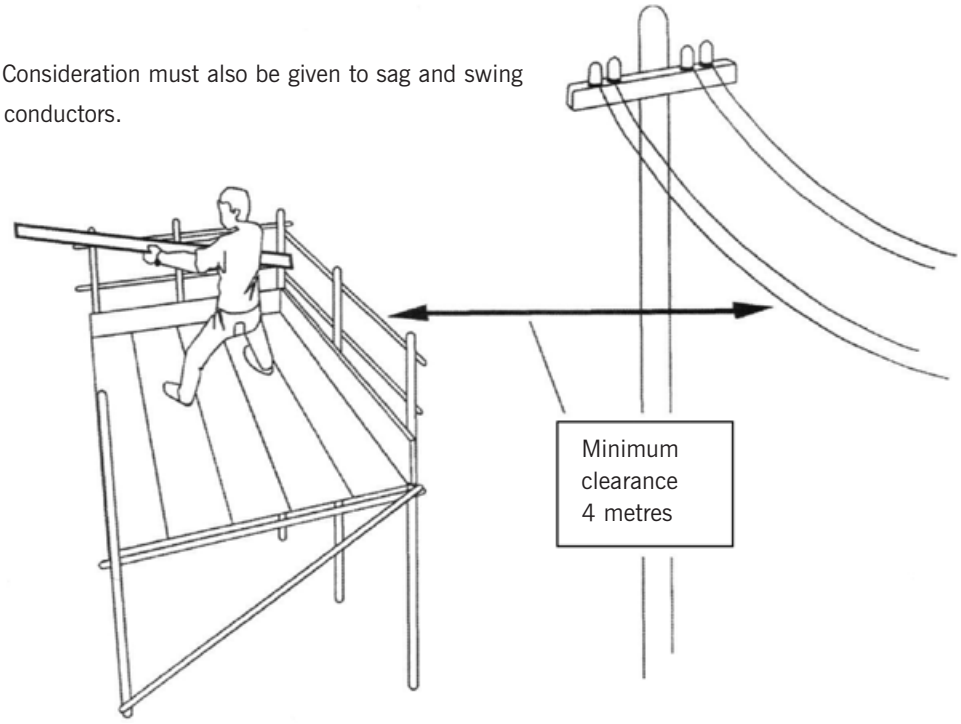
6.5 Control measures for the erection and dismantling of scaffolding near overhead power lines up to and including 33kV

(a) Ensure a thorough examination and assessment is undertaken of the surroundings prior to the erection or dismantling of the scaffold near overhead powerlines. No scaffold work should commence until the presence, location, type and operating voltage of all overhead power lines are determined by a competent person.

(b) Overhead powerlines should be de-energised and an access authority or other form of written documentation obtained from the network operator if the scaffold and the overhead powerlines is or has the potential to come within the 4 metre approach distance. Refer to Figure 10 below.

(c) If there is the risk that the 4 metre approach distance cannot be maintained, the network operator must be contacted and a written risk assessment and safe work method statement including safe systems of work developed for the activities associated with the erection, use and dismantling of the scaffolding.

Note: Consideration must also be given to sag and swing of the conductors.



Note: End protection omitted for clarity

Figure 10 – A 4 metre approach distance applies in any direction where metallic scaffold is erected, used or dismantled near overhead power lines.

(d) Where low voltage overhead powerlines (up to and including 1000 volts) cannot be de-energised and isolated, 'tiger tails' should be provided and installed by the network operator for the full length of the scaffolding plus a minimum distance beyond each end of the scaffolding of 5 metres. A competent person should visually inspect the tiger tails each day prior to commencing scaffolding operations. If the tiger tails have moved or been damaged the network operator must be contacted to ensure the tiger tails are replaced or located in the correct position.

Note: Tiger tails may be used to provide a useful visual indication to people working in the area of overhead power lines. They should not be regarded as providing protection against mechanical interference nor should they be regarded as providing electrical protection from electrical hazards. Refer to Section 9.1 of this code for further guidance.

(e) Electrical wires or apparatus that pass through a scaffold must be de-energised or fully enclosed to the requirements of the network operator. These requirements must incorporate full enclosure of the wires or electrical apparatus by a non-conductive material such as moisture resistant flooring – grade particle board, dry timber, dry plywood or similar dry non-conductive material as approved by the network operator. Refer to Section 6.6 and Figure 11.

(f) To prevent a person or anything held by a person, or attached to the person, coming closer than the 4 metre approach distance the network operator may require the erection of a hoarding on the external face of the scaffolding and, if applicable a suitable enclosure on the internal side of the scaffold. Refer to Section 6.6 and Figure 11.

Example of live low voltage overhead power lines passing through a scaffold that has been fully enclosed in a non-conductive material to the requirements of the network operator.

Figure 11 – Enclosure of overhead powerlines

6.6 Erected Scaffolding – Use of a hoarding and enclosure for reduced safety clearances

This section describes the requirements for the use of a hoarding and, if applicable, a suitable enclosure between an erected scaffolding and a live overhead power line when a non-conductive hoarding and enclosure is used to provide an impenetrable barrier to persons, tools, materials and equipment.

The A and B clearances shown in Figure 12 are horizontal safety clearances and vertical mechanical clearances from the conductors and will be advised by the network operator prior to the erection of the scaffolding near the overhead power lines.

The following installation conditions apply for the use of a hoarding and enclosure for reduced safety clearances,

- Gaps between fitted sheets of plywood must not exceed 3mm.
- No exposed cut or drilled holes are permitted in the sheets of plywood.
- Scaffolder is responsible for attaching plywood to the scaffold, and ensuring that the arrangement can sustain an appropriate wind load.
- Warning signs must be affixed to the safe side of the hoarding warning of the presence of the electrical hazard on the other side of the hoarding and warning that the hoarding must not be removed.
- A competent person should visually inspect the hoarding and, if applicable the enclosure on a daily basis to ensure the hoarding and enclosure are in a satisfactory condition and remain impenetrable.

Further guidance on the erection, dismantling and use of scaffolding can be found in the Australian Standard AS/NZS 4576 – Guidelines for Scaffolding.

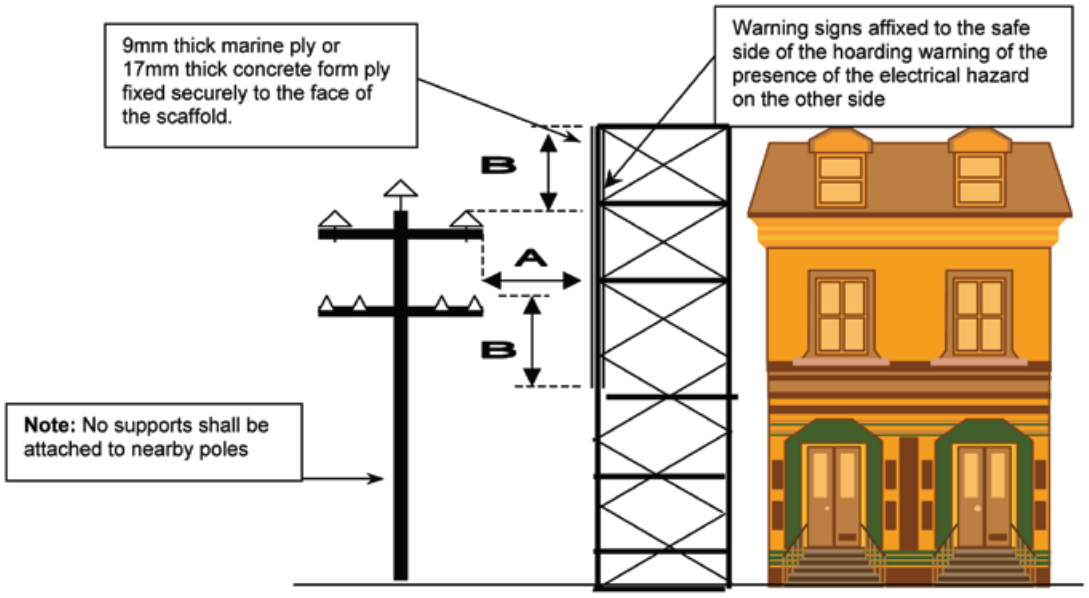


Figure 12 – Scaffolding with hoarding

CHAPTER 7 – AGRICULTURAL WORK NEAR OVERHEAD POWER LINES

7.1 Scope

In addition to the general requirements listed in Chapter 3, this chapter details any variations applicable where work is being conducted at rural workplaces where:

- the person or something the person is operating or holding could contact overhead power lines or come closer than the approach distances specified in Table 1 of this code or;
- the work creates risk of damage to overhead power lines or electrical apparatus.

Examples of such work include:

- the use of lifting or elevating plant or agricultural plant such as grain augers, hay bale elevators, cotton harvesting equipment, tipper and livestock transport trucks, travelling irrigators or harvesters under or near overhead power lines;
- handling irrigation pipes under or near overhead power lines;
- moving or relocating agricultural plant, such as folding cultivators, where the transit (stowed) height of the equipment is greater than its operating height;
- any other work that involves the risk of a person or anything attached to or held by a person, coming into contact with overhead power lines.

7.2 Hazard identification

Many people have been killed by electrocution when metal parts of agricultural plant (such as augers, field bins, harvesters or tip trucks) have come into contact with or close to live overhead power lines. Such accidents usually occur when the operator has not lowered the equipment before moving it or has raised the item of mobile plant upwards into the live overhead power lines. For example,

- working near and in the process may come into contact with machinery operating near overhead powerlines;
- driving machinery with tall attachments through paddocks where overhead powerlines exist; or
- operating or moving tipper trucks, mobile silos, field bins, harvesters or other large rural machinery (cotton harvesters, field irrigators) under or near live overhead power lines; or
- moving or re-arranging long metallic irrigation pipes.

Where work is carried out near live overhead power lines, the height and location of the power lines needs to be identified as part of an overall site hazard identification process. Contact should be made with the electricity network operator who can assist with this process.

Operators of agricultural plant and equipment also must be made aware of the design height and the transit (stowed) height of the mobile plant they operate.

7.3 Risk assessment

If a hazard involving overhead power lines has been identified, a written risk assessment must be undertaken to determine the risk of any part of the agricultural plant or equipment coming near or into contact with the overhead power lines. This step will help to determine the level of risk associated with the identified hazards and establish a priority list based on the level of risk.

The following factors may be relevant to the risk assessment:

- the type of work activities being undertaken or agricultural equipment being used;
- proximity of the work to the overhead power lines and the height of the overhead power lines;
- environmental conditions, such as rain, wind or uneven terrain, which may bring an increased risk;
- visibility of the overhead power lines and their supporting structures;
- location of overhead power lines supporting structures such as poles and towers in relation to the agricultural work to be performed;
- how often the work will need to be done near the overhead power lines;
- proximity of stationery or fixed plant and equipment to overhead power lines.

7.4 Control measures for agricultural work near overhead power lines

Once the hazards associated with agricultural work near overhead power lines have been identified and assessed then control measures must be implemented to eliminate the risk. If it is not practicable to do so, the risks associated with the hazard must then be controlled.

The use of specific control measures to eliminate or control identified risks should be done on the basis of the risk assessment. In particular, consider the following:

1. Eliminating the hazard. Identify the location of overhead power lines and relocate the plant and equipment, such as a mobile silo or tipper trucks away from the overhead power lines. Lower augers before transporting to eliminate the risk of contacting overhead power lines. Keep mobile irrigator sprayed water at least 8 metres away from overhead power lines. Consideration may also be given, following consultation and agreement of the network operator, to relocating the overhead power lines or having them run underground. In this case consult with the network operator.
2. Separating the hazard. This could mean erecting a physical barrier to prevent any part of the agricultural plant encroaching the approach distance specified in Table 1.
3. Minimising the risk by engineering means. This could mean substituting with a less hazardous material, process or equipment. This could mean, for example, filling a silo through a ground-level filler pipe on the silo rather than using a truck-mounted auger or limiting the height of all mobile plant in order to maintain safety clearances from overhead power lines.
4. Introduce administrative controls. These include:
    - planning and documenting a safe system of work before starting work;
    - developing work procedures and travel routes for equipment and vehicles that ensure workers, their equipment and containers such as field bins, stock and tipper trucks do operate near or under live overhead power lines;
    - using another worker (to act as an observer) to ensure the work activity does not come closer than the approach distances specified in Table 1

- installing warning signs on gates to paddocks or on roadways where overhead power lines exist, (Refer to Figure 13 below);

Figure 13 – Overhead power lines warning sign

- having markers installed on overhead powerlines to make them easier to see and locate.

5. Use appropriate personal protective equipment. This includes the use of rubber soled boots, gloves and safety helmets when agricultural plant or equipment is being operated near overhead power lines.

A combination of the above control measures is required to be taken to minimise the risk to the lowest level reasonably practicable if no single measure is sufficient for that purpose.

CHAPTER 8 – WORK NEAR LOW VOLTAGE OVERHEAD SERVICE LINES

8.1 Scope

In addition to the general requirements listed in Chapter 3, this chapter details any variations applicable where an ordinary person is required to carry out work near low voltage overhead service lines where the work involves:

- Minor building work such as painting; or
- Operation of motor vehicles (concrete trucks, furniture removal vans, etc); or
- Any other non-electrical work where there is a risk of contact with low voltage overhead service lines.

For the purposes of this code 'low voltage overhead service lines' covered by this chapter and illustrated in Figure 14 are:

- insulated low voltage aerial conductors and associated electrical apparatus that are connected from the point of supply (either the overhead power pole located on the street or the consumer's boundary) and terminated on the consumer's building, pole or structure at the point of attachment, or;
- insulated low voltage aerial consumers mains and associated electrical apparatus forming part of the consumer's electrical installation.

Note: For work involving cranes or mobile plant or work where any metal material is being handled (scaffolding, roofing materials and guttering) the risk control measures and increased approach distances described in other chapters of this code must be applied to the work.

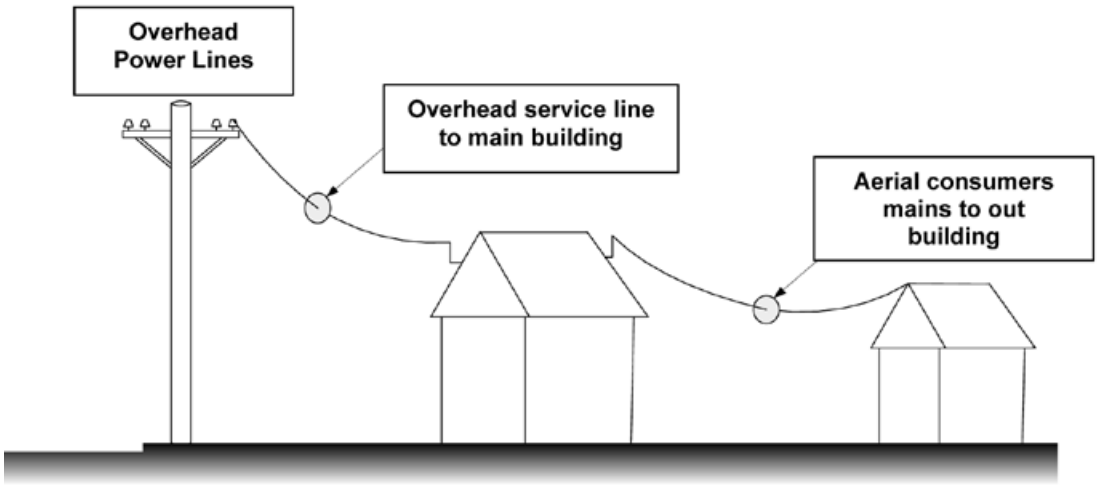


Figure 14 – Low Voltage Overhead Service Lines

8.2 Approach distances for work near low voltage overhead service lines

Table 4 provides approach distances for ordinary persons:

- performing minor building work near low voltage overhead service lines, (including hand tools held by a person); or
- operating cranes (and their loads) and items of mobile plant near low voltage overhead service lines; or
- handling metal materials near overhead service lines (such as scaffolding, roofing materials and guttering); or

- handling non-conductive materials near overhead service lines (such as timber, plywood, PVC pipes and guttering, etc); or
- driving or operating a vehicle under overhead service lines. **Note:** the approach distance specified in Table 4 is based on the fact that the design or transit envelope of the vehicle does not allow any part of the vehicle to come closer than the 0.6 metre approach distance specified.

TABLE 4

Approach distances for work near low voltage overhead service lines

Ordinary Persons (m)				
Hand held tools	**Operation of crane or mobile plant**	**Handling of metal materials (Scaffolding, roofing, guttering, pipes, etc)**	**Handling of non-conductive materials (Timber, plywood, PVC pipes and guttering, etc)**	**Driving or operating vehicle**
0.5	3.0	4.0	1.5	0.6

8.3 Work inside the relevant approach distances

If the work cannot be carried out without coming inside the relevant approach distance (ie closer than the approach distances listed in Table 4), prior to commencing work the employer or self-employed person must comply with the following requirements:

- identify the hazards,
- complete a written risk assessment for the proposed work,
- apply a safe system of work, and
- meet the requirements of the relevant network operator or in the case of overhead service lines forming part of the consumer's electrical installation, the controller of the premises.

8.4 Hazard identification

Before undertaking any work where the work might come closer than the specified approach distances an inspection of the worksite must be carried out and reasonable care taken to identify any potential hazards. Hazards associated with the low voltage overhead service lines may include:

- bare exposed live conductors;
- deteriorated or broken down insulation;
- damaged overhead service line mains connection box or damaged insulation around conductor clamps;
- deterioration of earthing of exposed conductive parts that are required to be earthed;
- voltage of the line is higher than the expected low voltage (240 / 415 volts a.c.); and
- possibility of hand held tools and equipment coming into contact with exposed live parts.

8.5 Risk assessment

If a hazard involving low voltage overhead service lines has been identified, a written risk assessment must be undertaken to determine the risk to persons encroaching within the specified approach distance for the work. This step will help determine the level of risk associated with the identified hazards and establish a priority list based on the level of risk.

The following factors may be relevant to the risk assessment:

- The type of work activities being undertaken, including how safe access and egress will be made to the work area;
- Tools or equipment being used, and the risk of mechanical damage to the low voltage overhead service lines if inadvertent contact is made with the conductors and electrical apparatus; Examples may include:
    - Handling a sheet of roofing material that inadvertently comes into contact with the service lines.
    - Use of cutting or grinding tools where the operator could loose control and come within the 0.5 metre approach distance.
- Proximity of the work to the low voltage overhead service lines;
- Environmental conditions, such as rain, wind or uneven terrain, which may bring a risk of unexpected movement of tools or equipment held by workers.

8.6 Control measures for work near low voltage overhead service lines

Once the hazards associated with work near low voltage overhead service lines have been identified and assessed then control measures must be implemented to eliminate the risk. If it is not practicable to do so, the risks associated with the hazard must then be controlled.

The use of specific control measures to eliminate or control identified risks should be done on the basis of the risk assessment. In particular, consider the following:

- Eliminating the hazard. This could involve de-energising the low voltage overhead service lines by arranging for the Network Operator or in the case of overhead service lines forming part of the consumer's electrical installation the controller of the premises to isolate the supply for the duration of the work or arranging for the re-routing of the low voltage overhead service lines away from the work area.
- Separating the hazard. If work has to be carried out in close proximity to the point of attachment and the power cannot be isolated, arrange for the Network Operator to fit insulated matting and 'tiger tails' at the point of attachment and over the overhead service lines before the work commences. Refer to Figure 15 below.

Figure 15 – Insulated matting and tiger tail fitted to overhead service line

- Minimising the risk by engineering means. This could mean substituting with a less hazardous material, process or equipment, for example, using an insulated fibreglass extension handle on a paint roller, instead of a conductive aluminium extension handle. Or carrying out sanding by hand near the point of attachment rather than using an electric disc sander.
- Introduce administrative controls such as planning and documenting the work procedures before starting work. Another administrative control could be using another worker (to act as an observer) to warn people before they encroach into the relevant approach distance.
- Use appropriate personal protective equipment. This includes the use of electrically tested insulating gloves by anyone who may be at risk of encroaching into the relevant approach distance.

A combination of the above control measures is required to be taken to minimise the risk to the lowest level reasonably practicable if no single measure is sufficient for that purpose.

CHAPTER 9 – ADDITIONAL CONSIDERATIONS FOR WORK NEAR OVERHEAD POWER LINES

9.1 Tiger tails

Tiger tails may be used to provide a useful visual indication to crane, mobile plant operators and other persons working in the area of live overhead power lines, however, they do not protect people from the risk of electrocution or electric shock.

Figure 16 – Tiger tails fitted to overhead power lines

They are **not** to be regarded as effective insulation against contact by cranes or items of mobile plant and are not to be relied upon for mechanical protection. They should not be regarded as providing protection from electrical hazards. As such, the approach distances specified in this code are to be adhered to.

Tiger tails must only be fitted to overhead power lines by an electrically qualified person who is authorised by the network operator.

A competent person should visually inspect tiger tails at the worksite on a regular basis and prior to commencing crane, scaffolding or mobile plant operations. If the tiger tails have moved or been damaged the network operator must be contacted to ensure the tiger tails are replaced or located in the correct position.

WARNING

Tiger tails do not provide protection from electrical hazards and must only be fitted to the overhead power lines by an electrically qualified person who is authorised by the network operator.

9.2 Notification of incidents

The OHS Act and the OHS Regulation require employers to notify certain classes of workplace incidents.

Whether you are an employer, self-employed person and/or occupier you are required by law to notify incidents to WorkCover NSW and/or your workers compensation insurer as soon as practicable after becoming aware of the incident.

An occupier (of premises/workplaces) is someone who, manages or has responsibility for a workplace or a particular operation at a workplace, even though they may not be the employer.

Depending on the type of incident you may need to notify WorkCover and/or your workers compensation insurer. Some incidents classified as 'serious incidents' must be notified to WorkCover immediately. These 'serious incidents' include, but are not limited to the following;

- An incident where there has been a fatality,
- An incident where there has been a serious injury, and
- An incident where there is an immediate threat to life but result in no injury or illness.

In addition to the above, the OHS Act and OHS Regulation requires that certain occurrences that occur at the work place are not to be disturbed for 36 hours, (unless performing a rescue or permission has been given by WorkCover).

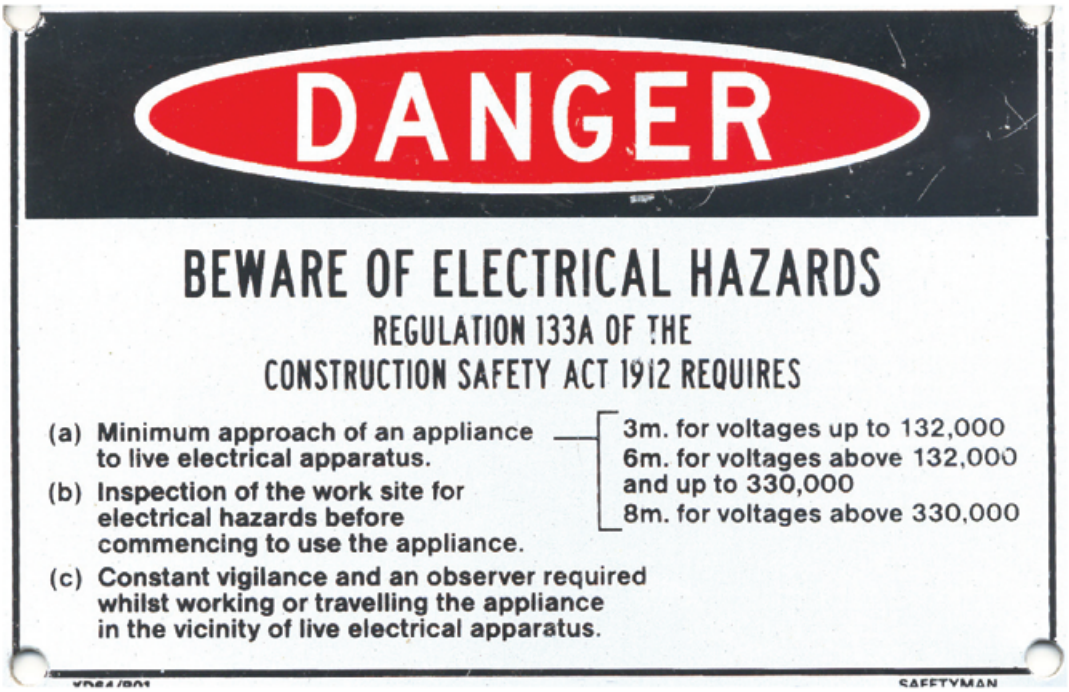
Working near overhead powerlines can be a high-risk activity and any contact with overhead power lines must be notified to WorkCover NSW and the relevant network operator in accordance with the requirements of the relevant legislation.

Serious incidents can be notified to WorkCover on **13 10 50** as an urgent investigation may be needed.

For more information regarding your legal obligations to notify incidents please refer to the OHS Act and OHS Regulation.

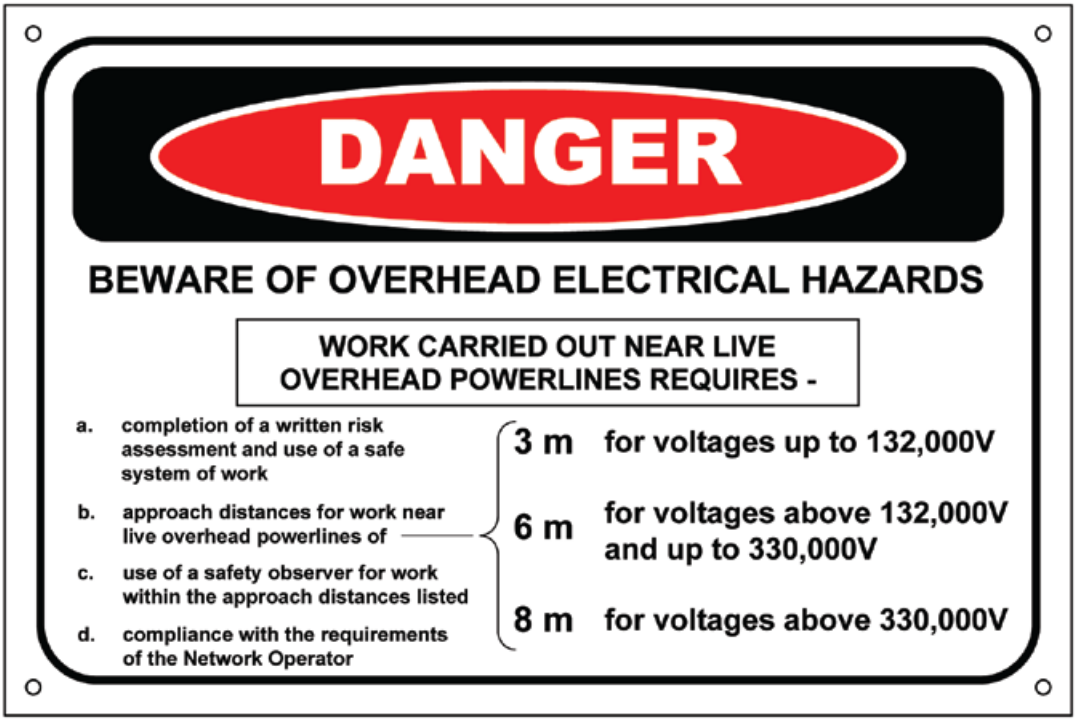
APPENDIX 1– WARNING NOTICE FOR OVERHEAD ELECTRICAL HAZARDS

(Dimensions 150 mm wide, 100 mm high, except if small plant item)



Notice that may remain fitted to cranes and mobile plant commissioned before 1 September 2001 (ie existing Notice as at the date of introduction of the OHS Regulation 2001)

Alternative Notice or Label for cranes and mobile plant commissioned after 1 September 2001



APPENDIX 2 – EXAMPLE OF A RISK ASSESSMENT CHECKLIST

Cranes and mobile plant working near overhead power lines risk assessment checklist

Worksite location:.....

Employer / Principal contractor:.....

Crane / Plant contractor:.....

Site Supervisor:.....

Network Operator:..... Contact phone:.....

This checklist is designed to help identify the hazards associated when operating cranes or mobile plant near overhead power lines that may encroach on the approach distances specified in Table 1 of this code. The checklist covers the main items described in Chapter 4 of this code. This checklist is not designed to cover all of the risks of working near overhead power lines and should be adapted as appropriate to meet the particular circumstances.

If you mark a NO box on the checklist, you need to take appropriate action to eliminate or control the hazard.

Section 1. PROJECT PLANNING AND INITIAL ASSESSMENT	**Yes**	**No**
Has the network operator been consulted regarding the proposed work?		
Do you know the height of the overhead power lines at the worksite?		
Is the voltage of the overhead power lines and associated electrical apparatus known?		
Can the overhead power lines be safely de-energised to allow work to proceed?		
Can the work be rescheduled to another time so that the overhead power lines can be de-energised?		
Has the network operator agreed to de-energise the overhead power lines and issued you with a documented clearance (access authority) so that work may proceed? Record N/A if not applicable.		
Have you ensured appropriate traffic management is in place at the worksite? Record N/A if not applicable.		
Have you assessed environmental conditions, including visibility and wind that could exist for the duration of the project that may adversely affect the work?		
Have you assessed the design and transit envelope of the crane or item of mobile plant being used for the proposed work in relation to the height of the overhead power lines at the worksite?		
Have you assessed the worksite where the crane or item of mobile plant is to be set-up, used and dismantled in relation to the location of overhead power lines?		
Additional planning and assessment factors:		

Section 2 – CONTROL MEASURES – OPERATING A CRANE OR ITEM OF MOBILE PLANT NEAR LIVE OVERHEAD POWER LINES	Yes	No
Have you completed a written risk assessment and identified all electrical hazards and non-electrical hazards, both actual and potential? All materials should be regarded as conductive unless you have definite knowledge to the contrary.		
Have you developed a safe system of work for the proposed work and determined the control measures required to eliminate or control the risks?		
Have you met the requirements of the network operator for the proposed work?		
Are workers trained, competent and confident in applying the particular procedures or techniques that are required for the task at hand?		
Do workers carrying out prescribed work tasks hold the relevant certificates of competency, eg crane operator, dogman, scaffolder, rigger, EWP operator?		
Have workers been authorised by the employer or person in control of the premises to work near live overhead power lines?		
Has a safe work method statement (SWMS) been completed for the task? Note: High-risk construction requires that an SWMS is completed for the work. Refer clause 209 of the OHS Regulation for further information.		
Is the work area clear of obstructions and is there a safe entry and exit?		
Are the necessary first aid and emergency facilities provided and accessible?		
Will an Accredited Safety Observer be present during the work task and assigned the duty of observing and warning against unsafe approach to overhead power lines?		
Additional control measures for the work:		

Section 3 – AFTER COMPLETING THE WORK	Yes	No
Have all workers been advised to treat the power lines as being live from this time?		
Has the network operator and all other relevant parties been advised that the work is completed?		
Additional measures following completion of work:		

_____ _____ ____ /____ /____

Checklist Completed By | Signature | (Date)

APPENDIX 3 – EXAMPLE SAFE WORK METHOD STATEMENT

Safe Work Method Statement (Part 1)		**Accepted:** Yes / No
Employer / Contractor: *Enter the name of the employer or contractor*		**Signed off:** *Enter the name of the person approving the SWMS*
Project: *Enter the name of project*		**Date:**
Job Description: *Enter the task to be undertaken*		
Procedure (in steps):	**Possible Hazards:**	**Safety Risks:**
1. *Write out the job step by step (Include all major phases of the work to be done)*	*Include all possible hazards. Some examples of hazards are: such as* • *Working near live overhead power lines* • *Falls from heights* • *Working near moving plant*	*High, Medium or Low*
2.		
3.		
4.		
5.		

Points to remember when writing out your work method statements:

- **Write out the job procedure step by step**
- **Put the main idea first**
- **Start each step with an action word. For example Isolate, erect**
- **Use active, not passive voice. For example check approach distance, erect ground barriers**
- **Keep sentences short and clear**
- **Choose words carefully**
- **Keep it simple**
- **Get somebody who does not know the job to read the work method statement to check if they understand the job.**

Control measures:

List all safety controls such as:

- *Access authority*
- *Safety Harness*
- *Mechanical Controls / PPE*
- *Safety Observer required*

Write all your work method statements after consulting the workers who are going to use them. You may then need to redraft them to include their suggestions. They may see a better and safer way of doing the job.

Note: The possible hazards, safety risks and control measures are placed side by side. This will make it easier for you to consider the possible hazards for each step and decide on the appropriate controls to over come each hazard.

Safe Work Method Statement (Part 2)

Project: *Enter name of project here*

Personal Qualifications and Experience	**Personnel, Duties and Responsibilities**	**Training required to complete proposed work**
Enter all the qualifications for everybody to undertake the tasks: *WorkCover Certificates, Training Certificates, Network Operator Certificates, experience in doing the tasks that may not require certificates.*		• *Safe electrical approach training*
Engineering Details / Certificates / Approvals	**Legislation / Codes of Practice / Standards**	
Enter details of certification that may be required to undertake tasks. Engineers Certificates for major lifts, plant usage eg EWP's.		
Plant / Equipment	**Maintenance Checks**	
List all major items of Plant and Equipment that will be used during the duration of the task. Eg: Mobile Crane, EWP, Vehicle loading crane, etc.		
Read and signed by all employees on site:		

Enter details of duties and responsibilities of Supervisors, Plant Operators and other employees. Enter such things as daily safety checks, weekly site inspections.

Detail here the training required by all personnel before the activity is commenced.

Enter here all Legislation, Codes of Practice and Standards that is relevant to the work to be undertaken. Refer to the requirements when completing the safe work method statements.

Detail here the system in place to ensure plant and equipment is serviced and maintained. Enter details of tagging for lifting equipment.

Safe Work Method Statement (Part 3) **Read and signed by all employees on site:**			
Project:	*Enter name of project here*		
Job Description:	*Enter the task to be undertaken*		**Revision No.:**
Name	**Company**	**Date Inducted**	**Signature**

APPENDIX 4 – MODEL TRAINING COURSE GUIDELINES – SAFE ELECTRICAL APPROACH TRAINING

Introduction

This model training course framework provides information for registered training organisations (RTO's) wanting to develop a competency assessed training course for non electrical persons wanting to acquire the necessary knowledge and skills of an 'Accredited Person' as described in this code.

The suggested minimum structured learning time for new students is approximately 12 hours, which includes a 2 hour assessment. The subject areas listed should be considered as the minimum course requirements; RTO's may wish to add additional topics as appropriate.

Persons successfully completing the training course are to be awarded a statement of attainment or certificate from the RTO that indicates the person's name and an identifying number particular to the holder of the qualification. The name and contact details of the RTO should also be displayed on the statement of attainment or certificate.

Unit 1 **Preparation to work safely near live overhead power lines as a non electrical worker**	Identification of the relevant legislative requirements including OHS Act 2000 and OHS Regulation 2001 including the Code of Practice – Work near overhead powerlines. Ordinary and Accredited Persons. Principles of electricity, 3 phase power system. Electric shock and resuscitation. Safe work practices and procedures. Identification and confirmation of the approach distances for safe work and access near live overhead power lines and associated electrical apparatus. Identification and implementation of safe systems of work including safe work method statements. Hazard identification, risk assessment and control options prioritised. Development of risk assessment documentation and safe work method statements. Permit systems and established supporting procedural systems. Responsibilities identified for the safety observer, crane and plant operator in accordance with requirements and established procedures /systems of work to ensure safety measures are followed in the event of an incident. Reporting and notification procedures for work closer than the approach distances identified in the Code of Practice – Work near overhead powerlines. Identification of electricity infrastructure for low voltage and high voltage overhead power lines. Relevant approach distances as defined in the Code of Practice – Work near overhead powerlines.

Unit 2 **Carry out the work safely near live overhead power lines as a non electrical worker**	Application of OHS principles and practices to reduce risk of incidents with overhead powerlines. Process for monitoring and reporting hazards and OHS risks to immediate authorised personnel for directions according to established procedures. Non routine events. Emergency procedures in the event of and responding to an incident. Working safely in accordance with instructions and established routines/ procedures.
Unit 3 **Complete the work safely near overhead power lines as non electrical worker**	Work schedules, requirements for returning work permit(s) and/or access authorisation permits. Process for reporting to authorised personnel incidents in accordance with established procedures. Work completion records, reports/data sheets for completed works.

Qualification and experience of the trainer:

Persons presenting the above training course should have relevant industry experience associated with the NSW Electricity Supply Industry and have as a minimum a 'Workplace Trainer and Assessor Certificate 1V 'and be conversant with all the relevant NSW Acts, Regulations, Codes and Industry Guides associated with work near live overhead power lines.

Overview of assessment:

Registered training organisations should ensure that assessment of the above training course be carried out in accordance with accepted industry and regulatory practice. Evidence for competence should be considered holistically and cover the essential knowledge and associated skills for work that is to be carried out safely near live overhead power lines by a non-electrical worker.

Trainees should be assessed across a representative range of contexts from the Units listed in the model training course including,

- Preparation to work safely near live overhead power lines
- Carry out the work safely near live overhead power lines
- Complete the work safely near live overhead power lines.

Further information on training and assessment for work that is to be carried out safely near live overhead power lines by a non-electrical worker can be found in the Australian National Training Authority document UETTDREL04A – Working safely near live electrical apparatus as a non electrical worker.

APPENDIX 5 – EMERGENCY PROCEDURE FOLLOWING CONTACT WITH LIVE OVERHEAD POWER LINES

Should contact be made with a live overhead power line or a flash-over occurs between a live overhead power line and a crane or an item of mobile plant, the following actions shall be taken:

- An attempt should be made to break the machinery's contact with the live overhead power line by moving the jib or driving the machine clear.
- If it is not possible to break the contact with the live overhead power line, the operator of the crane or mobile plant should remain inside the cabin of the crane or on the plant item. The network operator should be called immediately to isolate power to the live overhead power line. The operator must remain in place until the power has been isolated, and the 'all clear' given by the network operator.

WARNING

When a crane or item of plant inadvertently contacts overhead power lines circuit protective devices may operate to automatically turn the power off. However some protection devices are designed to automatically reclose thereby re-energising the powerlines after a short period of time, typically 1 – 4 seconds.

- If it is essential to leave the cabin or the operator's position due to fire or other life threatening reason, then jump clear of the equipment. Do not touch the equipment and the ground at the same time. When moving away from the equipment, the operator should hop or shuffle away from the plant item (with both feet together) until at least eight metres from the nearest part of the crane or plant. Under no circumstances run or walk from the crane or item of plant as voltage gradients passing through the ground may cause electricity to pass through the body resulting in an electric shock.
- Warn all other personnel and members of the public to keep 8 metres clear from the crane or item of plant. Do not touch or allow persons to touch any part of the crane or plant item and do not allow persons to approach or re-enter the vehicle until the network operator has determined the site safe. Remember electricity flows through the ground, so an electric shock could be received from walking close to the scene. If the crane or plant operator is immobilised, ensure the power supply has been isolated and the site made safe before giving assistance.
- Untrained, unequipped persons should not attempt to rescue a person receiving an electric shock. All too often secondary deaths occur because others get electrocuted trying to help earlier victims. If the crane or plant operator is immobilised, ensure the power supply has been isolated and the site has been made safe before giving assistance.

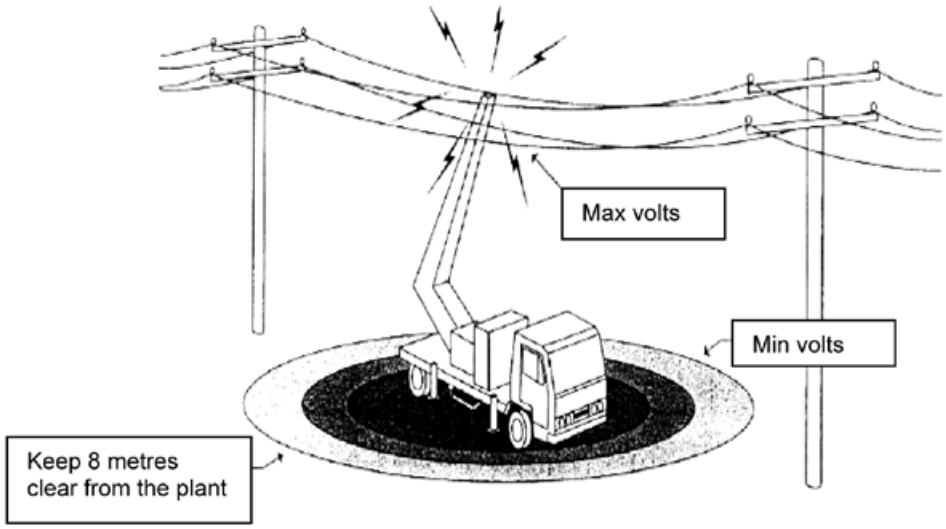


Figure 17: Affected area surrounding mobile plant when in contact with a live overhead power line

Post – incident inspection by a competent person

When a crane or item of mobile plant has been in contact with a live overhead power line, it should checked by a competent person for any damage to the components of the crane or mobile plant. Any actions recommended by the competent person are to be completed before the crane or mobile plant is returned to service.

Tyres on cranes and mobile plant that have been in contact with overhead power lines where electrical flash-over and current flow occurs through the rubber tyres should be considered as a potential hazard. These rubber tyres may catch fire, with the obvious potential for them to explode. Additionally, a lesser known danger may occur, which results when combustion takes place within the tyre, with no apparent external signs. When excessive heat is developed in or applied to a tyre as in the case from contact with overhead power lines, it can initiate a process known as pyrolysis, which is the decomposition of a substance by heat. This can generate a build up of flammable gases and pressure within the tyre, which may ultimately rupture or explode.

Vast amounts of energy can be released by a tyre explosion, often leading to significant equipment damage, serious injures or fatalities. Pyrolysis related explosions are very unpredictable, and have been known to occur immediately or up to 24 hours after initiation. An explosion can occur where no fire is visible and the danger area can be up to 300 metres from the tyre.

Any rubber tyred crane or plant item involved in an incident where contact is made with overhead power lines which results in discharges or flash-over of electrical current through the tyres should be considered as a potential hazard. If any personnel suspect there is a danger of a tyre explosion, as in the case of the mobile crane contacting overhead power lines, then the procedure should include:

- parking the crane in an isolation zone, with a minimum 300 metre radius,
- removing all personnel from the area, and not allowing access to isolation zone for 24 hours, and
- alerting fire fighting services

APPENDIX 6 – CASE STUDIES OF OVERHEAD POWER LINE INCIDENTS

CASE 1

Incident – Mobile Crane Operation

A mobile crane came into contact with 132,000 volt overhead power lines that were located adjacent to a worksite. At the time of the incident the crane driver had slewed the boom of the crane towards the overhead power lines, which resulted in the lifting chains swinging outwards, making contact with the power line.

Luckily no persons were injured, however the crane sustained extensive damage to the tyres, lifting rope and electrical system on the crane.

Contributing factors and relevant sections

Failure to:

- maintain relevant approach distance to the power lines and take outcome of the possibility of the lifting chains swinging towards the overhead power lines when the crane was operated. – Section 3.3
- carry out an adequate risk assessment of the worksite – Section 4.3
- implement appropriate control measures for the work – Section 4.4
- use a safety observer to observe the crane operations near the power lines – Section 4.7

CASE 2

Incident – Scaffolding Work

A worker died and three apprentice roof plumbers were injured when attempting to move an 8.9 metre high aluminium scaffold at a construction site. At the time of the incident the workers were moving the mobile scaffold over soft sand when the castor wheels located at the base of the scaffold sunk into the sand causing it to fall and make contact with 33,000 volt overhead power lines that were located adjacent to the construction site.

As a result of this incident the construction firm and roofing contractor were fined a total of $224,000 by the NSW Industrial Relations Commission.

Contributing factors and relevant sections

Failure to:

- carry out an adequate risk assessment of the worksite that took account of the ground conditions at the worksite – Section 4.3
- implement appropriate control measures for the work – Section 4.4.

CASE 3

Incident – Work on a rural property

The victim, a 17 year old rural worker, received a fatal electric shock due to a flashover when a steel flagpole came into close proximity with an 11kV overhead power line that was located above the entrance to a rural property. At the time of the incident the worker was attempting to erect the 5.2m flag pole at the main entrance gate to the property.

Contributing factors and relevant sections

Failure to

- identify the hazard of the overhead power lines – Section 7.2
- carry out a risk assessment of the worksite and implement appropriate risk controls – Sections 7.3 and 7.4.

CASE 4

Incident – Tipper truck operation

A tipper truck contacted an 11,000 volt overhead power line causing it to break and fall to the ground striking a worker who was at the worksite. At the time of the incident the tip truck was delivering a load of granulated bitumen to the worksite when the tip tray of the truck was raised upwards into the overhead power lines.

As a result of this incident the NSW Chief Industrial Magistrates Court fined the construction firm a total of $15,000.

Contributing factors and relevant sections

Failure to:

- plan the work and identify the hazard of the overhead power lines – Section 2.5 and 4.2
- maintain the relevant approach distance to the overhead power lines and take account of the height of the raised tray when the load was dumped at the worksite. Sections 3.3
- carry out a risk assessment of the worksite – Sections 3.7 and 4.3
- implement appropriate control measures for the work – Section 4.4
- use a safety observer to observe the truck operations near the power lines – Section 4.7.

APPENDIX 7 – USEFUL PUBLICATIONS

WORKCOVER NSW APPROVED INDUSTRY CODES OF PRACTICE

- *Code of Practice: Occupational Health and Safety Consultation*
- *Code of Practice: Risk assessment*
- *Code of Practice: Occupational Health and Safety induction training for construction work*
- *Code of Practice: Moving plant on Construction Sites*
- *Code of Practice: Amenity Tree Industry*
- *Code of practice: Technical Guidance*

Note: The Australian Standards listed below are also WorkCover approved industry codes of practice.

WORKCOVER GUIDES

- *Identification Tool for Electrical Hazards on-site*
- *Subby Pack – OHS contractor management tool*
- *Dangers of Power Lines when Pumping Concrete*
- *WorkCover Safety Alert – Tiger Tails*

Standards and Codes offer practical guidance on health and safety for work. However, these are subject to change from time to time. For further information contact the WorkCover Assistance Service on: **13 10 50**.

For information about the wide range of other codes of practice, certification guides and publications on OHS, rehabilitation and workers compensation, contact the Publications Order line: 1300 797 003.

Information on the latest laws can be checked at www.legislation.nsw.gov.au or contact (02) 9238 0950 or 1800 463 955 (NSW country only).

AUSTRALIAN STANDARDS

Australian Standards can be purchased from SAI Global by contacting the Customer Service Centre on 131 242 or over the net at http://www.saiglobal.com/shop

AS 2550.1 Crane, hoist and winches – Safe use Part 1: General requirements

AS 2550.1 Crane, hoist and winches – Safe use Part 5: Mobile and vehicle loading cranes

AS/NZS 4576 Guidelines for Scaffolding

NATIONAL ELECTRICITY NETWORK SAFETY GUIDELINES

National Guidelines can be purchased from the Electricity Supply Association of Australia by phoning 03 9670 0188 or over the net at http://www.esaa.com.au

- NENS 04-2003 *National guidelines for safe approach distances to electrical apparatus*

NETWORK OPERATORS – CONTACT NUMBERS

- Energy Australia: 13 15 25
- Integral Energy: 13 10 81
- Country Energy: 13 23 56
- Rail Corp: (02) 9379 4911
- Transgrid is divided into three regional areas:
    - Central Region – 1800 625 108
    - Northern Region – 1800 998 049
    - Southern Region – 1800 654 195.

Catalogue No. **WC01394** WorkCover Publications Hotline **1300 799 003**

WorkCover NSW 92-100 Donnison Street Gosford NSW 2250
Locked Bag 2906 Lisarow NSW 2252 WorkCover Assistance Service **13 10 50**
Website **www.workcover.nsw.gov.au**

Amendment no. 0
(Supersedes NPS 0001.am0 and MMI 0015.am1)

Mains Design Instruction

Easements and Property Tenure Rights

IMPORTANT DISCLAIMER

As the information contained in this publication is subject to change from time to time, Endeavour Energy gives no warranty that the information is correct or complete or is a definitive statement of procedures. Endeavour Energy reserves the right to vary the content of this publication as and when required. You shall make independent inquiries to satisfy yourself as to correctness and currency of the content. Endeavour Energy expressly disclaims all and any liability to any persons whatsoever in respect of anything done or not done by any such person in reliance, whether in whole or in part, on this document.

Document no. MDI 0044

Amendment no. 0
(Supersedes NPS 0001.am0 and MMI 0015.am1)

51 Huntingwood Drive, Huntingwood NSW 2148

Postal address: PO Box 811 Seven Hills NSW 1730

Phone: 13 37 18 **Fax**: (02) 9853 6000

MAINS DESIGN INSTRUCTION

PRIMARY SYSTEMS	Document no. Amendment no. Approved by Approval date	MDI 0044 0 MPS 31/10/2013

MDI 0044 – Easements and Property Tenure Rights

CONTENTS

1.0 PURPOSE

To set out in detail Endeavour Energy's design and management requirements for easements and other property tenure related to all overhead and underground network assets.

2.0 SCOPE

This design instruction applies to Endeavour Energy's entire franchise area. This instruction also covers the management, control and safe operation of activities within easements.

3.0 REFERENCES

- Company Policy 9.2.3 – Property Tenure for Network Assets
- Company Policy 9.2.4 – Network Easement Release
- Company Policy 9.2.5 – Network Asset Design
- Company Policy 9.6.8 – Public Lighting
- National Electricity Network Safety Code (ENA Doc 001-2008)
- *Electricity Supply Act* 1995
- *Electricity Supply Amendment (Protection of Electricity Works) Act* 2006
- *Roads Act* 1993
- *Land Acquisition (Just Terms Compensation) Act* 1991
- *Conveyancing Act* 1919
- Endeavour Energy Network Management Plan 2011-2013
- Endeavour Energy General Terms & Conditions for Connection of Public Lighting Assets
- State Environmental Planning Policy (Infrastructure) 2007
- AS / NZS 7000:2010 Overhead Line Design – Detailed procedures
- ISSC 20 - Guidelines for the Management of Activities within Electricity Easements and close to Electricity Infrastructure (April. 2012)
- Environmental Management Standard EMS 0006 - Maintenance and construction of access tracks
- Mains Design Instruction MDI 0012 – Overhead and underground transmission lines
- Mains Design Instruction MDI 0028 – Underground distribution design
- Mains Design Instruction MDI 0031 – Overhead distribution: Design standards manual
- Mains Maintenance Instruction MMI 0013 – Clearances to be maintained between network assets and vegetation
- Substation Design Instruction SDI 100 – Distribution Earthing Design, Construct and Test
    - Drawing no. 016665 - 11kV and 22kV Padmount substation easement layout
    - Drawing no. 282551 - SIize16 Switching station easement layout
    - Drawing no. 289702 – Fencing arrangement for padmount substation easement details

4.0 DEFINITIONS AND ABBREVIATIONS

Earthing system	The system of interconnected electrodes, earthing / bonding conductors and/or other conductive paths acting in the same manner (for example tower footings and cable copper wire screens) to return fault current to the source of supply.
Easement	An easement is an encumbrance on the title of land (which may be limited in width and height above or below the land) conferring a right to construct, operate, maintain, repair, renew, replace or upgrade electrical infrastructure
EMF	Electric magnetic field

EPR	Earth potential rise
HV	High Voltage
LV	Low Voltage
MEN	A system of earthing in which the parts of an electrical installation required to be earthed in accordance with AS/NZS 3000 are connected together to form an equipotentially bonded network. This network is connected to both the neutral conductor of the supply system and the general mass of the earth
Public road	Defined under the Roads Act 1993. A road usually includes a vehicle carriageway and associated footpath areas on each side of the carriageway.

5.0 ACTIONS

All Endeavour Energy overhead and underground easements shall comply with the requirements of this document which are based on the requirements of ISSC 20 “Guidelines for the Management of Activities within Electricity Easements and close to Electricity Infrastructure”.

Regional easement officers shall be responsible for the management of permitted and controlled activities / encroachments within easements as outlined in this document.

5.1 Easements

An easement is an encumbrance on the title of land, giving one party rights over land owned by another party. All transmission and distribution infrastructure newly installed, relocated or rebuilt not constructed on public roads, shall have an easement in favour of Endeavour Energy in accordance with the requirements of this standard.

Temporary easements / licencing agreements may be considered on a case by case basis for staged works within industrial, commercial or residential developments. All such agreements shall be approved by the Manager, Primary Systems before being committed to.

The establishment of an easement for rebuilt feeders is optional if the size of the easement and the impact on the land is unchanged and/or reduced and shall only be pursued if it is considered practical and economical to do so. Where the proposed rebuild of the feeder would negatively impact the surrounding land by either increasing the required easement width or changing the position of the easement (if one were to exist) an easement shall be created for the rebuilt feeder.

The easement shall be created over a defined part of the land and recorded on the title of the property held by Land and Property Information (LPI) NSW.

Electricity infrastructure already constructed or installed that does not have the benefit of an easement shall be treated in the same manner as infrastructure that has an easement. Infrastructure constructed prior to the commencement of the *Electricity Supply Amendment (Protection of Electricity Works) Act* 2006 is protected under Section 53 of the Electricity Supply Act 1995.

Where no easement exists, power lines will be managed as though they had an easement which relates to their voltage and construction type.

In particular circumstances Endeavour Energy standards may require restrictive covenants to be listed around electrical equipment / assets. Standard terms for such restrictions have been included in Annexure 3 of this document.

5.1.1 Minimum easement widths

The table below specifies the minimum easement width for each of the typical asset classes. These minimum widths are based on typical span lengths (for overhead lines) and maintenance requirements for each voltage level & asset construction type. A request for dispensation shall be made to Endeavour Energy's Overhead & Underground Mains Manager for any proposed easement that is smaller than the stated minimum for approval by the Chief Engineer.

Larger easements may be specified and/or required on a project by project basis. All designs shall certify that the easement widths below are acceptable for the span lengths / conductors used in the design.

All overhead and underground assets (other than padmounts / switching stations) shall be positioned in the centre of the easement (refer to drawings 016665 and 282551 for easement details of padmounts and switching stations).

	Voltage	**Asset Type**	**Construction**	**Minimum Easement** (m)
Underground Assets	400V - 22kV	Cables	Ducted / Direct buried	3
			Concrete covered ducts *(min 50 mm concrete cover at standard burial depth)*	1
	33kV - 132kV	Cables *(single feeder only)*	Ducted / Direct buried	5
			Cable Pits / Joint Bays	6
	-	Communications cables	-	1
		Earthing conductors		1
		Streetlight Column		1.0 x 1.0
		Switching station		2.75 x 2.75
		Padmount substation		2.75 x 5.5
		Auto Transformer		
		Indoor substation		See note 1
Overhead Assets	400V–22kV	Bare Construction	All	9
		ABC		
		CCT		
	33kV / 66kV	Bare conductor *(see note 2)*	Line post insulators	18
			33kV Suspension Insulators	18
			66kV Suspension Insulators	25
			H pole Structures	30
	132kV	Bare conductor *(see note 2)*	Line post insulators	25
			H pole Structures	30
			Steel tower	30
	-	Pole stays / Ground stays	-	6
		Vehicle access tracks[1]		4

Table 1 - Minimum easement widths

[1] Refer to EMS 0006 Maintenance and construction of access tracks for further details.

1. The easement for indoor substations shall be defined by the internal face of the walls, ceiling, floor, and cable trenches of the room(s).
2. An easement for overhead power lines or pole / ground stays shall extend at least half the easement width beyond the last network pole or stay.

Where a request is made to reduce the easement widths from those above, the submission shall show there is no reduction in access for maintenance purposes and that the easement provides adequate electrical clearance to any existing and/or future structures that may be built adjacent to the easement.

All designs shall consider the following factors when determining an easement width:

- Electrical safety clearance
- Insulator and conductor blowout
- Access for maintenance, repair and upgrading
- Future requirement for additional feeder(s)
- Public safety based on potential EPR and EMF issues
- Radio and television interference
- Audible noise
- Cable duct / jointing bay requirements

At an absolute minimum the easement shall be the greater of the following two criteria:

- The width of the structure plus two (2) times the conductor blowout (at 50°C and 500 Pa wind pressure) plus the appropriate clearance from Table 3.8 of AS/NZS 7000.
- Minimum maintenance requirements of the voltage class / type of construction.

Assets proposed to be installed within the road reserve are subject to the design considerations / requirements stated above whether or not an easement is required for the construction of the asset. If the road reserve / verge does not provide adequate separation between the assets and private land, easements shall be taken out on all impacted land to ensure the safety of the current and future land owner(s) and to maintain the reliability of the future asset.

5.1.2 Easement creation

Easements must be created in favour of Endeavour Energy and can be created by the following three methods:

5.1.2.1 Creation by Section 88B

The most commonly used method of creating an easement is by showing the easement on a plan suitable for registration at LPI and preparing an instrument (easement document) under section 88B of the *Conveyancing Act 1919*.

The plan and instrument must be signed by the owner and any mortgagee, and registered at LPI. The easement is created upon registration.

It is not possible to create by this method an easement affecting crown land, national parks or other land parcels created by a statutory dedication.

5.1.2.2 Creation by Deed or transfer granting easement

A Transfer Granting Easement form is signed by both transferor and transferee and must incorporate a definition plan (unless the whole parcel is to be affected) and agreed terms.

The Transfer Granting Easement form must be registered at LPI. The easement is created upon registration.

It is not possible to create by this method an easement affecting crown land, national parks or other land parcels created by a statutory dedication.

If the land is old system title, a deed will need to be used instead of a Transfer Granting Easement form.

5.1.2.3 Creation by compulsory process

Acquisition by compulsory process is subject to the approval of the Minister for Energy.

The power to acquire land and easement by compulsory process is set out in section 44 of the *Electricity Supply Act 1995*. The procedure is set out in the *Land Acquisition (Just Terms Compensation) Act 1991*.

Compulsory acquisition should be undertaken with the written consent of the owner, and hence the owner shall be consulted in the same way as in any other property tenure negotiations.

In relation to crown land, Endeavour Energy must consider the possible existence of unextinguished native title. It is necessary to carry out additional searches and enquiries and to attempt to trace the native title owner.

The easement is created by publication of a notice in the NSW Government Gazette. The compulsory acquisition should also be recorded at LPI.

Due to the nature of the process, at least 12 months' notice may be required for the compulsory acquisition of an easement, unless the owner is willing to enter into a pre-acquisition agreement.

5.1.3 Easement terms

The terms of an easement must be defined in writing. Endeavour Energy standard easements terms are defined in Annexure 1 of this document for the following asset categories:

- Easement for overhead power lines, padmount substation, switching station, underground cables
- Easement for indoor substation

If standard easement terms are required for other asset categories a proposal shall be submitted to the Manager, Primary Systems for review and endorsement and final approval from the Chief Engineer.

Additionally in unusual situations, the owner may have specific site requirements that require amendment to the standard terms. The details of any proposed amendment should be submitted to Endeavour Energy's Manager Primary Systems for review prior to certification of the design and receive approval from the Chief Engineer before being agreed to.

5.1.4 Easement release

Easements may be released if the need arises and the easement has no / limited benefit to Endeavour Energy. Easements releases shall be managed in accordance with Company Policy 9.2.4, each request shall be assessed by the Asset & Network Planning Branch to identify and manage the risks to the network, commercial interests and public reputation.

All easement release requested shall be endorsed by the relevant Regional Manager, Manager Primary Systems and Manager, Asset & Network Planning and approved by the Chief Engineer prior to being agreed / committed to.

Easement releases associated with situations specified in clause 5.2.2 of Company Policy 9.2.4 may be approved by Manager, Network Connections.

5.2 Asset relocations

In order to maintain the functionality and capability of existing assets and easements, all assets in the Endeavour Energy franchise area that are relocated shall be provided with a new easement equal to the original easement width, and not the minimum values specified in Section 5.1.1

If an applicant seeks to reduce the size of an existing and/or standard easement, a detailed plan shall be submitted to Endeavour Energy's Overhead and Underground Mains Manager proving that the easement factors set out in section 5.1.1 have been considered and will allow the continual safe / efficient operation of all new and existing assets and easements. The overall long-term performance and reliability of the entire feeder shall be considered for any proposed asset relocation projects where sections of transmission overhead lines (33kV and above) are proposed to be relocated underground. The proposal shall contain an impact statement addressing the reliability / earthing requirements of the entire feeder and shall minimise the number of joints and terminations along the feeder.

All applications to relocate / reconstruct overhead transmission assets to underground shall be submitted to Manager, Primary Systems for consideration. The proposal will not be accepted unless an impact and risk assessment for the entire feeder and its overall, long-term performance has been carried out.

Any such applications shall be made at the design stage of the project and before any work is commenced.

5.3 Community Title developments

All assets owned by Endeavour Energy within a Community Title development not installed in public roads are to be provided with an easement to allow for future maintenance and repair.

The minimum cable easement widths in this document do not apply to community title developments. Where the easement / access proposal does not meet the minimum easement widths in this document for transmission assets or the minimum clearance / access requirements of Endeavour Energy's distribution trench profiles (provided in MCI-0006) a proposal of the easement width / access ways shall be submitted to the OH & UG Mains Manager for endorsement.

The ownership of electrical assets (both HV and LV) within a community title development will only be accepted (owned and maintained) by Endeavour Energy if they are installed in accordance with Endeavour Energy's standard requirements and installation practices.

Endeavour Energy will generally own and maintain all high voltage electrical equipment within the development.

Endeavour Energy or the Community Title Association may own and maintain the low voltage electrical equipment and/or street lighting network.

Annexure 2 outlines the relevant by-laws that shall be incorporated into community title management plans to define the ownership and access requirements for the electricity assets within the development.

Community title developments and their management associations or developers are not considered to be public lighting customers under the NSW Public Lighting Code and therefore shall meet the requirements stated in Endeavour Energy's "General Terms and Conditions for Connection of Public Lighting Assets"

For all assets the installation shall provide the same level of security and access as normally would be found in standard urban residential development, this includes:

- All cables / spare conduits being located in the standard allocation within the road verge
- All pillars, padmount substations and switching stations are located in acceptable areas as stated in MDI-0028.

- No other assets and/or utilities being installed directly above the electrical assets
- Minimum distances between electrical assets and other utility services being maintained
- Sufficient access for Endeavour Energy vehicles (including trucks and EWP's) to access and maintain the assets without the need to close and/or block private roads.

All easements shall be created under a section 88B of the Conveyancing Act 1919.

5.4 Indoor substations

The boundaries of an easement for indoor substation shall be defined by the internal face of the walls, ceiling, floor, and cable trenches of the substation room.

An easement for the cables that enter and exit the substation room will also be required if they are not installed within public roads and/or existing Endeavour Energy easements.

A right of access may also be required to give Endeavour Energy staff, vehicles, and equipment unrestricted access to the indoor substation at all times.

5.5 Management of easements

For easements managed by Endeavour Energy, activities / encroachments fall into two (2) categories – *prohibited* or *controlled*. Endeavour Energy does not allow any activities within its easements without some level of control.

5.5.1 Prohibited activities / encroachments

The following activities / encroachments listed below are prohibited within all Endeavour Energy easements and will not be approved:

- Construction of buildings (permanent or temporary)
- Construction of climbable and non-climbable structures (permanent or temporary)
- Any type of construction within the padmount substation / switching station easement
- Any increase in ground level above the concrete base of the padmount substation site
- Building overhangs within six (6) metre airspace above a padmount substation site
- The installation of fixed plant or equipment
- The planting of trees that exceed a height of three (3) metres in overhead easements
- Plants with root systems that grow greater than 400 mm below ground level in underground easement
- The placement of obstructions which may hinder access requirements
- Swimming pools permanent and / or temporary constructions
- The storage and / or use of flammable, combustible or explosive material
- The storage and / or handling of conductive material of lengths in excess of three (3) metres in overhead easement
- Lighting of any fires (refer to section 5.5.2.11 regarding back burning requirements)
- Parking of campervans and tankers with fixed ladders
- Concrete driveways located above and/or that restrict access to existing cable joints/pits.
- Electric fencing
- Changing of ground level such that relative depth of underground cables increases or decreases
- Ploughing near electricity structures and supporting guys that may impact the assets structural integrity.

Where an activity or encroachment violates the above requirements, arrangement of its removal shall be made. Any cost incurred will be at the expense of the owner of the land.

5.5.2 Controlled activities / encroachments

The application for a controlled activity must be made in writing to Endeavour Energy's Regional Easement Officer to assess the activity within the easement as set out in section 5.8 of this document. The proposed activity must not commence unless approval is received in writing from Endeavour Energy Regional Easement Officer.

No structure is allowed to be within five (5) metres of the vertical projection of the overhead conductors, exceed a maximum height of 2.5 metres or allow any part of a person to be greater than 4.3 metres above the ground.

No mobile plant and equipment shall exceed a maximum height of 4.3 metres.

Before commencing any underground activity, all applicants are required to obtain advice from the ***Dial before You Dig*** **1100** service in accordance with the requirements of the Electricity Supply Act and associated Regulations. All relocation costs to enable the activity to proceed will be borne by the applicant.

Workcover Authority of NSW Publications provides guidance on risk control measures when working close to electricity infrastructures both below and above ground. Refer to Code of Practice – Work near Overhead Power Lines or Work Near Underground Assets Guide.

No mechanical compacting is to occur within an easement.

The activities listed below may be permitted (if approved in writing by Endeavour Energy's regional Easement Officer(s)) within Endeavour Energy easements, only where appropriate controls are designed and implemented to mitigate safety risks.

5.5.2.1 Mobile plant and equipment and parking

Within an overhead easement area, approval for the operation of mobile plant and equipment is dependent upon available clearances to the conductors under maximum operating conditions, power line voltages, vehicle operating heights and the level of accreditation of the vehicle operator.

Consequently, each application for the operation of mobile plant and equipment will be processed by the regional easement officer and assessed to ensure compliance with relevant OH&S and NSW WorkCover legislation. A dedicated observer must also be present to ensure that clearances are maintained.

Precautions must be taken to prevent collision or interference with overhead structures or supporting guys.

Parking within an overhead easement is subject to a vehicle height limitation of 4.3 metres and the vehicle not occupied or connected to power.

Within an underground easement area, approval is dependent upon an adequate surface to support the mobile plant up to 30 tonne or equipment likely to be parked to prevent the crushing of the cables/ducts or erosion of the ground. In some instances, the activity may require supervision by an Endeavour Energy representative at the operator's expense.

Padmount substation easements in the vicinity of parking facilities shall have suitable crash and impact protection from vehicles installed while maintaining access.

A proposal by operators shall be made to Endeavour Energy for the installation of suitable vehicle impact protection measures subject to approval from the regional easement officer.

No work is to commence until approval from the Regional Easement Officer is obtained.

5.5.2.2 Concrete driveways

Concrete driveways are permitted within Endeavour Energy easements where:

- cables are in existing continuous ducts;
- the driveway is capable of supporting the heaviest vehicle likely to traverse the driveway; and,
- the thermal rating of the cable is not compromised
- the concrete driveway is not proposed to be installed within a distance that would restrict access / maintenance of a joint / pit.

The need for (including size and quantity) of spare conduits shall be confirmed with Network Planning prior to the construction of concrete driveways within easements. All required conduits shall be funded by the applicant.

If ducts are not laid prior to the installation of the driveway, the owner must bear the cost of installing ducts, either by digging up the driveway or under-boring if required by Endeavour Energy at a future stage.

5.5.2.3 Minor structures

The following minor structures are permitted, subject to the requirements of clause 5.5.2.

- clothes hoists
- playground equipment
- non-metallic fences (Endeavour Energy may require gates)
- small brick barbecues

All metallic parts shall be effectively earthed and no electrical supply shall be brought within the easement.

Endeavour Energy reserves the right to have the structure removed, or to remove it, if and when required.

5.5.2.4 Erection of conductive fencing / sound walls

All conductive fencing and/or sound walls crossing or running parallel to an easement are to be effectively earthed and / or have interval breaks in electrical continuity to prevent electromagnetic induction and transferred voltage hazards.

If the earthing system in the easement is not common earthed, a minimum four (4) metre clearance between the fence / sound wall and the HV earth grid shall be maintained. If the four (4) metre clearance cannot be maintained, the section of the fence shall be fitted with insulated posts or be suitably modified to avoid transfer potential. An assessment of potential touch voltages in the vicinity of the fence is required.

If the earthing system in the easement is common earthed, a metallic fence can be installed on the easement boundary.

A minimum 4.2 metre wide opening or gate (with provision to accept Endeavour Energy locks) for vehicle access will be a condition of approval.

Fencing within underground easements is subject to approval by the Earthing & Power Quality Manager provided an investigation demonstrating that the hazards related to induction and transferred voltage hazards is addressed.

5.5.2.5 Metal safety barriers and guardrails

Where a metal barrier (Armco guardrail or similar) crosses and continues beyond an easement, the following is required:

- The section of barrier within the easement shall be earthed.

- A minimum 300 mm clear air gap shall be left between the end of the barrier within the easement boundary and the starting point of the barrier beyond the easement boundary.

5.5.2.6 Rainwater tanks

Above ground rainwater tanks, either for fire-fighting purposes or rainwater harvesting, erected within an easement, shall be fully enclosed and of non-conducting material. Concrete is considered to be a conductive material.

All pipework is to be non-conductive and no electrical supply shall be supplied to the tank for any purpose (including pumps and/or lighting). Pumps and lights shall be installed outside the easement.

Ladders shall not be installed on the rainwater tank.

Rainwater tanks shall not be installed within 5 metres of a pole or supporting guy, 10 metres from a steel structure or within five (5) metres of the vertical projection of the conductor.

The tank and associated pipe work shall not interfere with maintenance or access to electricity assets.

5.5.2.7 Detention basins

Detention basins temporarily store runoff water - usually for one or two days - after storms and drain slowly to an essentially dry basin.

Applications for detention basins will be considered subject to:

- location has local council approval,
- not installed within 5 metres of a pole or supporting guy or 10 metres from a steel structure.
- Sufficient access is maintained to all structures along the easement.

5.5.2.8 Quarrying, filling, earthworks, or change of ground contours

Approval by the Easement Officer may be given subject to:

- the maintenance of standard ground clearances, or conductor heights adjusted at the proponents expense;
- access maintained to all line structures;
- the subsoil stability and surface drainage in the vicinity of structures is not adversely affected; and,
- excessive quantities of dust are not generated.

5.5.2.9 Domestic recreational activities and recreational facilities

Approval will be given for domestic recreation activities, but will not include activities that may interfere with clearances to the conductors, such as flying of kites, model aircraft, BMX bike riding (with jumps), and the like.

Approval will be given for recreational facilities subject to:

- fencing is to be non-conductive material or must be effectively earthed (refer to section 5.5.2.4);
- facilities surface construction will be required to withstand the movement of large heavy plant up to a 30 tonne truck;
- not within 5 metres from a power pole or 10 metres from a steel structure.

5.5.2.10 Storage of materials

Non-flammable, non-combustible, non-explosive and non-conductive materials are permitted subject to a height limitation of 4.3 metres if not climbable or 2.5 metres if climbable.

Additionally access to Endeavour Energy's assets shall not be restricted and the materials shall be capable of being removed in a reasonable amount of time.

5.5.2.11 Back burning

Back-burning operations carried out by fire authorities or bushfire brigades must be referred to Endeavour Energy's Control Room Manager and must include a map of the area showing the time, date and the area of the burn. An Endeavour Energy representative may attend back-burning to ensure the safety of structures and conductors.

5.5.2.12 Agricultural pursuits

Clear, defined vehicle access to structures is required to prevent damage to crops.

Irrigation systems shall not be placed within five (5) metres of the overhead conductors at any time.

The equipment as located must not be capable of projecting a solid jet of water to within three (3) metres of any overhead conductor.

Gun type irrigators must have the water jet directed away from the conductors.

Care shall be taken when moving equipment around such as irrigation pipes or equipment, grain augers and the like.

The equipment shall not interfere with maintenance or safe operation of the power line, nor shall it interfere with access to electricity assets.

5.5.2.13 Roads (other than access tracks)

Roads under power lines can be approved only if statutory clearances to the conductors can be maintained under maximum operating conditions and access for maintenance of assets is not unacceptably reduced and/or impeded.

For roads running parallel to power lines within the easement, a proposal shall be made to Endeavour Energy clearly evaluating the risk of impact with each structure as outlined in MDI-0012 and MDI-0031.

Roads and driveways required for access to electrical infrastructure must be capable of carrying a 30 tonne truck.

Earthing conductors may have been laid near, around and between the structures and must not have their electrical integrity compromised. Where a developer plans to construct a road which crosses the easement, the onus is on the developer to locate and avoid all earthing cables. If earthing cables are damaged, Endeavour Energy shall be notified immediately.

Signage on either side of the road crossing giving the clearance to the line may be required and shall be maintained by the property owner.

Alterations to conductor height and/or relocation of poles required for the development of the road will be at the cost of the developer. This will include any work required to maintain safety clearances arising from activities in the easement after the road works are completed.

Applicants will be required to submit detailed survey information, to Endeavour Energy's Overhead and Underground Mains Manager, for assessment and approval. No work is to commence until written approval is obtained.

5.5.2.14 Installation of utility services

Provided there is no practical alternative method available, installation of utilities, such as telephone, water and sewerage services (overhead, underground, or on the surface) may be considered for approval by Endeavour Energy's Overhead and Underground Mains Manager.

Any services within 15 metres of a structure shall be constructed of non-conducting materials.

The integrity of all line structures and guy supports are to be maintained at all times.

Designers and installers of utility services must consider any hazards associated with induced voltages and transferred earth potentials, which must be controlled.

Applications will require a risk assessment and proposed controls for each of the identified hazard.

Establishment of an easement for other utilities assets within Endeavour Energy's easement may be required.

5.5.2.15 Retaining walls

Retaining walls shall be built to comply with the relevant building codes and local government requirements.

The wall shall be built using concrete material (for example, *Besser* blocks, concrete / clay bricks) to prevent later deterioration and shall provide sufficient strength for all work performed by Endeavour Energy within the easement

Extreme care shall be taken when excavating for foundations to protect the ducts, cables and earthing system from damage, and to allow access for future maintenance or repairs.

The risk of damage to underground ducts / cables when digging post holes reinforces Endeavour Energy's preference for brick retaining walls on the shallowest foundations possible.

This would allow a sturdy retaining wall in concrete material approximately one (1) metre in height. Taller retaining walls shall be stepped to avoid the need for deep foundations near the easement.

Retaining walls built around distribution substations or switching stations, as part of reticulation requirements, shall be outside the standard easement. In the case of a retaining wall built to protect a padmount substation from vehicle impact, the easement size will be increased to include the retaining wall.

Proposed retaining walls shall not impact the maintenance activities performed by Endeavour Energy on any assets within the easement.

5.5.2.16 Access to padmount substations / switching stations

If guard dogs are to be used, or if a complex security system is installed, the padmount substation or switching station shall be fenced outside of the property (refer to Drawing no. 289702 - Basic fencing in easement layout).

5.5.2.17 Landscaping / vegetation

Minimum acceptable vegetation clearances to all electrical assets shall be in line with the requirements of MMI 0013.

Additionally all landscaping surfaces shall be such that it provides a stable work surface and shall be readily removed and / or restored. Materials such as wood chip and blue metal are acceptable. Grass may be used, however, the applicant shall be advised that Endeavour Energy is not responsible for its maintenance or replacement.

Screening vegetation for padmount substations shall be planted outside the easement. Any vegetation adjacent to the easement shall not obstruct access to the padmount substation and shall be maintained in such a manner as to allow easy access to Endeavour's assets.

5.6 Transfer earth hazards

In addition to all requirements stipulated in this standard the risk of transfer earth hazards associated with Endeavour Energy's assets and/or equipment, structures or objects shall be managed in accordance with SDI 100 "Distribution earthing design, construct and test".

This requirement may impose restriction zones around Endeavour Energy's assets limiting the use of land within the defined area(s).

5.7 Locking arrangements for shared access gates

In some cases, access to land with electricity easements is shared by Endeavour Energy with others - utilities, customers, and organisations such as the NSW National Parks and Wildlife Service or the Rural Fire Service.

Where access is through a gate protected by dedicated locks, an EL specification lock shall be installed. The preferred arrangements for single or multiple locks are shown in Figure 1 below. Where there is more than one lock, the locks shall be spaced as evenly as possible by joining with equal lengths of chain.

The entire chain shall be of exact length to allow the gate to be fully secured, while allowing for the chain to be rotated so that access to the locks is possible from either side of the gate.

When replacing locks after entering or leaving, users shall ensure the lock joins the correct ends of the chain so that it remains a continuous loop.

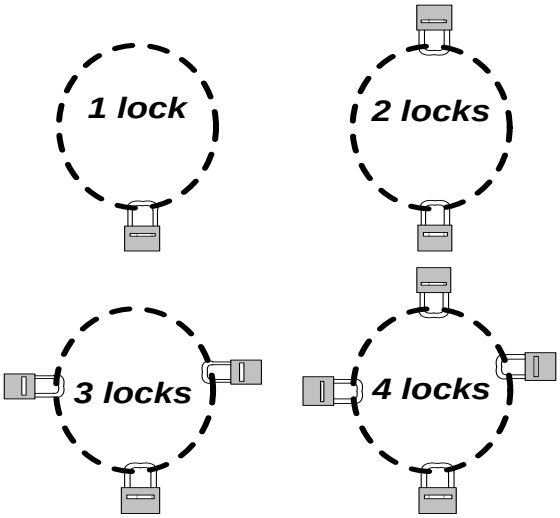


Figure 1 – Locking arrangements for shared access gates

5.8 Encroachment approval process

Local councils approve / disapprove structures on private property and from time to time an existing encroachment will be found. Where an encroachment is found that has not previously been approved, it will require individual assessment.

The first approach is to determine whether approval would be usually given. Where it is a controlled activity that is usually permitted, approval for it to continue shall be given with the usual imposed conditions included.

Prohibited encroachments / activities require the owner or occupier to remove the encroachment or cease the activity.

On completion of the assessment, the course of action will be guided by:

- Explanation of the terms of the easement.
- Highlighting the dangers involved the hazards to themselves, members of the public and Endeavour Energy's staff; and, providing advice on possible solutions to overcome / lessen the encroachment.

Legal action will be considered when all other avenues are exhausted.

The local council must be included in correspondence to highlight the need for their approval process to include a corresponding approval from Endeavour Energy where easements are involved.

All applications for an activity or encroachment, or requests for advice, shall be referred to Endeavour Energy's regional Easement Officers. Applications shall be addressed to:

> Regional Easement Officer - North / South / Central *(see table below)*
> Endeavour Energy
> PO Box 811
> Seven Hills NSW 1730

Endeavour Energy's network franchise area has three (3) regions, responsible for the local government areas set out in the following table:

Region	Local government areas
North	Bathurst, Baulkham Hills, Blacktown, Blue Mountains, Hawkesbury, Lithgow, Parramatta, Penrith, plus parts of Hornsby, Mid-Western and Ryde.
Central	Camden, Campbelltown, Fairfield, Holroyd, Liverpool, Wingecarribee, Wollondilly, plus parts of Bankstown.
South	Kiama, Shellharbour, Shoalhaven, Wollongong.

Due to the varied circumstances that apply to easements, all applications will be assessed individually, and will be site specific.

All proposed activities or encroachments are subject to the following:

- The application is to be made in writing.
- The application is to include detailed plans, drawn to scale and with full dimensions, showing property boundaries, lot number, Deposited Plan (DP) number, any electricity structures, and other relevant information.
- A survey plan of an easement for padmount substation shall show the substation number and at least two (2) offsets from adjacent sides of the concrete plinth to the easement boundary.
- Each application will require an impact and risk assessment and shall be assessed on the site-specific circumstances and Endeavour Energy's risks assessment company procedure of the proposal.

- Access to Endeavour Energy assets contained within the easement must be available at all times.
- Minimum design and safety clearances to the Endeavour Energy assets must be maintained at all times.
- Where Endeavour Energy is uncertain about the impact of the activity or encroachment, the applicant/s will be asked to arrange an independent study at their expense. Endeavour Energy will consider the outcome of the study when deciding on the application.
- Where additional testing is required, the applicant will be responsible for arranging the test, at their cost, by an organisation acceptable to Endeavour Energy, and for supplying the test results.

It shall be noted that the activities set out in this Standard are guidelines only, and may not cover all applications. Any scenarios not covered should be referred to Manager Primary Systems for consideration and/or approval.

6.0 AUTHORITIES AND RESPONSIBILITIES

The **Chief Engineer** has the authority and responsibility for

- approving this instruction.
- approving non-standard / reductions in easement widths
- approving non-standard easement terms
- approving the release of an easement

The **Manager Primary Systems** has the authority and responsibility for making recommendations to the Chief Engineer in respect to this instruction and endorsing the following proposals:

- non-standard / reductions in easement widths
- releasing an easement

The **Manager Network Connections** is responsible for ensuring that the provisions of this instruction are applied to all new contestable works electrical designs.

The **Regional Managers** are responsible for providing the resources and staff required to ensure easements are managed in accordance to this instruction.

The **General Manager, Network Develop** and staff are responsible for ensuring that the provisions of this instruction are applied to all new distribution and transmission projects.

The **Earthing and Power Quality Manager** is responsible for approval for the various encroachments within easements.

The **Overhead & Underground Mains Manager** is responsible for ensuring that the content of this instruction is kept up to date and approval for the various encroachments within easements.

The **Strategic Network Planning Manager** is responsible for ensuring that the provisions of this standard are met.

The **Substations Manager** is responsible for providing input to the content of this instruction.

The **Easements Officers** are responsible for the management of Endeavour Energy easements based on the requirements of this standard, including providing advice and consultation to landowners.

7.0 DOCUMENT CONTROL

Documentation content coordinator: Overhead & Underground Mains Manager

Documentation process coordinator: Branch Process Coordinator

Annexure 1 STANDARD EASEMENT TERMS

1 **Overhead Lines, Underground Cables, Padmounts, Auto-Trf's & Switching Stations**

The authority benefited may:

1.1 install electrical equipment within the easement site,

1.2 excavate the easement site to install the electrical equipment.

1.3 use the electrical equipment for the transmission of electricity,

1.4 enter the lot burdened using the most practical route (with or without vehicles, machinery or materials) at all reasonable times (and at any time in the event of an emergency) and remain there for any reasonable time. This may include the installation of gates in existing fencing if access is not readably available,

1.5 trim or remove any vegetation from the lot burdened that interferes with or prevents reasonable access to the easement site or the electrical equipment, and

1.6 remove any encroachments from the easement site and recover the costs of carrying out the removal work and repairing any damage done to the electrical equipment by the encroachment.

2 In exercising its rights under this easement the authority benefited will take reasonable precautions to minimise disturbance to the lot burdened and will restore the lot burdened as nearly as practicable to its original condition.

3 The owner agrees that it will not:

3.1 install or permit to be installed any services or structure within the easement site, or

3.2 alter the surface level of the easement site, or

3.3 do or permit to be done anything that restricts access to the easement site by the authority benefited

without the written permission of the authority benefited and in accordance with such conditions as the authority benefited may reasonably impose.

4 The authority benefited will not be responsible if the electrical equipment causes magnetic interference to computer equipment or electronic equipment operated within the lot burdened.

5 Definitions:

5.1 **authority benefited** means Endeavour Energy and its successors (who may exercise its rights by any persons authorised by it).

5.2 **easement site** means that part of the lot burdened that is affected by this easement.

5.3 **electrical equipment** shall be defined as stated below for each of the easement terms associated with the following asset classes:

5.3.1 Overhead Power Lines - includes pole, tower, overhead electrical conductors, underground earthing system, and ancillary equipment.

5.3.2 Underground Cables - includes underground electrical cable, duct, service pillar, underground earthing system, and ancillary equipment.

5.3.3 Padmount Substation / Switching Station - includes electrical transformer (padmount only), switchgear, protective housing, concrete plinth, underground electrical cable, duct, underground earthing system, and ancillary equipment.

5.3.4 Street Lighting – includes the column, lantern and foundations of the street light.

5.4 **install** includes construct, repair, replace, maintain, modify, use, and remove.

5.5 **owner** means the registered proprietor of the lot burdened and its successors (including those claiming under or through the registered proprietor).

5.6 **services** includes overhead and underground gas, telephone, communications, water, sewage, and drainage services.

5.7 **structure** includes building, wall, retaining wall, carport, and swimming pool; but excludes garden furniture and garden ornament.

The terms implied by s88A(2A) & Schedule 4A Part 8 of the Conveyancing Act 1919 are excluded

Indoor Substation

1.0 The authority benefited may:

1.1 install electrical equipment within the easement site,

1.2 use the electrical equipment for the transmission of electricity,

1.3 enter the lot burdened (with or without vehicles, machinery or materials) at all reasonable times (and at any time in the event of an emergency) and remain there for any reasonable time,

1.4 install its own security doors to gain access to the electrical equipment and to prevent access by others, and

1.5 install conduits, cables, and pipes on, under or through the building for the purpose of connecting the electrical equipment with any services and to operate those services.

2.0 The authority benefited agrees that it will not cut, drill, alter or demolish any part of the building necessary to install or operate the electrical equipment without the written permission of the owner and in accordance with such conditions as the owner may reasonably impose.

3.0 In exercising its rights under this easement the authority benefited will take reasonable precautions to minimise disturbance to the lot burdened and will restore the lot burdened as nearly as practicable to its original condition.

4.0 The owner agrees that it will not:

4.1 install or permit to be installed any thing within the easement site, or

4.2 interfere with, allow to be interfered with, or prevent the ventilation of the easement site, or

4.3 direct or allow to be directed drainage into the easement site, or

4.4 do or permit to be done anything that restricts access to the easement site by the authority benefited,

without the written permission of the authority benefited and in accordance with such conditions as the authority benefited may reasonably impose.

5.0 The authority benefited will not be responsible if the electrical equipment causes magnetic interference to computer equipment or electronic equipment operated within the lot burdened.

6.0 Definitions:

6.1 **authority benefited** means Endeavour Energy and its successors (who may exercise its rights by any persons authorised by it).

6.2 **building** means the building within which the electrical equipment is located.

6.3 **easement site** means that part of the lot burdened that is affected by this easement.

6.4 **electrical equipment** includes electrical transformer, electrical switchgear, electrical cable, duct, services, ventilation, and ancillary equipment.

6.5 **install** includes construct, repair, replace, maintain, modify, use, and remove.

6.6 **owner** means the registered proprietor of the lot burdened and its successors (including those claiming under or through the registered proprietor).

6.7 **services** includes electricity, telephone, communications, ventilation, water, sewage, and drainage services.

The terms implied by s 88A(2A) and Schedule 4A Part 8 of the Conveyancing Act 1919 are excluded.

Annexure 2 COMMUNITY TITLE BY-LAWS

To ensure access to assets the following by-law shall be incorporated into all community title management statements where HV or LV (including street lighting) assets are owned and maintained by Endeavour Energy:

> **BY-LAW [X] ENDEAVOUR ENERGY – Access Ways**
>
> *The Association agrees that if the surface of the accessways does not support the heavy vehicles, machinery and materials necessary to maintain Endeavour Energy's electrical equipment, the Association will be responsible for repairing any damage caused to the surface of the access ways during such maintenance.*
>
> *This provision applies despite any other easement term to the contrary.*

Where the ownership of any part of the electricity network (HV, LV or street lighting) within the community title development is to be the responsibility of the community association, the following by-law shall be incorporated into the community title management statement:

> **BY-LAW [X] ENDEAVOUR ENERGY – Ownership of Assets by the Association**
>
> *The low voltage electricity system is defined on the prescribed diagram as [eg "electricity"].*
>
> *This electricity system is Association property.*
>
> *The Association is responsible for the maintenance, repair, refurbishment, and augmentation of this electricity system.*
>
> *The design of this electricity system has been based on a maximum demand of [as advised by the designer] Amps per dwelling.*

Annexure 3 RESTRICTIVE COVENANTS

In situations where Endeavour Energy design and/or construction standards require restrictive covenants to be provided around electrical equipment / assets the following standards terms shall be used.

The dimensions / size of these restrictive covenants are specified in the relevant standards where they are specified as a requirement.

The following standard terms are provided below:

- Safety Clearance between Padmount Substations and Adjacent Buildings
- Fire Proof Screen Walls
- Separation of Metal Structures to an Earth Grid
- Separation of Swimming Pools to an Earth Grid

3.1 Safety Clearance between Padmount Substations and Adjacent Buildings

Terms of Positive Covenant numbered [xx] in the plan

1.0 No building shall be erected or permitted to remain within the restriction site unless:

1.1 the external surface of the building erected within 1.5 metres from the substation footing has a 120/120/120 fire rating and

1.2 the external surface of the building erected between 1.5 and 3.0 metres from the substation footing has a 60/60/60 fire rating

and the owner provides the authority benefited with an engineer's certificate to this effect.

2.0 The fire ratings mentioned in clause 1 must be achieved without the use of fire fighting systems such as automatic sprinklers.

3.0 Definitions:

3.1 **"120/120/120 fire rating"** and **"60/60/60 fire rating"** means the fire resistance level of a building expressed as a grading period in minutes for structural adequacy / integrity failure / insulation failure calculated in accordance with Australian Standard 1530.

3.2 **"building"** means a substantial structure with a roof and walls and includes any projections from the external walls.

3.3 **"erect"** includes construct, install, build and maintain.

3.4 **"restriction site"** means that part of the lot burdened affected by the restriction on the use of land as shown on the plan.

3.2 Fire Proof Screen Walls

Terms of Positive Covenant numbered [xx] in the plan

1. The owner covenants with the prescribed authority that the owner:

    1.1 Will construct fire proof screen **[***wall/s***]** adjacent to the **[***northern, southern, eastern, western***] [***boundary/ies***]** of the easement for padmount substation.

    1.2 Will maintain the fire proof screen **[***wall/s***]** in a satisfactory state of repair and in accordance with any reasonable conditions that the prescribed authority may impose.

2. Definitions

    2.1 **"fire proof screen wall"** means a wall of brick or concrete necessary to achieve a 120/120/120 fire rating up to a minimum height of **[***xx***]** metres from the level of the substation footing.

    2.2 **"owner"** means the registered proprietor of the lot burdened and its successors (including those claiming under or through the registered proprietor).

    2.3 **"prescribed authority"** means Endeavour Energy (and its successors).

    2.4 **"120/120/120 fire rating"** means the fire resistance level of a building structure expressed as a grading period in minutes for structural adequacy/integrity failure/insulation failure calculated in accordance with Australian Standard 1530.

3.3 Separation of Metal Structures to an Earth Grid

Terms of Positive Covenant numbered [xx] in the plan

1.0 Except as provided in clause 2, no metal structure shall be erected or permitted to remain within the restriction site.

2.0 Metallic fencing may be erected within the restriction site if the fence panels are insulated from the fence posts and from the ground.

3.0 Definitions:

    3.1 **"erect"** includes construct, install, build and maintain.

    3.2 **"restriction site"** means that part of the lot burdened affected by the restriction on the use of land as shown on the plan.

3.4 Separation of Swimming Pools to an Earth Grid

Terms of Positive Covenant numbered [xx] in the plan

1.0 No swimming pool or spa shall be erected or permitted to remain within the restriction site.

2.0 Definitions:

2.1 **"erect"** includes construct, install, build and maintain.

2.2 **"restriction site"** means that part of the lot burdened affected by the restriction on the use of land as shown on the plan.

Energex Contestable Works Subdivision Handbook

18 September 2023

Energex Contestable Works Subdivision Handbook

CONTENTS

1 PURPOSE AND SCOPE

This Subdivision Standard has been developed to provide a reference tool to summarise Energex's Standards and Policies that relate to the planning, design, construction, and commissioning of electrical reticulation for subdivisions that is to be gifted to Energex.

This standard is to be used in conjunction with other Energex Standards and Policies by Accredited Service Providers undertaking contestable works for Developer Design and Construct (DD&C) subdivision projects.

2 DEFINITIONS, ABBREVIATIONS AND ACRONYMS

Term	Acronym	Definition
Security Bond	-	An amount in cash or an irrevocable financial undertaking executed by a bank or an approved lending authority, which shall be lodged with Energex in accordance with the terms of the Subdivision Electricity Supply Agreement.
Certificate for Electricity Supply	CoS	The document from Energex confirming that the newly created lots have been provided with electricity supply or the developer has entered a contract with Energex to provide electricity supply to all lots.
Certificate of Acceptance	CoA	The document from Energex issued at the satisfactory completion of the project which accepts the transfer of ownership of the as constructed assets from the developer to Energex.
Community Title Scheme	CTS	A development comprising a subdivision of land by a Material Change of Use in which the individual lots do not necessarily have a frontage to road reserve, and which comply with the Body Corporate and Community Management Act 1997.
Manufactured Home Park	MHP	A development by a Material Change of Use for the creation of Manufactured Home Park which complies with the Manufactured Homes (Residential Parks) Act 2003.
Accredited Service Provider - Design Consultant	Design Consultant	The company accredited by Energex and engaged by the Developer to design the electrical reticulation infrastructure to make electricity supply available to all lots in the subdivision.

Term	Acronym	Definition
Developer	-	Any person, organisation, entity, or company, which enters into an agreement with Energex for the supply of electricity to a subdivision project in accordance with the terms and conditions of the Subdivision Electricity Supply Agreement.
Registered Professional Engineer of Queensland	RPEQ	Registered Professional Engineer of Queensland (Division Electrical).
Accredited Service Provider - Electrical Contractor	Electrical Contractor	The company accredited by Energex to construct electrical reticulation infrastructure for the subdivision as described within the relevant Work Category Specifications.
Subdividers Electricity Supply Agreement	SESA	A signed agreement (contract) between a Developer and Energex for the developer to make supply of electricity available to all lots in a subdivision project.
Local Government Authority	LGA	Local Government Authority (Council)
Department of Transport and Main Roads	TMR	Department of Transport and Main Roads
Certificate of Completion	CoC	Documentation submitted by the electrical contractor on completion of the works to be gifted to Energex

3 REFERENCES

Provide Contestable Design and Contestable Construction Services in accordance with, but not limited to:

Contestable Work Category Specifications

- WCS 2 Underground Construction.
- WCS 25 Overhead Mains Electrical Construction.
- WCS 31 Commissioning, Operating and Accessing the Network.
- WCS 37 Public Lighting Installations.
- WCS 47.1 Subdivision Design.
- WCS 47.3 Public Lighting Rate 2 Design.

Policies, Standards and Manuals

- Underground Distribution Construction Policy Manual.
- Worksplans Standard (Electricity).

- As Constructed Drawing Standard.
- Queensland Electricity Connection Manual.
- Queensland Electricity Metering Manual
- Overhead Construction Manual (OHCM – South East)
- Underground Distribution Construction Manual (South East)
- Overhead Design Manual (South East)
- Queensland Public Lighting Design Manual.
- Queensland Public Lighting Construction Manual.
- The Standard Conditions for Public Lighting Services.
- Standard for Network Labelling and Signage
- Standard Network Building Blocks.
- Standard Network Building Blocks Feeders.
- Operating Practices Manual.
- Distribution Earthing Manual.
- Resource Estimation Guide.
- Joint Working Voltage Management Standard.
- Environment Management System Manual
- Environmental Management System Environmental Standard
- Energex and Telstra Power Coordination Guidelines.
- Energex Underground Distribution Construction Manual and Work Practice 1146 - Installation of cables and joints into underground cable pits

4 ACCREDITED SERVICE PROVIDERS

Energex Accredited Service Providers (ASP's) for contestable works consist of two categories.

The ASP Design Consultant generally referred to as "design consultant".

The ASP Electrical Contractor generally referred to as "electrical contractor".

Throughout this standard the words "Design Consultant" and "Electrical Contractor" are used to differentiate between the two different roles and different responsibilities of the two Energex Accredited Service Providers.

5 ENERGEX CORE WORK ACTIVITIES

There are Energex Core Work Activities associated with contestable works projects. To obtain a list of these activities please refer to the Energex Core Work Activities for Contestable Works document available on the Energex website.

6 CONTESTABLE WORK / NON-CONTESTABLE WORK

6.1 CONTESTABLE WORK

Contestable work includes all electrical works formally conditioned by local government (i.e., council) by way of a ROL (Reconfiguration of Lots) Development Application (DA), operational works approval or other official means.

It does NOT include work associated with a community titles development, either ROL or MCU (Material Change of Use) DA unless it has:

- at least 5 lots, and
- an internal road from which all lots can be served using Energex standards.

Similarly, it does NOT include work which is being mandated under an infrastructure agreement whereby lots are not being developed.

If work is not mandated by an ROL DA or other official council means, then developers cannot design/construct reticulation, including overhead, URD cables, pillars, transformers, etc. In that case, developers are restricted to Rate 2 street lighting or future use conduit installation works and Energex must nominate, design, and construct the point of supply if such does not already exist.

Note: By definition, Rate 3 street lighting is inherently contestable, and Energex must nominate, design, and construct the point of supply.

6.1.1 SUBDIVISION SPECIFICS

In addition to the above general contestability criteria, the following conditions must be met:

- There must be reticulation required to supply the proposed new lots (which inherently includes provision of rate 2 street lighting as well).
- Any relocation, reconfiguration, or augmentation of existing Energex distribution network assets (e.g., uprate existing overhead mains, install new pad mount transformer, install new LV underground circuits) must be driven by and be solely for the benefit and purposes of the development.
- There must be an obvious close and clear alignment between the development geographically and the location and timing of any “associated” electrical works.
- Any changes to the existing Energex distribution network must be within the boundaries of the development/precinct or existing stage of the development or be directly associated with & in immediate proximity/adjacent to the proposed subdivision development.

CONTESTABLE WORK EXAMPLES

- Relocation of existing Energex distribution assets due to road widening or reconstruction that is directly associated with and in immediate proximity to proposed new lots that require electricity supply to be made available (i.e., “Associated” works directly driven by the development).
- Relocation of existing Energex distribution assets to enable the creation of a new road or lots, associated with a DA condition inside the precinct of a subdivision or master planned subdivision.
- Temporary relocation of existing Energex distribution assets to enable construction of the subdivision development in the immediate proximity to proposed new lots (e.g., “early works” project to enable bulk earthworks for the development, or provision of future works required).

- Augmentation of existing Energex distribution assets to provide supply to the new lots (e.g., removal of network constraint, upgrade, reconfiguration and or removal of existing Energex distribution assets). This includes extension of existing HV & LV networks in the vicinity of the development required to supply the development.
- Design and installation of future use conduit works.
- Relocation of point of supply (e.g., LV pillar) where the only change is a lot boundary (i.e., no new lots per se created) undertaken on a ROL DA.
- All electrical reticulation associated with Manufactured Homes (Residential Parks) Act 2003 style single point of supply developments (i.e., single lot/single point of supply multi dwelling MCU developments having the character of a dwelling house, but the homes are designed to be moved from one position to another and are not permanently attached to land). Energex have better appreciated the scope of these developments and the typical prestige nature based on recent developer feedback and will approve reticulation to the community titles development standards.

Note: This does NOT apply to mobile home/caravan parks and similar style developments. The nature of the development must reflect a typical community title scheme type development with obvious appropriate verges, roads and common areas & consultation is mandatory at design initiation with Energex.

NON-CONTESTABLE WORKS EXAMPLES

- All electrical reticulation works associated with Material Change of Use (MCU) development types (i.e., single point of supply), excepting community titles developments of greater than 5 (standard format plan) lots reticulated to Energex specifications.
- All electrical works associated with Infrastructure Agreements that do NOT provide supply to new lots.
- Amalgamation of lots into a single lot.
- Any relocation or reconfiguration of existing Energex network assets (e.g., relocation of Energex pilot cables, overhead or underground distribution network assets) that do NOT augment (i.e., upgrade/reconfigure) supply solely for the purposes of the development such as:
    - Relocation of existing Energex distribution assets due to road widening or reconstruction that is NOT directly associated with and in immediate proximity to proposed new lots or developments that require electricity supply to be made available.
    - Relocation of existing Energex distribution assets that are NOT associated with a ROL development type.
    - Relocation of existing Energex distribution assets as a result of road widening where the resumption of land is the only change to the lot configuration.
- 33kV underground.
- 110/132kV overhead and underground (including engineering assessments such as line profiling and clearance to ground/structures).
- Sag/Swing Blowout Assessments for voltages of 110kV and above to confirm clearance to ground/clearance to structures proposed within existing easements
- Compliance Assessments associated with the Electrical Safety Code of Practice - Works 2010, “Special Location” Earthing Requirements.
- Joints and terminations associated with communications cables and systems (i.e., Pilot Cables).

- Establishing telecommunications to remotely operated plant.
- 11kV termination on to a circuit breaker within a substation.
- Any works within the boundary of a zone supply substation.
- Community titles development of less than 5 (standard format plan) lots. Energex will provide the point of supply (e.g., padmount transformer/pillar), and internal reticulation will be to AS/NZS 3000.

6.1.2 RATE 2 PUBLIC LIGHTING ONLY SPECIFICS

The following conditions must be met:

- Involves works (i.e., design/construction) associated with the provision of street lighting infrastructure ONLY where mandated in a DA or a Council/TMR initiated project, or Council /TMR instruction to change the category of lighting. This includes:
  - Any relocation or reconfiguration of existing street light infrastructure connected to the underground network.
  - Provision of any new street light infrastructure connected to the underground network.
  - Any relocation or reconfiguration of existing street light infrastructure connected to the existing overhead network that does NOT impact/involve relocation or reconfiguration of any electrical distribution network infrastructure (e.g., moving LV/HV cross-arms to obtain clearance to street lights).
  - Provision of any new stand-alone overhead street light infrastructure (i.e., dedicated streetlight only pole supplied from LV overhead street light service).
  - Provision of overhead or underground street light services from the point of supply.

- Does NOT involve ANY works on the electrical distribution network. This includes:
  - Provision of new points of supply for the rate 2 street lighting infrastructure.
  - Relocation, reconfiguration, or augmentation of the electrical distribution network infrastructure associated with provision of the rate 2 street lighting infrastructure.

CONTESABLE WORKS EXAMPLES

- Installation of a new or alteration to an existing underground street light installation (e.g., footing, pole, luminaire, service construction).
- Addition of a new dedicated overhead street light installation (e.g., new standalone street light pole requiring footing, pole, luminaire, service construction).
- Alteration to an existing street light outreach/luminaire at an existing overhead pole that does NOT require alterations to distribution network infrastructure (e.g., no change to king bolt spacing's to achieve clearance to street lighting infrastructure).
- Connection of street light services to the existing distribution network.

NON-CONTESTABLE WORKS EXAMPLES

- Addition of a new overhead street light installation that requires co-location of electrical distribution network infrastructure (e.g., new mid span pole requiring footing, pole, luminaire, service, HV/LV cross-arms/conductors/insulator construction).

- Alteration to an existing street light outreach/luminaire at an existing overhead pole that DOES require alterations to distribution network infrastructure (e.g., change to king bolt spacing's to achieve clearance to street lighting infrastructure).
- Extensions to existing LV distribution network to supply street light installations.
- Relocation of an existing street light due to a conflict with proposed infrastructure (e.g., conflict with proposed driveway, bus stop etc), even if additional lighting is required to provide compliance with the existing lighting code for that section of roadway.

6.2 NON- CONTESTABLE WORK – DESIGN CONSULTANTS RESPONSIBILITY TO NOTIFY ENERGEX

All non-contestable works that are to be completed by Energex as part of a contestable project shall be identified by the design consultant. It is the responsibility of the design consultant to notify Energex as early as possible of the need for non-contestable works. The developer will need to enter a Customer Initiated Works project with Energex, separate from the DD&C contestable project. These non-contestable works have lead times that may affect the timing of the completion of the contestable project.

7 GENERAL

7.1 ELIGIBLE SUBDIVISIONS

- Residential freehold subdivisions, irrespective of the number of lots.
- Commercial and Industrial subdivisions.
- Community Title Schemes with internal Energex reticulation.
- Retirement villages with permanent building structures.
- Manufactured home parks. (These shall comply with Energex reticulation standards and shall be purposed for permanent building structures).
- Amalgamating lots for a Community Title Scheme that will have internal Energex reticulation.

7.2 INELIGIBLE SUBDIVISIONS

- Developments with inappropriate access, without clearly defined sealed roadways or insufficient area to install and maintain Energex assets.
- Amalgamation of lots
- Where twenty-four-hour access is not available to Energex assets.
- Where Energex network standards cannot be achieved for the project.
- A subdivision by lease.
- Caravan parks.
- Caravan parks that contain a section of manufactured homes.
- Where it is proposed to have a combination of AS/NZS3000 reticulation and Energex reticulation.

7.3 NETWORK ASSET REMOVAL

Queensland Electricity Regulation 2006 Section 62 will only apply in situations where Energex receives a request for removal of the assets and there is no development application lodged with the local council for a subdivision of land or for other works to prepare the land for subdivision. If Energex receives a request for asset removal and there is a development application lodged with the local council, the asset removal shall be treated as a contestable works project fully funded and completed by the developer.

8 PLANNING AND DESIGN

8.1 POINT OF CONTACT

The design consultant is the developer's representative and point of contact with the Energex Contestable Works team

8.2 NETWORK MAPPING INFORMATION

Upon written request, copies of Energex's network mapping information will be made available to the design consultant for the project. The design consultant is responsible for undertaking the scoping and planning tasks so as to ascertain what works are required to make electricity supply available to all lots in the subdivision. As part of the scoping and planning tasks, the design consultant is responsible for confirming on site the location of all existing assets and all existing network connectivity. All requests for mapping information shall contain details of the planned subdivision, the existing lot on plan, street address and suburb.

8.3 SITE INSPECTIONS

The design consultant is responsible for undertaking all site inspection work as part of providing design services for subdivision projects. Site inspections are necessary to confirm the Energex Network Mapping Information and enable the consultant to scope and plan the proposed works. The design consultant may also need to visit site (during construction of the project) should there be issues that relate to the design of the works.

8.4 CONCEPT PLANS

As a general guideline, concept plans should be submitted for the following scenarios:

- Masterplan and multi-stage subdivisions that require HV works.
- Large Commercial and Industrial subdivisions.
- The subdivision site is within one kilometre of an existing or proposed zone substation.
- The subdivision requires alterations to 33kV assets, remote operated assets, or pilot cables. E.g., Pole Mounted Reclosers, Voltage Regulators.
- There are 11kV planning issues or switching issues that require evaluation by Energex.
- There are possible conflicts with adjacent subdivisions.
- There are project specific issues that need to be resolved prior to the detailed design.
- Non-standard proposals for the Energex reticulation. E.g., Non-standard alignments, conflicts with bio-retention basins, narrow footpaths, protected vegetation, etc.
- Energex funded works as a part of the subdivision project. E.g., Additional HV conduits.
- Concrete cable pit and duct network.

- CBD / Prestige precincts which generally have a full concrete verge from kerb to property boundary.
- Planned Community Title Schemes located within a residential development.
- Planned Commercial and Industrial developments located within a residential development. E.g. Shopping centres, schools, community centres, etc.
- Developments containing narrow laneways or restricted width verge.

8.5 APPROVALS

The design consultant is responsible for obtaining all approvals required for a subdivision project. These include items such as:

- Local council / EDQ approval of the electrical reticulation design.
- Local council / EDQ approval of the public lighting design.
- Other approvals that may need to be obtained by the design consultant include:
- Department of Transport Main Roads (DTMR) for public lighting on a state-controlled road.
- DTMR for electrical reticulation works on a state-controlled road. The Contestable Works team will assist the design consultant with this type of request.
- Vegetation management reports and approval for vegetation works.
- The approval of any proposed works in Powerlink transmission easements.
- The approval of proposed works near oil / gas transmission pipelines.
- The approval of proposed works near trunk water pipelines
- Any Environmental permits, cultural heritage reports, water crossings.
- It is the design consultant's responsibility to provide any required EMF reports based on engineering data supplied by Energex.

8.6 MATERIAL LISTS

The design consultant shall prepare a list of materials to be included with the design submission package when requesting a Subdivision Electricity Supply Agreement. The materials shall be sectioned into the following categories and supplied as a separate sheet.

- Underground Developer (UGD) - This includes padmount transformers, ring main units, underground cables, and underground cable terminations on poles.
- Overhead Developer (OHD) - This includes poles, pole top constructions, pole mounted plant and overhead conductors.
- Streetlight Developer (SLD) - This includes streetlight poles, luminaires, cables.
- Energex Supplied Materials Underground (ESM-UG) – Underground equipment and materials to be funded and / or supplied by Energex. This includes items such as padmount transformers, ring main units, underground cables, cable joints, underground cable terminations.
- Energex Supplied Materials Overhead (ESM-OH) – Overhead material to be funded and / or supplied by Energex. This includes poles, pole top constructions, pole mounted plant and overhead conductors.

The developer supplies all materials for all subdivision projects however on some specific projects, Energex may supply some materials. Any proposals for Energex Supplied Materials (ESM) shall be negotiated with Energex Contestable Works team during the design consultant's planning phase of the project.

8.7 CONDUITS – DEVELOPER

The developer is required to fund the installation of HV and LV conduits for the subdivision, along with the requirements for all future stages and adjacent land that can be subdivided at some future time.

- In multistage developments, the developer shall fund the installation of all conduits required for the ultimate load of the development.
- In a master planned multistage development, the developer shall fund the installation of four HV conduits on the "main backbone routes" through the subdivision. These four HV conduits shall commence at a point in the current subdivision as close as practicable to the existing HV network. If there are C&I lots within the master planned development, then the developer shall fund the installation of C&I conduits to these lots. E.g., Schools, shopping centres, community centres, etc.
- The minimum number of HV conduits on any HV cable route is two 125mm conduits to be funded and installed by the developer.
- The developer shall fund the installation of a minimum of two HV conduits to all commercial/industrial loads within a residential subdivision. E.g., Loads such as pump stations, water boosters.
- A minimum of one Energex 100mm communications conduit shall be installed on all HV conduit routes.
- The developer shall install LV conduits to ensure full utilisation of all LV circuits from a padmount transformer where the transformer may be utilised by adjoining future / existing developments.
- The developer shall fund the installation of conduits across the full width of the road reserve frontage of all lots in a subdivision including all small subdivisions.
- On underground LV radial feeder routes, in excess of 250 metres, with only one planned LV cable, Energex requires the installation of a 100mm spare contingency conduit for future use. Typically, these types of LV radial feeders are in long and sometimes "dead end" roads in semi-rural / rural areas.
- Refer to the Commercial and Industrial / General Design Parameters section of this document for the Energex requirements for C&I conduits to be funded by the developer

8.8 CONDUITS – ENERGEX FUNDED

When Energex identify additional conduit requirements, above the number of conduits to be funded and installed by the developer, Energex will require these additional conduits to be installed during the construction of the project. The additional conduits shall be negotiated with Energex by the design consultant, during the consultant's planning phase of the project. I.e., Prior to commencement of the detailed design of the project.

Energex will only fund the installation of additional HV conduits in a subdivision project where the developer is required to add an additional horizontal row/s or add an additional vertical row/s in the trench cross section to accommodate the Energex required additional conduits. The design consultant is responsible for including these additional conduits in design drawings for the project.

An example of where Energex may fund additional conduits is when the subdivision is located in the vicinity of an existing zone substation or planned zone substation.

For details on how Energex funds the installation of additional conduits on a subdivision project please contact the Energex Contestable Works team.

8.9 CONDUITS GENERAL

All conduits, associated fittings and bends shall comply with the requirements of the Energex Underground Distribution Construction Manual. The conduit cross section layout of the standard trench details are shown in the Energex Underground Distribution Construction Manual.

Conduit sizes are:

11kV Feeders

- 125mm min Light Duty Orange PVC

Low Voltage Feeders

- 100mm min LD orange PVC – standard use.

Public Lighting

- 50mm HD orange PVC.

Energex Communications

- 100mm MD white, UPVC to AS/NZS 2053.1 and AS1345

8.10 CONDUITS – PROVING WITH A CONDUIT MANDREL AND ROPING

Energex's requirement is that all new conduits shall be proven by pulling a cylindrical mandrel (100mm long and sized 6mm less than the conduit bore) through the conduit.

The use of a short rubber plug or a rubber conduit cleaner as a substitute for a mandrel **is not permitted** as the rubber is flexible and can squeeze through a deformed conduit where a mandrel will not pass an obstruction or deformation.

All conduits shall be provided with a polypropylene draw rope prior to backfilling of the trench. Metallic draw wire shall not be used in any conduits.

Energex Form 1485, as specified in WCS2 and WCS61, is not required for conduit certification unless specifically requested by the Energex Contestable Works team. A conduit certification block shall be provided on the As Constructed drawings certifying that all conduits have passed mandrel testing and have been provided with ropes in accordance with Energex Standards.

8.11 PADMOUNT TRANSFORMER SITES / RING MAIN UNIT SITES

All padmount transformer sites and ring main unit sites shall be designed and constructed in accordance with applicable standards including:

- Energex 00305 Underground Distribution Construction Manual.
- Energex Commercial and Industrial Substations Manual.
- Energex 00758 Distribution Earthing Manual
- AS2419 Fire Hydrant Installations
- AS2067 Substations and High Voltage Installations exceeding 1kV AC
- Building Code of Australia.

8.11.1 Locations - General

Padmount Transformer sites and Ring Main Unit sites located in freehold subdivisions shall be recessed into the property alignment on an area of land dedicated as public road reserve.

Padmount Transformer sites and Ring Main Unit sites located in Community Title Schemes shall be located in an area of land that is part of the CTS common property.

Padmount Transformer sites and Ring Main Unit sites located in Manufactured Home Parks shall be located in an area of land that what would be classified as “common property” if it was a CTS. All of the Energex assets in a CTS or MHP may be required to be protected by an easement, with Energex as a registered party.

The finished surface level of Padmount Transformer sites and Ring Main Unit sites shall comply with a 1:100-year event or the prescribed Defined Flood Level (DFL), whichever is the greater.

Special attention shall be given to environmentally sensitive areas, swimming pool areas, hazardous area facilities, fire hydrants, fire booster pumps, telecommunication assets, etc when planning the location of Padmount Transformers and Ring Main Units. Design consultants also need to be aware of the increased clearance distances for separately earthed high voltage assets.

24-hour 7-day unrestricted access shall be provided to Padmount Transformers and Ring Main Units.

8.11.2 Locations – Site Specific

Padmount transformers and Ring Main Units shall be located such that any external face is no closer than four metres to a habitable area or non-fire rated part of any dwelling. Subject to the physical location of the Transformer / RMU site, Energex may require an easement within the adjacent lot/s to ensure future buildings do not compromise this four-metre clearance distance.

To ensure due diligence has been taken to ensure Energex and future customers do not have clearance issues in the future, Energex requires the proposed building envelopes adjacent to proposed transformer sites to be shown on the design drawings. In addition, Energex will not permit a new transformer to be positioned in a location that is adjoining an allotment that is already owned by a 3rd party. This is only possible if the padmount transformer site is already dedicated road reserve (for a transformer) prior to the adjoining lot being sold to a 3rd party.

For further information refer to C-0020 v2 Energex - Contestable Works - Operational Update - PMT location and clearances

8.11.3 RETAINING WALLS

If a change in ground level of 300mm or more occurs within 2000 mm of Padmount Transformer or RMU site, then a retaining wall shall be constructed for the site in accordance with Energex Standards. Energex will not grant acceptance, either during design or retrospectively after construction, of any artificially shaped earth retained Padmount Transformer or RMU sites.

8.11.4 FENCES

All fences around padmount transformer sites and Ring Main Unit sites shall comply with Energex standards. Should the developer propose alternative fencing material then any such fence shall be constructed “outside” the Energex Standard fence. I.e., For that section of fence around the padmount transformer site / RMU site there will be two parallel sections of fence.

8.11.5 DOORS AND GATES

A Padmount Transformer site or a Ring Main Unit site may be enclosed on three sides by walls but will be open to the front and with no encumbrance above the site.

If gates (or doors) are proposed across the front of the site, then the following criteria apply.

- The gates must be the full width of the site, minimum 3.0 m for padmount sites.
- The gates must be fitted with an Energex security lock.
- The gates must be fitted with the same signage as the front of the transformer.
- The gates must fully open 180 degrees without fouling on any obstructions such as landscaping, vegetation, or other street hardware. (This is for safety of staff during maintenance work or switching operations on the Transformer or RMU).
- The gates must be capable of being secured in the fully open position.
- The gates when in the fully open position must not create a hazard to the general public, such as block or partially block access to property. E.g., block part of a driveway
- The gates must open without swinging over the kerb and onto the road pavement.

Energex will not accept responsibility for ownership or future maintenance of the gates. The gates are required either by the local council or by the developer and therefore the council or the CTS body corporate has to accept ownership and maintenance responsibility for the gates. Energex requires the developer to provide a letter from council or CTS body corporate stating the council or body corporate accepts ownership of and responsibility for the gates.

8.11.6 PAINTING / ARTWORK

Energex permits the painting or vinyl wrapping artwork on Padmount Transformers in subdivision projects subject to Energex corporate and technical guidelines. All proposals for painting or artwork have to be submitted to the Energex Facilities Access team for evaluation. For subdivision projects, initial correspondence shall be submitted to the Contestable Works team

8.12 PADMOUNT TRANSFORMER SITES – GENERATOR ACCESS

All Padmount Transformers shall be located so that it is possible to manoeuvre and position a 500kVA trailer mounted generator in an area adjacent to the transformer. The parking location of the generator shall be such that traffic control is not required whilst the generator is on site.

8.13 ACCESS TRACKS

Access tracks are required for Energex to gain access to their assets for maintenance and network switching purposes where there is no constructed and sealed public roadway. It is always the first preference to construct a sealed roadway to provide access to Energex assets and access tracks should be considered the access means of “last resort”. Access tracks may be permanent or temporary constructions and irrespective of the type shall comply with the technical requirements of WCS 1.5 or equivalent.

An example of a temporary access track is when a padmount transformer is being installed as part of a subdivision however the transformer is located within the “next stage” of the subdivision but not in the area presently being fully completed and ready for sale of lots. These temporary access tracks shall always become permanent road reserve in the next stage of the development.

Another example of a permanent access track is where there are overhead mains traversing a property and this track will never become road reserve open to the general public.

Access Tracks shall comply with the following parameters:

- Be constructed to the technical requirements of the relevant Work Category Specification (WCS) or equivalent.

- Have unimpeded 24-hour access to Energex staff and Energex vehicles.
- Shall be constructed to accommodate mobile cranes, general purpose trucks up to 30 tonnes and 500kVA mobile generators sets.
- A vehicle turn-around area shall be included in the civil design.
- The access track and asset surrounds shall be constructed to final surface levels.
- Access tracks shall not traverse through areas deemed dangerous to personnel. E.g., Areas patrolled by guard dogs, old mine workings, etc.
- The access track shall be designed and certified by a RPEQ Civil Engineer.

The approval process for any proposed access tracks is as follows:

- The project specific requirement for an access track shall be identified by the design consultant in the early planning stages of the project.
- The design consultant shall submit to the Energex Contestable Works team a concept detailing the proposed access track for evaluation and feedback.
- The Energex Contestable Works team shall “approve in principle” the proposal for an access track.
- The developer shall engage a RPEQ Civil Engineer to design the access track.
- The design documentation and certification for the access track shall be submitted to the Energex Contestable Works team prior to the submission of the design package and a request for a Subdivision Electricity Supply Agreement.

The final acceptance of the access track by Energex will be an on-site inspection by the Energex Contract Officer and a sign-off on the construction works by the RPEQ Civil Engineer.

Energex assets will not be switched and commissioned until final Energex acceptance of the access track.

8.14 EARTHING REQUIREMENTS

Earthing shall be designed and installed in accordance with the requirements of:

- Energex 00758 Distribution Earthing Manual.
- Energex 4920 Overhead Construction Manual
- Energex 00305 Underground Distribution Construction Manual
- EQL Standard for Queensland Public Lighting Construction Manual.

Design consultants shall confirm on site the status of the existing earthing of the existing network prior to commencing the detailed design any new HV and or LV extensions to the network. This is to determine whether Common Earthing or Separate Earthing is required for the proposed new works.

8.15 LOCAL COUNCIL ROAD NAMES

For any subdivision, CTS or MHP project that involves the creation of new public road reserve, or proposed street, it is the responsibility of the design consultant to ensure that the official road name / street name assigned by the local council or developer are shown on the design drawings for the project. Energex will not prepare a Letter of Offer or Subdivision Electricity Supply Agreement without this information.

8.16 11KV TIE REQUIREMENTS FOR SUBDIVISIONS

The maximum allowable installed transformer capacity of a residential multi-transformer 11kV feeder spur is 1.2MVA for both overhead and underground 11kV feeders. This capacity shall be determined from the total of the nameplate ratings of the connected transformers on the 11kV feeder spur. It shall not be determined using the number of customers or actual load.

Developers are responsible for the design and construction of any 11kV feeder ties associated with and required by a subdivision project. Master planned and multistage developments shall eliminate or reduce to a minimum the number of 11kV feeder spurs through effective 11kV planning.

Masterplan and multistage developments may construct large 11kV feeder spurs before the ultimate 11kV feeder ring or the 11kV feeder tie is closed. These progressive 11kV feeder spurs shall be negotiated with the Energex Contestable Works team and based on stage timing of the subdivision and the ultimate 11kV concepts.

Energex may mandate loop in / loop out arrangements for the 11kV network based on projected future developments, future undergrounding of overhead, and / or reliability for planned and unplanned customer outages.

8.16.1 11KV PARALLEL BRANCH JOINTS (T-JOINTS)

Parallel Branch Joints are not permitted where the subdivision forms part of a master planned or multistage subdivision development.

In areas that are not master planned or part of a multistage development, a parallel branch joint may be used to supply a single transformer with nameplate rating of no more than 315kVA. A spare 11kV conduit shall be installed from the location of the parallel branch joint to the transformer to allow for future looping in / looping out of the 11kV feeder.

Written approval is required from the Energex Contestable Works team for any proposed installation of a parallel branch joint.

8.16.2 COMMUNITY TITLE SCHEMES AND MANUFACTURED HOME PARKS

If the ultimate loading of the Community Title Scheme or Manufactured Home Park requires the installation of more than two transformers, (regardless of their kVA nameplate size), an 11kV loop in / loop out arrangement shall be installed within the development.

To maintain flexibility in the 11kV network, a 4-way RMU may be required where the 11kV network enters the development. This is to avoid having the 11kV feeder backbone looping in and out of the development and impacting on reliability to customers outside the development should there be a problem inside the CTS or MHP.

8.16.3 COMMERCIAL AND INDUSTRIAL SUBDIVISIONS

Commercial & Industrial Subdivision Developments shall only have a loop in / loop out configuration for the 11kV network.

8.17 11KV FEEDER CAPACITY

The subdivision shall cause no reduction of existing 11kV feeder capacity. For example, if the subdivision requires a new loop in / loop out 11kV configuration, then the loop in / loop out 11kV cable / overhead conductors shall be of an equivalent or greater current carry capacity as the existing cable / conductors in the feeder backbone.

8.18 11KV POLE TRANSFORMER LOAD ON THE OVERHEAD NETWORK

The maximum permitted pole transformer load between Isolation Points (switches) on the 11kV overhead distribution network is 650kVA. This load shall be determined from the total of the nameplate ratings of the connected pole transformers. It shall not be calculated using the number of customers or actual load.

Where the subdivision project (i) Upgrades an existing pole transformer or (ii) Install a new pole transformer, and the result is that there is greater than 650kVA in that 11kV section, the developer is required to install an 11kV Load Break Switch at a suitable electrical location so as to reduce the transformer load to below 650kVA in that section.

Where there is a padmount transformer/s supplied via an underground cable termination on a pole on the 11kV overhead network, the padmount transformer load shall not be included in the above calculations. The incoming 11kV Isolator at the padmount transformer is deemed to be an Isolation Point (switch) for the purposes of these calculations.

8.19 LOW VOLTAGE TIE REQUIREMENTS FOR SUBDIVISIONS

Developers are responsible for the design and construction of Low Voltage Feeder Ties on circuits emanating from transformers. Low Voltage Ties improve network reliability, operational flexibility and reduce customer outages as a result of a fault on the network.

Low Voltage circuits emanating from a transformer should be inter-connected with circuits from other adjacent transformer areas however Low Voltage ties between circuits of the same transformer are also required for network reliability and operational flexibility.

This is sometimes not always practical due to factors such as lot layouts, road layout, topography, and proximity of other LV tie points. The requirement for Low Voltage Ties should be subject to an engineering assessment of the technical feasibility and network reliability.

The below table provides criteria for LV Ties for subdivision projects.

Maximum Low Voltage Tie Length for given situation		
Situation		**Tie Length**
Underground Reticulated Subdivisions	Civil Works are required	2 lot frontages. I.e., One bay between service pillars, typically 40m total in residential subdivisions and additional distance in C&I subdivisions
	Civil Works not required	4 lot frontages. I.e., Typically, 80m total in existing LV conduits in residential subdivisions and additional distance in existing LV conduits in C&I subdivisions
Overhead Reticulated Subdivisions	New Poles are required	1 span per 100kVA of transformer capacity
	Using Existing Poles	2 spans per 100kVA of transformer capacity

The above table provides general criteria; however, Energex may stipulate a LV Tie outside these guidelines. This will be based on network reliability and the nature of customer loads. (E.g., Critical LV load customers requiring a LV back-up, number of customers on the LV radial).

8.19.1 LV "RING" CIRCUITS

A LV "ring circuit" is a circuit that emanates from a transformer and splits in two (2) directions. The cable routes "ring" back to each and are electrically continuous for its entire length with no form of isolation other than at the point of origin (I.e., No isolation links in the middle of the circuit). "Ring" circuits for new installations are no longer permitted. It is still a requirement for LV Ties on same circuits emanating from the same transformer, however the circuit must be broken with a set of links. (I.e., A suitable placed LV Link Pillar with links in the "Normally Open" position).

8.20 LOW VOLTAGE NETWORK DESIGN

- The maximum acceptable voltage drop is 11.0 volts in the LV underground network.
- The maximum acceptable voltage drop is 10.0 volts in the LV overhead network.

The maximum acceptable voltage drop is measured from the transformer LV terminals to the last pillar or last pole on the LV circuit. This includes any 16mm2 Cu 4 core sections exceeding 25m of underground cable from the end the 240mm2 cable. Cross road pillars shall be included for the purposes of modelling the planned load and the resulting voltage drop however the crossroad pillars are not required to be shown on the LV Drop layout diagram.

Energex may request a copy of the LV Drop XML file for design review or design audit purposes and such file shall be provided by the design consultant.

Where calculated voltage limitations are found in the existing network, Energex requires voltage drop calculations showing the existing network issues. Energex will also require voltage drop calculations showing the proposed subdivision load so as to enable Energex to evaluate the impact of the proposed subdivision on the existing network.

All planned load on the LV circuit shall be designed to be as balanced as possible for all lots on that circuit. The planned LV service phasing for each lot shall be shown on the design drawings.

The ADMD design criteria to be used for each type of subdivision project is contained within the relevant dedicated sections of this document.

8.21 PARALLELING OF LV CABLES

The paralleling of low voltage underground cables is only permitted on the first segment of the LV circuit from the padmount transformer, this being between the LV isolator at the transformer and the first pillar on that circuit. The maximum length of parallel cables is 250 metres and both cables must terminate on the same LV isolator in the transformer and in the same LV pillar.

Any proposal for paralleling of LV cables requires the written approval from the Energex Contestable Works team during the design consultant's planning phase of the project. A copy of the Energex approval for parallel LV cables shall be included in the design submission package when sent to Energex with a request for a Subdivision Electricity Supply Agreement.

8.22 SOLAR PV, BATTERY STORAGE AND ELECTRIC VEHICLE CHARGING STATIONS

Where a developer has plans to facilitate Solar PV including Battery Storage or EV Charging Stations as an integral part of a subdivision project, the following parameters will apply:

- The design ADMD shall remain as listed in the relevant sections of this standard irrespective of the type of development.

- The Voltage Drop design shall remain as per the Low Voltage Network Design clause in this standard irrespective of the type of development.

For all subdivision projects where the developer is planning Solar PV including Battery Storage or EV Charging Stations the design consultant shall submit a concept proposal to the Energex Contestable Works team for evaluation and feedback

8.23 MAXIMUM NUMBER OF RESIDENTIAL CUSTOMER PER TRANSFORMER

The maximum number of Residential Customers per Transformer for any residential subdivision (Freehold, Community Title Scheme, Manufactured Home Park) shall be as per listed in the table below. (Distribution Transformer 125% Loaded)

ADMD (kVA)	DISTRIBUTION TRANSFORMER SIZE					
	63 kVA	100 kVA	200 kVA	300 kVA	315 kVA	500 kVA
3.0	15	33	69	108	114	186
4.0	12	24	51	78	81	135
7.0	6	12	27	42	45	75

8.24 POWER QUALITY – DISTURBING LOADS

The design consultant needs to be aware of any planned disturbing loads and / or motor start requirements for items such as sewer pump stations, water pump boosters, etc that are required to be installed by the developer as an integral part of the subdivision.

For all subdivision projects where the developer is planning to install pump stations, etc the design consultant shall submit a detailed concept proposal to the Energex Contestable Works team for evaluation and feedback.

8.25 UNDERGROUND DESIGN

All Underground works shall be designed and constructed in accordance with:

- Energex 4920 Underground Distribution Construction Manual.
- Energex RED 00758 Distribution Earthing Manual
- Energex RED 00694 Network Standard Building Blocks.
- Energex RED00367 Resource Estimation Guide.
- Energex WCS1.6 Vegetation Management Plan.

All new underground 11kV cables shall be 240mm2 Al Triplex XLPE cable. Energex may specify the use of alternative 11kV cable sizes, such as 400mm2 Al Triplex cable on subdivision projects in close proximity to an existing or a planned bulk / zone substation or at any other location required by Energex. In project specific locations where Energex specifies the use of 11kV 400mm2 Al Triplex cable, this cable will be contributed by Energex and installed by the developer. Energex will not contribute 11kV 400mm2 Al Triplex cable when the developer is required to maintain the existing current carrying capacity of the existing 11kV feeder as per Clause 7.17 of this document. For details on how Energex contributes 11kV cables on a subdivision project please contact the Contestable Works team.

The design consultant shall ensure that Cable Fault Indicators (CFI's) are located on the outgoing (away from source) underground cable leaving a Padmount Transformer or Ring Main Unit.

All new underground Low Voltage cables shall be 240mm2 Al 4 Core XLPE cable for the backbone cable. 16mm2 Cu 4 Core XLPE cable may be used for crossroad pillars and the last section of the Low Voltage circuit. E.g., From the second last pillar to the last pillar on the end of LV circuit. If the street is to continue at some future time into land that can be developed, then the 240mm2 Al 4 Core XLPE cable shall be installed to the last pillar on the circuit.

Design consultants need to carefully scrutinise the civil engineering drawings for the project and be aware of open swale and steep terrain topography when designing the underground network. Such topography items may significantly impact on the placement of LV Service Pillars and streetlight poles.

Refer the section on Concrete Cable Pit and Duct Reticulation for details of Energex requirements for conduits and types of cables being installed in Pit and Duct systems.

Energex does not permit underground cables to be designed and constructed through residential lots

8.26 OVERHEAD DESIGN

All overhead works shall be designed and constructed in accordance with:

- Energex RED 00302 Overhead Design Manual - Limit State.
- Energex 4920 Overhead Construction Manual.
- Energex RED 00758 Distribution Earthing Manual
- Energex RED 00694 Network Standard Building Blocks.
- Energex RED00367 Resource Estimation Guide.
- Energex WCS1.6 Vegetation Management Plan.

All overhead extensions require a line profile to be carried out to ensure statutory clearances are maintained. A copy of the line profile shall be placed on the design drawings.

All existing pole stays located within future urban lots shall be relocated out of the lot. Energex will not accept wayleaves, easements, or road reserve “cut-outs” for existing pole stays.

The following general guidelines apply to the integration of “new” 11kV, and LV overhead works into the existing network. This includes any projects involving an “over-build” of existing overhead conductors.

- Whenever a new feeder or part of a feeder (spur, tee-off) is added into an existing network, it shall be built to the current design standards and the current Network Standard Building Blocks.
- Where an existing overhead site is being altered, the entire site shall be upgraded to the current design standards and network standard building blocks.
- In rural areas where long runs and spans of bare low voltage conductors have previously been used, 11 kV reticulation in combination with greater numbers of smaller capacity distribution transformers may be required for the project.

Project specific engineering approval is required from the Energex Contestable Works team if it is proposed to install new or upgrade existing open wire overhead LV mains in a subdivision project.

The design consultant is the party solely responsible for pegging the location of any new or relocated distribution poles. The design consultant pegs the pole position at the time of design and (again if required) at the commencement of the construction works.

8.27 POLE INSPECTIONS

Pole inspections are required for all projects where the tip load of an existing in-service pole is altered by greater that 1kN or there is a proposal to alter existing or install new pole mounted plant on an existing pole. E.g., An upgrade of a pole transformer, installing a load break switch / pole mounted recloser.

This pole inspection requirement is irrespective of the last time that a pole was inspected as part of the Energex pole inspection program. A copy of the completed pole inspection form shall be included in the design submission package to Energex with the request for a Subdivision Electricity Supply Agreement.

8.28 LANEWAY DEVELOPMENTS

Laneways are narrow public streets and have both vehicular and pedestrian traffic. In many cases it is the primary means of access to a residential dwelling.

Laneway developments typically have a lot frontage to public roadway that has a reduced width “footpath” or “verge” approximately 500mm to 1.5m wide. The vehicular trafficable part of the laneway generally does not allow for two vehicles to pass side by side and is typically less than seven metres wide from boundary to boundary. A laneway development in many cases may not comply with Energex standards so it will require negotiation with Energex to ensure supply can be made to the proposed lots.

Concept plans are mandatory for laneway developments, along with more detailed site information. An example is architectural sketches, artist impressions or landscaping drawings. It is also important to know if the development is going to be sold as a turnkey development at building completion or sold as vacant lots. The location of future doorways and garage entry can significantly impact on the layout of the electrical assets in the laneway

8.29 LV SERVICE PITS

Energex does not permit the installation of LV Service Pits in Subdivision projects.

8.30 RATE 2 PUBLIC LIGHTING IN SUBDIVISIONS

The Rate 2 Public Lighting tariff is only offered to public entities such as Local Government Authorities (LGA’s) or TMR. Rate 2 Public Lighting shall only be installed in compliance with Energex Standards and Policies in the following locations:

- Public road reserve.
- Public areas such as local council parks and reserves.
- Public laneways (road reserve) subject to the condition that hinge poles are utilised in the design and the minimum width of “verge” in the laneway is 1.5 metres from rear of kerb to property boundary.

Rate 2 Public Lighting shall not be installed in Community Title Schemes or Manufactured Home Parks.

8.31 AS/NZS3000 CONSUMERS MAINS IN ROAD RESERVES

In some project specific instances, it may be necessary for the AS3000 consumers’ mains to run a short distance within the road reserve so as to connect to the appropriate LV service pillar. A maximum distance of two metres is generally acceptable where necessary, however Energex approval will be required on a per project basis from the Contestable Works team, where the pillar is offset from the survey peg. AS/NZS3000 consumers mains located within the public footpath must be double insulated, installed in a minimum 40mm heavy duty conduit, have a minimum of

600mm cover and be protected by PVC cover strip. A “detail view” must be shown on the drawings.

8.32 STATUTORY CLEARANCES / VEGETATION CLEARING AND LIAISONS WITHOTHER AUTHORITIES

Clearance to ground (CTG), clearance to structure (CTS) and inter-circuit clearances shall be maintained to Energex and statutory standards. Any existing clearance issues are to be brought to Energex’s attention prior to commencement of the detailed design of the project. CTS and CTG studies on transmission lines greater than 33kv are non-contestable and must be undertaken by Energex. These requests are to be sent to the Contestable Works team.

For all proposed overhead line routes, all planned vegetation clearing works must comply with the relevant Work Category Specification.

It is the design consultant’s responsibility to coordinate obtaining of all required approvals for vegetation works for new overhead lines in road reserve. In the case of private trees (inside private property) with the tree canopy overhanging the road reserve, written approval must be obtained from the private property owner of the tree.

The design consultant is responsible for ensuring 3rd parties utilising Energex assets are advised during the consultant’s planning phase of the project if alterations to their assets are required as part of the subdivision project. E.g., Telstra, NBN, Unmetered Supply consumer’s mains, 5G micro cells, etc. The 3rd party is to be advised as soon as possible to allow them to assess the impact using Energex form 1187 and where the works are developer initiated, the 3rd party must be advised that it is a Developer Design and Construct project.

The design consultant is responsible for ensuring that Earth Potential Rise (EPR) levels are maintained in accordance with the agreed clearances of Energex’s earthed assets to existing Telstra assets. Refer to the Energex - Telstra Power Coordination Guidelines.

8.33 EXISTING ENERGEX EASEMENTS

All proposed works in an existing Energex easement shall be approved by the Energex Property Department, prior to any works commencing within the easement. This includes any civil works; electrical reticulation works, and public lighting works associated with the subdivision project. All requests for approval of proposed works in an Energex easement shall in the first instance be submitted to the Energex Contestable Works team.

The easement conditions on existing easements should be investigated by the design consultant prior to planning and designing any alterations or upgrades to the existing network.

8.34 ROAD RESERVE

In freehold subdivisions, Energex 11kV assets and LV assets shall be installed by the developer in an area of public road reserve. To enable the Certificate of Acceptance to be issued at the closure of the project, Energex requires a copy of the survey plan, showing the subject area as dedicated road reserve.

8.35 EASEMENTS

In freehold standard lot subdivisions, Energex 11kV assets and LV assets shall be installed by the developer in an area of public road reserve. There are however project specific instances when an easement may need to be provided by the developer for the security of the network assets. The items below relate to the provision of easements in subdivision projects.

- During the planning phase of the project, the design consultant shall request approval from the Energex Contestable Works team for any proposed easements through park, reserves, or Commercial and Industrial lots.
- Easements for 11 kV and LV underground cables shall be a minimum width of two metres wide and with sufficient access to allow future repairs and maintenance. Any proposed alternative sizes of easements shall be negotiated with the Energex Contestable Works team.
- Easements will be required in the common property of a Community Title Schemes where the network supplies customers outside the Community Title Scheme, both now or in the future.
- Exclusion zone easements will be required for separately earthed High Voltage assets when it is proposed that these assets will be initially separately earthed assets and later, at some future time, converted to common earthed assets.
- Energex does not permit easements through residential lots for 11kV or LV cables.

Where an easement is required on a subdivision project and before a Certificate of Supply is issued to the developer or approval is granted to switch and commission the new assets, Energex requires the developer to provide the following items:

- A copy of the surveyor signed survey plan showing the proposed easement, and
- The relevant easement documentation.

The Certificate of Supply will not be issued to the developer until the above items have been actioned, even if the developer has lodged a security bond for the project.

The Land Registry Form 9 shall show the following:

- Item 5 - Grantee as “Energex Limited (ACN 078 849 055)”
- Item 7 – Purpose of Easement as the “Supply of Electricity”. (UG and OH Assets)
- Item 7 – Purpose of Easement as the “Underground Electricity”. (UG Assets Only)
- Item 8 – Shall refer to one of the following relevant memorandum numbers below:

The standard easement conditions used by Energex are:

Dealing No 708346714 – Freehold tenure - Underground and Overhead conditions
Item 7 Description: “Supply of Electricity”

Dealing No 713599598 – Freehold tenure - Underground conditions
Item 7 Description: “Underground Electricity”

Dealing No 711950329 – State land tenure (Reserve) - Underground and overhead conditions
Item 7 Description: “Supply of Electricity”

Dealing No 711950324 – State land tenure (Reserve) - Underground conditions
Item 7 Description: “Underground Electricity”

Dealing No 712398229 – State land tenure (Reserve) - Underground and Access conditions
Item 7 Description: “Underground Electricity”

Dealing No 706152965 – Separately earthed exclusion zones
Item 7 Description: “Supply of Electricity”

The design consultant is responsible for ensuring that the easement documentation is forwarded to Energex’s Contestable Works team. The Contestable Works team will ensure that

the easement satisfies Energex requirements and if so, will then arrange for the easement documentation to be executed by Energex's Property Department and returned to the developer or their solicitors.

The Energex subdivision project number shall be quoted in all correspondence.

At the closure of the subdivision project, Energex will not issue a Certificate of Acceptance to the developer or refund the security bond, until such time as Energex is provided with a copy of the Registration Confirmation Statement for the easement.

All costs and outlays associated with the preparation and lodgement of easement documentation in a subdivision project are the responsibility of the developer.

8.36 WAYLEAVES

In subdivision project, Energex 11kV assets and LV assets shall be installed by the developer in an area of public road reserve or common property. There is however project specific instances when a wayleave may need to be provided by the developer for the security of the Energex overhead network assets.

Wayleaves are only applicable for overhead assets up to an including 11kV. Wayleaves are not applicable for underground assets. All documentation regarding wayleaves is to be submitted electronically to the Energex Contestable Works team. The items below relate to the provision of a wayleaves in subdivision projects.

Energex Wayleaves

Energex Form – Contestable Works Consent to the Erection of an Electric Line

- A wayleave is acceptable for Energex overhead assets with voltages less than 33kV and associated assets. E.g., Ground stays, pole transformers, poles, etc.
- A wayleave cannot be issued for future Energex assets. E.g., A future overhead service to a customer. In these situations, it is necessary to erect the service as part of the project works and issue a Wayleave for this service. It is however not necessary to commission the service.
- A new wayleave is required for any alterations to an existing Energex overhead line such as a line route deviation, upgrading conductors, additional phase conductor, new pole mounted plant, etc. A new wayleave is required even if the existing line is under an existing wayleave.
- Energex requires a new wayleave to be established with any alterations to an existing property description, where there are existing assets crossing property boundaries.
- Refer to the Energex Guideline for Completing the Wayleave Form.

Where there are 33kV overhead assets or any underground assets crossing property, Energex will require an easement as security for these assets. Contact the Energex Contestable Works team for further information.

Queensland Rail Wayleaves

In the case of Energex overhead mains or underground mains crossing railways lines, special conditions apply for Queensland Rail wayleaves. For more detail regarding these types of wayleaves and easements, please contact the Energex Contestable Works team.

8.37 COMMUNITY AND ENVIRONMENTAL ISSUES

Community and environmental issues need to be considered in the design and construction of any overhead feeders and associated assets. Key issues for consideration include:

- Visual impact of the overhead line construction.
- The planned positions of new or additional poles.
- Impact on other authorities (E.g., Gas, Water, Telecommunication, Road Authorities)
- Disruption to business, community, and traffic during construction
- The need to clear vegetation to construct the line and to maintain safety.
- To consider the impact on existing customers when installing Energex assets in existing areas.
- The siting of transformers in environmentally sensitive areas shall be considered during the planning and design of the project.

The design consultant shall consider the impact on existing customers when installing Energex assets in existing areas. Energex reputation and community engagement is most important to our brand. The design consultant is responsible for ensuring there is community consultation, in particular where Energex assets are proposed to be installed in front of existing lots not associated with the development.

8.38 NETWORK OUTAGES

Design Consultants and Electrical Contractors need to be aware of Energex's requirements with respect to planned outages to customers during the switching and commissioning of subdivision projects. Refer to WCS31 - Commissioning, Operating and Accessing the Network.

8.39 SWITCHING AND COMMISSIONING PLANS

A commissioning plan must be included on all design drawings. The design consultant is responsible for developing a commissioning plan that contains sufficient information to enable the works to be switched and commissioned by the electrical contractor with minimal interruption of supply to existing customers.

The commissioning plan may require Live LV work by the electrical contractor however the commissioning plan does not have to contain the level of detail that is required for a Switching Sheet.

Supply outages to major customers such as schools, shops, businesses, factories, and large numbers of domestic customers are not acceptable to Energex. Outages to customers of this type require early negotiations, as per WCS31 - Commissioning, Operating and Accessing the Network.

The commissioning plan shall not involve the proposed use of Live Line resources to break bridges / make bridges on the day of switching (to isolate the HV network) if the switching can be achieved by the use of existing switches on the network or with the use of temporary HV Flying Links. The use of HV Live Line resources to break bridges / make bridges on the day of HV switching is the option of last resort due to resource availability, climatic conditions, storm season, emergency work, etc.

The commissioning plan enables the design consultant to ascertain the network switching costs, cable ID and spike costs, level 2 cable test costs, generator costs and HV live line costs (all costs as applicable). These costs are available on the list of Connecting to the Energex Network Fees and Charges and shall be included with the consultant's design submission package. These costs are to be paid by the developer and will be incorporated into the Subdivision Electricity Supply Agreement.

8.40 HIGH VOLTAGE LIVE LINE RESOURCES

Energex provides all High Voltage Live Line resources should they be required for a subdivision project. The developer pays the applicable costs as per the list of standard fees charges and these costs will be included in the Subdivision Electricity Supply Agreement. ASP rated electrical contractors do not undertake High Voltage Live Line activities.

8.41 CURRENT ENERGEX AGED ASSET REPLACEMENT PROGRAM

There have been several Energex programs in place to replace existing aged assets in the network. The design drawings for the subdivision project shall include the replacement of any Energex assets, identified under the replacement program, where these assets are directly impacted by the consultant's design of the subdivision project. Such activities include but not limited to:

- Recovery of 7/16 copper overhead conductor
- Replacement of bush poles
- Recovery of overhead public lighting circuits
- Recovery of Consac cable
- Recovery of asbestos duct lines

8.42 DESIGN CONSTRUCTABILITY

The design consultant is responsible for all safety in design matters, ensuring that the design is practical and safe to construct, operate and maintain.

8.43 NON-STANDARD APPROVALS

All subdivision projects shall be designed and constructed strictly in accordance with Energex Standards and Policies. Any project specific engineering-based proposals for non-standard design and/or non-standard constructions shall be negotiated with the Energex Contestable Works team during the design consultant's planning phase of the project. A copy of any non-standard approvals shall be included in the design submission package when sent to Energex.

8.44 DESIGN CERTIFICATION

Energex does not approve design drawings from consultants, Energex only accepts design drawings from consultants. The RPEQ (Electrical Division) who is supervising the design work is the person Energex deems responsible for certifying that the design work complies with Energex Standards and Policies.

Energex also deems that the RPEQ (Electrical) supervising the design work provide the certification that the public lighting design, within the subdivision project, complies with the relevant Australian Standards and/or the specific requirements of the LGA or TMR.

An electronic signature of the same shape and style as the RPEQ's "wet signature" together with the RPEQ's name, RPEQ's number and date shall be placed on the design drawings.

9 RESIDENTIAL SUBDIVISIONS – FREEHOLD LOTS

9.1 GENERAL DESIGN PARAMETERS

The following general design parameters apply:

Design ADMD for new lots:

- An ADMD of 4.0kV.A is to be used for all Standard Residential Lots.
  - 4.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97.
- An ADMD of 7.0kV.A to be used for Prestige Housing.
  - 7.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97.

Design ADMD for any existing lots:

- An ADMD of 3.25kV.A is to be used for all existing transformer areas built prior to 1 July 2004.
  - 3.25kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97 shall be used for all existing standard residential lots when adding new lots to an existing transformer area-built pre-July 1st, 2004.
- An ADMD of 4.0kV.A is to be used for all existing transformer areas built after 1st July 2004
  - 4.0kVA single phase, standard deviation = 50% of ADMD, power factor = 0.97 shall be used for all existing standard residential lots when adding new lots to an existing transformer area-built post July 1st, 2004.
- An ADMD of 7.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97 shall be used for all existing prestige residential lots when adding new lots to an existing transformer area built after July 1st, 2004.

The ADMD for any existing lots shall not be determined by using the supply transformer loads, actioning a house count and then undertaking the associated mathematical calculations.

There shall be no reduction in the ADMD for subdivisions with reticulated gas supply or Solar PV.

Three phase LV supply shall be made available to every lot in the subdivision.

The maximum permissible size of Padmount Transformer for a freehold residential subdivision is 500kVA.

Any existing customer owned lines that cross the new lot boundaries created by the subdivision shall be re-located so as to be wholly contained within the respective lot. The exception being the consumer's mains located within an access and services easement that benefits the respective lot.

9.2 HATCHET LOT SUBDIVISIONS

Where there are two or more "hatchet lots" located behind another lot with access down the side of the front lot, the developer shall make underground supply available in the road reserve. Multiple customer owned property poles or single joint-use customer property poles are not permitted by Energex. It may be necessary for the developer to provide two or more service pillars adjacent to each other on the footpath in the road reserve. No more than two customers shall be supplied from any six-fuse pillar as this will allow customers to upgrade to three phase supply at a future time. Alternatively, the developer may take the option of installing a 14 fuse Supa-Pillar. Energex will permit up to five residential consumers to be connected to one Supa-Pillar.

If the direct means of pedestrian and vehicular access to the rear lot or rear lots is via an access and services easement, then the AS/NZS3000 consumer's mains to the rear lot/s shall be located within the access and services easement. Energex will not permit a Services Easement (this being solely for services) for the AS/NZS3000 consumer's mains to the rear lot/s when the direct means of vehicular / pedestrian access to the rear lot/s is via a different route. The Point of Supply shall be located in the immediate vicinity of the vehicular / pedestrian entry to the rear lot/s.

9.3 LV ASSETS IN PRIVATE DRIVEWAYS

The installation of Energex LV assets in private driveways is not desirable however will be permitted when there is a clear benefit to the future customers. Benefit is defined as a situation where the lots are at the end of a lengthy private driveway, 80+ metres in length with the house site/s some further distance from the end of this private driveway. In these instances, due to the distance, it is not feasible to install AS/NZS3000 consumer's mains from the road reserve to the lot/s due to possible future voltage problems. The private driveway shall have sufficient space to install Energex LV assets in a 1.5-metre-wide grassed area adjacent to the driveway. The 80+ metre distance is measured from the property boundary at the frontage with road reserve and the driveway shall have a sealed surface such as concrete or asphalt with a "grass verge".

A reciprocal rights access and services easement over both the private driveway and the Energex assets will be sufficient to protect the LV Assets located within the private driveway. If not, then a two-metre-wide underground electricity easement shall be granted in favour of Energex.

9.4 SMALL RESIDENTIAL SUBDIVISIONS THAT CREATE UP TO AND INCLUDING FOUR NEW URBAN LOTS

This scenario is applicable where the small subdivision is located where the existing network is not suitable to supply the subdivision and works are required to upgrade or extend the Energex network for the subdivision.

- Residential developments creating an additional four new lots or less to be connected to the network. I.e., A maximum total of five new lots on a new survey plan.
- The lots being created are for single residential dwellings only. (E.g., No units, no townhouses, no duplexes, etc)
- LV Volt Drop calculations are not required for the small subdivision project, if:
    - The small subdivision is located less than 250 metres circuit length from the supply transformer. This distance includes any extension of the LV network to the location of the subdivision, and,
    - The LV circuit being extended or altered must tie to another transformer LV area, and,
    - A minimum existing pole transformer size of three phase 25 kVA.
    - There must be no transformer overload for existing 25kVA or 63kVA transformers.

Note: All of the general design parameters for residential subdivisions also apply to small subdivisions. design application fees, switching fees, Live Line fees and final product audit fees are also applicable.

10 RESIDENTIAL SUBDIVISIONS – COMMUNITY TITLE SCHEMES

10.1 GENERAL DESIGN PARAMETERS

These Section 9.1 general design parameters apply to both Standard Lot Format Plan and Building Format Plan Residential Community Title Schemes.

Energex permits the internal reticulation of a Community Title Scheme as Contestable Work provided that the internal road is located within common property and the internal road provides vehicular access to all dwellings. The Energex internal reticulation must supply five or more lots and must require multiple LV service pillars. Consideration shall be given to a staged Community Title Scheme development.

If the Community Title Scheme does not meet these above requirements, and the design parameters as listed below, then Energex considers the project non-contestable works which will be designed and constructed by Energex as a Single Point of Supply with AS/NZS3000 internal reticulation.

The following general design parameters apply for Community Title Schemes with Energex internal reticulation:

Design ADMD for new lots:

- An ADMD of 3.0kV.A is to be used for each Standard Residential Living Units.
  - 3.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97.
  - In the case of a duplex the ADMD is as above for each living unit.
- An ADMD of 4.0kV.A is to be used for Prestige Residential Living Units.
  - 4.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97.
  - In the case of a duplex the ADMD is as above for each living unit.

Design ADMD for any existing lots:

- An ADMD of 3.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97 shall be used for all existing standard CTS lots when adding new lots to an existing transformer area.
- An ADMD of 4.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97 shall be used for all existing prestige CTS lots when adding new lots to an existing transformer area.
- The ADMD for any existing CTS lots shall not be determined by using the transformer loads, actioning a house count, and then undertaking the associated mathematical calculations.

There shall be no reduction in the ADMD for CTS subdivisions with reticulated gas supply or Solar PV.

Community title lots located within a freehold residential subdivision will require an ADMD allowance of 30 kVA as per the standard for Commercial and Industrial lots. A minimum of two 125mm HV conduits and one 100 mm communications conduit shall be installed from the existing 11kV network to the community title lot. Additional planning work may be required by the design consultant, and it is recommended that a concept plan be submitted to the Energex Contestable Works team.

The maximum permissible size of Padmount Transformer for a CTS residential subdivision is 500kVA.

In Community Title Schemes, Energex conduits, cables and assets shall be installed on a consistent alignment in common property and details are contained in the Energex Underground Distribution Construction Manual.

The allocated corridor for Energex assets shall be an area that is turfed with only cross overs for driveways and parking bays, and a minimum width of 1.5 metre common property verge. The allocated corridor shall be free of all landscaping (such as gardens including mulched beds, shrubs, and trees) and permanent structures (such as Bio-retention basins, rubbish bin enclosures, group mailboxes, carports, and retaining walls.

In Community Title Schemes, Energex will not approve:

- A reduction in the width of the allocated corridor.

- Any proposed “pillar cut-outs” into the lots.
- Easements in lieu of Common Property.

Energex conduits, cables, and assets, shall not be installed in areas with limited access, such as swimming pool enclosures, under gazebos, tennis court enclosures, etc.

The supply method for a Standard Format Plan CTS development is each lot must have three phase supply available to the lots.

The supply method for a Building Format Plan CTS development is a maximum of four individual single-phase units supplied from a single six fuse LV pillar. The location of the main switchboard for each unit needs to be shown on the works plans.

A Community Title Scheme should not have mixed points of supply from Energex network both inside and outside of the development. Where this is not practical or where the principal point of entry for some of the lots faces the outside of the development, approval in writing shall be requested from the Energex Contestable Works team.

Any proposed community facility lots within in a Community Title Scheme will require an ADMD allowance of 30kVA as per the standard for Commercial and Industrial lots. Two HV conduits will be required to the location of the community facility lot from the existing 11kV network, and a detailed concept plan shall be submitted to Energex. If the planned AS/NZS3000 ultimate load is known for the community facility lot, and this load exceeds 30kVA, then the design consultant shall use this AS/NZS3000 known load in all LV Drop calculations and may need to install the relevant padmount transformer. A community facility lot is for uses such as a clubhouse, entertainment venue, etc.

If the ultimate loading of the Community Title Scheme requires the installation of more than two transformers, (regardless of their kVA nameplate size), an 11kV loop in / loop out arrangement shall be installed within the development. To maintain flexibility in the 11kV network, a 4-way RMU may be required where the 11kV network enters the development. This is to avoid having the 11kV feeder backbone looping in and out of the development and impacting reliability to customers outside the development should there be a network fault inside the CTS development.

24 Hour unrestricted access is required to all Energex assets located within the Community Title Scheme

11 RESIDENTIAL SUBDIVISIONS – MANUFACTURED HOME PARKS

11.1 GENERAL DESIGN PARAMETERS

Energex permits internal reticulation of a Manufactured Home Park if the internal roads provide sufficient area for the installation of Energex Assets. The design and installation requirements for reticulation of a Community Title Scheme shall apply to the electrical reticulation within a Manufactured Home Park

The following general design parameters apply for Manufactured Home Park (MHP) with internal Energex reticulation:

Design ADMD

- An ADMD of 3.0kV.A is to be used for each Standard Residential Living Units.
  - 3.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97.
  - In the case of a duplex the ADMD is as above for each living unit.
- An ADMD of 4.0kV.A is to be used for Prestige Residential Living Units.

- 4.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97.
- In the case of a duplex the ADMD is as above for each living unit.

There shall be no reduction in the ADMD for MHP subdivisions with reticulated gas supply or Solar PV.

Any proposed community facility lots within in a Manufactured Home Park will require an ADMD allowance of 30 kVA as per the standard for Commercial and Industrial lots. Two HV conduits will be required to the location of the community facility lot from the existing 11kV network, and a detailed concept plan shall be submitted to Energex. If the planned AS/NZS3000 ultimate load is known for the community facility lot, and this load exceeds 30kVA, then the design consultant shall use this AS/NZS3000 known load in all LV Drop calculations and may need to install the relevant padmount transformer.

The maximum permissible size of a Padmount Transformer for a MHP residential subdivision is 500kVA.

In a Manufactured Home Park, Energex conduits cables and assets shall be installed on a consistent alignment in the road verge and a minimum width of 1.5 metre verge. The allocated corridor for Energex assets shall be an area that is turfed with only cross overs for driveways and parking bays. The allocated corridor shall be free of all landscaping (such as gardens including mulched beds, shrubs, and trees) and permanent structures (such as Bio-retention basins, rubbish bin enclosures, carports, townhouses and retaining walls).

In a MHP subdivision Energex will not approve

- a reduction in the width of the allocated corridor.
- any proposed “pillar cut-outs” into the lots.

Energex conduits, cables, and assets, shall not be installed in designated areas with limited access, such as swimming pool enclosures, under gazebos, tennis court enclosures, etc.

All dwellings in a Manufactured Home Park shall be provided with access to three phase LV supply and three fuses available for each dwelling.

If the ultimate loading of the Manufactured Home Park requires the installation of more than two transformers, (regardless of their kVA nameplate size), an 11kV loop in / loop out arrangement shall be installed within the development. To maintain flexibility in the 11kV network, a 4-way RMU may be required where the 11kV network enters the development. This is to avoid having the 11kV feeder backbone looping in and out of the development and impacting reliability to customers outside the development should there be a network fault inside the MHP.

Where there is Energex internal reticulation within a Manufactured Home Park each dwelling shall have their own metering point located on the dwelling that the meters service.

24 Hour unrestricted access is required to all Energex assets located within the Manufactured Home Park.

12 COMMERCIAL AND INDUSTRIAL SUBDIVISIONS

12.1 COMMERCIAL AND INDUSTRIAL SUBDIVISIONS – FREEHOLD LOTS

The following design guidelines apply to Commercial and Industrial Subdivisions that are freehold lots.

- An ADMD of 30.0kV.A is to be used for all Commercial and Industrial subdivisions.
  - 30.0kV.A three phase, standard deviation = Nil% of ADMD, power factor = 0.8.

- When performing LV drop calculations this is 30kVA ADMD for a three-phase calculation and 10kVA ADMD for a single-phase calculation.

The minimum transformer size shall be 500kVA and the proposed use of padmount transformers greater than 500kVA in a Commercial and Industrial Subdivision shall be approved by the Energex Contestable Works team during the design consultant's planning phase of the project.

No overload is permitted on transformers supplying Commercial and Industrial loads.

4 x 125mm conduits + 2 x 100mm conduits + 1 x 100 Energex communication conduits shall be installed along one side of the road. 2 x 125mm conduits + 2 x 100mm conduits + 1 x100mm Energex communications conduit shall be installed to the opposite side of the road or equivalent conduit route.

When a subdivision is known as having significantly large loads, Energex may require additional conduits to be installed as part of the project.

Conduits shall be installed to a location in the existing 11kV network suitable for Energex to extend the 11kV network when customers start building on the vacant lots.

Energex may require more than one communications conduit in certain circumstances.

Joint Use Trenches will not be permitted in the footpath of Commercial and Industrial subdivisions. Telstra, Optus, NBN Co, Gas and all other services are to be installed on their own alignment, except for road crossings, where a shared trench arrangement will be acceptable.

16mm2 Cu 4 Core XLPE cable is not permitted for use in Commercial and Industrial subdivisions.

An industrial service pillar complete with 6 x 100 A fuses and a 200 A combined fuse switch shall be installed on the shared property boundary of every second lot.

When there is a confirmed future load, greater than the base allowance of three phase LV 30kVA supply for each subdivision lot being created, Energex will permit this to be incorporated as a part of the subdivision project, provided that no additional transformers are required. Design consultants shall provide written evidence of the confirmed load. The confirmed future load shall not be calculated by using a VA per square metre basis for the overall size of the lot being created in the subdivision. Where high load requirements have been confirmed, an industrial service pillar complete with 6 x 100 Amp fuses and a 400 Amp CFS Unit or a Supa Pillar equipped with two 400 Amp CFS units shall be installed as part of the subdivision project. This may require dedicated LV circuits from the transformer.

Three-way pillars must be installed for crossroad 240mm2 LV mains in addition to the Commercial and Industrial pillars supplying the lots in the subdivision. To facilitate the installation of a three-way pillar adjacent to Commercial and Industrial pillar, it is acceptable to use 185mm² single core copper cables, installed in HD conduit between the two pillars. Alternatively, a single large Commercial & Industrial "Supa-Pillar" could be used in lieu of two separate pillars.

Energex may require Concrete Cable Pit and Duct reticulation should the electrical corridor not be turf. Refer to the section 10 – Concrete Cable Pit and Duct Reticulation for further information.

12.2 COMMERCIAL AND INDUSTRIAL SUBDIVISIONS – COMMUNITY TITLE SCHEMES

These design guidelines apply to Commercial and Industrial Subdivisions that are a Standard Lot Format Plan Community Title Scheme and shall have five or more lots. Consideration shall be given to staged Community Title Scheme developments. The lots must be of a similar layout as standard freehold lots and the sealed "roadway" must be wholly located within Common Property. In essence, if the CTS Lots were to be freehold lots and the Common Property was to be road reserve then the C & I subdivision would comply with the criteria in Section 11.1 of this standard.

A Community Title Scheme with Building Plan Format is deemed Non-Contestable work.

For all Commercial and Industrial CTS subdivisions, the design consultant shall submit a concept plan to the Energex Contestable Works team for evaluation and feedback. The design consultant shall include in the concept submission package a copy of the survey plan showing details of the layout of the CTS Lots and the Common Property. The requirements of Section 7 apply with regard to Transformer and RMU sites that are proposed to be located in Common Property in CTS subdivisions.

- An ADMD of 30.0kV.A is to be used for all Commercial and Industrial CTS subdivisions.
    - 30.0kVA three phase, standard deviation = Nil% of ADMD, power factor = 0.8.

When performing LV drop calculations this is 30kVA ADMD for a three-phase calculation and 10kVA ADMD for a single-phase calculation.

The proposed use of padmount transformers greater than 500kVA in a Commercial and Industrial CTS subdivision shall be approved by the Energex Contestable Works team during the design consultant's planning phase of the project.

No overload is permitted on transformers supplying Commercial and Industrial loads.

4 x 125mm conduits + 2 x 100mm conduits + 1 x 100 Energex communication conduits shall be installed along one side of the road located in common property. 2 x 125mm conduits + 2 x 100mm conduits + 1 x100mm Energex communications conduit shall be installed to the opposite side of the road located in common property.

All conduits, cables and pillars shall be installed within common property on the nominal 0 – 900 alignment offset from the lot boundary. I.e., The same position as in road reserve. Padmount Transformers and Ring Main Units shall be installed only in Common Property. In a C&I Community Title Subdivision Energex will not approve (i) A reduction in the width of the allocated corridor, (ii) Any proposed "pillar cut-outs" into the lots, (iii) Easements in lieu of Common Property.

When a CTS subdivision is known as having significantly large loads, Energex may require additional conduits to be installed as part of the project.

Conduits shall be installed to a location in the existing 11kV network suitable for Energex to extend the 11kV network when customers start building on the vacant lots.

Energex may require more than one communications conduit in certain circumstances.

Joint Use Trenches will not be permitted in the common property of Commercial and Industrial CTS subdivisions. Telstra, Optus, NBN Co, Gas and all other services are to be installed on their own alignment, except for road crossings, where a shared trench arrangement will be acceptable.

16mm2 Cu 4 Core XLPE cable is not permitted in Commercial and Industrial subdivisions.

An industrial service pillar complete with 6 x 100 A fuses and a 200 A combined fuse switch shall be installed on the shared property boundary of every second lot.

When there is a confirmed future load, greater than the base allowance of three phase LV 30kVA supply for each C&I lot being created, Energex may permit this to be incorporated as a part of the subdivision project, provided that no additional transformers are required. Design consultants shall provide written evidence of the confirmed load. The confirmed future load shall not be calculated by simply using a VA per square metre basis for the overall size of the lot being created. Where high load requirements have been confirmed an industrial service pillar complete with 6 x 100 Amp fuses and a 400 Amp CFS unit, or a Supa Pillar equipped with two 400 Amp CFS units shall be installed in the subdivision project. This will require dedicated LV circuits from the Transformer.

The future ultimate loads allocated to a lot shall be shown on the design drawings.

Three-way pillars must be installed for crossroad 240mm2 LV mains in addition to the Commercial and Industrial pillars supplying the lots in the subdivision. To facilitate the installation of a three-way pillar adjacent to Commercial and Industrial pillar, it is acceptable to use 185mm² single core copper cables, installed in conduit, between the two pillars. Alternatively, a single large Commercial & Industrial "Supa-Pillar" could be used in lieu of two separate pillars.

Energex may require Concrete Cable Pit and Duct reticulation should the electrical corridor not be turf. Refer to the section 10 – Concrete Cable Pit and Duct Reticulation for further information.

13 CONCRETE CABLE PIT AND DUCT RETICULATION

13.1 GENERAL DESIGN PARAMETERS

Concrete cable pits in accordance with Energex specifications may be utilised in CBD, commercial and industrial, or high prestige areas. This type installation facilitates easier access for future network augmentation, reduces re-excavation and reinstatement costs, reduces impacts on the local community during future works. For example:

- There is a high probability that access to the joints or conduit therein will be required.
- The surface is sealed with pavers or decorative surfaces such as signature concrete footpaths

The following general design guidelines apply for concrete cable pit and duct reticulation in subdivision projects.

- Concept plans shall be provided by the design consultant to the Energex Contestable Works team during the planning phase of the project.
- Full cable pit specifications must be detailed on the design drawings.
- Feeder designation descriptions must be shown on the design drawings for each circuit passing through a cable pit as part of the conduit cross sections.
- All pit and duct systems require 11kV and LV cables with armoured protection. This is considered the standard building block for Concrete Cable Pit and Duct systems.
- A 4C 240mm² Al XLPE/PVC/MDPE Low Voltage cable is the standard building block LV cable to be used in pit and duct systems. Note: 240mm² Al Low Voltage 4C XLPE PVC cable is not acceptable for use in cable pits.
- All new conduits installed within a pit and duct network area shall be 125mm diameter, except for the Energex 100mm communications conduit.
- Pit cards will be required and shall be provided with the Certificate of Completion package submitted to Energex by the electrical contractor who has constructed the works. These are to be separate items and shall accompany the "as constructed" drawings.
- The installation and layout of cables and joints within the cable pit should be in accordance with Energex Underground Distribution Construction Manual and Work Practice 1146 - Installation of cables and joints into underground cable pits.
- Service pillars, Ring Main Units and Transformers shall not be installed over cable pits unless approved by the Energex Contestable Works team.
- Service pillars integrated into the pit and duct system shall be installed such to minimise the impact of excavation and reinstatement within the pillar exclusion zone (I.e., Pavers or weak mix concrete around the pillar base)

- Pre-cast pits must be of a type approved by Energex. The manufacturer's technical specifications or "shop drawings" shall be submitted to Energex Contestable Works team for evaluation and acceptance, prior to manufacture or installation on site.
- Where a concrete pit design deviates from the prescribed designs as shown in the Energex Underground Distribution Construction manual, a Registered Professional Engineer Queensland (RPEQ) – Civil / Structural will be required to certify the design of the cable pit.
- The concrete pits are to be constructed and installed by a WCS 61 rated service provider in accordance with WCS 61.2 and certified by the Principal Contractor's or Developer's supervising Registered Professional Engineer Queensland (RPEQ) – Civil / Structural Engineer.
- Cable pits must be constructed in accordance with the Energex RED 00305 Underground Distribution Construction Manual, Energex WCS 61.2 Concrete Pit Construction, and relevant Technical Specifications.
- Public Lighting cables shall be positioned in a concrete cable pit in such a way as to be protected from mechanical damage. I.e., Strapped to the rear of other cables, close to the wall of the cable pit and positioned on insulating porcelain supports or equivalent.
- Public Lighting cables and control cables shall not to be coiled in concrete cable pits.
- Public Lighting cable Bell Joints shall be installed high and adjacent to the pit entrance in such a manner the Bell Joint can be easily removed from the pit without the necessity for staff to enter the cable pit.

14 RURAL SUBDIVISIONS

14.1 GENERAL DESIGN PARAMETERS

Rural subdivisions are subdivisions with lots that are two hectares or larger.

The following general design parameters apply:

- An ADMD of 4.0kV.A is to be used for all Standard Rural Residential Lots.
  - 4.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97.
- An ADMD of 7.0kV.A to be used for Prestige Rural Residential Lots.
  - 7.0kV.A single phase, standard deviation = 50% of ADMD, power factor = 0.97.

Three phase LV supply shall be made available to every lot.

The nominated building envelope for each lot shall be shown on the design drawings.

Three phase LV supply is to be established on the road reserve as close as practical to the proposed building envelope. The design consultant shall give due consideration as to the local topography and the route of any future consumer's mains between the Energex Point of Supply and the nominated building envelope.

The provision for future 11kV overhead mains shall be considered during the planning phase for any overhead reticulation. I.e., Full height poles being installed making allowance for future 11kV mains to be erected above the proposed LV mains required for the subdivision.

Existing consumer's lines that trespass and cross the property boundaries created as the result of a subdivision shall be relocated at the developer's expense.

15 FAST TRACK – REQUEST FOR A CERTIFICATE OF ELECTRICITY SUPPLY

15.1 SMALL RESIDENTIAL SUBDIVISION – FREEHOLD LOTS

The Fast Track - Certificate of Supply for Small Subdivisions is the terminology only applicable to the process when the small freehold subdivision is located where the existing network is suitable to supply the subdivision and no works are required to upgrade the network.

This scenario is for residential developments creating an additional four new lots or less to be connected to the network, this being a maximum total of five new lots on a new survey plan. The lots being created shall be for single residential dwellings only with no units, no townhouses, no duplexes, no high rise, etc.

Energex will issue a Certificate of Supply to the developer based on the following criteria:

- The design consultant is responsible for providing a documented submission to Energex detailing how each lot is to be supplied from the existing Low Voltage network. I.e., The proposed Method of Supply.
- There is existing three phase Low Voltage network at the location of the subdivision this being the frontage of the lots to road reserve.
- The new lots can be supplied from the existing Low Voltage network without the need for any works to upgrade or extend the network.
- The proposed new lots do not create a supply transformer overload or create voltage drop problems to the existing network.
- The proposed method of supply must comply with Energex Standards and Policies.
- The proposed method of supply must comply with any policies specified in the local council's planning scheme and any specific conditions within the development approval for the subdivision.

15.2 NETWORK VALIDATION

In an underground reticulated area, the design consultant is responsible for confirming on site that there are sufficient spare fuses in the nominated LV Service Pillar to make three phase supply available to the new lots. I.e., Three spare fuses available for each new lot. Should there be insufficient fuses, the upgrade of an existing LV Service Pillar (for additional fuses) requires a SESA project.

In an overhead reticulated area, the design consultant is responsible for confirming on site that it will be possible to erect a future overhead service without the need for vegetation management or removal. E.g., An overhead LV service from the Energex pole direct to the building or from an Energex pole to the customer's property pole.

15.3 VEGETATION

It is the developer's responsibility to obtain any required approvals for vegetation works such as tree trimming and to arrange for the required works to be completed so that Energex will be able to erect the proposed overhead service line (as per the consultant's proposed method of supplying the lot) when the future customer requests connection to supply.

Energex does not undertake vegetation works for Developer Design and Construct subdivision projects. The developer is responsible for organising all required approvals and completing all vegetation works prior to receiving the Certificate of Supply.

15.4 FLYING FOX SERVICES

Energex does not offer new Flying-Fox services as an option for the developer to make electricity supply available to lots being created in a subdivision project.

Flying-Fox services are a customer requested1 option for an overhead service and they incur additional costs due to the resources associated with the erection of this type of service. The prescriptive engineering standards for the design and construction of a Flying-Fox Service reside within the Energex Overhead Construction Manual.

1 Reference the Queensland Electricity Connections Manual.

Standard service connections that are options for a developer to make supply available to the lots being created are:

- (i) An overhead service from an Energex distribution pole direct to the customer's building.
- (ii) An overhead service from an Energex distribution pole direct to the customer's property pole.
- (iii) Underground supply from a Low Voltage service pillar.

The only time that a Flying-Fox Service may be considered by Energex as a method of making supply to lots created in a subdivision project is when there is no other acceptable engineering option for the developer to make supply available to the lots.

15.5 PROPERTY CROSSINGS

Property crossings (trespass) created as a direct result of the subdivision shall be removed by the developer. This is an Energex requirement, and in most instances, it is also a requirement of the local council town planning scheme and development approval.

Existing consumer's lines and cables that cross property boundaries created as the result of a subdivision, shall be relocated at the developer's expense prior to Energex issuing the Certificate of Supply.

If the subdivision creates an internal property boundary, not fronting road reserve, such that an existing Energex service line will cross a new lot to supply another new lot, then the Energex service line shall be relocated at the developer's expense, prior to Energex issuing the Certificate of Supply. Each new lot being created must be serviced directly from the road reserve.

It is the responsibility of the design consultant to ensure that all trespass and property crossing matters are removed / rectified prior to making a request to Energex for a Certificate of Supply

15.6 CUSTOMER ASSETS

Existing customer owned AS/NZS3000 lines and cables that cross property boundaries created as the result of a subdivision shall be relocated to remain wholly within each respective lot, prior to Energex issuing a Certificate of Supply

15.7 EXISTING SERVICE LINE THAT CROSSES A NEIGHBOUR'S LOT

If there is an existing Energex service line that crosses a neighbour's lot (who is not part of the subdivision) to supply an existing structure on the land being subdivided, then that service line shall be relocated by the developer so as to not cross the neighbour's lot. There is no option for the developer to leave this service line property crossing in situ and have the neighbour sign a Wayleave Form.

The relocation of the existing Energex service line and removal of the property crossing must be organised and completed by the developer prior to requesting the Certificate of Supply.

15.8 EXISTING SERVICE LINE THAT CROSSES THE LAND BEING SUBDIVIDED

If there is an existing Energex service line crossing the land being subdivided supplying an adjacent lot (that is not part of the subdivision), and the developer wishes to remove the property crossing, they are required need to negotiate with the owner of the adjacent lot with respect to any alterations to the neighbour's electrical installation and if applicable to the neighbour's property so it can accept a new (relocated) service line. The neighbour service line, point of attachment and method of supply (OH vs UG) is protected by the Electricity Act. Any negotiations between the developer and the neighbour are a matter between those parties. Energex will not be party to any of these negotiations.

If the existing Energex Service Line crossing the land being subdivided to the neighbour's lot has to remain in-situ, then Energex requires the developer to provide a new signed Wayleave Form for the existing service line. Note that the town planning schemes of some local councils require the developer to remove all property crossings associated with the subdivision.

15.9 NEW PROPERTY CROSSINGS

Energex will not approve a Service Line property crossing where the purpose of the crossing is to supply one or more of the lots within the subdivision.

15.10 EXISTING ENERGEX DISTRIBUTION ASSETS THAT CROSS THE LAND BEING SUBDIVIDED

If there are existing Energex assets (other than a service line) crossing the land being subdivided, then Energex will require a signed Wayleave Form or an Easement depending upon the type and voltage of the assets. Further information can be obtained from the Energex Contestable Works team.

15.11 DESIGN CONSULTANT'S RESPONSIBILITIES

It is the responsibility of the design consultant to ensure that all property crossing matters are resolved / rectified prior to making a request to Energex for a Certificate of Supply.

15.12 CLEARANCE TO STRUCTURE – CUSTOMER PROPERTY POLES

Energex has legislated requirements for maintaining Clearance to Structures (CTS) that are located near the overhead network. A customer owned property pole is a structure and as such these statutory clearance requirements apply to customer property poles.

It is the design consultant's responsibility to ensure that the location of any proposed customer owned property poles does not compromise the clearance to structure requirements of the existing overhead network. This is a three-metre distance measured radially from the existing overhead network. I.e., Three metre distance measured radially from the property side conductor of open wire mains and the distribution pole.

The exact location of the proposed customer property pole may need to be set out on the consultant's Method of Supply drawings with accurate dimensions to survey pegs / survey boundary, etc

15.13 LOCAL COUNCIL TOWN PLANNING SCHEMES

Design Consultants need to be fully conversant with the town planning scheme of the local council as these contain council policy with respect to electrical supply to new subdivisions including small subdivisions. As an example, some councils do not permit customer owned property poles and some councils do not permit proposed new overhead service lines that have to cross a roadway to

service a new lot. Another council may require evidence that if a lot has a proposed customer owned property pole, then that property pole has been installed by the developer.

15.14 ENERGEX FORM 2019 FAST TRACK CERTIFICATE OF SUPPLY CHECKLIST

All Design Consultants shall include completed Energex Form 2019 in the submission package with the request for a Fast Track - Certificate of Supply.

16 SUBDIVISION PROCESS

16.1 PROCESS MANAGEMENT

The design consultant is responsible for managing the process of the subdivision project. From commencement of the design work through to completion of the project and acceptance of the assets by Energex. The electrical contractor is responsible for managing the construction and commissioning works of the project.

16.2 CORRESPONDENCE

All correspondence relating to a proposed subdivision must be specific in its intent, and the subject line in the email correspondence shall contain the Energex project number, address/subdivision description and suburb. Example: S8900190 Callum Chase Stg 1.

16.3 FEES AND CHARGES

All subdivision project fees, and public lighting project fees are calculated in accordance with the requirements of the AER pricing principles. Details of these fees and charges can be found on the Energex website or by contacting the Energex Contestable Works team.

Please refer to Connecting to the Energex Network Fees and Charges.

16.4 DESIGN CONSULTANTS DOCUMENTATION TO BE SUBMITTED TO ENERGEX

The following items list the documentation that the design consultant should submit to Energex with a request for a Subdivision Electricity Supply Agreement (SESA).

The submission shall be sent electronically via email to contestable@energyq.com.au

- Covering letter.
- Subdivisions Detail Sheet.
- Design Drawings (Worksplans).
- Materials Summary Sheet
- Switching Fee Sheet.
- Live Line Activities Sheet. (If applicable to the project).
- Low Voltage Drop calculations.
- Motor Start Calculations.
- Earth Fault Loop Impedance calculations.
- Local Council approvals.
- TMR approvals as and when required for a specific project.
- Other authority approvals, as and when required for a specific project.

- Any project specific approvals for non-standard constructions, previously granted by Energex to the design consultant during the planning phase or detailed design phase.

The above items form what is generally referred to as the “Design Submission Package”.

Note: Energex does not download design submission packages from “drop boxes” or similar types of electronic storage facilities.

16.5 DESIGN REVIEW

Energex conducts a design review on every project submitted by a design consultant. This is a design review only and not a full in-depth design audit. Any non-conformance issues identified in the design submission package will be referred to the design consultant for corrections and then re-submission to Energex. A resubmission fee may be applicable.

16.6 DESIGN COMPLIANCE

Energex conducts design compliance audits based on a sampling of projects that a consultant submits in a financial quarter. Energex reserves the right to conduct a design compliance audit at any time during the life of the project. As part of any compliance audit Energex may request copies of the design consultant’s field notes, site photographs and any other relevant documentation pertaining to the project.

16.7 LETTER OF OFFER / SUBDIVISION ELECTRICITY SUPPLY AGREEMENT

Upon receipt of a compliant submission package from the design consultant, Energex will prepare a Letter of Offer and a Subdivision Electricity Supply Agreement for the developer. The Letter of Offer and SESA will be forwarded to the developer via the design consultant’s office. The SESA must be signed by the developer and returned to Energex via the design consultant. The developer is responsible for payment of all fees as detailed on the SESA.

16.8 SECURITY BONDS / NO SECURITY BONDS

Security Bond

If the developer lodges a refundable security bond with Energex for the project, along with the signed SESA and payment of all fees, Energex will issue the Certificate of Electricity Supply to the developer, via the design consultant’s office.

- A minimum of a $15,000 refundable security bond applies to all subdivision projects that have a security bond.
- Energex will calculate the refundable security bond based on following items:
- $1500* per lot for Residential and Commercial and Industrial Subdivisions.
- $1500* per dwelling unit in Community Title Schemes.
- $1500* per dwelling unit in a Manufactured Home Park.

* Energex may increase the bond or not offer a bond based on any perceived risk.

No Security Bond - Freehold Lots and Community Title Lots.

The developer has the option not to lodge a refundable security bond for a project. In this situation the Certificate of Electricity Supply will only be issued to the developer concurrent with the issuing of the Certificate of Acceptance at completion of the project. The developer remains responsible for payment of all fees and charges as detailed on the SESA.

Energex reserves the right to impose the requirement for a bond on a project based on any perceived risk.

Should the developer require a Certificate for Electricity Supply for a project where no security bond has been lodged, and:

- There has been significant works constructed, or,
- The project has been switched / commissioned in any way, then,

Energex will not accept a security bond from the developer. The project must proceed to final completion and be accepted by Energex before the Certificate of Electricity Supply is issued to the developer.

Should Energex consent to accept a security bond in exchange for the Certificate for Electricity Supply, a revised Subdivision Electricity Supply Agreement will be required, and a resubmission fee will be applicable. Energex will not reduce the security bond when there is a partial completion of a project, the developer shall provide the full amount of the security bond.

Security Bond - Manufactured Home Park.

There is no option to the developer for no Security Bond for a Manufactured Home Park project. The developer is required to lodge a security bond for the project with Energex.

16.9 CERTIFICATE OF ELECTRICITY SUPPLY

The Certificate of Supply is the Energex document required by the developer to “seal” the survey plans of the subdivision with the local council for lodgement and survey plan registration with the State Titles Office. On a project where the developer must establish easements in favour of Energex, the Certificate of Electricity Supply will not be issued to the developer until all the easement documentation has to be submitted to Energex. This being the surveyor signed and endorsed survey plan and Form 9 for the easement. Please contact the Energex Contestable Work Team for further information on this process.

16.10 APPROVAL TO CONSTRUCT

It is the responsibility of the design consultant to notify Energex the details of the electrical contractor and any sub-contractor who has been engaged by the developer to construct the works for the project. The electrical contractor is not permitted to commence construction of the works until Energex has issued the Approval to Construct to the electrical contractor.

16.11 SUPPLY OF MATERIALS FOR THE PROJECT

The developer shall supply all materials for the project. Only material included on Energex approved material list shall be utilised for the purpose of construction of electricity reticulation.

If the developer wishes to use material that is not on the Energex approved material list, a submission to Energex is required to have the item included on the list. Energex will require a minimum lead time of three months to evaluate a submission and, if acceptable, include a new item on the list. The Energex Approved Material List can be located on the Energex website.

In some project specific instances where Energex may be supplying some materials, these shall be negotiated with Energex, during the design consultant’s planning phase of the project.

16.12 CONSTRUCTION OF THE PROJECT

The electrical contractor is responsible for ensuring that all construction work is completed in accordance with the latest revision of the design drawings for the project and all relevant Energex standards and policies.

16.13 CHANGES DURING THE CONSTRUCTION OF THE PROJECT

Any proposed changes to the design by the electrical contractor due to on-site issues during the construction phase of the project, shall be directed to the design consultant. The design consultant shall evaluate the proposed changes, and if required seek approval from Energex. It may also be necessary to seek approval from the LGA or other authorities depending on the change.

16.14 SWITCHING AND COMMISSIONING OF THE PROJECT

Energex switches and commissions the HV network built by the electrical contractor. Energex undertakes any required HV Live Line activities required during the network switching.

The electrical contractor switches and commissions the LV network and Rate 2 public lighting networks as built by the electrical contractor. The electrical contractor undertakes all customer outage notifications in accordance with the network planned outage guidelines.

Energex does not switch and commission the LV network or the Rate 2 public lighting network, this is the role and responsibility of the electrical contractor.

On a project where the developer must establish easements in favour of Energex, the approval to switch and commission the new assets will not be issued to the electrical contractor until all the easement documentation has to be submitted to Energex. This being the surveyor signed and endorsed survey plan and the Form 9 for the easement. Please contact the Energex Contestable Work Team for further information on this process.

16.15 CERTIFICATE OF COMPLETION

Following the commissioning of the project, the electrical contractor submits the completion package for all works direct to the Energex Contestable Works team within the required time frames. The Certificate of Completion along with all other mandatory documentation, must be included in the completion package sent from the electrical contractor to Energex.

16.16 FINAL PRODUCT AUDIT

Following receipt of the completion package from the electrical contractor, the Energex Contestable Works team will schedule a final product audit of the constructed works.

Any construction defects identified must be rectified by the electrical contractor.

16.17 CERTIFICATE OF ACCEPTANCE

A Certificate of Acceptance will be only issued when Energex is satisfied that:

- There are no construction defects on the project.
- Construction complies with Energex standards.
- The project has been completed by the developer in accordance with the Subdivision Electricity Supply Agreement.
- The developer, via the design consultant's office, has provided survey plans to Energex showing that all new assets are located in public road reserve, where required.
- The developer, via the design consultant's office, has provided to Energex a copy of the survey plan and a copy of the Registration Confirmation Statement from the State Titles Office for any easements created for security of Energex assets.

Note: Energex will not take responsibility for any assets installed by the developer that are damaged prior to the issuing of the Certificate of Acceptance, including stolen cables.

16.18 REFUND OF THE SECURITY BOND

For a project where the developer has provided a security bond, the bond will be refunded to the developer after the Certificate of Acceptance has been issued by Energex. The bond will only be refunded to the name of the developer as listed on the Subdivision Details Sheet.

16.19 CERTIFICATE OF ELECTRICITY SUPPLY – NO BOND PROJECT

For a project where the developer has not provided a security bond, the Certificate of Electricity Supply will be issued concurrent with the issuing of the Certificate of Acceptance.

16.20 TERMINATION OF A SUBDIVISION ELECTRICITY SUPPLY AGREEMENT

If a Certificate of Electricity Supply has been issued for a project, the Subdivision Electricity Supply Agreement may be cancelled / terminated, by the developer or by Energex if, but not limited to:

- Energex or developer revoking the Certificate for Electricity Supply (Form 1266 or 1185).
- The LGA advising Energex that the survey plans for the subdivision have not been sealed by council.
- The survey plans have not been registered on title with the State Titles Office.
- The security bond for the project shall not be released without the confirmation in writing from the local council that the Certificate for Electricity Supply has been cancelled and that the local council will not seal the survey plans for the subdivision.
- All costs incurred by Energex due to projects that are cancelled may be recovered from the security bond.
- Project being novated from the developer to another developer

16.21 RESUBMISSION AFTER THE TERMINATION OR EXPIRY OF AN OFFER OF A SESA

An offer of a SESA to the developer remains open until the expiry date has elapsed or either party has cause to terminate the offer. Should the offer of a SESA be terminated or expire then:

- All commitments made by Energex will be withdrawn.
- Re-negotiation of any Energex funded activities.
- Re-negotiation of any Energex supplied materials.
- All cost estimates to be reviewed and where required be amended.
- The design drawings shall be bought up to current standards and policy.
- A resubmission fee shall apply where a revised SESA is issued by Energex.
- Current fees and charges may be applied (e.g., switching fees)

At Energex's discretion, based on project circumstances, Energex may decide to completely cancel the project, rather than putting it on hold. Should Energex decide to cancel the project, a new Energex project number must be assigned to the project and a new design package submitted should the developer wish to proceed. The design consultant is responsible for ensuring that the design drawings for the project comply with Energex standards and policies at the time of the new submission.

16.22 PARTIAL ENERGISATIONS

Under extenuating circumstances only, the Energex Contestable Works Manager may approve the partial commissioning of the developer's works.

Energex will require the following items prior to partial commissioning:

- A written request detailing the reasons for the partial commissioning.
- The timing for ultimate completion of the reticulation works.
- Revised LV Voltage Drop calculations from the design consultant.
- Compliance with WCS 31 - Commissioning, Operating and Accessing the Network.
- The Network Signage and Labelling shall reflect the partially commissioned network.
- A completion package from the electrical contractor for the partially commissioned works.

The Energex Contestable Works team will advise in writing of the approval or otherwise of the request for partial energisation of the project. If approval is granted, a copy of the approval letter shall be forwarded to the electrical contractor undertaking the construction works. This will need to be included with the application for switching, as well as the completion package for the partially commissioned works.

Additional switching fees and additional field audit fees will be required by Energex for the works for the ultimate completion of the project and these fees shall be funded by the developer. Energex will not consider a reduction of the amount of security bond, previously provided by the developer, upon part commissioning of a project.

Energex will not issue a Certificate of Acceptance for assets energised under the partial energisation, nor take responsibility for any assets damaged prior to the issuing of the Certificate of Acceptance by Energex at the time of full completion of the project. As such, any damage to any assets remains the responsibility of the developer.

Note: Certificates of Partial Acceptance will not be issued by Energex.

16.23 DEVELOPER FAILS TO COMPLETE WORKS ARE PER THE SESA.

Where the developer fails to complete the works in accordance with the terms of the Subdivision Electricity Supply Agreement, Energex may elect to complete the electricity supply works to the subdivision. The actual cost of such work by Energex shall be recovered from the security bond, provided by the developer. Should the security bond not cover the actual cost of the Energex works, the outstanding costs incurred by Energex will be recovered from the developer.

17 UNMETERED SUPPLY CONNECTIONS IN SUBDIVISION PROJECTS

17.1 EXAMPLES OF UNMETERED EQUIPMENT

Rate 3 public lighting for the LGA or TMR installed as a part of a subdivision project.

Traffic signals, traffic cameras, telephone cabinets, NBN cabinets, 5G micro cells, Telecommunications Equipment, etc.

These items are all AS/NZS3000 types of electrical installations.

17.2 NON-CONTESTABLE CONNECTIONS

The ASP electrical contractors, constructing the subdivision project are not permitted to connect these types of AS/NZS3000 electrical installations to the Energex network. They can construct these types of installations however the ASP electrical contractor is required to lodge a EWR

(Electronic Work Request) for connection via the Energex Electrical Partners Portal. Connection to the Energex network will be made by an Energex Connections Officer.

17.3 APPLICATIONS FOR SUPPLY TO ENERGY RETAILER

It is the responsibility of the design consultant to ensure that all applications for supply are lodged with the electricity retailer. The applications for supply may be made by the design consultant on behalf of the billable customer, or the application may be made by the billable customer. In either case, it is the responsibility of the design consultant to ensure that the applications for supply have been lodged with the electricity retailer. This may involve multiple applications for supply where there are multiple (stand-alone) Rate 3 streetlights in the subdivision.

17.4 APPLICATIONS FOR CONNECTION TO SUPPLY

It is the responsibility of the ASP electrical contractor to lodge the applications for each connection via the Energex Electrical Partners Portal. There is no facility in the Energex portal for submitting one application for connection for multiple points of supply I.e. A subdivision project where there are multiple points of supply to multiple (stand-alone) Rate 3 streetlights in the subdivision.

18 TRANSFORMER EQUALISATION SCHEME

This scheme has been withdrawn and is no longer available for transformers being installed on subdivision projects. There are several legacy transformer sites previously funded by Energex under the TES in the form of a transformer equalisation payment to a developer. These sites will continue to attract a transformer equalisation payment, by the developer to Energex, until such a time as Energex has been fully reimbursed for expended TES costs.

For further information please contact the Energex Contestable Works team.

19 IMPLEMENTATION AND AMNESTY PERIOD

The implementation of this standard shall be by way of an Energex Operational Update.

The amnesty period shall be three months from the date of implementation of this standard and all design submission packages received by Energex shall conform to this new standard after expiry of the amnesty period.

Any design submission packages lodged during the amnesty period will be required to be amended to meet compliance with this new standard where any of the following has occurred:

- The amnesty period has lapsed, and a Subdivision Electricity Supply Agreement has not been requested by the developer.
- A Subdivision Electricity Supply Agreement issued during the amnesty period has not been executed by the supply agreement expiry date.
- A Subdivision Electricity Supply Agreement issued during the amnesty period has been executed by the Subdivision Electricity Supply Agreement expiry date, but construction has not commenced within six months or been completed within twelve months of the execution date of the Subdivision Electricity Supply Agreement.

20 ENQUIRIES REGARDING THIS STANDARD

For further information regarding this standard or for clarification of any items contained within the standard please contact the Energex Contestable Works team at contestable@energyq.com.au

21 CHANGES FROM PREVIOUS VERSION

Energex Contestable Works Subdivision Handbook

Document name changed from Subdivision Standards v1.0 to Subdivision Handbook v1.0

5.11 – PADMOUNT TRANSFORMER SITES / RING MAIN UNIT SITES

- minor changes

5.11.3 – RETAINING WALLS

- minor changes

5.11.5 – DOORS AND GATES

- minor changes

13.8 – SECURITY BONDS / NO SECURITY BONDS

- reduction in bond from $2,500 per lot to $1,500 per lot

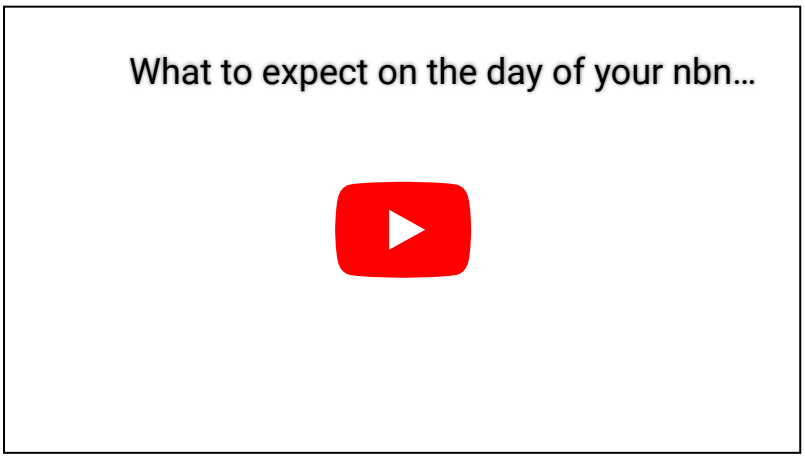
nbn® Fibre to the Node explained (FTTN)

nbn™ FTTN made easy

All types of **nbn**™ broadband access network connections that utilise a physical line running to the premises are considered Fixed Line connections. An **nbn**™ Fibre to the Node (FTTN) connection is utilised where the existing copper phone and internet network from a nearby fibre node is used to make the final part of the connection to the **nbn**™ access network.

The fibre node is likely to take the form of a street cabinet. Each street cabinet will allow the **nbn**™ access network signal to travel over a fibre optic line from the exchange, to the cabinet, and connect with the existing copper network to reach your premises.

What to expect on the day of your nbn™ Fibre to the Node installation



This video will show you how to prepare for installation day and make the most of your **nbn**™ Fibre to the Node (FTTN) connection.

PDF

nbn™ FTTN Preparing guide

Download (PDF - 2 MB)

How to help optimise your nbn™ FTTN connection at home

Make the most of your experience with the **nbn**™ broadband access network thanks to these handy tips.

Find out more

Power outage information

Talk to your provider about whether your device will work during a blackout when connected to the **nbn** access network.

Find out more

Device compatibility

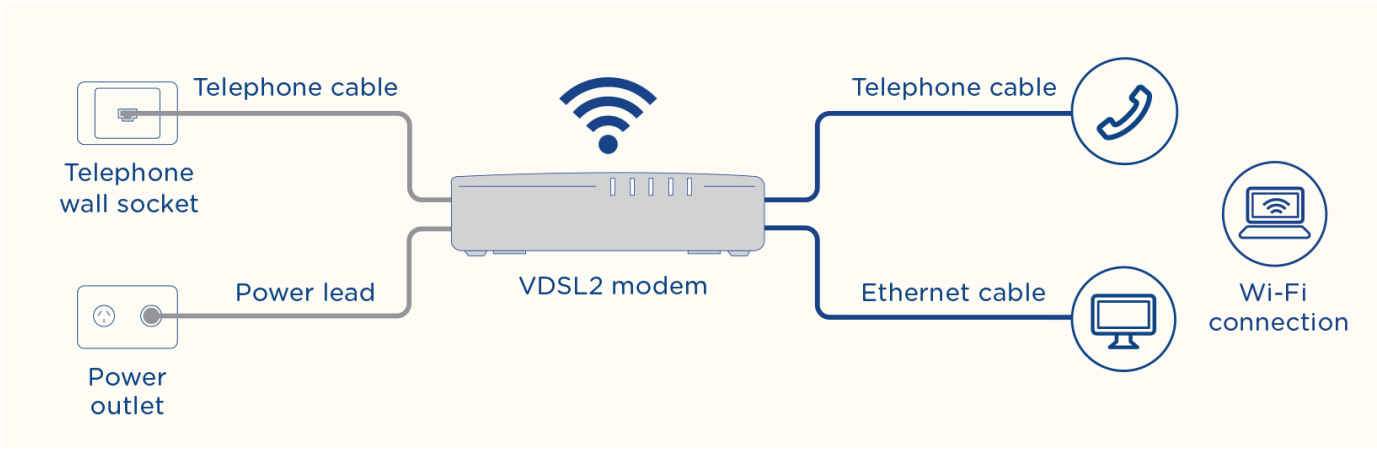
The rollout of the **nbn** access network will involve new technologies which some existing devices may not be compatible with

existing devices may not be compatible with.

Find out more

Setting up your equipment

To prepare for your new **nbn**™ powered plan, simply set up your VDSL2 compatible modem (**that should have been supplied by your internet/phone provider)** using the instructions given by your provider. If you already have a modem, it must be VDSL2 compatible for it to work over the **nbn**™ access network.



Have questions?

My order has been confirmed. What should I expect from my connection?

Will there be any equipment installed at my premises?

Is nbn responsible for installing the modem supplied by my provider?

I am renting, what do I need to do before the installation day?

When will my service be activated?

Can I continue to use my home phone service over the nbn™ broadband access network?

Will installing an nbn™ service affect my pay TV service?

Do I need to remove my ADSL filters?

What kind of speeds should I expect on my FTTN connection?

Can I remove or relocate my nbn™ supplied equipment?

Register for nbn updates

Sign up for news from **nbn** including:

- Updates about the **nbn**® network at your location
- New products and features
- Tips to help you make more of your internet experience

Property location

Next

Privacy Collection Notice

nbn is collecting your personal information to keep you informed about news and updates from **nbn.** You can choose to unsubscribe at any time. **nbn** may link your personal information to cookies and tracking pixels for improving website performance and user experience. You can access our cookie notice for more information. **nbn** uses service providers who may be located outside of Australia to carry out our work. **nbn**'s Privacy Policy sets out how we handle your personal information, how you can access or correct your personal information, or make a complaint about **nbn**'s handling of your personal information and how we will deal with your complaint.

*Although most existing services will be replaced by the **nbn** access network, there are some services that should not be impacted. These include those services provided over non-**nbn** fibre networks, some services in some apartment complexes, and some business and Special Services. **nbn** strongly recommends you contact your current phone and internet provider as soon as possible to find out if your services are impacted. You can also find out more at nbn.com.au/switchoff.

Select Language

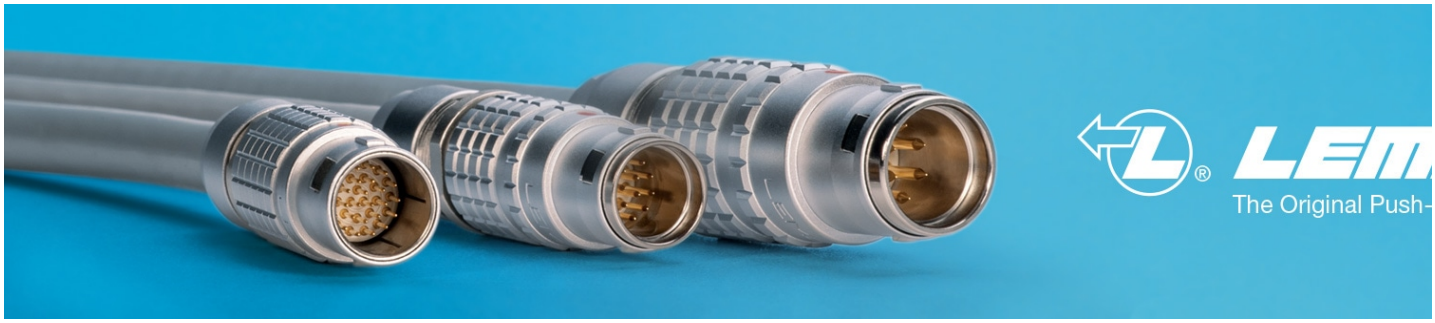
nbn acknowledges First Nation peoples and recognises their role as the Traditional Owners and Custodians of the lands and waters across Australia. We pay our respects to all Elders past, present and emerging, especially those within **nbn**, and celebrate the diversity of First Nations and their ongoing cultures and connections to this country.

nbn.com.au

Corporate

General

Support



High-speed data transfer Twisted pairs connectors
1 / 36Pages

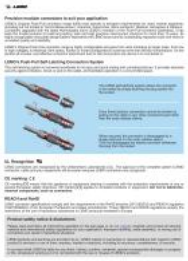
Add to favorites

Are you interested in the products in this catalog?
Request a personalized quote
Request documentation

Catalog excerpts

High-speed data transfer Twisted pairs connectors

Open the catalog to page 1



Precision modular connectors to suit your application LEMO’s Original Push-Pull connector range fulfils most specific & stringent requirements for many market segments, including but not limited to Test & Measurement, Industrial, Automotive, Semi-conductor, Medical, Aerospace & Defence. Constantly upgraded with the latest technologies since LEMO’s invention of the Push-Pull connector (patented), it has been the trusted solution to build long lasting, safe and high precision interconnect solutions for more than 75 years. Its highly recognizable chocolate design pattern represents the LEMO...

Open the catalog to page 2

High-speed data transfer introduction Equipped with more and more sensors, objects, vehicles and machines are more and more communicating with each other and with the outside world thanks to the emergence of the Internet of Things (IoT). The reliable transfer of more and more data in the shortest possible time is becoming increasingly important. High-speed data transfer can be achieved with different cable technologies, mainly twisted pairs ①, coaxial ② and fibre optic ③ cables. Environmental conditions, distance, cost and application are key decision criteria to select the appropriate...

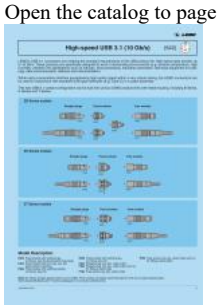
Open the catalog to page 3

LEMO High-speed data transfer connectors USB Insert configuration Proprietary interface Maximum data transfer speed 1 High speed pair 1 High speed pair Proprietary interface IEEE standard Maximum data transfer speed Number of twisted pairs Cable category

Open the catalog to page 4

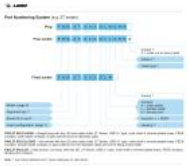
Technical characteristics Shell material Chrome or black chrome Insulator material Stainless steel or brass Shell plating Antracite nickel or chrome Male contact material Female contact material Locking mechanism Screw locking Ratchet 3/4 turn locking Mating cycles Operating temperatures (Standard) Operating temperature (Watertight or vacuumtight) Ingress protection (mated) Environment (vacuum. socket avail.) Outdoor or harsh environment Electrical performance Characteristics Data protocols / Standard Test voltage / Rated current Note: to take advantage of the increased bandwidth the data...

Open the catalog to page 6



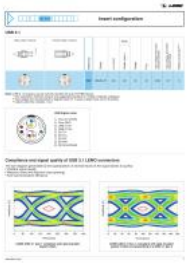
LEMO’s USB 3.1 connectors are meeting the stringent requirements of the USB protocol for High-speed data transfer up to 10 Gb/s. These products are specifically designed to work in demanding environments (e.g. extreme temperature, high humidity, vibration) for applications such as industry, food processing, industrial automation, technical equipment in buildings, data communication, defence and instrumentation. While using a proprietary interface guaranteeing high quality signal within a very robust casing, the LEMO connectors can be used in conjunction with standard USB type interfaces...

Open the catalog to page 7



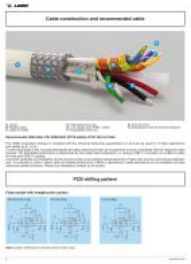
Part Numbering System (e.g. 2T series) Plug Free socket F G G . 2 T . 5 4 2 . C L A C 6 0 P H G . 2 T . 5 4 2 . C L L C 6 0 Z Variant 1): Z = collet nut for bend relief Cable ø 1) Collet type 1) Fixed socket Contact: A = male solder L = female solder N = female print Insert configuration: (page 7) FGG.2T.542.CLAC60 = straight plug with key (G) and cable collet, 2T Series, USB 3.1 type, outer shell in chrome-plated brass, PEEK insulator, male solder contacts, C type collet for 6.0 mm diameter cable. PHG.2T.542.CLLC60Z = free socket with key (G) and cable collet, 2T Series, USB 3.1 type,...

Open the catalog to page 8



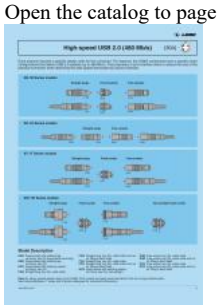
Insert configuration Test voltage (kV DC)1) Contact-contact Female solder contacts Male solder contacts Test voltage (kV DC)2) Contact-shell Note: USB 3.1 insulators can be built into the 2B, 2K and 2T (IP68) Series. 1) see calculation method, caution and suggested standard on unipole-multipole catalogue. 2) test voltage (kV) contact-shell is slightly lower for T series (values here are for B series). 3) rated current for contacts 1 & 2. Vbus 5V (PWR) Vbus GND USB 2.0 DUSB 2.0 D+ SS TXSS TX+ SS RXSS RX+ SS Drain/Shield Compliance and signal quality of USB 3.1 LEMO connectors The eye diagram...

Open the catalog to page 9



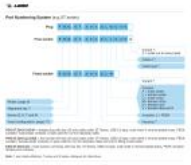
Cable construction and recommended cable A: Jacket B: Braided shield C: Cable foil shield D: High-speed wires (2x) E: Low voltage wires (PWR + GND) F: SuperSpeed wires (4x) G: Drain wire (2x) H: SuperSpeed wires foil shield (mandatory) Recommended USB cable: PIC USB3-2624 (PTFE jacket) of PIC Wire & Cable The LEMO proprietary interface is compliant with the Universal Serial Bus specification 3.1 and can be used for 10 Gb/s applications with cables up to 1.5 m. To take advantage of the increased bandwidth the data protocols provide; all components must be compatible with the respective data...

Open the catalog to page 10



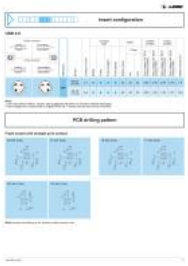
Each protocol requires a specific design rules for the connector. For instance, the LEMO connectors have a specific insert configurations that deliver USB 2.0 speeds (up to 480 Mb/s). The proprietary 4 pins interface allow to reduce the size of the physical connector while delivering the data speed demanded by several markets. 0B-1B Series models Straight plugs Fixed sockets Free sockets 0K-1K Series models Straight plugs Free sockets 0T-1T Series models Straight plugs Fixed socket Free sockets 0W-1W Series models Straight plugs Fixed socket Free sockets Vacuumtight fixed socket Model...

Open the catalog to page 11



Part Numbering System (e.g. 0T series) Plug Free socket F G G . 0 T . 3 0 4 . C L A C 4 0 P H G . 0 T . 3 0 4 . C L L C 4 0 Z Variant 1): Z = collet nut for bend relief Cable ø 1) Collet type 1) Fixed socket Contact: A = male solder L = female solder C = male crimp M = female crimp N = female print V = female elbow print Insert configuration: (page 11) FGG.0T.304.CLAC40 = straight plug with key (G) and cable collet, 0T Series, USB 2.0 type, outer shell in chrome-plated brass, PEEK insulator, male solder contacts, C type collet for 4.0 mm diameter cable. PHG.0T.304.CLLC40Z = free socket with...

Open the catalog to page 12



Print (elbow) Print (straight) Crimp contacts Test voltage (kV DC)2) Contact-shell Crimp contact Test voltage (kV DC)1) Contact-contact Solder contact Test voltage (kV DC)2) Contact-shell Contact type Test voltage (kV DC)1) Contact-contact Solder contacts Note: 1) see calculation method, caution and suggested standard on unipole-multipole catalogue. 2) test voltage (kV) contact-shell is slightly lower for T series (values here are for B series). PCB drilling pattern Fixed socket with straight print contact Note: contact numbering is for female contact version

Open the catalog to page 13

All LEMO catalogs and technical brochures

1. 

HALO LED CONNECTORS DISPLAY CONNECTION STATUS

2 Pages

2. 

unipole & multipole connectors

204 Pages

3. 

COAXIAL, TRIAXIAL, MULTI & MIXED CONNECTORS

36 Pages

4. 

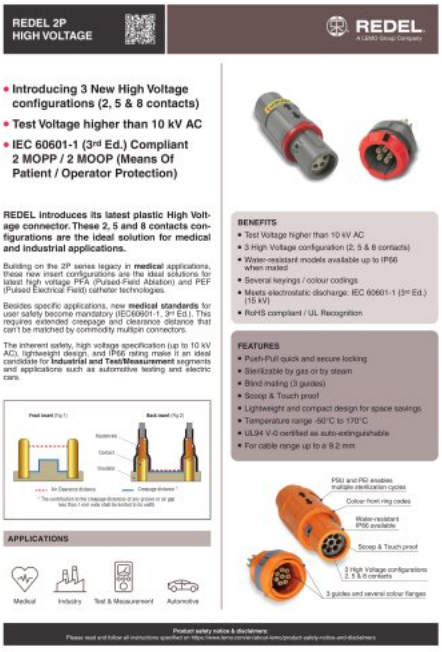
T SERIES

32 Pages

5. 

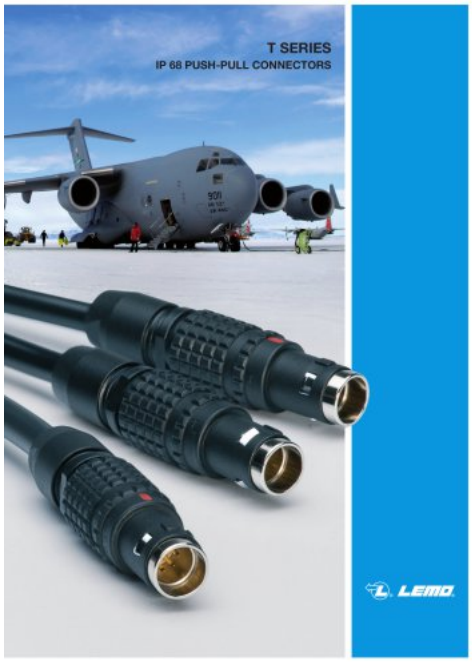
SPECIAL CABLE AND FIBRE OPTIC CABLE

50 Pages

6. 

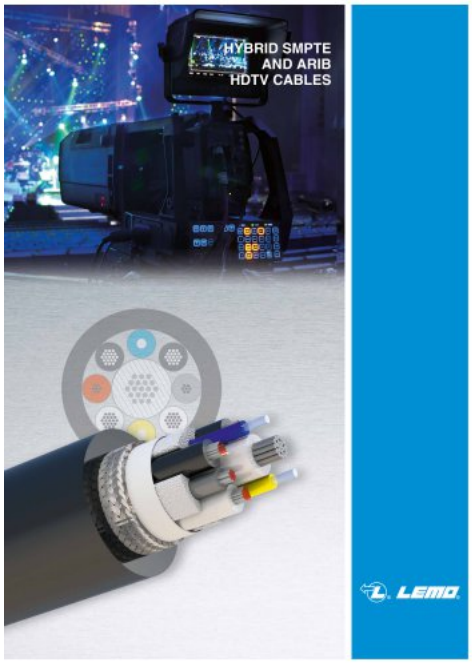
REDEL 2P High Voltage Product Brief

4 Pages

7. 

T SERIES

28 Pages

8. 

HYBRID SMPTE AND ARIB HDTV CABLES

12 Pages

9. 3K.93C.Y Series

   16 Pages

10. ETHERNET 1000 BASE T1

    8 Pages

11. 

F Series

48 Pages

12. 

R SERIES

32 Pages

13. 

REDEL P

76 Pages

14. 

V SERIES

24 Pages

15. 

W SERIES

24 Pages

16. 

2G/2C SERIES

20 Pages

17. 

SMPTE & ARIB HDTV CONNECTION SYSTEM CONNECTORS, CABLES AND MEDIA CONVERTERS

40 Pages

18. 

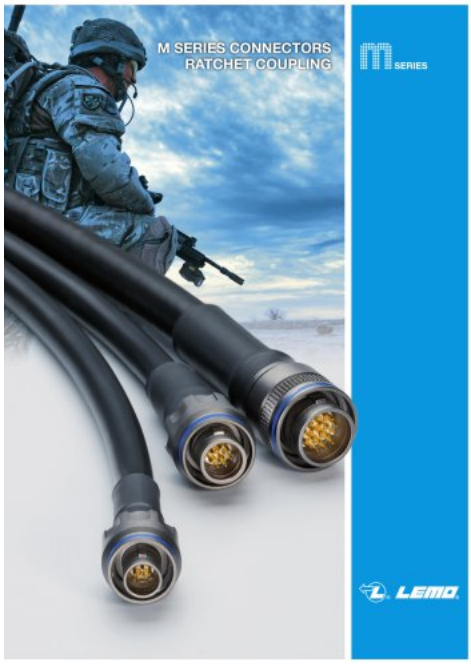
Broadcast Shack SMPTE converter

2 Pages

19. 

REDEL SP

20 Pages

20. 

M SERIES CONNECTORS

44 Pages

21. 

HIGH PRESSURE CONNECTORS

16 Pages

22. 

HALO LED CONNECTORS DISPLAY CONNECTION STATUS

2 Pages

23. 

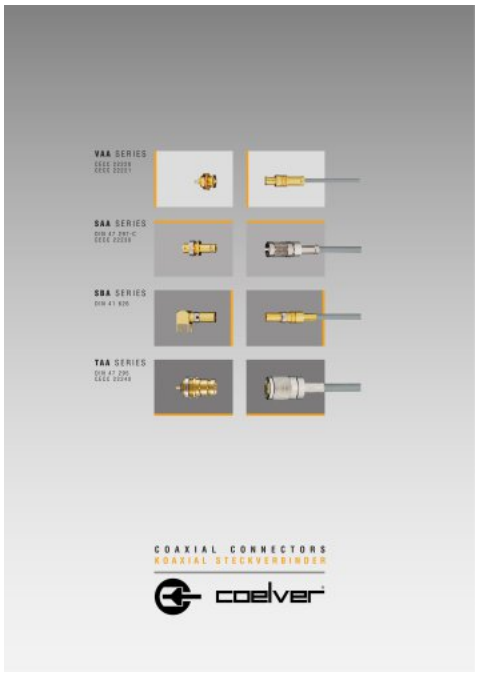
FLC, FLM AND FPG MODELS

4 Pages

24. 

compact splice tray

4 Pages

25. 

COAXIAL CONNECTORS

60 Pages

26. 

CAT 6 HIGH SPEED HARSH ENVIRONMENT CONNECTORS

4 Pages

27. 

LEMO CABLE ASSEMBLY SOLUTIONS

4 Pages

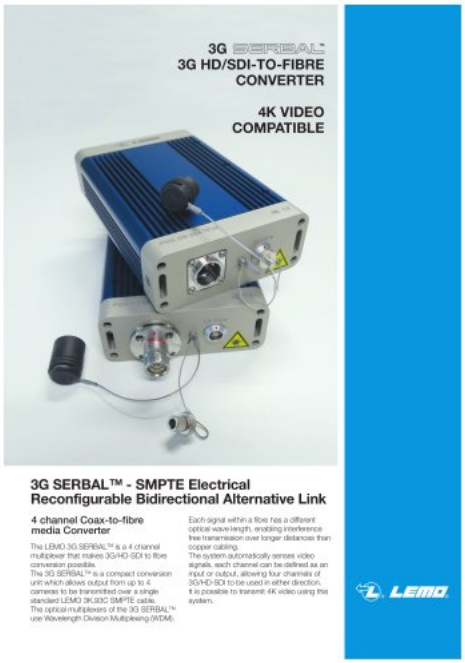
28. 

C1 SeRieS

4 Pages

29. SMPTE HYBRID ALTERNATIVE CONNECTOR KIT

    2 Pages



30. Serbal 3G

    2 Pages

31. 

PATCH PANELS AND ACCESSORIES FOR AUDIO & VIDE

2 Pages

32. 

SMPTE & ARIB HDTV CONNECTION SYSTEM CONNECTORS, CABLES AND MEDIA CONVERTERS

36 Pages

33. HD Z-LINK

    2 Pages

34. smpte 304 hdtv coNNectioN system 3k.93c.y series

    16 Pages

35. 0A SERIES PUSH-PULL CONNECTOR

2 Pages

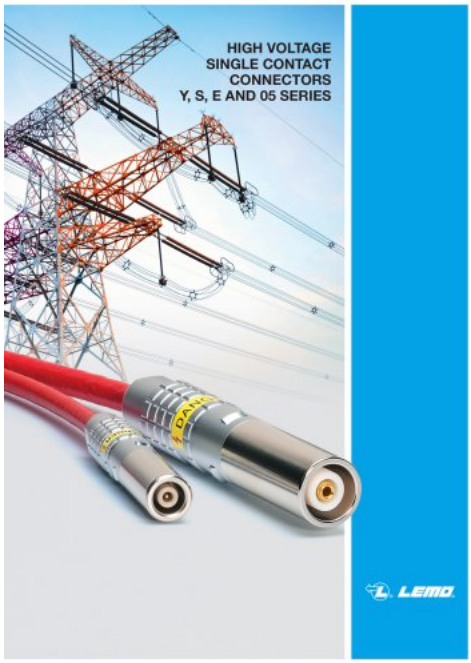
36. RIGHT ANGLE ANGLISSIMO PLUGS (IP

2 Pages

37. 

Unipole & Multipole connectors

204 Pages

38. 

high voltage single contact connectors Y, s, e and 05 series

48 Pages

39. 0A Series

    2 Pages

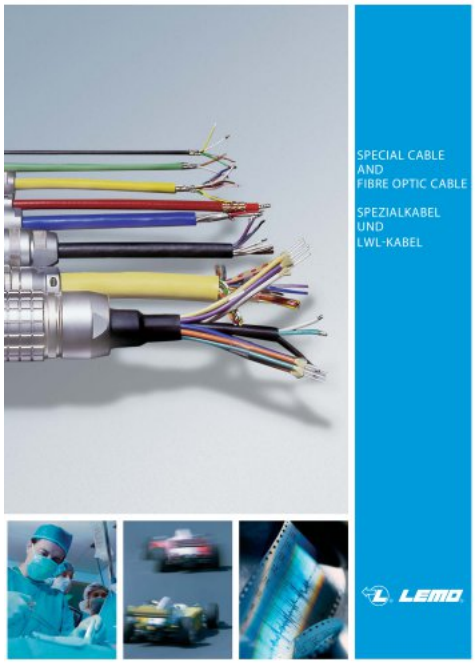
40. 75Ω/3GHz coaxial contact

    4 Pages

41. 

Coax triax mixed

36 Pages

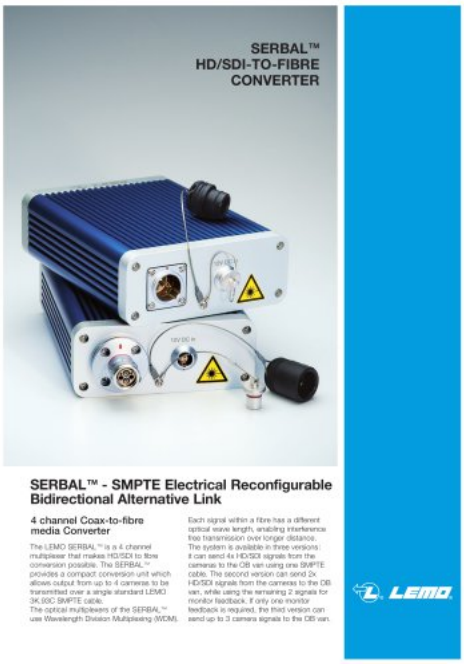
42. 

Cable special and fiber optic

53 Pages

43. Broadcast Shack SMPTE converter

    2 Pages

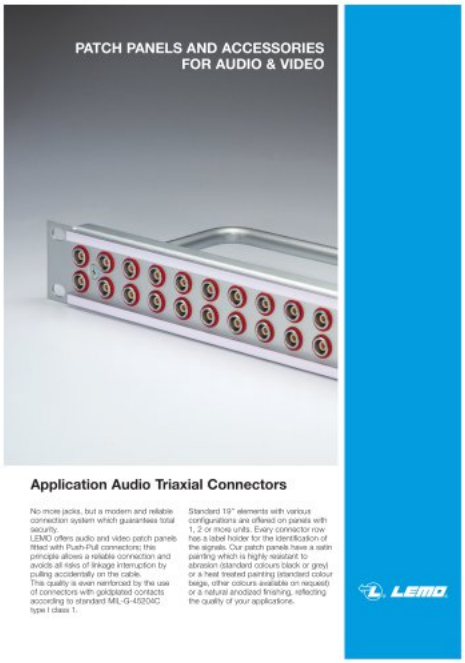


44. Broadcast Serbal

    2 Pages

45. Broadcast Patch panel 2U

2 Pages



46. Broadcast Patch panel 1U

2 Pages

47. 

Broadcast Multishack 3X

2 Pages

48. 

Broadcast HDTV - 3K.93C series - SMPTE

36 Pages

49. Broadcast Multishack

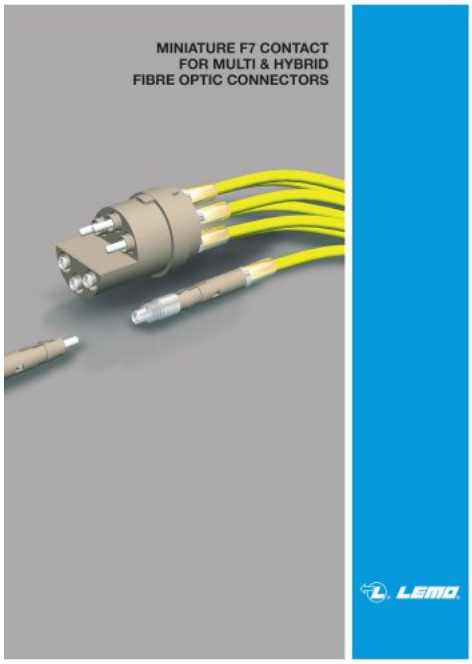
    2 Pages

50. Broadcast Meerkat

    4 Pages

51. Broadcast HD Z Link

    2 Pages



52. Broadcast F7 contact

    16 Pages

53. 

Broadcast F2 contact

4 Pages

54. 

Broadcast audio video

38 Pages

55. Broadcast 4M series triaxial connector

4 Pages

56. Broadcast 4E triaxial connector

4 Pages

57. 

B series connector - Unipole Multipole General Catalog

186 Pages

58. 

Broadcast ARIB / SMPTE cable

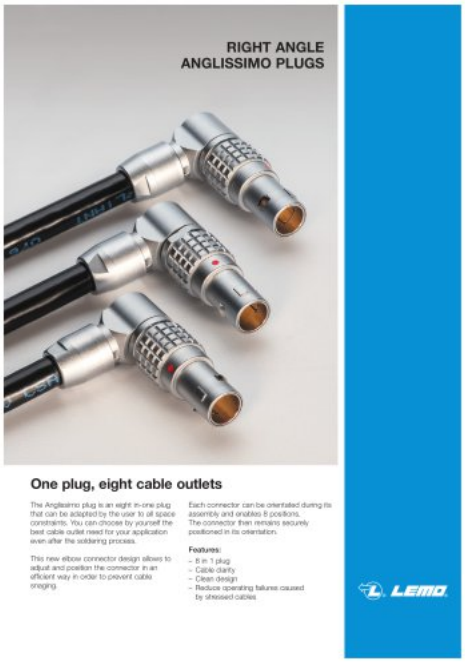
8 Pages

59. Broadcast 4A triaxial connector

    4 Pages

60. Broadcast 3T triaxial connector

    4 Pages

61. 

Anglissimo - Right Angle Plugs

2 Pages

62. 

2G series connector - Unipole Multipole General Catalog

186 Pages

63. 

2C series connector - Unipole Multipole General Catalog

186 Pages

64. 

1D series connector - Unipole Multipole General Catalog

186 Pages

65. 

Right Angle "ANGLISSIMO" Plugs

2 Pages

66. 

Coaxial catalogue

64 Pages

67. Multi concentric contact connector

    4 Pages

68. Elbow plugs

    4 Pages

69. Coaxial 3GHz

2 Pages

70. Halo LED connector

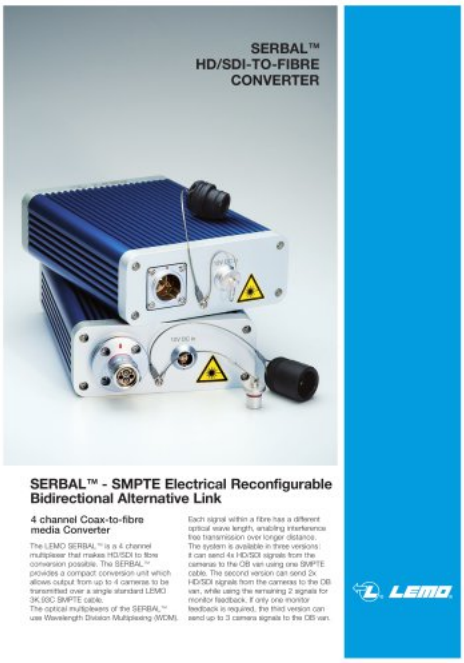
2 Pages

71. WIRES AND MULTICONDUCTOR CABLES FOR LEMO CONNECTORS

    8 Pages

72. HYBRID SMPTE AND ARIB HDTV CABLES

    8 Pages



73. SERBALTM HD/SDI-TO-FIBRE CONVERTER

2 Pages

74. SHACK: SMPTE HYBRID ALTERNATIVE CONNECTOR KIT

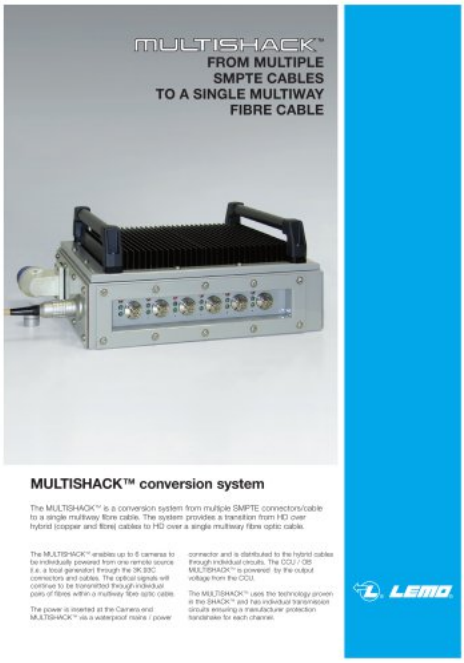
2 Pages

75. PATCH PANELS AND ACCESSORIES FOR AUDIO & VIDEO

2 Pages

76. MULTISHACK3X: FROM MULTIPLE SMPTE CABLES TO A SINGLE MULTIWAY FIBRE CABLE

2 Pages



77. MULTISHACK: FROM MULTIPLE SMPTE CABLES TO A SINGLE MULTIWAY FIBRE CABLE

2 Pages

78. MEERKAT HD: FULLY DIGITAL TRIAX-TO-FIBRE VIDEO MEDIA CONVERTER

4 Pages

79. FIBRE OPTIC LINK SYSTEM FOR VIDEO, AUDIO AND CONTROL SIGNALS

2 Pages

80. ETHERNET-TO-FIBRE MEDIA CONVERTER

2 Pages

81. 

COMPACT MULTIPOLE CONNECTORS

48 Pages

82. 

HIGH VOLTAGE CONNECTORS FOR SPECIAL APPLICATIONS

24 Pages

83. 

SMPTE COMPATIBLE HDTV CONNECTION SYSTEM 3K.93C SERIES

12 Pages

84. 

P1/P3 FLUIDIC CONTACT WITH VALVE

16 Pages

85. ANGLED-PC F8 FIBRE OPTIC CONTACT

4 Pages

86. MINIATURE F7 CONTACT FOR MULTI & HYBRID FIBRE OPTIC CONNECTORS

16 Pages

87. 

COAXIAL, TRIAXIAL, MULTI & MIXED CONNECTORS

36 Pages

88. 

TRIAXIAL CONNECTORS FOR BROADCASTING USA STANDARD 4A SERIES

4 Pages

89. 

COAXIAL & TRIAXIAL CONNECTORS FOR BROADCASTING 3T SERIES

4 Pages

90. 

SPECIAL CABLE AND FIBRE OPTIC CABLE

58 Pages

91. 

CONNECTOR SELECTION GUIDE

8 Pages

92. 

Plastic Connectors XP Series

20 Pages

93. 

Hermaphroditic Push-Pull Connectors

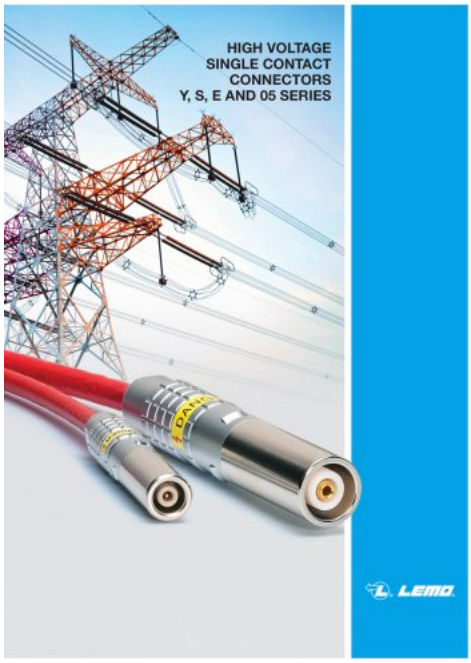
12 Pages

94. 

Unipole Multipole Catalogue

186 Pages

Archived catalogs

1. 

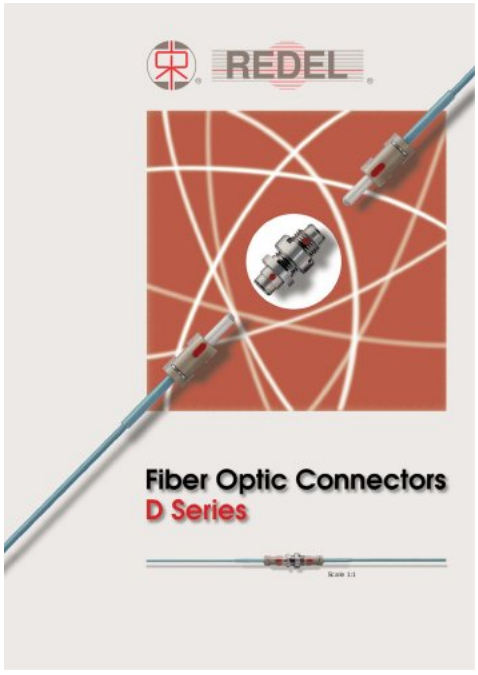
High voltage catalogue

48 Pages

2. 

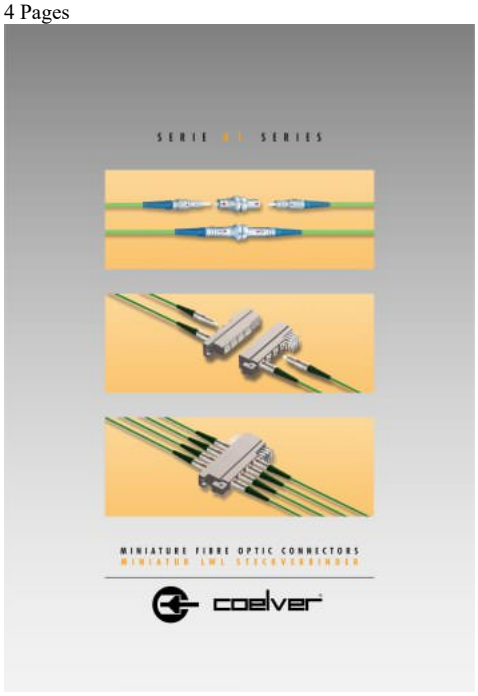
HARSH ENVIRONMENT CONNECTORS LF SERIES

4 Pages

3. 

FIBER OPTIC CONNECTORS - D SERIES

4 Pages

4. 

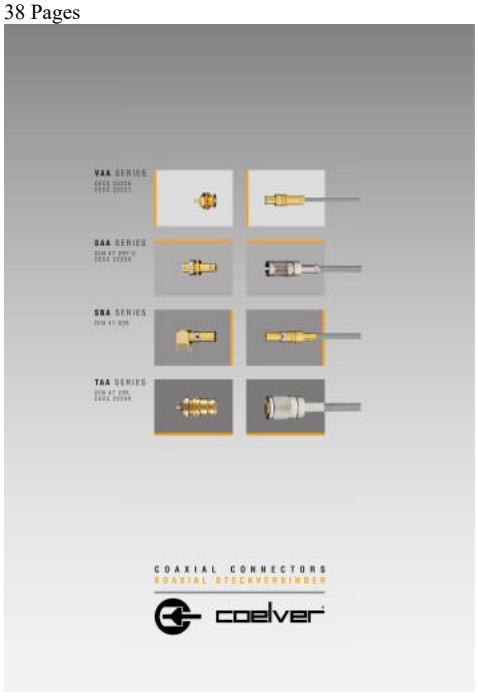
MINIATURE FIBER OPTIC CONNECTORS COELVER

9 Pages

5. 

AUDIO VIDEO

38 Pages

6. 

COAXIAL CONNECTOR COELVER

58 Pages

7. 

Plastic catalogue

76 Pages

8. 

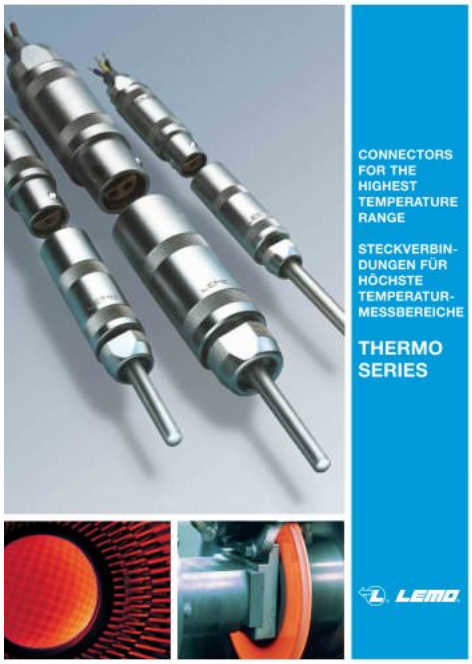
Coaxial - Triaxial - Mixed catalogue

27 Pages

9. 

Fiber Optic connector

122 Pages

10. 

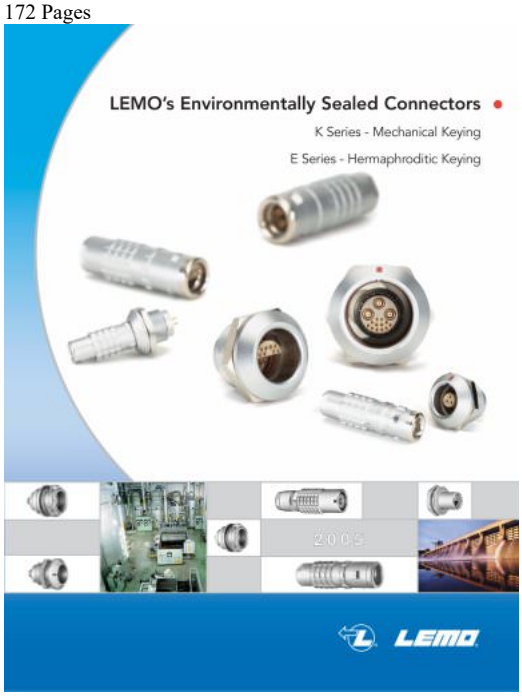
Thermocouple

52 Pages

11. 

Lemo's B & S Series Connectors

172 Pages

12. 

Lemo's Environmentally Sealed Connectors

124 Pages

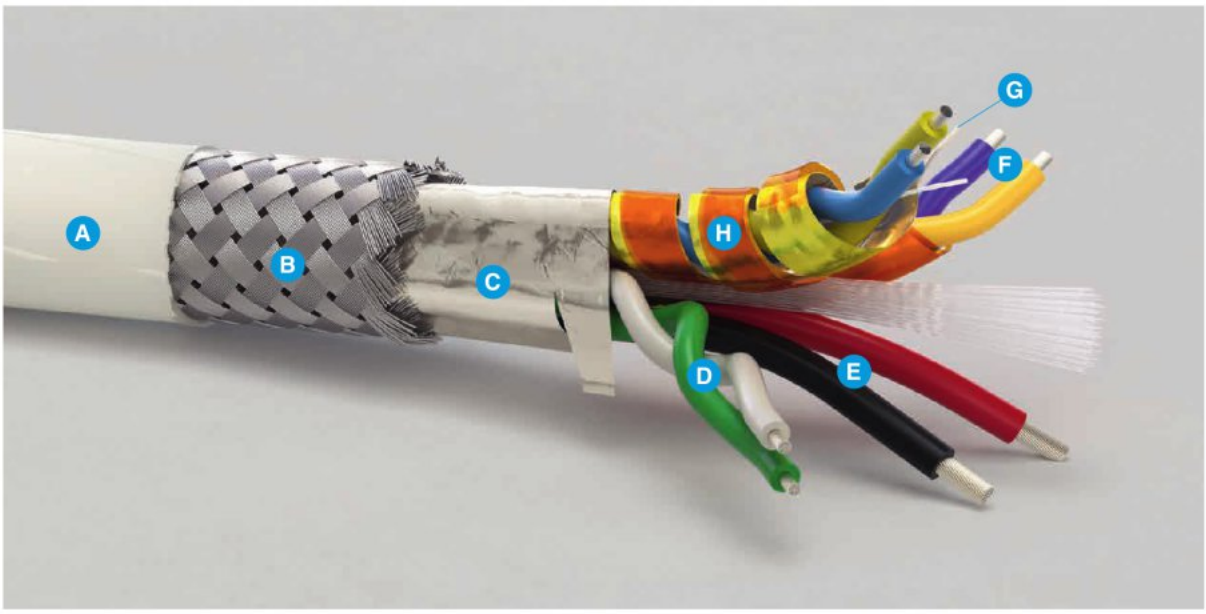
Related Searches

- LEMO electrical cable
- LEMO data connector
- LEMO electrical power supply connector
- LEMO power cable
- LEMO metal connector
- Insulated cable
- LEMO round connector
- Insulated electrical cable
- Optical cable
- LEMO plastic connector
- LEMO flexible cable
- Rectangular connector
- LEMO screw-in connector
- Female electrical connector
- Data electrical cable
- Circular connector
- Flexible electrical cable
- IP67 connector
- LEMO PVC-sheathed cable

*Prices are pre-tax. They exclude delivery charges and customs duties and do not include additional charges for installation or activation options. Prices are indicative only and may vary by country, with changes to the cost of raw materials and exchange rates.

HOW TO SOURCE PRODUCTS

Cable construction and recommended cable



A: Jacket
B: Braided shield
C: Cable foil shield
D: High-speed wires (2x)
E: Low voltage wires (PWR + GND)
F: SuperSpeed wires (4x)
G: Drain wire (2x)
H: SuperSpeed wires foil shield (mandatory)

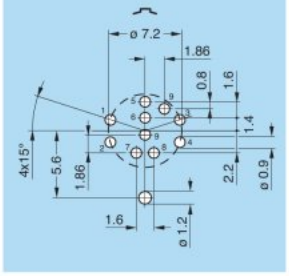
Recommended USB cable: PIC USB3-2624 (PTFE jacket) of PIC Wire & Cable

The LEMO proprietary interface is compliant with the Universal Serial Bus specification 3.1 and can be used for 10 Gb/s applications with cables up to 1.5 m.
To take advantage of the increased bandwidth the data protocols provide; all components must be compatible with the respective data protocol. The bandwidth performance is determined by the lowest rated component, i.e. wiring a USB 3.1 connector to a USB 2.0 cable will only give USB 2.0 speeds.
Connector assembly and installation should only be carried out by properly trained personnel. Proper tools must be used during installation and / or assembly in order to obtain safe and reliable performance. LEMO is specialized in cable assemblies and is available to provide wired and certified solutions. Please don't hesitate to contact us for quotes.

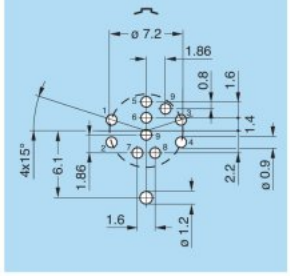
PCB drilling pattern

Fixed socket with straight print contact

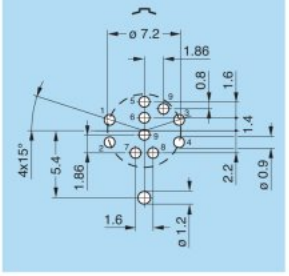
2B.542 (EA●+ EC●)



2K.542 (EA●)



2T.542 (EA●)

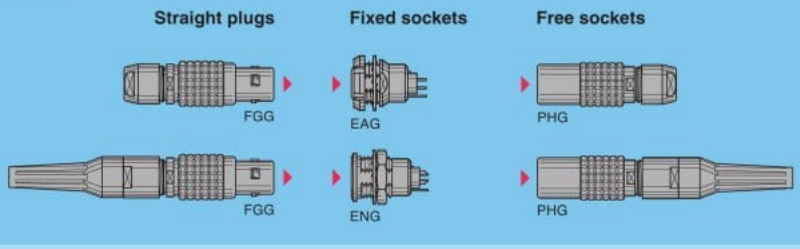


Note: contact numbering is for female contact version only.

High-speed USB 2.0 (480 Mb/s) (304)

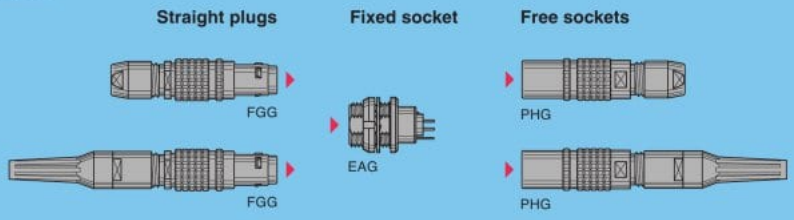
Each protocol requires a specific design rules for the connector. For instance, the LEMO connectors have a specific insert configurations that deliver USB 2.0 speeds (up to 480 Mb/s). The proprietary 4 pins interface allow to reduce the size of the physical connector while delivering the data speed demanded by several markets.

0B-1B Series models

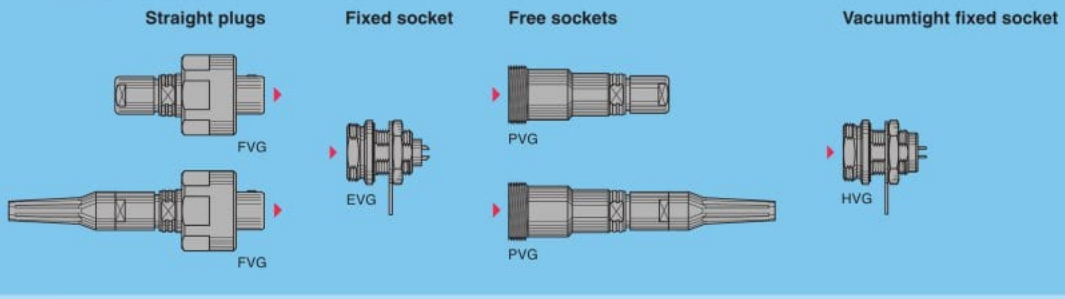


0K-1K Series models

0T-1T Series models



0W-1W Series models



Model Description

EAG Fixed socket with earthing tag, nut fixing, key (G) (back panel mounting)
ENG Fixed socket with earthing tag, nut fixing, key (G)
EVG Fixed socket with earthing washer, nut fixing, key (G)
FGG Straight plug, key (G), cable collet
FGG Straight plug, key (G), cable collet and nut for fitting a bend relief
FVG Straight plug, key (G), cable collet
FVG Straight plug, key (G), cable collet and nut for fitting a bend relief
HVG Fixed socket with earthing washer, nut fixing, key (G), vacuumtight
PHG Free socket, key (G), cable collet
PHG Free socket, key (G), cable collet and nut for fitting a bend relief
PVG Free socket, key (G), cable collet
PVG Free socket, key (G), cable collet and nut for fitting a bend relief

Note: for others models please reach out to LEMO. Print contact are highly recommended to limit risk of signal deterioration.
See Unipole-Multipole, T series and W series catalogues for connectors dimensions.

P. 1

P. 2-3

P. 4-5

P. 6-7

P. 8-9

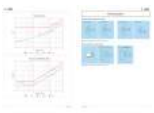
P. 10-11

P. 12-13

P. 14-15

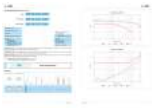
P. 16-17

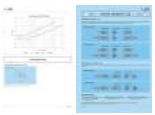
P. 18-19

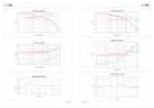


P. 20-21

P. 22-23







SERVICING SOUTH FLORIDA

BLUE WAVE COMMUNICATIONS

HORIZONTAL AND BACKBONE CABLING EXPLAINED

July 29, 2020 | Blue Wave Communications

Cable installations for computer systems and networks can be both complex and specific. Two indispensable main cabling methods used in structured cabling are horizontal and backbone cabling. These two methods make up some of the most basic components of structured cabling.

Although they are different, horizontal and backbone cabling complement each other and are necessary for different types of cabling environments and specifications.

What Does Backbone Cabling Consist Of?

Backbone cabling can be described as cabling that delivers interconnection between entrance facilities, equipment rooms, and telecommunication rooms and is usually installed from floor to floor but can also be installed between IT rooms on the same floor.

The standard backbone cable definition set by the Telecommunications Industry Association (TIA) states that:

"The function of the backbone cabling is to provide interconnections...Backbone cabling consists of the backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection. Backbone cabling also includes cabling between buildings."

Backbone wiring and cabling can be separated into two types, inter-building and intra-building cabling. While inter-building backbone wiring is installed between buildings, intra-building cabling is installed between IT rooms within a single building.

The Main Backbone Cabling Components

The essential components of backbone cabling include:

- Cable pathways to provide routing spaces for the cabling. This can include options such as shafts, raceways, conduits, or floor penetrations like sleeves or slots.
- Connecting hardware such patch panels, connecting blocks, interconnections, or cross-connections. Sometimes, connecting hardware can be a combination of these options.

What is Horizontal Cabling?

Horizontal cabling extends from a Telecommunications Room or enclosure out to the individual workstation outlets or Work Area Outlet (WAO). Generally, it is installed in a star topology that links each work area to the telecommunications room.

Copper cabling (CAT5e, CAT6, CAT6a) is the most common type used for the Horizontal runs, however, fiber optic and coaxial cables can also be used. It is important to point out that horizontal cabling, regardless of the cable type, must be limited to 90 meters in length between the Work Area Outlet and the termination point in the telecommunications room in order to meet TIA standards.

Differences Between Horizontal and Backbone Cabling

Backbone and horizontal cabling differ in the areas they cover. While backbone cabling connects entrance facilities, equipment rooms, and telecommunications rooms, horizontal cabling connects telecommunications rooms to individual outlets throughout the building's floors. Backbone cabling also runs between floors, whereas horizontal wiring should not. There are circumstances where horizontal cables for workstations on one floor may be routed to a telecommunications room on a different floor but this is not a recommended practice nor does it change the designation to "Backbone" even though the cables may run vertically.

The two structure cabling methods also have separate specifications. Though they may use the same type of cables, backbone cabling has certain requirements since it passes between floors. It must be strong enough to support its own weight and be secured correctly to pass properly between floors.

Additionally, both horizontal and backbone cabling must adhere to specific fire-rating specifications, which will vary from project to project. This is relatively straightforward for horizontal cables, but backbone cabling (and inter-building backbone, in particular) can get complicated when the cables are routed underground. It is best to check with your structured cabling contractor to make sure the correct type of cable is being used for the environment in which they are being installed.

Choosing the Right Structured Cabling Partner

Since backbone and horizontal cabling are integral components of structured cabling, it's important to have a qualified cabling contractor design and install your cabling infrastructure. A substandard design and a poor installation job can cause a plethora of inconvenient and expensive problems down the road for your business.

Blue Wave Communications has been a trusted cabling contractor for designing and installing high-quality structured cabling systems with years of experience helping customers throughout the South

SERVICING SOUTH FLORIDA

BLUE WAVE COMMUNICATIONS

Subscribe to Our Blog

Email*

Subscribe

SERVICING SOUTH FLORIDA

SERVICING SOUTH FLORIDA

SERVICING SOUTH FLORIDA

BLUE WAVE COMMUNICATIONS

Blue Wave Communications | June 24, 2020

The Most Shocking IT Room Cable Management Transformations

The IT room is an essential part of an organization's infrastructure. It could take the form of a telecommunications room or any space with ...

Read More

Blue Wave Communications | August 7, 2019

Blue Wave Communications: A Different Low Voltage Cabling Contractor

One of the problems with low voltage cabling in Florida, and probably throughout the country, is that the cabling is being treated more and more like ...

SERVICING SOUTH FLORIDA

BLUE WAVE COMMUNICATIONS

STRUCTURED CABLING

SECURITY

NURSE CALL

AUDIO/VISUAL

WIRELESS SYSTEMS

RESOURCES

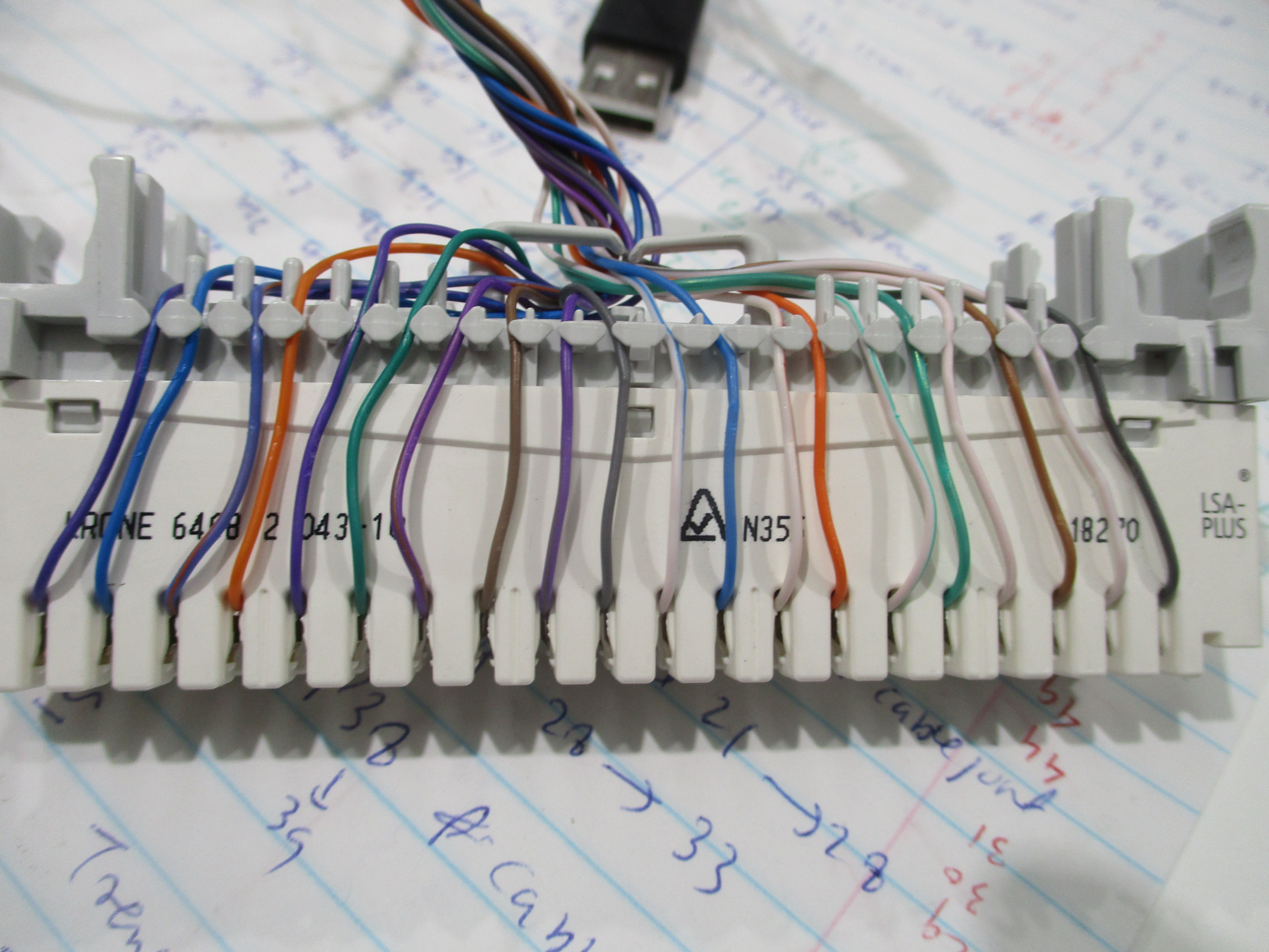
CONNECT WITH US

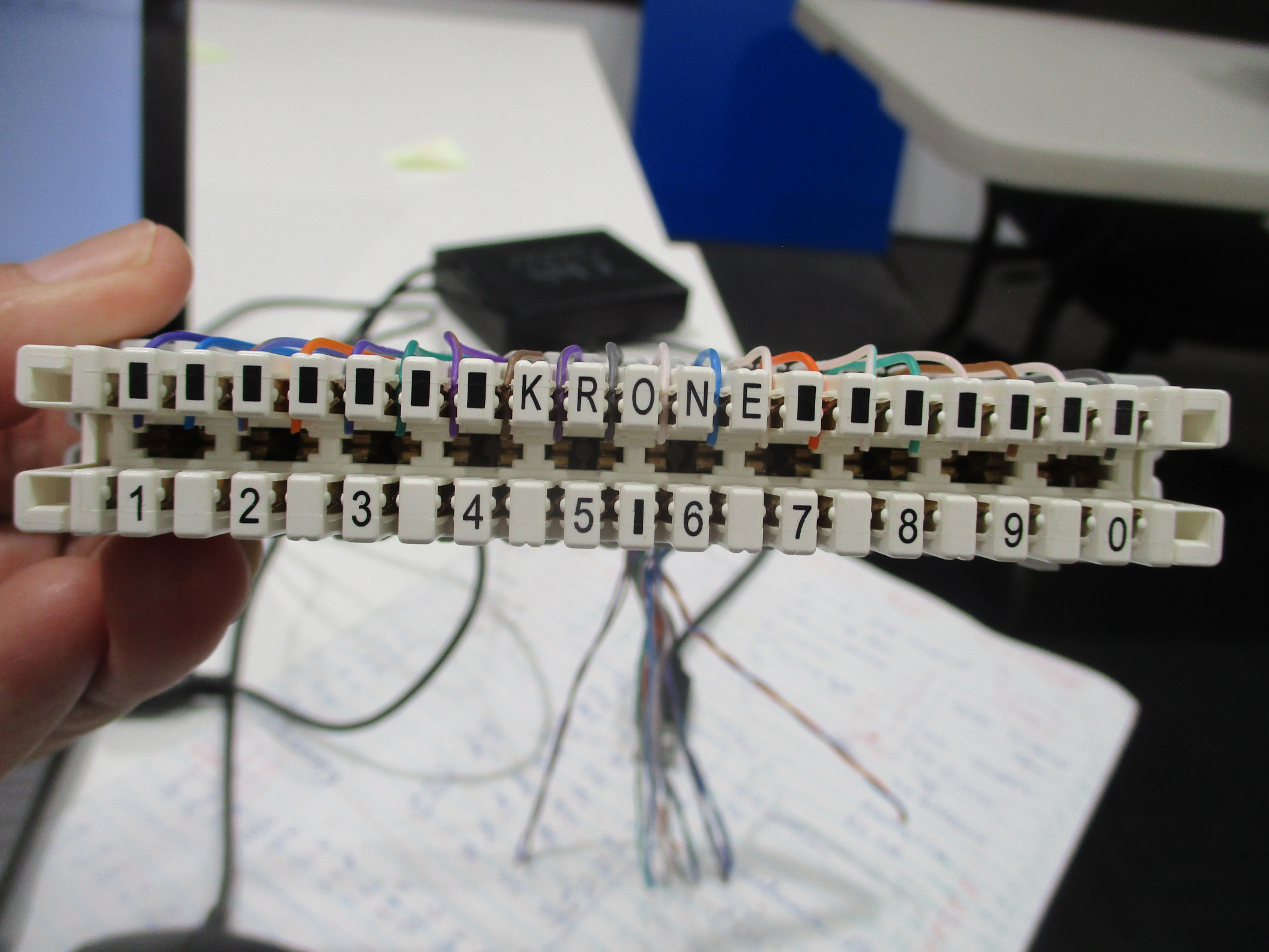
Follow Us On:

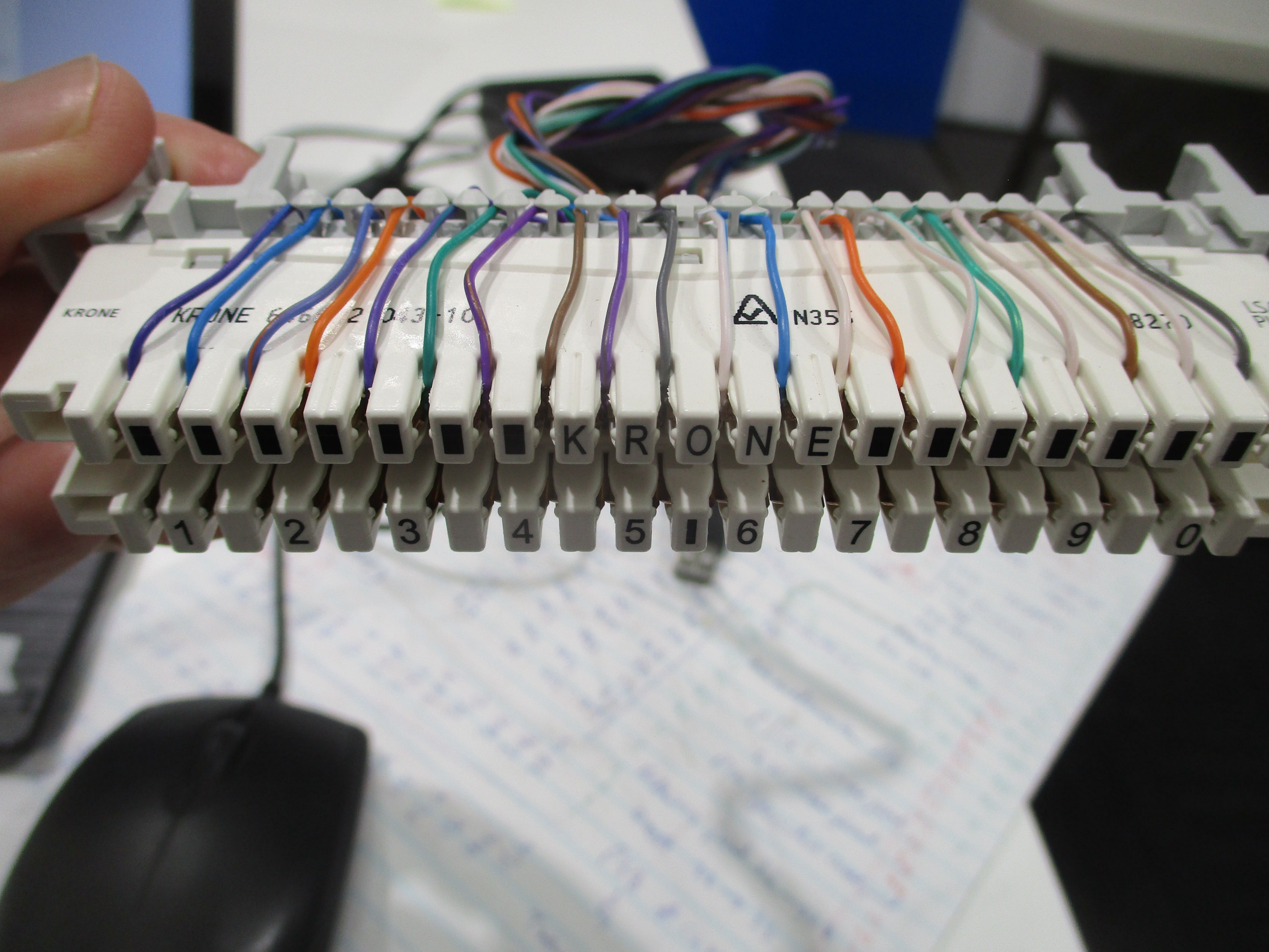
Facebook

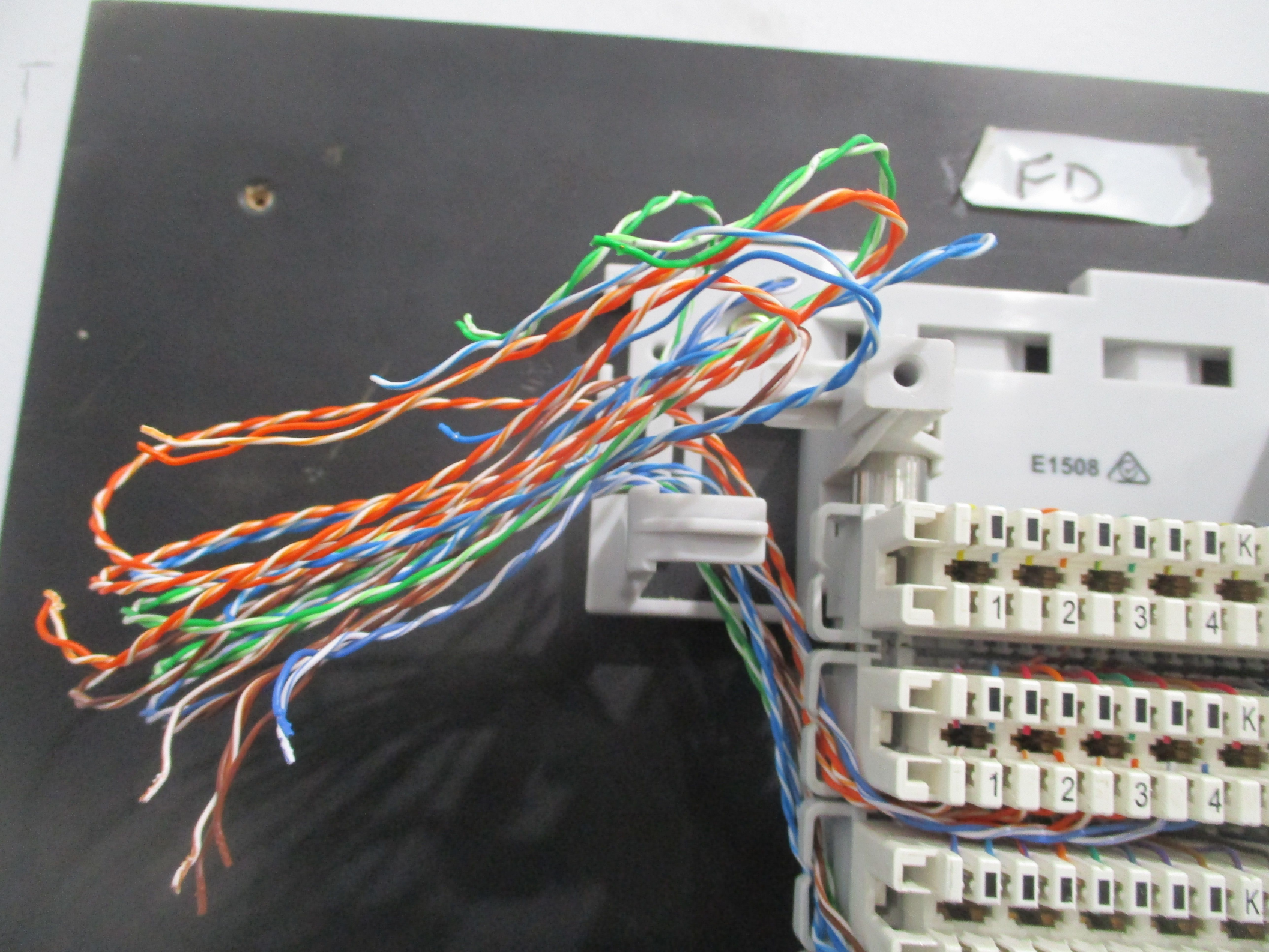
LinkedIn

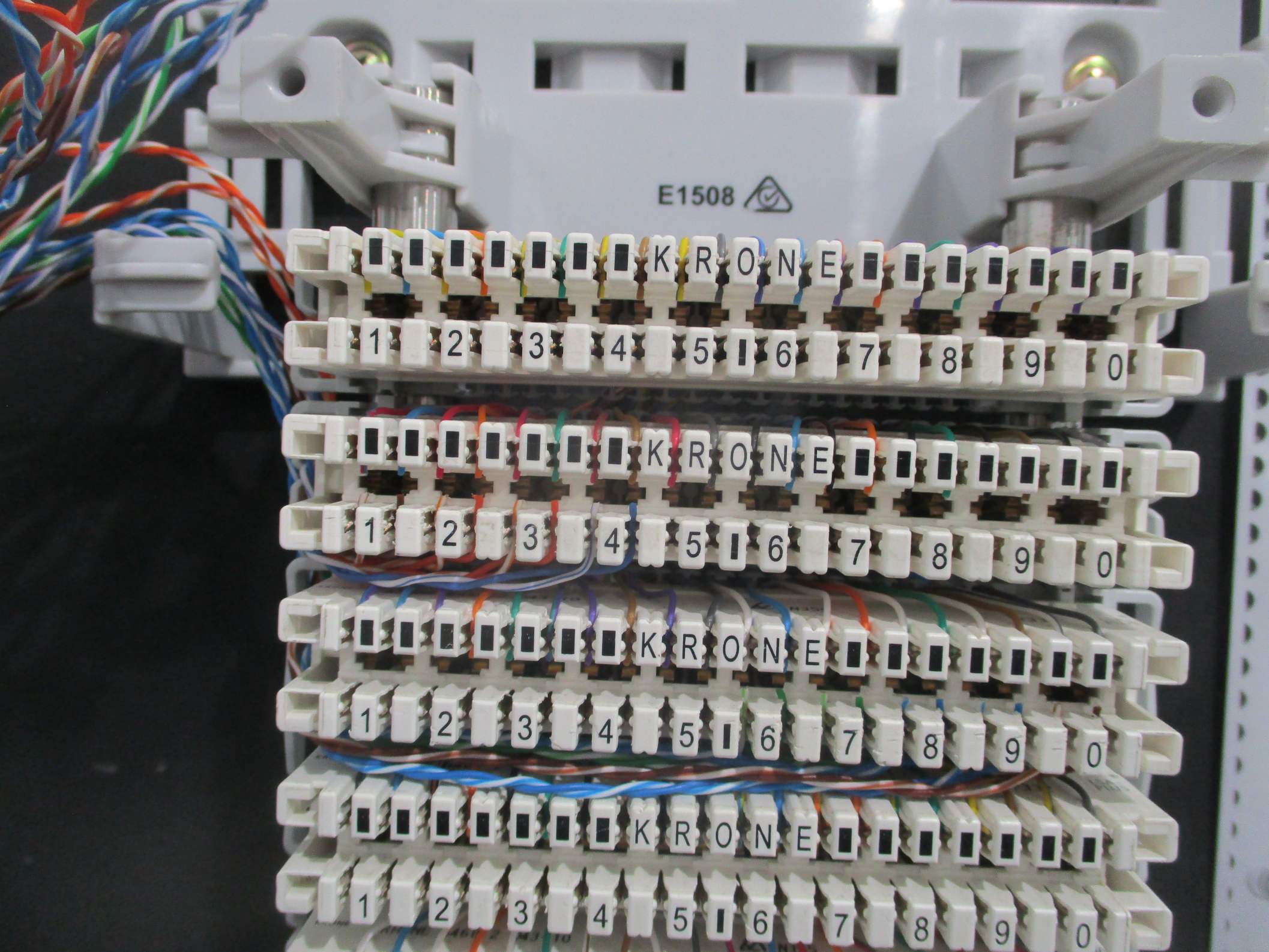
Instagram


LSA-
PLUS


KRONE
1 2 3 4 5 6 7 8 9 0


KRONE
KRONE
K R O N E
1 2 3 4 5 6 7 8 9 0


FD
E1508
K
1
2
3
4
K
1
2
3
4
K


E1508
KRONE
1 2 3 4 5 6 7 8 9 0
KRONE
1 2 3 4 5 6 7 8 9 0
KRONE
1 2 3 4 5 6 7 8 9 0
KRONE
1 2 3 4 5 6 7 8 9 0

CORNING

Installation of Corning Optical Communications Self-Supporting (Figure-8) Aerial Cable

P/N 005-026
Issue 11

Table of Contents

1. General

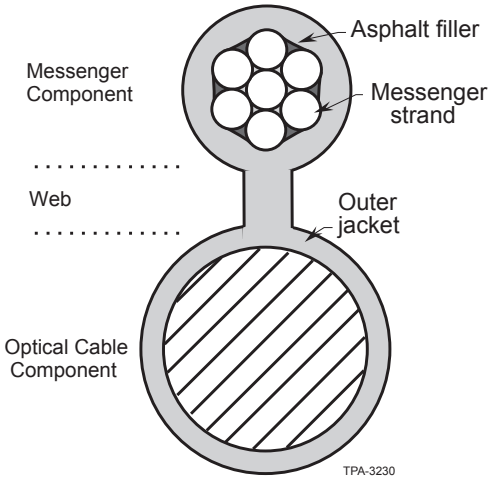
Corning Optical Communications self-supporting (figure-8) optical fiber cable greatly simplifies the task of placing fiber optic cable on an aerial plant. It incorporates both a steel messenger and the core of a standard optical fiber cable into a single jacket of figure-eight cross-section. The combination of strand and optical fiber into a single cable allows rapid one-step installation and results in a more durable aerial plant.

This procedure provides general guidance for the installation of self-supporting cable. It is not intended to be a comprehensive summary of the steps and procedures required for successful placement, as each installation will be influenced by local conditions. It is assumed that the reader is experienced in aerial cable placement.

This procedure contains references to specific brand-name tools in order to illustrate a particular method. Such references are not intended as product endorsements – other manufacturer's equivalent tools can be used.

Definitions

Because of the nature of self-supporting cables, this practice employs terms in ways with which the reader may be unfamiliar.



These are defined below:

CABLE refers to the entire figure-8 product including the messenger and cable components.

MESSENGER COMPONENT and CABLE COMPONENT describe the two halves of the figure-eight cable.

DEAD-END POLE is a utility pole on which the messenger component is tensioned and terminated into a dead-end fixture.

MESSENGER SPAN refers to the length of continuous messenger component tensioned between two dead-end poles.

INTERMEDIATE POLES are those between dead-end poles where the cable is supported in tangent clamps.

2. Safety Precautions

This section discusses some basic safety considerations applicable to aerial cable installations. This section is not intended to provide a comprehensive guide to safety pre-cautions and not all items mentioned will apply to every installation. In all cases, your company's procedures and precautions should take precedence over the recommendations in this document.

CAUTION: Before starting any aerial cable installation, all personnel must be thoroughly familiarized with all applicable Occupational Safety and Health Administration (OSHA) regulations, the National Electrical Safety Code (NESC), state and local regulations, and your company safety practices and policies. Failure to do so can result in life-threatening injury to employees or the general public.

WARNING: To reduce the chance of accidental injury:

- Before work begins, all personnel must be thoroughly familiar with the operation of all equipment and procedures to be used during the installation.
- Before use, all equipment, especially safety gear, must be inspected and tested for proper operation. Replace or repair as necessary.
- Arrange or secure any loose articles to be taken aloft so that they cannot fall.
- Personnel going aloft must wear a safety harness or body belt and safety strap at all times. Additional safety gear, including insulated or lineman's gloves, eye protection, hard hats, and other protective clothing should be worn as necessary.
- Before climbing a pole, it should be inspected for significant deterioration, insect nests, and other potential safety hazards. If work near power lines is required, appropriate caution should be exercised.
- Read the entire procedure before starting a figure-eight cable installation. Thoroughly understand the procedure, its precautions, and the tools and equipment required before starting work.

WARNING: Never look directly into the end of a fiber that may be carrying laser light. Laser light can be invisible and can damage your eyes. Viewing it directly does not cause pain. The iris of the eye will not close involuntarily as when viewing a bright light. Consequently, serious damage to the retina of the eye is possible. Should accidental eye exposure to laser light be suspected, arrange for an eye examination immediately.

3. Cable Handling Precautions

CAUTION: Fiber optic cable is sensitive to excessive pulling, bending, and crushing forces. Consult the cable specification sheet for the cable you are installing. Do not bend the cable more sharply than the minimum recommended bend radius. Do not apply more pulling force to the cable than specified. Do not crush the cable or allow it to kink. Doing so may cause damage that can alter the transmission characteristics of the cable; the cable may have to be replaced.

Maximum Pulling Tension

3.1. The maximum tension at which figure-8 cable can be pulled depends on whether the force is applied to the messenger or cable component. Both of these figures are listed on each cable's specification sheet.

MAXIMUM PULLING TENSION (MESSENGER): Because of its unique construction, figure-8 cable can be pulled by its messenger component at much higher tensions than typical fiber optic cables. For standard figure-8 cable, this figure is 2,000 lb_F (9000 N).

MAXIMUM PULLING TENSION (CABLE): When pulling force is applied to the cable component (as in the case of duct installations as described in Section 10), figure-8 cable has a lower maximum pulling tension than standard cables. For standard figure-8 cable, this figure is 450 lb_F (2025 N).

Exceeding the maximum tension when pulling by either component risks severe damage to the cable. Methods of attaching the pull-line to either component are discussed in Section 6. If the cable is to be pulled mechanically, use of a tension-limiting device or a breakaway swivel in the pull-line is recommended. Avoid surges and jerks during pulling by using properly adjusted reel brakes.

Maximum Installation Tension (Span Tensioning)

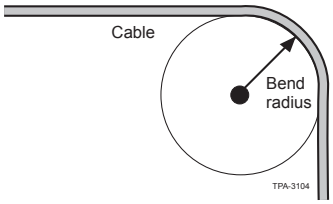
3.2. The maximum tension at which figure-8 cable can be installed for a given span length may be determined from your company's standard engineering practices for self-supporting copper cable taking into account the appropriate size strand and cable weight. Please contact Corning Optical Communications Engineering Services at 1-800-743-2671 only for sag and tensioning requirements for special applications.

Minimum Bend Radius

3.3. Corning Optical Communications cable specification sheets also list the minimum cable bend radius both "Loaded" (during installation) and " Installed" (after installation). If these sheets are not available on the job-site, the following formulas may be used to determine general guidelines for installing Corning Optical Communications fiber optic cable; however refer to the cable specification sheet for the listed minimum bend radius:

From GR-20 and ICEA-640: Minimum Bend Radius Requirements			
Operation		Installation	
MBD	20 x OD	MBD	40 x OD
MBR	10 x OD	MBR	20 x OD
If MBR > 216 fibers			
MBD	30 x OD	MBD	40 x OD
MBR	15 x OD	MBR	20 x OD
NOTE: *Corning® RocketRibbon™ extreme-density cable (1728- and 3456-fiber) exceeds these requirements.*			
Operation		Installation	
MBD	30 x OD	MBD	30 x OD
MBR	15 x OD	MBR	15 x OD

Example: To arrive at a working bend radius for cable installation, multiply 15 times (15 x) the cable outside diameter.



Cable Diameter = 0.46 in (11.8 mm)

15 x 0.46 in = 6.9 in (177 mm)

Minimum Working Bend Radius = 6.9 in (17.7 cm)

2 x 6.9 in cm=
13.8 in (35.4 cm)

To find the minimum diameter requirement for pull wheels or rollers, simply double the minimum working bend radius:

Rated Crush Strength

3.4. The rated crush strength for each type of figure-8 cable is stated on its respective cable specification sheet. For standard armored and non-armored figure-eight cables, the maximum rated crush strength is 220 N/cm.

Uncontrolled Twisting

3.5. Uncontrolled twisting can damage any fiber optic cable. To prevent such damage during a pull, place a pulling swivel between the pull-line and the pulling grip (see Step 6.7). Whenever a cable is unreeled for subsequent pulling, figure-eight the cable as outlined in Steps 5.2 through 5.5.

NOTE: *Check with the manufacturer for load variation on the breakaway swivel. This must be taken into consideration so that the maximum tension for the cable is not exceeded.*

Equipment Inspection

3.6. All equipment to be used during handling and installation should be inspected for features which might damage the cable. Examples of dangerous features are nails, broken flanges on cable reels, and damaged blocks.

Cable Care And Inspection

3.7. Leave cable reel lagging, the protective boards nailed between the flanges of the reel, intact until the reel arrives at the installation site. Upon removal of the lagging, inspect the cable jacket for signs of damage. If the lagging has been previously removed, secure the cable end(s) during transit to prevent damage. Cable reels should be stored vertically on their flanges and chocked to prevent rolling.

3.8. Refer to Applications Engineering Note 165 Cable Handling: Squirting, Tangling, and Storage for proper storage methods and what to do prior to installation.

3.9. Determine if your company requires that the cable be tested for optical continuity prior to installation. These tests can be done with an Optical Time Domain Reflectometer (OTDR).

3.10. Do not, under any circumstances, make unplanned cuts in the cable. Unplanned cuts mean additional splices, which are costly in monetary and attenuation terms. Any departure from the planned installation should be approved by the construction supervisor.

4. Planning and Preparation

4.1. Prior to beginning an aerial cable installation, careful planning and preparation are necessary. Representatives of each organization potentially affected by the installation (utilities, street department, police, etc.) should be present during the route survey. Approval by all necessary parties should be secured before detailed planning begins. A few of the issues to be considered are listed in the following paragraphs. Planning should be undertaken jointly by construction and engineering personnel. Hardware requirements should also be considered at the planning stage.

Route Selection And Planning

4.2. Installation costs will be minimized by using existing poles whenever possible. The ability of existing poles to accept new figure-8 cable and the need for modification should be determined using your company's normal criteria for installing an additional cable with a dedicated messenger. Ideally, the guying of the cable plant should remove all lateral stress, leaving the poles to support only the weight of the cable and associated hardware. Sufficient clearance for new cable along the right of way should be confirmed during the route survey.

Cable Placement

4.3. Several factors should be considered when deciding where on a pole to place figure-8 cable. Like other fiber optic cables, figure-8 cable weighs less than equivalent copper cables and will tend to sag less over a given aerial span. Because of this, it should occupy the uppermost available communications space on a pole in order to maintain adequate clearance.

4.4. On joint-use poles, care must be taken to ensure sufficient clearances between figure-8 cable and electrical power and other cables. The necessary clearance should be determined on a case-by-case basis by referring to the current NESC, appropriate local codes and your company's standards.

WARNING: Notwithstanding the fact that NESC spacing is observed, there is still a danger of flashover (arcing) from a power line to the metallic messenger which may cause electrocution to installers of the cable. A safety meeting should be held between all involved parties to discuss a plan of action concerning the proper clearances required to ensure a safe outside plant installation.

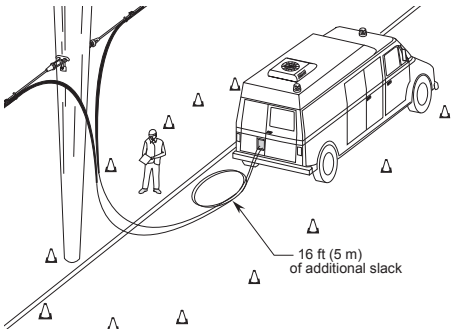
Installation Planning

4.5. Planning the actual installation should take place only after a thorough route survey. The installation method to be used will be largely dictated by the cable route. Both the moving reel (drive-off) and stationary reel methods of aerial cable installation are outlined in this procedure, as well as conditions requiring use of one, the other, or both. Duct and direct burial installation are also discussed. With the proper hardware, any of these methods can be used to install figure-8 cable.

4.6. Examine the ability of existing dead-end poles to withstand the temporary stresses of installation. Because it is impossible to tension each of the messenger spans along the route simultaneously, a dead-end pole will be subjected to an unbalanced load as the messenger is tensioned on one end of the cable run before the other. This temporary unbalanced loading can be relieved by temporary guy wires where required. Determine whether temporary guying is needed according to your company's standard route engineering guidelines.

Splice Locations And Cable Slack Requirements

4.7. Select splice locations during the route survey and make plans for slack and splice closure storage. Splice locations should be placed to allow for the longest possible continuous cable spans and a minimum number of splices. The splice points should be chosen to facilitate the later splicing operation and should be easily and conveniently accessible to a splicing vehicle.



4.8. The amount of slack cable component at each splice point must be sufficient to reach from the pole's height to the planned splicing vehicle location on the ground. An additional 16 ft (5 m) should be added onto this figure to allow for closure requirements. This slack should be allowed for when planning the route and ordering cable. Leave sufficient slack at each future drop point to allow for splicing.

4.9. Because of its configuration, figure-8 cable is not well suited to the use of "repair" slack. Movement of slack along the pole line is discussed in Section 9, which describes how to make emergency restorations of damaged figure-8 cable.

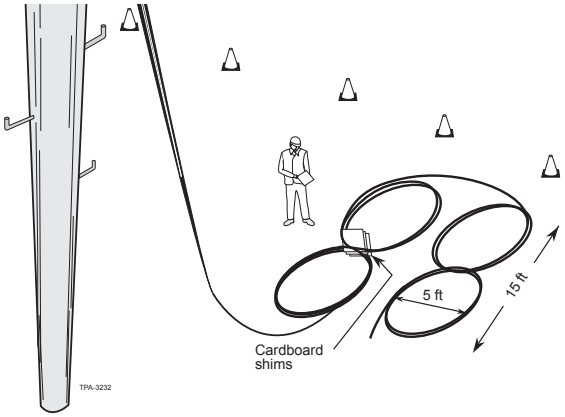
5. Figure-8 Cable Aerial Plant

5.1. This section provides a general overview of the elements of an integrated messenger aerial plant installation:

- Figure-eighting cable
- Separating figure-8 cable components
- Dead-ends
- Grounding requirements
- Support hardware types and installation
- Cable twist
- Slack storage
- Splice closures
- Slack spans

Figure-Eighting Cable

5.2. Whenever cable is unreeled for subsequent pulling, it should be coiled in a figure-eight configuration as shown. This procedure will prevent damage due to twisting of the cable. The figure-eight coil should measure at least 15 ft (4.5 m) by 5 ft (1.5 m) and be protected from passersby.



5.3. When long lengths of cable need to be unreeled, there is a danger that the weight of the figure-eight coil may damage the cable on the bottom. This can be prevented by adding support shims at the crossover to

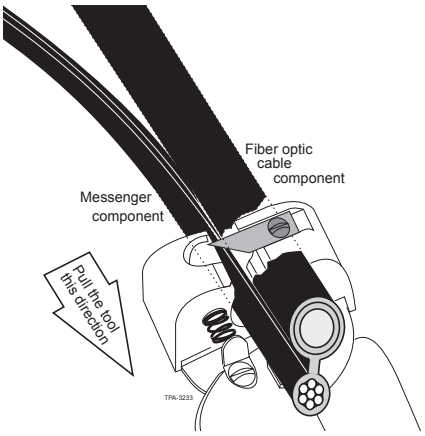
spread the weight out (cardboard works well) or by spreading the cable out into several figure-eight coils as shown.

5.4. In order to pull from a figure-eight coil, it is sometimes necessary to turn it over to expose the cable end. This task usually requires at least three persons, one at the center and each end.

5.5. Figure-eighting can be used in order to pull in both directions from a central location or to make a transition from the moving reel (drive-off) installation method to the stationary reel installation method. This makes it is possible to use the relatively quick and uncomplicated moving-reel technique on that portion of a cable route accessible by vehicles and the more involved stationary reel method where vehicle access to the pole line is not possible.

Separating Figure-8 Cable Components

5.6. Figure-8 cable components must be separated for splicing and termination operations. While short lengths of figure-eight cable components may be separated by scoring the web with a cable knife and pulling the two components apart, this task is made easier and safer for both the cable and personnel by using a web-splitting tool (General Machine Products® model # 82730 Web Splitter, or equivalent).



5.7. To use the tool, place the pliers-based device over the messenger component with the blade penetrating the cable web. Pull it along the cable to cut the web. Long lengths [e.g., 500 ft (150 m) or more] of cable can be separated easily with this tool.

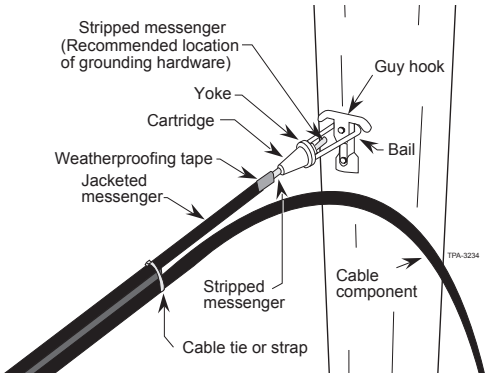
Dead-ends

5.8. Dead-end poles are the anchor points for a tensioned messenger span. The messenger strand is terminated into dead-end fittings which engage pole fixtures and maintain the tensile loading of the span. This procedure describes two basic types of dead-end fittings, strandvises and strand grips (wrap type).

Strandvise Dead-end

5.9. The strandvise type dead-end uses a spring-type compression sleeve to grip the bare messenger strand. This sleeve cartridge attaches to the yoke and bail to produce a fitting which can be hung on guy hooks.

NOTE: *A key arrangement in the side of the cartridge sleeve allows removal of the messenger from the strandvise. The bail and yoke can be reused, but the used cartridge should be discarded. If applicable, ensure that your company's policy concerning dead-end and pole line hardware in corrosive environments such as coastal areas are followed.*



5.10. Prepare the dead-end pole by installing the guy hook. To install a strandvise dead-end on a figure-8 cable:

a. Determine and mark the point where the strandvise will be mounted on the figure-8 cable's messenger component:
   - If you are installing the dead-end at the end of a cable span or providing slack for a future splice point (e.g., prior to beginning a moving reel installation) allow for the appropriate slack requirements.
   - If the dead-end is being assembled on a tensioned cable at its installation level, ensure that the span is properly tensioned according to Section 8. Provide support to the cable extending beyond the dead end location to prevent damage from bending and or tensioning to the cable component once the messenger is cut.

b. Separate the two cable components with a web splitter or cable knife, starting about 11 in (27.5 cm) before the point where the messenger will enter the strandvise. The component separation lengths may vary with the strandvise type and are best determined by holding the strandvise you are using alongside the cable.

c. Determine the messenger component strip length required to fit both the messenger component into the strandvise and provide sufficient length for a bonding/grounding clamp to bond/ground the exposed end(s) of the strand. At least 3 in (7.5 cm) of stripped messenger should extend out of the strandvise. Cut the messenger strand to length with a pair of bolt cutters.

d. Strip the jacket from the messenger component by running a cable knife along the strand, removing a strip of the jacket. Pull the remaining jacket away from the strand. Use care during this step to minimize damage to the anti-corrosive zinc coating of the strand.

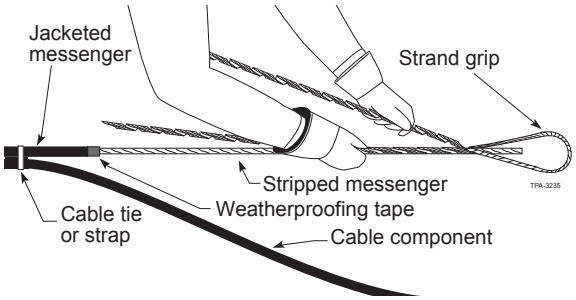
e. Slide the stripped strand into the assembled strandvise cartridge and assemble per its manufacturer's instructions.

f. Apply weather-resistant cable ties (Thomas & Betts® TYZ series Ty-Raps® or equivalent) or a cable strap outboard of the separation between components to prevent the split from propagating down the web.

g. Apply weather proofing tape (Scotch® 2228 rubber mastic or equivalent) around the strand at the point where the jacket is stripped off of the messenger in order to seal the jacket.

Strand Grip (Wrap-type) Dead-end

5.11. The strand grip consists of spirally formed high strength steel wires which are applied to the bare messenger strand in two wraps. The portion of the wires between the two legs form an eye when installed. This type of dead-end can be used to terminate a messenger strand onto guy hook. Follow the strand grip manufacturer's instructions during its application to the figure-8 cable. Step 5.12 details how to prepare the cable for this device.



5.12. Prepare the dead-end pole and figure-8 cable as described in 5.10 a. - b. After these steps are complete:

c. Determine the cable splitting and stripping lengths by holding the grip up alongside the cable. Mark the points where the messenger should be stripped and the components separated in order to place the eye at the pole fixture (refer to 5.10 c).

d. Strip the jacket as described in step 5.10 d).

e. Assemble the strand grip on the stripped section of strand according to its manufacturer's instructions.

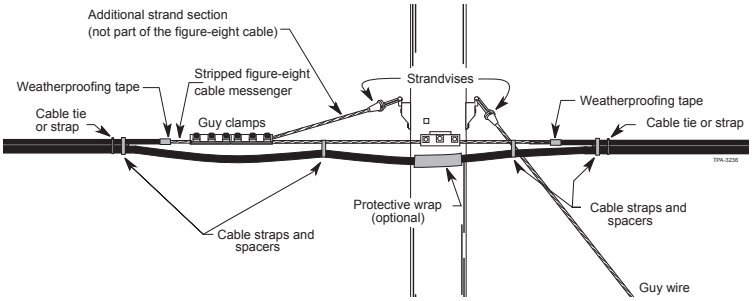
f. Apply weather resistant cable ties (or a cable strap) and tape as described in steps 5.10 f) and g).

NOTE: *Strand grips are fairly easy to remove, but should not be reused.*

False Dead-ends

5.13. False dead-ends are frequently used to eliminate unbalanced loading of poles, either intermediate or dead-end. Different types of false dead-ends utilize various combinations of strand vises, strand grips and guy clamps to apply tension to the messenger without terminating it.

NOTE: *The possible configurations of false dead-ends are too numerous to detail in this procedure, but all utilize hardware and installation techniques similar to those discussed in this procedure. One possible arrangement is depicted as shown. By using elements of the methods already discussed, each can be adapted for use with integrated messenger cable. Follow your company's standard false dead-ending procedures for steel messengers.*



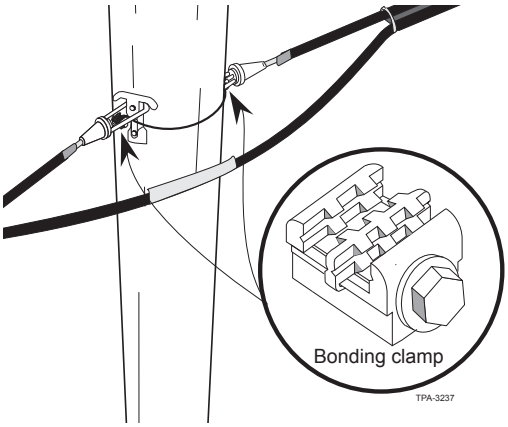
Grounding Requirements

5.14. As with any cable containing conductive elements, figure-8 cable must be electrically grounded. Grounding dissipates and limits voltage accumulation by the cable, thus reducing the danger of electrical shock and outside plant damage. Grounding interval requirements vary widely, especially on joint-use pole lines, and the standard route engineering procedures of your company or the concerned utility must be followed. Procedures for grounding each of the cable's conductive elements are discussed below.

Messenger Component

5.15. Electrical continuity of the strand must be established by bonding messenger spans together at dead-end poles. This may be done in two ways:

- Leave sufficient strand past the dead-end fitting so that the two strands can be placed in a bonding clamp (Reliable 438 ACL or equivalent).
- Jumper between the two strands with No. 6 AWG wire bonded to each strand by one of the above clamps. Electrical continuity between parallel strands should also be established at each dead-end pole using the latter method.



5.16. Actual grounding of the messenger is usually done at dead-end poles by jumpering between the stripped messenger strand and a grounded guy wire at a dead-end pole.

5.17. Where grounding of the messenger strand at an intermediate pole is required, electrical contact with the messenger is made with a C or D type connector on the jacketed strand and a No. 6 AWG ground wire. This connector has teeth which penetrate the jacket and contact the strand when compressed. Again, grounding interval requirements vary widely, especially on joint use pole lines, and the standard route engineering procedures of your company or the concerned utility must be followed.

Cable Component

5.18. Corning Optical Communications recommends that metallic central members and armor sheath (if present) be grounded at each splice point. Most splice closures provide an internal means for bonding the central members and the steel tape to a ground lug which can be attached to a ground wire outside the splice closure. Use the specific instructions provided by the closure manufacturer. Follow your company's recommended procedures if shorter grounding intervals are required.

5.19. If electrical continuity is not established between the cable component's metallic central member, armor, and the messenger strand, there is a possibility of an electrical potential existing between them. At a minimum, these components should be electrically connected at each splice point. Follow your company's recommended procedures if shorter bonding intervals are required.

Support Hardware Types and Installation

5.20. The type of cable support hardware installed at each pole in a figure-8 cable aerial plant is determined by several factors. The primary factor in hardware selection is the amount of "pull," if any, present at a pole. This figure, measured in feet (meters), can be found by using a pull finder or by calculating the distance as outlined in step 5-21.

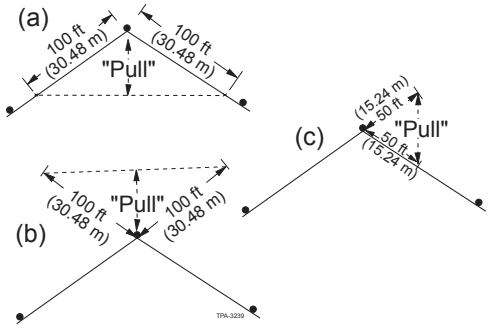
Determining "Pull"

5.21. "Pull" at a pole can be determined by the following method (a):

a. Measure 100 ft (30.48 m) away from the pole along both intended cable span directions. Mark these distances by stakes or other means.

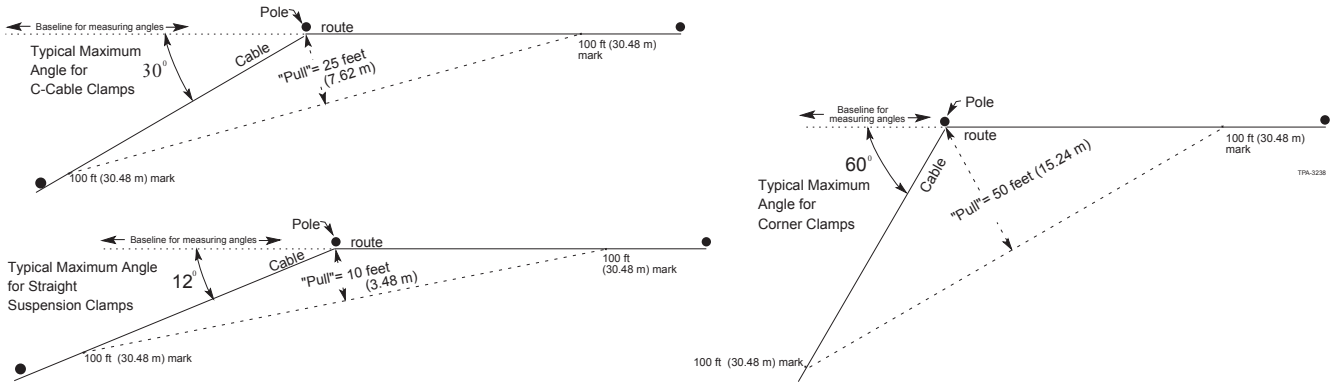
b. Measure the distance between the two 100 ft (30.48 m) marks.

c. Mark the mid point of the distance found in b). The distance from this midpoint to the pole is the "pull" present at the pole.



5.22. (b) and (c) illustrate methods which can be used when physical barriers prohibit the use of the above method. The calculated "pull" value will be the same with all three methods.

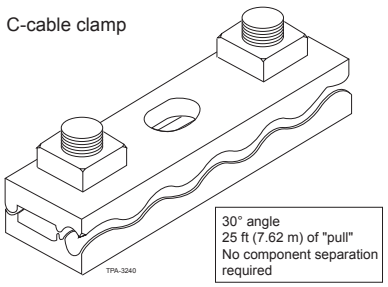
5.23. Acute angles resulting from "tight" turns in the cable route can present "pull" figures which can require dead-ending of the strand component of figure-8 cable. The figure below illustrates intersection angles which produce the maximum rated "pull," for the three tangent clamps discussed in the next section: C-cable clamps, straight suspension clamps, and corner clamps.



Tangent clamps

5.24. Tangent clamps are used to support the cable's weight at intermediate poles where no significant tension is applied. They are typically of a 3-bolt configuration with the central bolt mounting the fixture to the pole and the outer two bolts used to compress the clamp onto the messenger component. Tangent clamps are widely available from cable hardware suppliers. Check the manufacturer's "pull" tolerances and strand size accommodation before selecting a particular clamp.

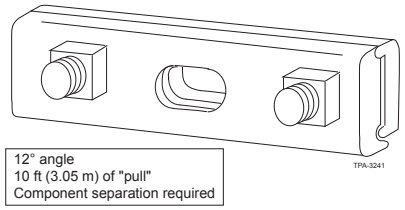
C-CABLE CLAMP



5.25. The C-cable clamp is specially designed to support figure-8 configuration cable and is the clamp best suited for use with Corning Optical Communications figure-8 cable. It can be used on intermediate poles with a "pull" of up to 25 ft (7.62 m). Refer to the respective manufacturer's specifications for actual "maximum "pull" values. Unlike other tangent clamps, the C-cable clamp features a serpentine clamp jaw which accommodates a figure-8 cable without requiring separation of the two components.

STRAIGHT SUSPENSION CLAMP

Straight suspension



5.26. The straight suspension type tangent clamp has several limitations when used with figure-eight cable:

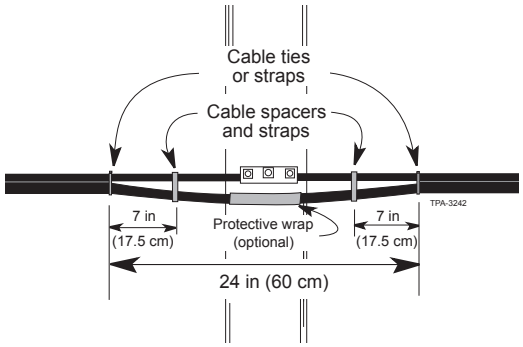
a. The straight clamp can only be used on intermediate poles with a "pull" of 10 ft (3.05 m) or less. Refer to the respective manufacturer's specifications for actual "maximum "pull" values.

b. The straight clamp jaw of this design will not accommodate figure-8 cable unless the two components are separated and installed with the cable component passing below the clamp. To use a straight suspension clamp with figure-eight cable:

   a. Separate the two cable components for approximately 24 in (60 cm).

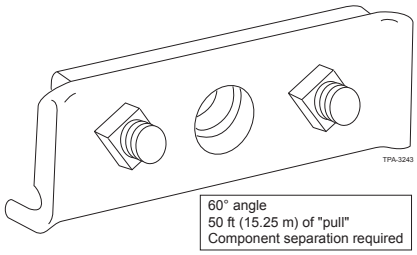
   b. Maintain component separation by standard cable spacer straps placed about 5 in (12.5 cm) inboard of the separations. These dimensions are approximate and should be adjusted to accommodate specific hardware.

   c. Place weather resistant cable ties (Thomas & Betts® TYZ series TY-RAPS® or equivalent) or cable straps around the cable just outboard of the separated section to prevent the slit from propagating down the web.



CORNER SUSPENSION CLAMP

Corner suspension clamp



5.27. The corner suspension clamp differs from the straight suspension clamp only in that the ends of the clamp jaw are beveled, allowing its use on intermediate poles with a pull of up to 50 ft (15.25 m). Refer to the respective manufacturer's specifications for actual "maximum "pull" values. Cable component separation and installation procedures are identical to those outlined for the straight suspension clamp in Step 5.25.

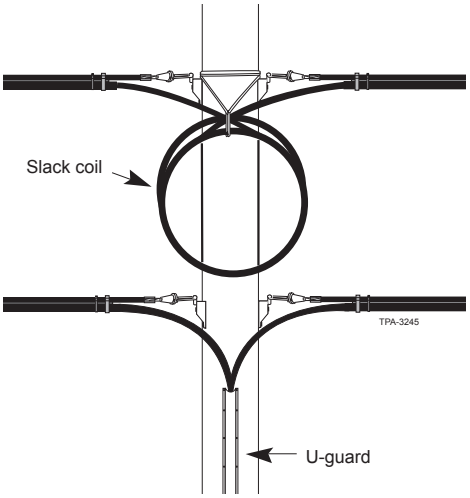
Cable Twist

5.28. Because figure-8 cable has a non-symmetrical cross-section it can exhibit airfoil characteristics during certain wind loading and icing situations. To prevent this potentially damaging situation, twist should be applied to the cable between poles. Corning Optical Communications recommends twisting the cable so that it makes one 360-degree revolution every 20-30 ft (6-9 m).

5.29. Apply the twist to the cable as it is moved from its temporary support hardware into the permanent fittings after tensioning and dead-ending. For pole lines of equal spacing, the twist can be applied in alternating directions at every other pole. In this way, two pole spans are twisted simultaneously. Where pole spans vary, the twist may need to be applied at each pole to maintain the same pitch.

Slack Storage

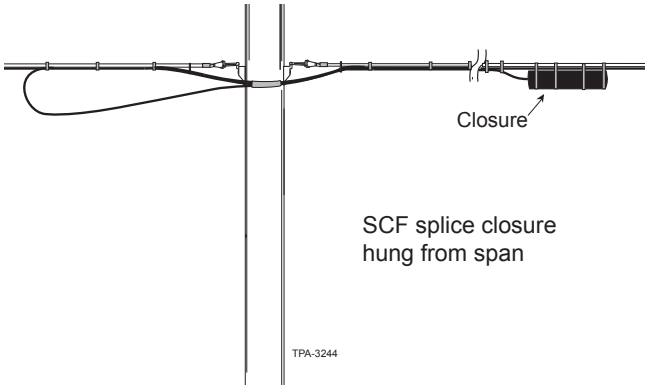
5.30. Slack cable can be distributed throughout the cable route (see steps 4.7 and 4.8). At locations like splice points and future drop points, the messenger component serves no purpose. The cable will be smaller, lighter and easier to handle if the messenger is removed. Slack cable being left for a future drop point can be coiled at the top of the pole (as shown on top), lashed to adjacent span, or placed in an enclosure at the top or base of the pole. Slack cable with the messenger strand removed can easily be run down the pole to a splice point under a U-guard (as shown on bottom).



Splice Closures

5.31. Splice closures should be mounted according to their manufacturer's suggestions but, in general, can be placed on the pole, hung from the span, placed in a pedestal, or buried.

5.32. Entry of figure-8 cable into splice closures is no different from that of any other cable once the messenger component is removed. At the point where the closure seals around the cable component, make the cable component as round as possible by removing the remaining web and trimming the jacket with a standard cable knife.



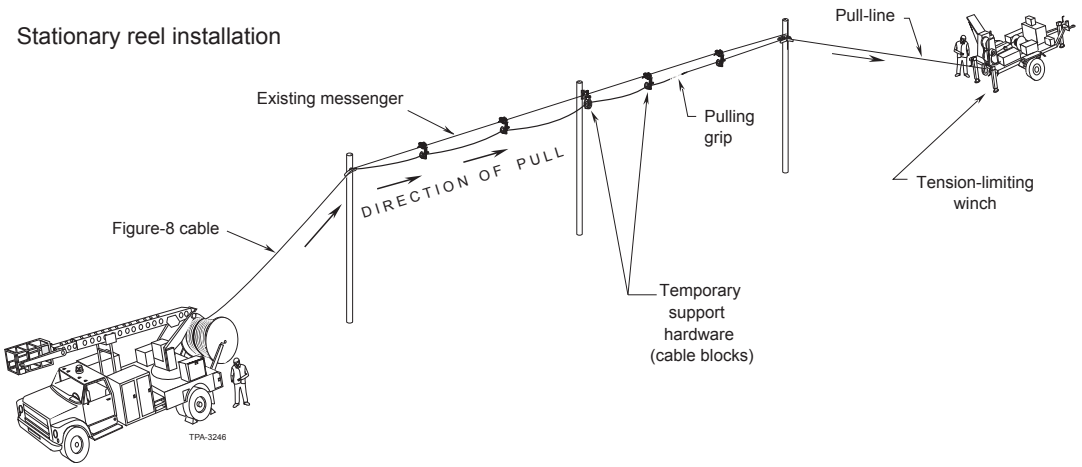
Slack Spans

5.33. Slack spans are generally placed at the ends of a cable route. The installation of figure-8 cable in a slack span differs from a standard installation only in the reduced tension at which the cable is placed. The primary difficulty introduced by the slack span is in relieving the unbalanced load placed on the intermediate poles where this transition in tension takes place. Typically this is done with a dead-end (Steps 5.8 through 5.12) and guy wire installed at this pole.

6. Stationary Reel Installation Method

6.1. In the stationary reel method of aerial cable installation, the cable is pulled along the cable route through temporary support hardware installed for this purpose. When the cable is in place between splice points, the messenger component is tensioned and terminated at each dead-end pole along the route. The cable spans are then lifted out of the temporary support hardware, twisted and placed in tangent clamps at each intermediate pole. Multiple cables can be installed simultaneously by using multiple-cable hardware during the pull.

6.2. The stationary reel method is generally slower and more costly than the moving reel method, but can be used anywhere since it doesn't require an unobstructed right-of-way or vehicular access to the pole line. Higher costs are imposed by the difficulty of coordinating the pulling operation over the length of the route.



6.3. Determine the cable reel and pull locations, each of which can be at any point along the route. The location of the cable reel and any subsequent intermediate pull points must be determined during the route survey. Some of the factors to consider are:

a. Where significant elevation change occurs along the route, it is usually best to pull downhill.

b. The cable reel location should be accessible by the reel carrying truck, but as removed from passers-by as possible.

c. By using the figure-eight coiling procedure, cable from one reel can be pulled in both directions from a central point. The route can be subdivided into shorter pulls to:

- keep the pulling tension below the cable's rated strength
- avoid pulling across sharp turns
- provide cable slack at designated points to allow for future drops.
- compensate for insufficient hardware or personnel to cover the entire route.

d. Installation time will be minimized if reels can be set up for continuous pulls in both directions from a splice point.

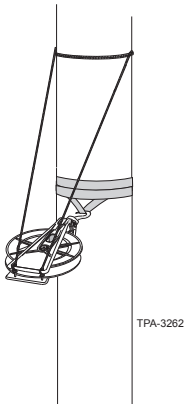
e. To prevent damage to the cable during payout: keep the cable reel level to avoid cable contact with the reel flanges; orient the cable reel so that the natural payout direction is directly towards the first pole; pay out the cable from the top of the reel as shown in the previous illustration to eliminate possible cable contact with the ground.

Temporary Support Hardware

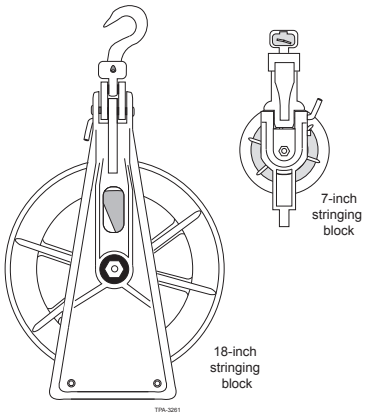
6.4. Temporary support hardware must be selected and placed so as to maintain the cable's minimum bend radius throughout the route and to prevent the cable's entanglement on obstructions in the right-of-way. Any rollers within the supporting hardware must meet the required minimum bend diameter.

Stringing Block Placement

6.5. Hang the proper stringing block on each pole or support structure. 18-inch (or greater) blocks should be used for any offset poles ≥ 10° and 7-inch blocks utilized for straight line poles.



6.6. On poles with an offset greater than 10°, elevate the block by securing a rope to the shackle to ensure proper retention of the cable in the block. Attach the rope to one bottom pin of the shackle, bring the rope above the attachment point and back down to the opposite shackle pin.

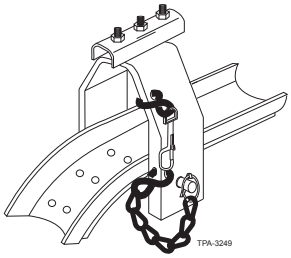


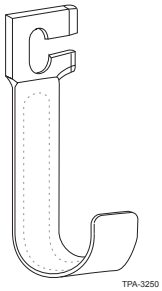
CABLE CHUTE GUIDE-

This device performs basically the same function as a horizontally mounted corner block but should be used on single-cable pulls only.

J-HOOKS -

Although producing more friction than rolling hardware, figure-8 cable can be pulled across J-shaped hooks of at least 1.5 in (3.75 cm) radius installed on intermediate poles. Check all J-hooks to make sure they are free of rough edges or burrs which could damage the cable. Maintain tension on the cable during installation to prevent excess slack which could result in the minimum bend radius being exceeded.





Application of a Pulling Grip To Figure-8 Cable

6.7. Pull the figure-8 cable through the route by a pull-line or tape attached to the messenger component with a properly sized grip (p/n 033-29-1195) and break-away swivel. Step 6.6 outlines how to apply a pulling grip to the messenger component. Follow the steps outlined in SRP 004-137 to attach a wire mesh pulling grip to the optical cable component but the maximum tension allowed with this method is greatly reduced in comparison to attaching a grip directly onto the messenger component.

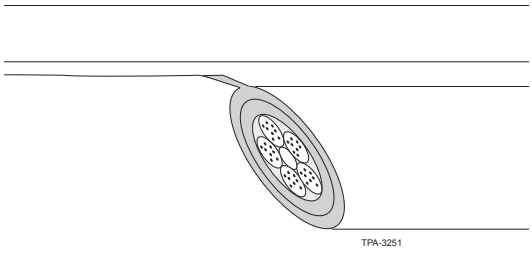
6.8. To install a pulling grip on the messenger component:

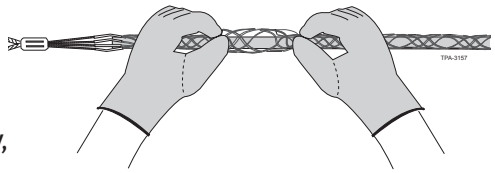
a. Separate the cable component from the portion of the messenger component which will be held in the pulling grip. There is no need to remove the residual web from the messenger component.

b. Cut the separated cable component off at an angle so that the transition from figure-8 cable to messenger is tapered.

c. Inspect the pulling grip for damage - broken wires, kinks, rust, etc. Smooth out the mesh as necessary by pulling along the length of the grip with a gloved hand.

d. Slide the grip over the jacketed messenger component by alternately expanding and contracting the mesh. For safety, wear gloves during this step. When finished, the end of the messenger component should extend into the basket portion of the pulling grip.

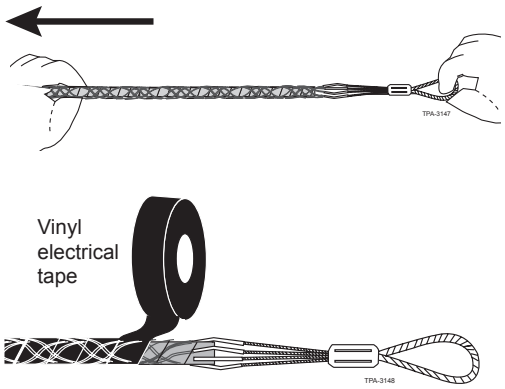




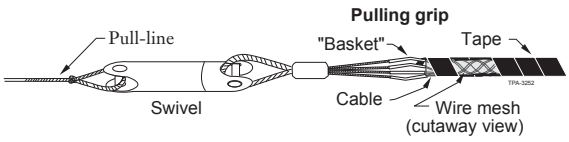
e. Smooth the grip down over the messenger component and tighten it by tugging on the pulling eye.

f. Starting before the cable component cutback point, wrap towards the pulling eye with vinyl electrical tape. Wrap the tape tightly enough so that the mesh of the grip is clearly visible through the tape. Upon reaching the basket, cut the tape and tuck the end inside the grip.

g. Removal of the grip is a straightforward reversal of the above process. After removal, smooth out the mesh, inspect for damage, and store in a dry place for reuse.



6.9. If you are using a non-swivelling grip, install a break-away swivel between the grip and the pull-line in order to prevent cable damage due to twisting. Check with the manufacturer for load variation on the breakaway swivel. This must be taken into consideration so that the maximum tension for the cable is not exceeded.



Pull-Line Placement

6.10. Once the temporary support hardware is in position, place the pull-line by walking it out at ground level along the cable route and lifting it into position in the temporary hardware. This can be done in two distinct stages, or simultaneously by lifting the pull-line up into each piece of hardware as it is passed while walking the pull-line out along the cable route.

NOTE: *This same procedure may be used to place figure-eight cable into temporary support hardware for short sections of a cable route, eliminating pull-lines and rolling hardware. However, maintaining the cable's minimum bend radius is more difficult when the cable is lifted up into each piece of hardware than when it is pulled through a prepared route.*

6.11. Once the pull-line is in place, attach it to the cable's swivel and grip assembly. The cable is now ready to be pulled into place.

Pulling Operation

6.12. The pull can be accomplished by hand or by using a cable pulling winch. In both cases, care must be taken not to exceed the cable's rated pulling strength. Use a tension-monitoring or limiting winch, or install a break-away swivel between the pull-line and the cable.

6.13. During the pull, sufficient personnel should be on hand to monitor the entire pull route. Two-way communication should be established between the pull point, the cable reel location, and each of the route observers.

6.14. Start the pull very slowly as the cable is drawn from the reel at ground level up through the temporary support hardware located atop the first pole. Once the cable end is past the first pole, the pulling speed can be gradually and steadily increased. If sufficient support hardware is in place, pulling speeds on the order of 150 ft (45 m) per minute can be achieved. This may require the placement of rolling support hardware at intervals as close as 50 ft (15 m).

6.15. Observers at the pull point, reel location and along the pull route must be alert for any condition which might cause cable damage and be able to stop the pull immediately if any damaging conditions are observed:

- Avoid exceeding the cable's rated pulling strength and bending the cable beyond its minimum bend radius.
- Control the unreeling of the cable either by hand or with a cable reel brake in order to prevent free-running or jerking of the cable.

- At the pull point, winch or hand-pull the cable so as to prevent either free-running or jerking of the cable. If either is observed, the pull must be halted until the cause is eliminated.
- Excessive oscillation or galloping of the cable can be damaging. Reduce the pulling speed or add additional temporary support hardware to minimize these conditions.

6.16. When the cable reaches the pull point, do not allow it to engage the winch unless the winch maintains the cable's minimum bend radius.

6.17. Pull the amount of cable specified in the route plan and pull plan. This amount should include all slack requirements as outlined in Steps 4.7 and 4.8.

6.18. When the cable has been pulled into place as specified by the route plan:

a. Install a dead-end on one end of the first messenger span to be tensioned as outlined in Steps 5.9 through 5.11.

b. Proceed to Section 8 for instructions on tensioning and terminating the messenger component. The sequence in which the messenger spans are tensioned and dead-ended is unimportant as long as a central pole is not converged upon from both directions.

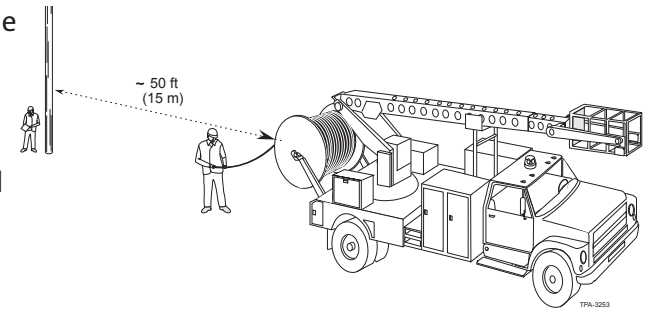
c. Twist and secure the figure-8 cable in the tangent clamp on each intermediate pole as described in Steps 5.27 and 5.28.

7. Moving Reel Installation Method

7.1. In the moving reel or drive-off method, the cable is payed off of a moving vehicle as it drives along the pole line. As the vehicle passes each pole, the cable is raised into place and into a J-hook or block fitting for temporary support. This procedure progresses down the pole line until a dead-end pole is reached. At this point the messenger component of the cable is tensioned and terminated into a dead-end fitting. The cable between dead-ends is then lifted out of the temporary fittings at each of the intermediate poles, twisted and placed in permanent clamp fittings.

7.2. In most cases, the drive-off method is the fastest and least expensive method of installing aerial cable. Pole-mounted hooks are the only temporary support devices required and fewer personnel are required than by other methods. It does, however, require vehicular access to the placement side of the pole line and a right-of-way clear of tree limbs, guy wires, and other obstructions.

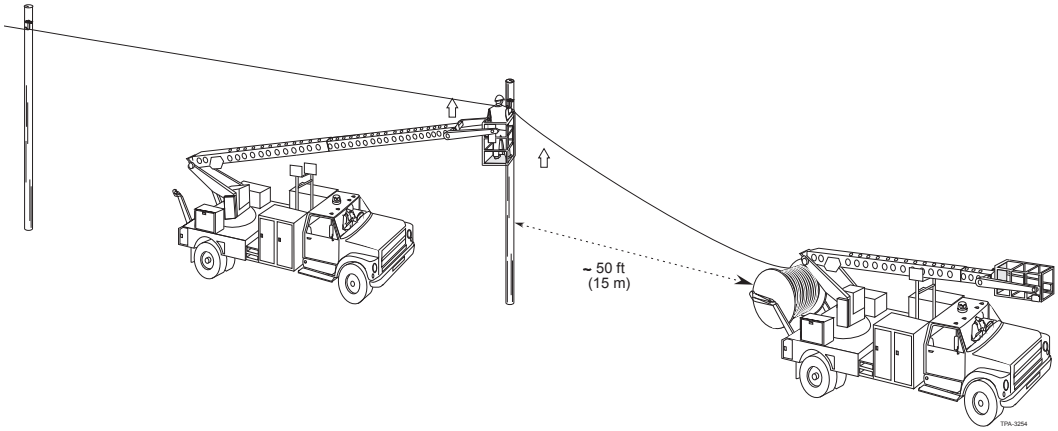
7.3. Begin the installation with the reel-carrying vehicle about 50 ft (15 m) from the pole and facing away from it down the pole line. The cable must pay off the top of the reel towards the rear of the vehicle.



7.4. Pull off the necessary amount of slack as specified in Step 4.8, and cut the messenger component at the point where the cable is to be dead-ended. Prepare the messenger component and install the dead-end as specified in Section 5.

7.5. With either a bucket or handline, lift the dead-end fitting to the top of the pole and mount on the pole fixture. Be careful to maintain the cable's minimum bend radius throughout this operation. Removing the messenger component from the slack cable may be necessary to prevent the weight of the messenger from sharply bending the cable as it is lifted. It may also be necessary to pay out additional length as the cable is lifted.

7.6. Slowly drive the reel-carrying vehicle down the placement side of the pole line, paying out cable off the back of the truck. Once the reel is approximately 50 ft (15 m) past each pole, lift the cable up the pole and place it in a J-hook or block fitting. If necessary, the figure-8 cable can be lifted into additional support hardware hung on existing messengers to provide temporary support until the cable is tensioned and dead-ended at the far end of the messenger span.



⚠	**CAUTION:** Monitor the entire installation process for any situation which could result in cable damage or injury to the crew. Communications between crew members must be effective enough to immediately stop the operation if problems arise.

7.7. Once the cable reel reaches the end of the messenger span, lift the cable to its assigned position on the dead-end pole.

7.8. Tension and terminate the cable into the dead-end as described in Section 8.

7.9. After the cable span is properly tensioned and secured into dead-ends at both ends of the cable span:

a. Lift the figure-8 cable out of the hooks/blocks at each intermediate pole.

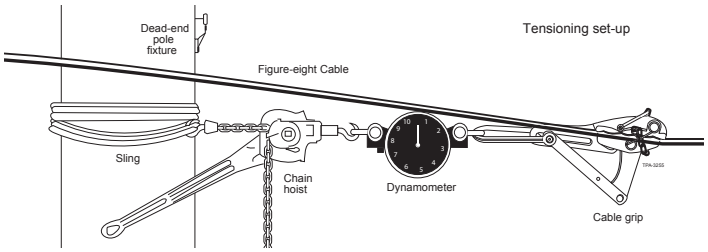
b. Apply cable twist as described in Steps 5.27 and 5.28 and secure the cable in the tangent clamp on each pole as described in Section 5.

8. Messenger Tensioning

General

8.1. After the proper amount of cable has been placed in temporary support hardware between the dead-end poles, the messenger component must be properly tensioned before it is permanently secured into cable clamps on intermediate poles and at all dead-end fixtures.

8.2. With a dead-end fitting already in place on one end of the span, the messenger is tensioned by pulling on its opposite "free" end with a chain hoist (come-along), using the set up shown here.



8.3. Once the entire messenger span is under the required tension, the "free" end of the messenger component is terminated into a dead-end as described in Section 5.

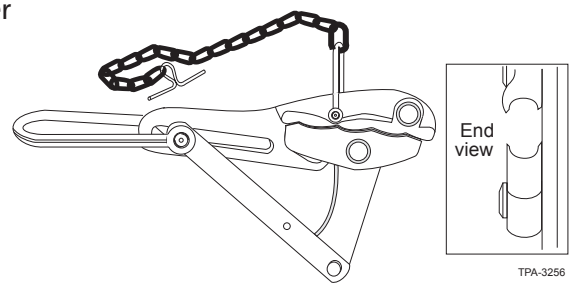
⚠	**CAUTION:** Proper measuring of messenger tension is critical for a safe installation of aerial plant. Please read and understand all of this section before attempting to apply tension to the figure-8 cable.

Tensioning Operation

NOTE: *Before beginning this stage of the installation, any pole modifications or additional temporary/permanent guying must be completed, as must the installation of the dead-end and tangent clamp pole fixtures (see Section 5).*

8.4. Proceed to the end of the cable run which does not have a dead-end fitting already in place from the cable installation procedure. Pull out all messenger component slack between the dead-end poles.

8.5. Clamp a "Chicago grip" onto the jacketed messenger component. The "Chicago grip" is specifically designed for use on a jacketed messenger, with an oval cross-section serpentine jaw, rather than a sawtooth jaw which could damage the jacket.



8.6. During the tensioning operation, tension should be monitored at the dead-end pole by an in-line dynamometer. Subsequent measurements can also be made midspan using the same set up as shown below.

8.7. Set up the grip, chain hoist, in-line dynamometer, and other hardware as shown in Step 8.2. Typically, the chain hoist is strapped to the dead-end pole. Specific operation of the chain hoist should follow manufacturer's recommendations.

8.8. Apply tension to the cable messenger with the chain hoist. Best results are obtained by initially overtensioning the messenger with the chain hoist, and then backing off until the desired tension is achieved. During the tensioning operation, stay within the limits of maximum pulling tension for the messenger and the strength of the poles themselves. For long messenger spans under high tension, it may be necessary to use two chain hoist/cable grip set-ups in succession to obtain the necessary tension.

	**CAUTION:** As the messenger component is placed under tension, weaknesses in the cable plant can cause failure of pole fittings, support hardware or even the poles themselves. The risk of death or injury due to such failures is best minimized by keeping all but essential personnel clear of the tensioning operation. Nobody should be allowed to climb intermediate poles as the messenger span they support is being placed under tension. If possible, passers-by on the ground should be kept away from the poles during this operation.

8.9. The proper installation tension of the messenger span can be determined from your company's installation procedures for standard figure-8 self-supporting cable of the same strand size. In addition, Corning Cable System's Field Engineering (1-800-743-2671) can answer specific questions about tensioning.

8.10. The tension can be initially monitored at the dead-end pole with the dynamometer shown previously. Subsequent measurements must be made with a mid-span dynamometer or other method approved by your company. Messenger tension must be measured not only at the dead-end pole, but as specified for various lengths and conditions described below:

a. Straight messenger spans without a change in grade:
Fewer than 11 poles: Measure the tension near the middle of the messenger span.

11 to 21 poles: Measure the tension at a point 2/3 of the messenger span length from the tensioning pole, then at a point 1/3 of the distance.

Over 21 poles: Measure the tension at a point 3/4 of the messenger span length from the tensioning pole, then at points 1/2 and 1/4 the distance.

b. Messenger spans with grade changes or turns:
Begin measuring tension at the far side of the corner or grade change most distant from the tensioning pole. Follow with measurements at each corner or grade change, working towards the tensioning pole.

8.11. If measurements show that the required tension is not present throughout the span, it will be necessary to tension the wire from intermediate poles. Use the same procedure as at the dead-end pole, working towards the tensioning dead-end. As each section is tensioned, install the messenger in the support hardware as described in Section 5.

⚠	**CAUTION:** Intermediate poles generally are not configured for lateral stress. If significant intermediate tensioning is required, perform it in gradual steps, repeating the process until the required tension is reached.

8.12. Once the entire messenger span is under the required tension, terminate the messenger into a dead-end as described in Section 5. The dead-end should be placed on the messenger where it reaches the pole fixture, unless allowance is being made for grade changes or turns as described in Step 8.13.

Tensioning Across Turns And Grade Changes

8.13. Within the hardware limitations discussed in Section 5, a messenger span may extend across turns and grade changes in the pole line. Since Corning Optical Communications figure-8 cable is normally placed in the permanent support hardware after tensioning, any change in pole line direction complicates the process. Three possible cases are discussed below.

a. CABLE ON OUTSIDE OF TURN: Place the cable in the permanent support hardware on the corner pole as described in Section 5. Tighten the hardware only enough to prevent the cable from falling out during tensioning. Do not twist the cable until after tensioning.

b. CABLE ON INSIDE OF TURN: As the messenger in this situation is tensioned, the cable will naturally tend to pull inside of the corner pole. A vertically mounted corner block will keep separation to a minimum.

⚠	**CAUTION:** Temporary support hardware used to restrain a cable being tensioned will be subjected to a significant portion of the messenger's tensile loading and should be mounted accordingly.

Tension the cable in stages:

- Tension the cable to the degree planned from the dead-end pole.
- While monitoring the tension, use a Type E strand shifter to move the cable from the temporary support hardware at the inside turn to the cable's permanent support hardware on the pole.
- As the cable is pulled out to the pole, tension will increase. Take care not to exceed the maximum pulling tension of the cable messenger or the capacity of the poles and hardware. It may be necessary to relieve tension by backing off with the chain hoist at the dead-end pole.

Continue this process until the cable is in place on the pole at the inside turn.

⚠	**CAUTION:** Do not allow personnel on the inside turn pole while tension is being increased at the dead-end pole. When personnel are sent up the inside turn pole, they must stay on the pole side of the cable.

c. CABLE ON THE POLE AT A GRADE CHANGE: The procedure used to tension the messenger across a change of grade is similar to that used on an inside turn. The cable will pull up or down, depending on the direction of the grade change, rather than horizontally as is the case on an inside turn. Temporary support hardware should be mounted accordingly.

9. Emergency Restoration and Route Reconfiguration

Emergency Restoration

9.1. Compared to conventional fiber optic cable, the use of figure-8 cable slack for emergency restoration is limited by several factors:

- The messenger component is normally cut to length between dead-end poles.
- The messenger component is frequently separated and removed from the slack cable to ease handling and storage.

- In those cases where the slack cable does still have its messenger component, moving the slack to the damage point may be a time consuming operation better suited to route reconfiguration than restoration.

9.2. Except for the increased difficulty of moving slack along the pole line, restoration procedures for figure-8 cable differ little from those used in conventional lashed aerial installations. Two possible restoration procedures for figure-8 cable are described below.

Cable Component Damage Only

9.3. If the messenger component is intact, separate and remove the damaged length of cable component and deal with its restoration just as you would with a conventional cable by splicing in a new section of cable:

a. Cut out the damaged cable component section, plus an additional 10 ft (3 m) on either side.

b. Protect the splice points with cable closures.

c. Splice in the replacement length of new cable using fusion or mechanical splicing.

d. The replacement cable section can either be lashed to the messenger component (see SRP 005-010, Lashed Aerial Installation of Fiber Optic Cable), or suspended beneath it with Thomas & Betts® TYZ series Ty-Raps® at 18 in (45 cm) intervals. Secure the closure to the cable per your company's normal practices (see Step 5.30).

9.4. For a more detailed description of this type of repair, see the documentation supplied with the emergency restoration kit for fiber optic cable.

Damage to Both Components

9.5. If a figure-8 cable is completely severed, or the messenger strand is damaged beyond safe re-use or reinforcement, it will be necessary to restore a continuous messenger and replace the damaged cable component:

a. Cut out the damaged section of messenger and splice in an appropriate length of replacement strand with strand connectors. The replacement strand must match the size and grade of the original messenger component.

Available in a range of sizes, strand connectors are 3-section, wrap-applied devices similar to the strand dead-ends (see Steps 5.11 and 5.12). Follow the connector manufacturer's instructions and/or your company's practices. Properly installed strand connectors have the same rated breaking strength as the original messenger component.

NOTE: *Strand connectors may also be used to reinforce weakened messenger components which have slightly damaged strands; apply the connector over the weak area, rather than cutting it out.*

b. Re-tension the restored messenger.

c. Repair the cable component and install it on the strand as described in Step 9.3.

Route Reconfiguration

9.6. If changes must be made to an existing figure-8 cable aerial plant (e.g., due to highway widening, etc.) "repair slack" can be used to reconfigure a cable route without introducing additional fiber splice points.

- If the messenger component was left intact on the stored slack, shift the slack as needed while rerouting the cable. Restore a continuous messenger between dead-end poles by splicing the strand together where it was cut with strand connectors.
- If the messenger component was separated and removed from the stored slack (as is more common), shift the slack as needed while rerouting the cable. Use strand connectors to splice in the necessary length of replacement strand of the same grade and size.

10. Special Applications of Figure-8 Cable

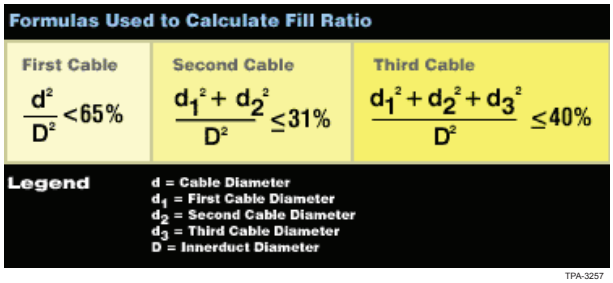
Duct Installation

10.1. Although figure-8 cable is intended for aerial placement, it can easily be pulled into ducts where required. The procedures to be used follow closely those outlined in SRP 005-011, Duct Installation of Fiber Optic Cable, with the following stipulations:

a. In typical ducts, space limitations may dictate pulling in only the cable component. The cable component of standard figure-8 cable has a rated pulling strength of 450 lb_F (2000 N). This figure must not be exceeded (see Step 3.1). Use a wire mesh pulling grip on the separated cable component as described in SRP 004-137, Installing Wire Mesh Pulling Grips.

b. Where duct space allows, pull in figure-8 cable by the messenger component. Do not exceed the maximum pulling tension of the messenger.

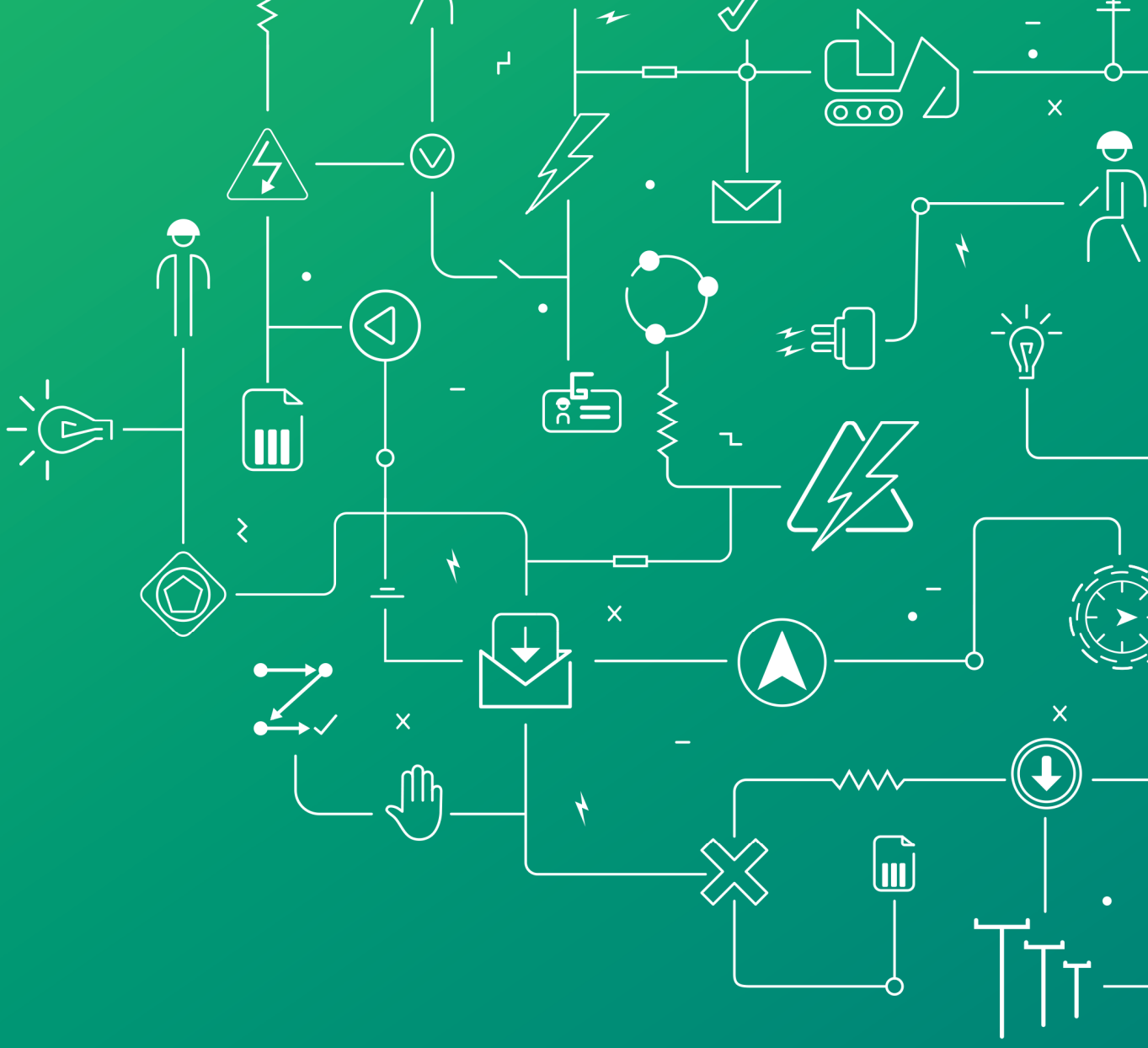
c. To calculate a fill ratio, use the following formulas in the chart. For a quick calculator, see www.corning.com/opcomm/fillratio. Treat the cable as two separate cables with one cable being the messenger component and the other the optical cable component.



Direct Burial

10.2. Where required, cable can be trench-buried as discussed in SRP 005-012, Direct Buried Installation of Fiber Optic Cable.

Corning Optical Communications LLC • PO Box 489 • Hickory, NC 28603-0489 USA
800-743-2675 • FAX: 828-325-5060 • International: +1-828-901-5000 • www.corning.com/opcomm

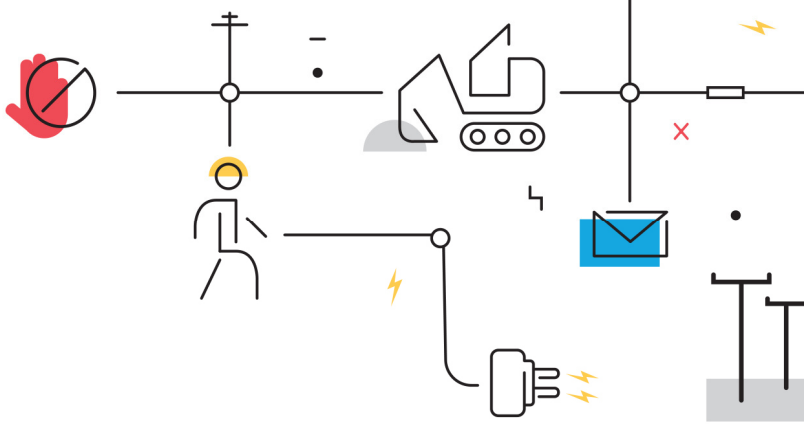


INSTALLATION REQUIREMENTS FOR TELECOMMUNICATION EQUIPMENT ON EVOENERGY ASSETS

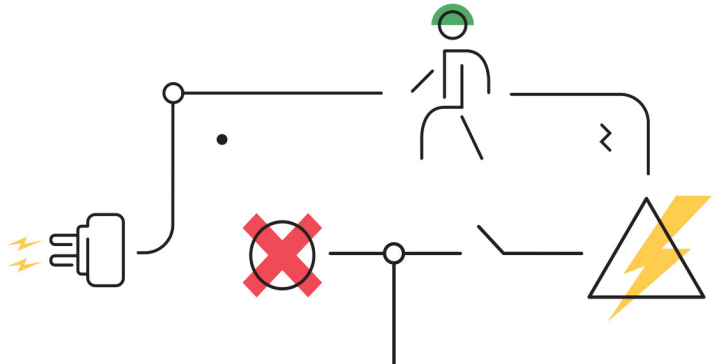
IMS DOCUMENT NUMBER: SM1311

JANUARY 2019 • SM1311 • VERSION 3.1

evoenergy



CONTENTS



Disclaimer

Whilst this document contains material relevant to the electricity industry legislation, codes of practice and standards, it is not intended to provide legal advice on how electrical contractors can meet their own statutory obligations or comply with legislation, codes of practice or industry standards such as AS/NZS 3000 (Wiring Rules). Whilst care has been taken in the preparation of this document, Evoenergy does not guarantee that the information contained in this document is accurate, complete or up to date at time of publication. To the extent permitted by the relevant legislation Evoenergy will not be responsible for any loss, damage, cost or expense incurred as a result of any error, omission or misrepresentation in relation to the information contained in this document.

Note

Printed versions of this document are “uncontrolled copies” - the latest version is available on the Evoenergy website.

Copyright

1. PURPOSE

This standard details the requirements for the attachment of third party communication equipment to Evoenergy assets.

The objective is to enable the installation of all communication equipment in a safe and efficient manner onto the Evoenergy network.

2. SCOPE

This standard specifies the acceptable positioning of both narrowband and broadband communication equipment and cables to all Evoenergy assets. These cables and equipment are generally installed to provide communication services, including cable television (CATV), telephone and interactive data services. Communication cables are both broadband and narrowband (self-supporting or integral bearer). Communication equipment will include mobile phone cells, transmitters/receivers and any other radio devices.

The requirements for working on telecommunication equipment installed on Evoenergy structures; or, working on Evoenergy structures that have telecommunications equipment are outside the scope of this standard.

Clearances, pole loadings and all other conditions must also continue to meet the requirements of this standard for the entire life cycle of the communication cable and equipment, including during maintenance and removal.

3. EXPENSES

In no case will any expense or fees incurred by the BCC in the preparation of any required assessments, studies, investigations and the like associated with this standard be borne by Evoenergy.

Evoenergy will neither be responsible for, nor pay for any expense or loss, which may be incurred by the BCC.

4. REFERENCES

TABLE 1. SCHEDULE OF REFERENCES

STANDARD	DESCRIPTION
AS/NZS 7000	Overhead line design, Detailed procedures.
SM 1138	Distribution Earthing Design and Construction Manual
SM 1139	Distribution Overhead Line Design Manual
SM 4605	Evoenergy Electrical Safety Rules
SM 1114	Evoenergy Service and Installation Rules
ESAA NENS 04	National Guidelines for Safe Approach Distances to Electrical Apparatus
ENA Doc 005	Joint use of power poles – Model agreement
Drawing 390-018	Clearance Requirements Between Evoenergy Infrastructure and Telecommunication Carriers Cable Installation

It is the responsibility of the communications designer to ensure the latest version of the appropriate standards and drawings referred to in this standard is used in all designs and calculations.

5. ABBREVIATIONS AND DEFINITIONS

TABLE 2. LIST OF ACROMYMS

TERM	DEFINITION
2CTW	2 Wire Twisted (1 phase) service
4CTW	4 Wire Twisted (3 phase) service
4WL	4 Wire Lateral (open wire 3 phase) service
AAAC	All Aluminium Alloy Conductor
AAC	All Aluminium Conductor
ABC	Aerial Bundled Conductor
ACSR	Aluminium Conductor Steel Reinforced
ACT	Australian Capital Territory
ADSS	All Dielectric Self-supporting (Communications cable—optical fibre)
AHD	Australian Height Datum
Al	Aluminium
Antenna	Transmitter, such as a wire or grid, sometimes mounted within a tube or panel, that emits and receives radio signals
Authorised person	A person with technical knowledge or sufficient experience who has been approved and authorised in writing by the Company to perform the function requiring authorisation.
BAZ	Bushfire Abatement Zone
BCC	Broadband Communication Cables
CATV	Cable television, that is, television provided by means of Broadband cable.
CBL	Calculated Breaking Load. In relation to a conductor, means the calculated minimum breaking load determined in accordance with the relevant Australian/New Zealand Standard.
CLAH	Current-limiting Arcing Horn, or gapped surge arrester
Communications Hardware	Communication hardware refers to the equipment associated with the transmitting device excluding the antenna, namely, the power supply, isolation device and any auxiliary equipment.
CSA	Cross-sectional Area

TERM	DEFINITION
Cu	Copper
EMF	Electromagnetic Field
Exclusion Zone	The safe working distance that has to be achieved from an energised radio frequency transmitter, which cannot be entered by any part of the body or metal object.
GL	Ground Level
HDC	Hard Drawn Copper
HV	High Voltage
IBC	Integrated bearer cable – an overhead cable used for telephone lines consisting of a metallic supporting strand or strands and a variable number of metallic telephone pairs
MEWP	Mobile elevated working platform
Microwave Dish	Dish-shaped transmitter device, used on some cells, that emits and receives radio signals that allow the cell to communicate with the telecommunications carrier's network
Mobile Phone Cell	Communications installation that communicates between mobile phones and the telecommunications carrier's network using radio signals
NENS	National Electricity Network Safety codes, issued by ENA
OPGW	Optical Ground Wire—an overhead earth wire with internal optical fibre/s
Radio transmitter	A device used to send radio signals. Such transmitters have associated communications hardware installed on the ground or the structure supporting the antenna
SC/GZ	Steel Conductor / Galvanized
SF	Safety Factor, also Strength Factor
SL	Street lighting
UG/OH	Underground to overhead transition structure
UTS	Ultimate Tensile Strength – the maximum mechanical load, which may be applied to a conductor, beyond which failure occurs.

6. CLEARANCES, SEPARATIONS AND ATTACHMENTS

6.1 General

Ground clearances for communications cables, structures attachment clearances, clearances between communication cable/equipment and electrical infrastructure, as well as safe working distances, shall not be reduced from those specified in this standard unless agreed to in writing by Evoenergy.

In the case of poles carrying 11 kV or 22 kV mains only, the minimum safe working distance is defined by Evoenergy - refer to Evoenergy drawing 390-018.

Before any communication cables or equipment are attached to an Evoenergy pole, a full detailed assessment of the pole strength is to be performed by the telecommunications provider. The proposed additional communication cable load, when combined with the existing electrical network conductor load, shall not exceed the rating of the pole under sustained loads and ultimate wind loads.

The pole strength shall be calculated in accordance with AS/NZS 7000 where the pole identification disk is not attached to the existing pole.

Where the communication provider has doubt concerning the condition of a pole, a special pole inspection shall be arranged at the expense of the telecommunications provider. Evoenergy authorised inspectors shall only carry out drilling of timber poles for the purpose of a pole decay assessment. Evoenergy must be notified prior to such assessment is carried out.

Evoenergy requires the following communication cable ground clearances.

TABLE 3. MINIMUM CLEARANCE REQUIREMENTS

CROSSING TYPE	MINIMUM CLEARANCE
Waterways	AS 6947
Ground clearance	AS7000
Railways and other utilities crossings.	Refer to relevant standards

All other clearances for telecommunication cables shall be in accordance with Evoenergy drawing 390-018.

6.2 Midspan Clearances

Midspan clearances between communication cables and the electrical infrastructure are to be determined under worst case operating conditions.

Clearances where a telecommunication cable is installed below electrical conductors are to be determined with the electrical network at maximum operating temperature and the communication cable at 5°C.

For ADSS cables installed above low voltage networks, where approval is given, a 0.1 m mid-span clearance must be maintained with both circuits at 5°C.

Crossing of communication cables between electrical network conductors is not permitted.

6.3 MEWP Access Window

A 600 mm attachment separation is required between an ADSS cable and LV ABC, bare LV or streetlight if the MEWP access window is 1500 mm. The ADSS cable is to be attached below the other cables.

Additionally, for an attachment above the LV, a minimum 1500 mm mid-span clearance to conductors for voltages up to 22kV located above the ADSS cable must be maintained with the electrical network at maximum operating temperature as specified by Evoenergy and the ADSS at 5°C.

6.4 Mains Ground Clearance

Mains ground clearances shall be as per AS/NZS 7000. If any locations are identified where clearances are not as per the latest standards, the designer shall determine if any remediation work to the existing overhead conductors will provide suitable ground and mid-span separation clearances to allow installation of communication assets. Works to be considered covers all available options including conductor re-tensioning, service main alterations and the replacement of the Evoenergy pole. The proposed remediation work is to be submitted to Evoenergy at the design stage for approval.

6.5 Asset Spacing

As a rule, all communications cables will be located lower than electricity cables/conductors and the only exception to this requirement shall be a non-conductive system where the cable may be permitted to be located above the service mains and street light cables/conductor. All proposals for this non-standard arrangement are to be submitted to Evoenergy for approval prior to works commencement.

Minimum separation distances between conductive communications cables and service cables are set out in Evoenergy drawing 390-018. In the case where there is the requirement for a second low voltage ABC to be installed where a single ABC exists additional allowances may be required for installation of communication assets.

6.5.1 Backyard Poles

In some ACT suburbs, the electricity supply to residential or commercial properties may be installed on poles located in the backyard of the property. All communications cable shall be installed facing the property side of the pole. Where multiple properties are supplied by a single pole, the communications cable owner shall decide the cable route for the length of the installation and ensure that all clearance requirements are met. The communications cable owner shall notify Evoenergy of the selected route.

6.5.2 Street Poles

All communications cable shall be installed on the roadside of the pole. Evoenergy may give approval for the attachment on the property side where road clearance may not be met under conductor blowout conditions if attached on the roadside.

6.6 Separation

6.6.1 Evoenergy Owned Poles

Evoenergy has installed non-conductive and conductive poles (steel reinforced concrete) in the electricity distribution systems. Hazardous voltages can be present on all types of poles during abnormal system conditions including, but not limited to; equipment failure, earth faults, weather conditions, etc.

When communication equipment is installed on:

- Conductive poles, equipment must be insulated to a minimum of
  - LV Pole (BIL 15kV)
  - 11 kV (BIL 95 kV)
  - 22 kV (BIL 150 kV)
- Conductive poles separately earthed (rural and urban) the equipment must be insulated to a minimum of
  - 11 kV (BIL 6.6 kV)
  - 22 kV (BIL 6.6 kV)
- Common earthed LV, 11kV and, 22 kV conductive poles, all metallic components of the communication cable and equipment can be bonded to the pole along with LV neutral.

During the installation process, allowance must be made for the any potential rises on poles and appropriate installation methods and safe working procedures shall be adhered to when working on or near them.

6.6.2 Metallic Fittings

Evoenergy poles may have unearthed, single insulated fittings installed, which can become live through the breakdown of the primary insulation (such as steel conduit, light fittings, street light outreach brackets and lantern choke boxes).

All persons working on structures must be made aware of the possibility of metallic fittings on non-conductive (wood and composite) poles becoming alive. Safe working procedures when working near unearthed, pole mounted, metallic fitting must be employed and shall include a voltage test to ensure that the work can be safely performed.

6.6.3 Service Cables

The minimum separation between service cables and conductive aerial communications conductors is as per Evoenergy drawing 390-018. Communication providers are not allowed to connect any cables to LV cross-arms.

Generally, Evoenergy aerial service cables are attached to the pole below LV mains. These cables are usually insulated; however, the minimum clearance between overhead service mains and aerial communication conductors is 600 mm.

The following situations, however, will require attention by those installing the communications cables if it is anticipated that BCC staff will be required to work within 500 mm of such wiring:

If there is exposed live metal, such as uninsulated connectors between mains and aerial service cables, those installing the communications cable shall cover the exposed metal with an Evoenergy approved insulating tape and a weatherproofing tape.

If the insulation on the service cables has deteriorated to the point that conductors are exposed, the overhead service to the customer will need to be replaced with a multi- core aerial bundled conductor. This type of insulation failure must be reported to Evoenergy immediately for remedial work.

If the number of services taken from a pole is large, and/or the connections between service conductors and the mains are untidy, the aerial service cables may impact upon the desired BCC location. The standard Evoenergy notification and outage processes to be followed to allow Evoenergy to carryout any remedial work.

6.7 Existing Infrastructure

The Evoenergy network will continue to have enhancements carried out in order to provide a more reliable and safe electrical distribution system.

Evoenergy reserves the right to change its structures at any time. In the situation where a telecommunications carrier's cable or equipment are attached to a structure, which needs to be modified, the owner shall be notified. If Evoenergy deem the cable/equipment needs to be adjusted or removed from the structure, the telecommunication carrier shall carry out these works at their own cost.

Existing electricity and communication infrastructure, which may not comply with the latest standards, may be deemed acceptable except where a specific risk may be posed to Evoenergy staff or the public. New and replaced communication cables and constructions shall comply with the requirements of the latest standards.

6.8 Training

All persons working on Evoenergy poles near live mains must be authorised persons with appropriate accreditation for working on pole tops and with optic fibre cables.

The communications provider shall ensure that all personnel working on Evoenergy poles for the attachment of communications infrastructure would receive suitable training and familiarisation including but not limited to:

- Evoenergy Electrical Safety Rules (Bluebook)
- Evoenergy Access Permit Requirements
- Evoenergy Network Outage Notification Lead Times
- Identification of voltages and mains types
- Knowledge of the hazards associated with pole top work
- Identification of suspect and condemned poles
- Working with fibre optic cables, NENS 04-2006 safe working distances
- Knowledge of the hazards associated with stringing communication cables beneath energised electricity conductors
- Awareness and knowledge of this Standard
- Any other
- required training

Required training can be obtained from industry training centres, including Evoenergy upon request and at an appropriate charge.

6.9 Tools and Equipment

All tools and equipment shall be kept in good working condition so that they are safe to use at all times. Tools, plant and equipment that require inspection shall be current in their period of inspection and tagged/logged accordingly.

MEWP and other equipment used by communication cable owners and their contractors shall be rated in accordance with standards issued by Standards Australia. A copy of the valid test certificates for all equipment must be available on request.

Work Safe ACT's guidance note, '*Working near Overhead Powerlines'*, will be applicable for all MEWP, cranes, plant, vehicles, individual's tools and equipment used on or near Evoenergy electrical network.

6.10 Safe Approach Distances

Clearances in the Evoenergy Electrical Safety Rules must be maintained and all conductors, including insulated/covered conductors, shall be treated as energised.

6.11 Non-conductive Networks

It shall be the responsibility of the BCC system owner to satisfy Evoenergy that the system is non-conductive and provide a statement before the attachment of such a system to the Evoenergy network.

6.12 Special Situations

6.12.1 UG/OH Poles

Electricity cables rising up the pole do not pose any particular problem for the attachment of a steel catenary cable to the pole. To provide additional protection however, a non-conductive section guard is to be fitted to Evoenergy UG/OH cables centred on the BCC attachment point. This work shall be carried out by Evoenergy personnel with all costs at the communications carrier's expense. For these poles, a clearance of 150 mm from parts with single insulation or covering shall be maintained.

6.13 Restricted Constructions

6.13.1 Pole Mounted Substations and Automated Switching Equipment

No communications cables or equipment are to be installed on pole mounted substation or automated switching equipment. In these situations the communications cable must be installed on a freestanding pole providing 2200 mm clearance between the substation or automated switching equipment or pass the pole as an underground cable.

6.13.2 Air Break Switches

Where an Air Break Switch (ABS) is currently installed, the telecommunication carrier must allow for the future replacement of an ABS with an automated switching device. In these circumstances, the clearance from the top of the pole to the communication cable shall be a minimum of three meters.

6.13.3 Transmission Structures

Telecommunication equipment shall not be attached to transmission structures (33kV to 132kV inclusive). Lines built for transmission but operating at lower voltages shall be treated as transmission lines for the purpose of this standard.

6.13.4 Streetlight Columns

Evoenergy do not own the ACT streetlight network. Any proposed telecommunications cable or equipment connection to a streetlight must be approved by the asset owner.

6.13.5 Aerial Splices

All splices shall be located in an underground pit. No splices shall be installed on the overhead network, due additional load on poles/structures, visual impact of splicing equipment and impediment to access for maintenance and operation of the Evoenergy distribution network.

6.13.6 Communication Equipment

Communications associated equipment must not be located on conductive poles without explicit written permission from Evoenergy for each pole. The telecommunications provider shall assess each concrete pole separately.

6.13.7 Private Poles

Evoenergy cannot provide approval to telecommunication carriers to install cable and equipment on these poles. The telecommunication carrier must negotiate directly with the owner of the pole to arrange access.

Notwithstanding this, the requirements of this standard still apply with respect to clearances and positioning of communications equipment relative to Evoenergy distribution mains or service cables/conductors.

6.14 Communication Hardware Attachment

6.14.1 Wood Poles

BCC infrastructure generally will be attached to the pole clamping the steel catenary to a king bolt on wood poles.

The communications cable, network amplifiers, and service tap boxes (which service individual customers) are attached to the catenary at a distance approximately 1.2 metres from the pole.

For non-conductive systems, the cable shall be supported by LV ABC hook-bolts and suspension clamps mounted on the pole. Connection to the LV cross-arm will only be allowed for Evoenergy ADSS. Cable terminations/strain constructions shall be attached to the poles by means of either LV ABC hook-bolts or eyebolts.

6.14.2 Other Poles

All connections on composite poles should be by means of an approved catenary clamp. Care must be taken to prevent any damage to the gel-coating during the installation of communication equipment. Under no circumstances, shall communications cabling/equipment installers drill any holes in to concrete, steel or composite poles.

On conductive pole, the communications cable will be attached in a manner agreed to by Evoenergy, such as stainless steel strapping around the pole.

Table 4 provides the acceptable methods of attachment.

TABLE 4. METHOD OF ATTACHMENT

POLE MATERIAL TYPE	TELECOMMUNICATIONS CABLING	TELECOMMUNICATIONS HARDWARE
Wood	Support Bracket attached with bolts. These fixtures shall be UV stabilised and not be affected by temperature cycle brittleness	Attached by 12mm x 75mm long galvanised coach bolts.
Fibre-Reinforced Composite (FRC)	Support Bracket attached with stainless steel straps. These fixtures shall be UV stabilised and not be affected by temperature cycle brittleness	Attached by stainless steel straps.
Steel	Support Bracket attached with stainless steel straps. (kingbolt hole not available) These fixtures shall be UV stabilised and not be affected by temperature cycle brittleness	Attached by stainless steel straps. (where a kingbolt hole is not available)
Concrete	Support Bracket attached with stainless steel straps. (kingbolt hole not available) These fixtures shall be UV stabilised and not be affected by temperature cycle brittleness	Attached by stainless steel straps. (where a kingbolt hole is not available)

POLE MATERIAL TYPE	TELECOMMUNICATIONS CABLING	TELECOMMUNICATIONS HARDWARE
Other Information	Catenary shall be isolated from HV Conductive Poles with an insulator capable of withstanding the Pole's EPR under all weather and pollution conditions – with the following specs: - Wet power frequency withstand voltage of 28kV for 1 minute; - Dry power frequency withstand voltage of 28kV for 1 minute; - Lightning impulse withstand voltage of 95kV; - Flashover distance > 120mm; - Creepage distance > 230mm; - Cantilever strength of 6 kN. The catenary shall be attached to wooden Poles via an insulator where that Pole carries a HV earth conductor down the Pole, i.e. cable screen, switch earth, surge arrester earth etc.	All metallic equipment shall be either hot dipped galvanised or treated by other Evoenergy approved methods to prevent corrosion. The attachment brackets, clamps, ancillary hardware and equipment must not interfere with existing installation and the Operations. The attachment brackets, clamps, ancillary hardware and equipment must also be able to be detached from the Pole with the use of standard hand tools.

6.15 Earthing of Communication Equipment

When the communication cable system installed adjacent to electricity aerial mains has metallic components such as sheath and catenary, these are required to be earthed at regular intervals. The External Telecommunications Carrier must design, install and maintain the earthing system to be sufficiently robust and well configured to maintain safety from hazardous voltages.

Evoenergy Earthing standard requires compliance with allowable step and touch potential as per AS/NZS7000. Evoenergy may permit BCC (including sheath and catenary) to be connected to the MEN system (LV neutral) to form one earthing system for electricity and BCC systems. This earth sharing arrangement is only allowed in common earthed areas where the LV neutral (MEN) is connected with a large number of customer's MEN.

Any situation that would not comply with this earthing requirement shall be brought into line with this standard or removed at the expense of the BCC installer.

6.16 Mechanical Protection of Communications UG/OH Cables

Communication cable shall be mechanically protected with a non-conductive material where it is likely that it will be damaged due to Evoenergy operations. Evoenergy takes no responsibility for damage to any unprotected cables during Evoenergy's normal operational activities.

Mechanical protection is required on all poles for all cables forming part of an overhead to underground connection, as follows:

- Suitable mechanical protection is required to be attached to the pole from a depth of 500 mm below ground to 4 m above ground level.
- Connection pits in the ground near poles must be a minimum of 1500 mm from pole.

Mechanical protection (conduit, U guard or similar) is required to protect telecommunications cables that run up the pole where a ladder or pole platform may be placed for work on the pole, its equipment or mains.

This is required from 500 mm below the highest electricity mains on the pole to at least 2500 mm below the lowest electricity mains on the pole.

6.17 Hazards

6.17.1 Safety Hazards

Evoenergy may restrict the attachment of communications equipment to its network at any location deemed unsafe. This includes condemned or nailed poles, poles in a less than satisfactory state of repair or condition, and termite affected poles. This may be due to:

- Access, maintenance or operational difficulty
- Environmental risk
- Visual amenity or other community impact
- Future capital works
- Future customer connection or relocation works

6.17.2 Electrical

Electrical hazards that could be associated with the installation of communications infrastructure include:

- earth return paths through coaxial cable screens due to open circuit neutrals or shared return paths during LV short circuits
- elevated neutral voltages
- power voltage injection
- voltage back-feed through communications system power supply transformers
- down earths on poles

Appropriate design, safety, training and risk management practices shall be implemented to prevent the exposure of these potential hazards to all staff, the community and equipment.

6.18 BCC Identification

The BCC owner shall at each pole, clearly identify the cable by an Evoenergy approved sign. Where a sign is installed for this purpose, it shall comply with the following requirements:

1. Up to a six (6) letter word or acronym identifying the owner of the cable only
2. A clear code to indicate the nature of the cable, NC for a non-conductive cable, and C for a conductive cable
3. Mounting of signs will be according to the methods set out in Table 4. Attachment using cable ties is not acceptable. Attachment to poles to be approximately 100mm below the cable
4. The sign material shall be aluminium sheet with an edge sealer
5. Reflective Class 2 individual numbers and letters, 30 mm high, are required.
6. The sign shall not impact any works to be carried out on Evoenergy assets by Evoenergy staff.

6.19 Make Ready Preparation Requirements

In some instances, there will be a requirement for redressing or replacement of some Evoenergy aerial facilities before they will be suitable for the attachment of communication infrastructure. The communication cable owner is responsible for all costs associated with this make ready work.

6.19.1 Pole Replacements

The agreements between various communication cable owners and Evoenergy define the process to be followed by both Evoenergy and the communication cable owners' staff. In general, Evoenergy staff are not permitted to interfere with the communication cable owners' equipment and cabling. The communication cable owner will make arrangements for the relocation of their assets where reasonable notice of the proposed works is given. The current arrangement with telecommunication provider's equipment is that Evoenergy staff will remove equipment from existing poles and tie/strap it to the new pole. Evoenergy will notify the relevant telecommunications provider who shall affix it as per the requirements of this standard. Replacement poles will generally be installed in the same position as the previous poles.

The BCC owner shall meet any requirement for the replacement of a pole for either clearance requirements or mechanical loadings due to the attachment of communication infrastructure, the cost of the pole replacement and associated works. In addition, any requirement to straighten leaning poles prior to the attachment of communication infrastructure shall be the responsibility of the communication cable owner.

The installation of a communication cable onto the electrical network shall utilise the existing poles where possible. Any requirement for the installation of additional network poles and stay poles is to be avoided and will only be approved if no other practical alternative arrangement is available

The conditions as stated in the agreements between various communication cable owners and Evoenergy set out the process to be followed by both Evoenergy staff and the various communication cable owners' staff.

6.19.2 Evoenergy Requirements

If Evoenergy choose to remove an overhead section of overhead mains line and replace it with an underground section the telecommunication has two options:

- BCC owner can take ownership of the pole
- Augment the telecommunications line underground

Any cost associated with the changes will be for the account of the communications owner.

Any upgrading of the network proposed by the BCC owner shall allow for any future proposal that Evoenergy may have for that structure. Evoenergy's right to install a structure on public land is dependent upon its use for electricity distribution. Undergrounding of all electrical circuits may require removal of the pole, or transfer of its ownership to the carrier.

6.19.3 Pole Movement with Existing Communication Cables

The variable nature of ground conditions and pole footings may prevent their accurate assessment at the time of assessing a pole's suitability for carrying communication cables. All costs are to be borne by the communication cable owner in the case where any corrective action is required to any infrastructure following the installation of communications cables.

6.20 General Requirements

6.20.1 Network Records

The communication cable owner shall provide GIS data in electronic format of the proposed alteration and additions in a form compatible with the Evoenergy GIS.

Annual rental received by Evoenergy is determined from Evoenergy network data and mapping records, which contain details of the communications networks. Evoenergy is to be informed within 30 business days when attachments occur to ensure the correct rental assessment.

6.20.2 Tree Trimming

Evoenergy maintenance crews do not make allowance for communication cables in the extent of the tree trimming undertaken. Any requirement by communications infrastructure owners for the trimming of trees, if any, will only be done if payment for such work is negotiated separately.

6.20.3 Aesthetics

Evoenergy is aware that its overhead electricity network will be implicated in any adverse community reaction due to the addition of communication infrastructure and accordingly, the telecommunications owner and Evoenergy staff involved in this exercise are to ensure the completed network is as aesthetically pleasing as possible.

The communication cable owner shall obtain the required approvals from the relevant authority and inform the residents before proceeding with the installation of any communications equipment. Evoenergy shall be provided this information prior to any works commencing.

7. ATTACHMENT OF COMMUNICATION TRANSMITTERS

7.1 Suitability of Structures

In order to ensure the minimum disruption to its customers Evoenergy retains the right to use its structures primarily for the purpose of the distribution of electricity.

The suitability of an Evoenergy structure for communication equipment will depend upon but not limited to the following:

- The possible impact of the equipment on Evoenergy ability to perform its operation of its network
- Evoenergy's future plans for augmentation, relocation and maintenance of the electricity network
- The proposed additional loading due to the communication equipment and the mechanical strength of the pole structure. All designs and calculations shall be submitted with all application showing the structure can support the additional mechanical load as per AS/NZS 7000

In addition to the above, some sites may have further restrictions and limitations due to unavoidable emergency outages, higher voltage and higher power capacity sites tend to be more critical.

The carrier's application shall include consideration of voltage rise, the imposed step and touch potentials due to fault conditions on the electricity network at the structure and the impact on the communications asset and their staff during installation and operation of the equipment.

7.2 Pole and Column Requirements

7.2.1 General Conditions

All carrier installations shall be designed so not to unduly interfere with Evoenergy activities during construction and maintenance of electricity networks. If an antenna is installed beneath an Evoenergy assets or streetlight outreach arms and connections, these locations could be subject to outages due to regular maintenance activities.

All designs shall be as per AS/NZ 7000 and as per the requirements of Evoenergy Standards.

Special design for the mounting of a transmitter may be required where an antenna is mounted below a mains circuit in order to provide access to Evoenergy assets by ladder for maintenance purposes. Permission for these installations will be on a case-by-case basis.

Any future corrective action required on the structure, due to pole foundation movement that has been established as caused by the addition of a carrier's equipment, shall be for the carrier's expense.

TABLE 5. SCHEDULE OF REFERENCES

VOLTAGE	INSULATION	LOCATION OF TRANSMITTER	CLEARANCE FROM TRANSMITTER TO THE LOWEST CIRCUIT
33 kV – 132 kV	Not allowed	Not allowed	Not allowed
11 kV – 22 kV	Bare, ABC and CCT	Below	2.1 m
LV and Street lights	Bare, ABC and Insulated Street Light	Below	0.75 m
BCC	Insulated	Above or below	0.3 m

Notes: Antennas are not permitted above bare conductors on tower structures.

7.2.2 Multi Circuit Poles

The antenna shall be installed below the lowest circuit and the clearance of this circuit, as indicated in Table 5, shall apply.

7.3 Attachment of Line Power Supplies

Where it is necessary to provide line power supplies to drive amplifiers and it need to be powered by the low voltage electricity system, this will be subject to an Evoenergy supply agreement.

Any devices that are required for the cable TV network will need to be powered by the low voltage electricity system, and will be subject to a special supply agreement with Evoenergy.

It is critical that the location of these devices is recorded in Evoenergy network data system. The communication hardware and associated power supply equipment shall be located:

- Outside the vertical exclusion zone distance for the type of antenna installed
- A minimum of 3.0 metres from the bottom of the equipment and ground. If this cannot be achieved, the hardware may be installed lower, however, a clearance of 3.0 metres above the equipment is required.

7.4 Prohibited Locations

- Antenna and associated equipment shall not be installed in the following situations:
- On conductive structures
- On hinged streetlight columns
- Where the non-industry worker emission zone from the antenna comes within 500 mm of where a worker can be during works on Evoenergy assets.
- Pole mounted substations
- Pole mounted automated switching equipment
- Pole mounted capacitors banks
- HV switching equipment
- Tee-off and UG/OH poles
- Above bare, covered and PVC insulated conductors (not including on tower installations)
- Any Evoenergy cross-arms

Evoenergy network communications equipment associated with the electricity distribution network shall not be subject to the restrictions as listed above provided relevant clearances are maintained as per the applicable standards.

7.5 Relocation and Modification of Current Evoenergy Network

7.5.1 Cell Owner Requested

At the request and expense of the owner, Evoenergy can carry out relocation and modification works on structures. The telecommunications owner may negotiate the relocation of other assets, including communication assets, which may be already attached to the pole. The cell owner will be required to get an agreement from all owners affected.

Where no alternative structure exists, a carrier may propose a different overhead construction of an Evoenergy structure to be able to install their communications equipment. Any changes will be for the account of the cell owner

7.5.2 Evoenergy Initiated Network Changes

Evoenergy reserves the right to change its structure at any time. In the situation where a cell owner's transmitters are attached to a structure, which needs to be modified, the cell owner shall be notified and has the responsibility to disassemble and remove the transmitter(s). The undergrounding of all electrical circuits would normally require the removal of all associated poles however, where the carrier requests, the pole ownership may be transferred to that carrier.

7.5.3 Multiple Antenna

When installing additional antenna on a structure, it is the responsibility of the carrier to Negotiate with owners of existing cells.

7.5.4 Mobile Cell Identification

The carrier shall clearly identify the cell by a nameplate, attached to the pole or to hardware on the pole. The nameplate shall be readable from the ground with the following information included:

- The name of the carrier owner.
- The carrier's Network Operations Centre phone number.
- The carrier's Site Reference Number

8. VERSION HISTORY

REV	DATE	CHANGE MADE
1	22 March 2017	Initial document
2	15 September 2017	Minor amendment (Section 7.1)
3	15 January 2018	Minor amendments (Rebranding)
3.1	17 January 2019	Disclaimer, note and copyright added

APPENDIX A – DRAWING 390-018

A copy of the aforementioned documentation has been included in this appendix for information as identified within this standard. The attached documentation is current as at the date of the standard and may be subject to amendment outside of this standard. Evoenergy does not warrant the accuracy of the content. The BCC shall be responsible for obtaining the current copy of all appended information directly from Evoenergy.

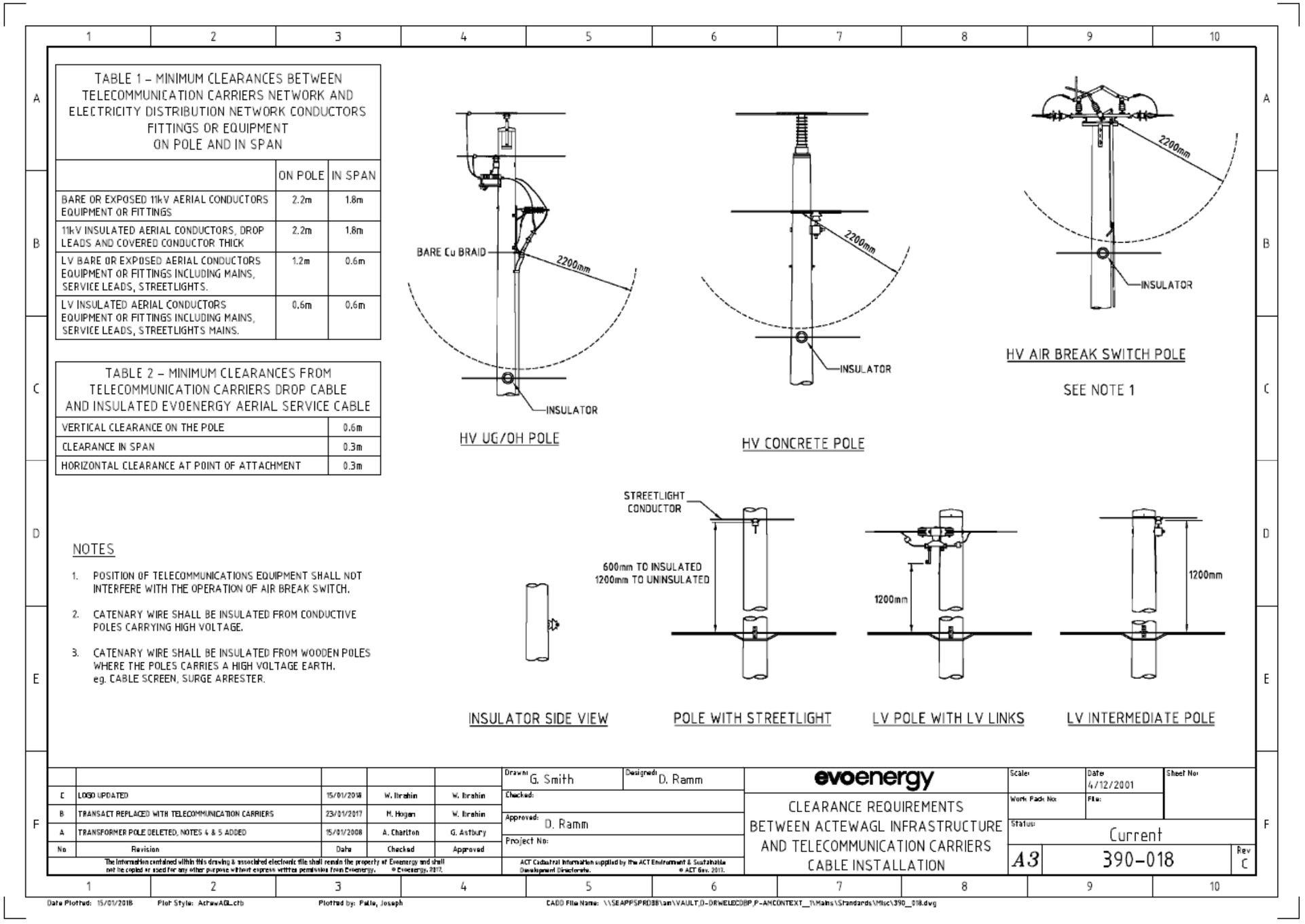


TABLE 1 – MINIMUM CLEARANCES BETWEEN TELECOMMUNICATION CARRIERS NETWORK AND ELECTRICITY DISTRIBUTION NETWORK CONDUCTORS FITTINGS OR EQUIPMENT ON POLE AND IN SPAN

	ON POLE	IN SPAN
BARE OR EXPOSED 11kV AERIAL CONDUCTORS EQUIPMENT OR FITTINGS	2.2m	1.8m
11kV INSULATED AERIAL CONDUCTORS, DROP LEADS AND COVERED CONDUCTOR THICK	2.2m	1.8m
LV BARE OR EXPOSED AERIAL CONDUCTORS EQUIPMENT OR FITTINGS INCLUDING MAINS, SERVICE LEADS, STREETLIGHTS.	1.2m	0.6m
LV INSULATED AERIAL CONDUCTORS EQUIPMENT OR FITTINGS INCLUDING MAINS, SERVICE LEADS, STREETLIGHTS MAINS.	0.6m	0.6m

TABLE 2 – MINIMUM CLEARANCES FROM TELECOMMUNICATION CARRIERS DROP CABLE AND INSULATED EVOENERGY AERIAL SERVICE CABLE

VERTICAL CLEARANCE ON THE POLE	0.6m
CLEARANCE IN SPAN	0.3m
HORIZONTAL CLEARANCE AT POINT OF ATTACHMENT	0.3m

NOTES

1. POSITION OF TELECOMMUNICATIONS EQUIPMENT SHALL NOT INTERFERE WITH THE OPERATION OF AIR BREAK SWITCH.
2. CATENARY WIRE SHALL BE INSULATED FROM CONDUCTIVE POLES CARRYING HIGH VOLTAGE.
3. CATENARY WIRE SHALL BE INSULATED FROM WOODEN POLES WHERE THE POLES CARRIES A HIGH VOLTAGE EARTH. eg. CABLE SCREEN, SURGE ARRESTER.

No	Revision	Date	Checked	Approved
C	LOGO UPDATED	15/01/2018	W. Ibrahim	W. Ibrahim
B	TRANSACT REPLACED WITH TELECOMMUNICATION CARRIERS	23/01/2017	M. Hogan	W. Ibrahim
A	TRANSFORMER POLE DELETED, NOTES 4 & 5 ADDED	15/01/2008	A. Charlton	G. Astbury

The information contained within this drawing & associated electronic file shall remain the property of Evoenergy and shall not be copied or used for any other purpose without express written permission from Evoenergy. © Evoenergy, 2017.

Drawn: G. Smith | Designed: D. Ramm | Checked: | Approved: D. Ramm | Project No:

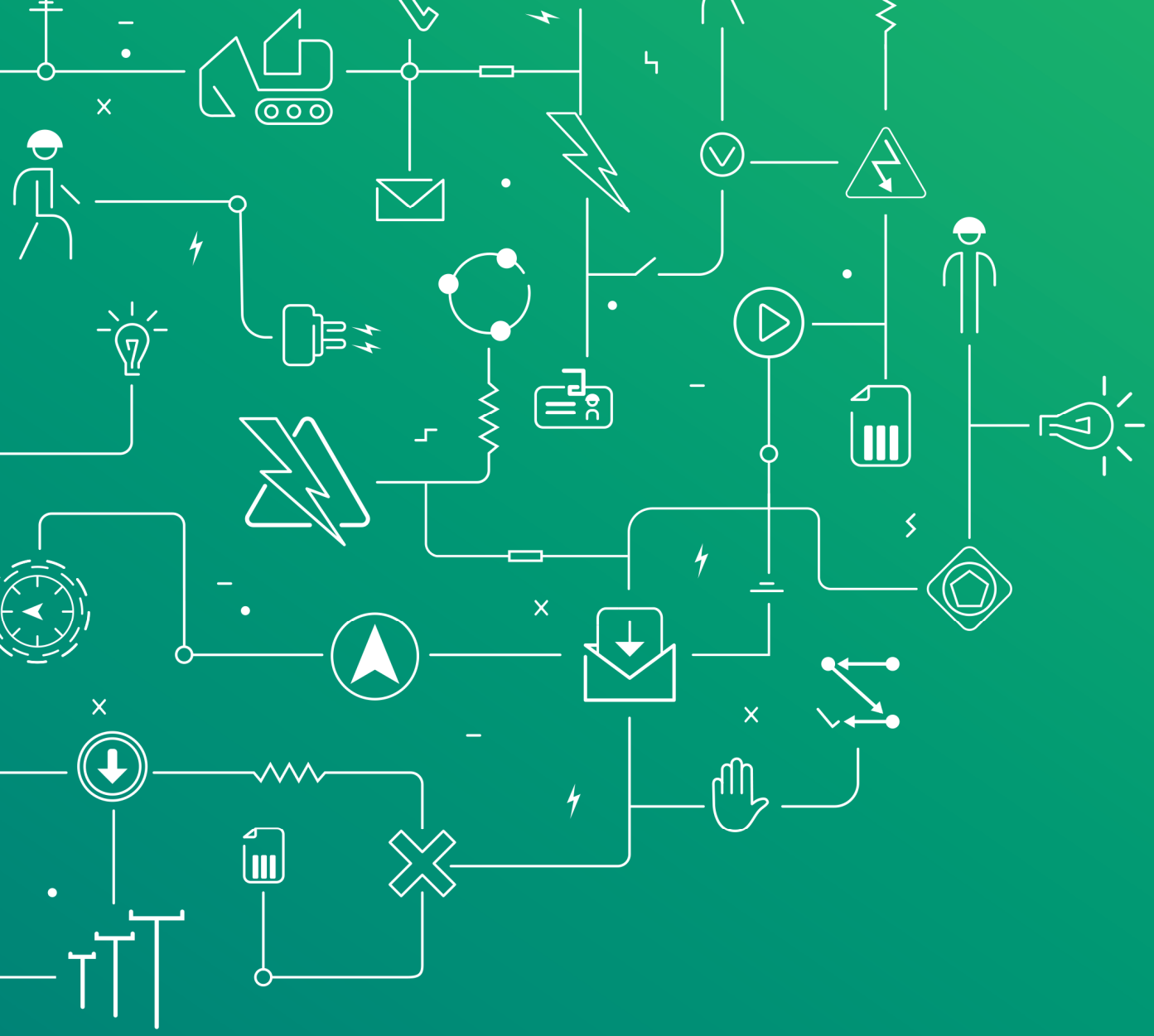
ACT Cadastral information supplied by the ACT Environment & Sustainable Development Directorate. © ACT Gov. 2017.

evoenergy

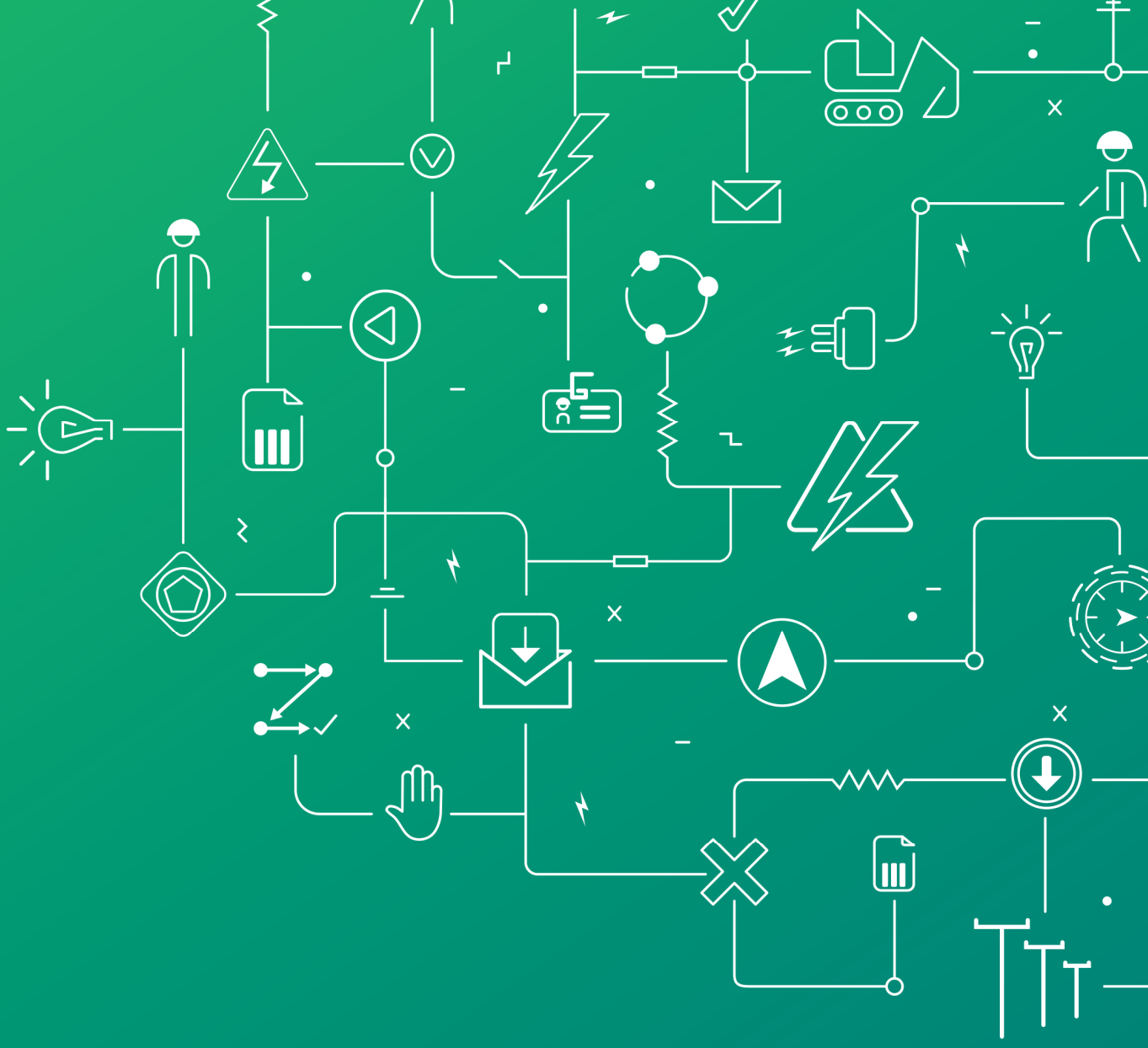
CLEARANCE REQUIREMENTS BETWEEN ACTEWAGL INFRASTRUCTURE AND TELECOMMUNICATION CARRIERS CABLE INSTALLATION

Scale: | Date: 4/12/2001 | Sheet No: | Work Pack No: | File: | Status: Current | A3 | 390-018 | Rev C

Date Plotted: 15/01/2018 Plot Style: ActewAGL.ctb Plotted by: Patle, Joseph CADD File Name: \\SEAPPSPRD38\am\VAULT,D=DRWELECDBP,P=AMCONTEXT_1\Mains\Standards\Misc\390_018.dwg



evoenergy

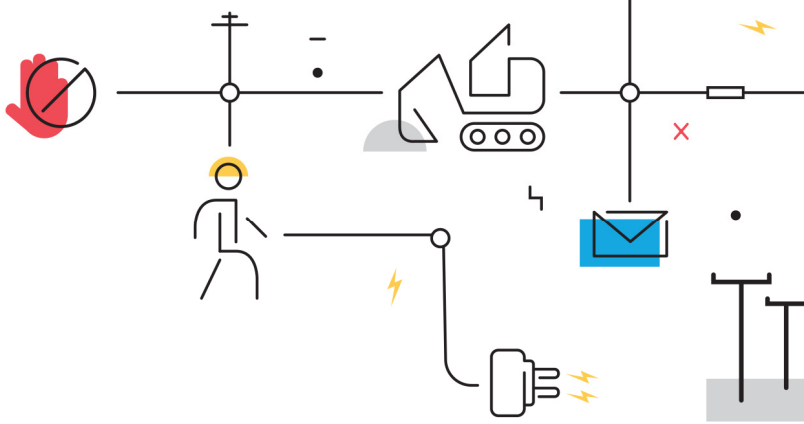


INSTALLATION REQUIREMENTS FOR TELECOMMUNICATION EQUIPMENT ON EVOENERGY ASSETS

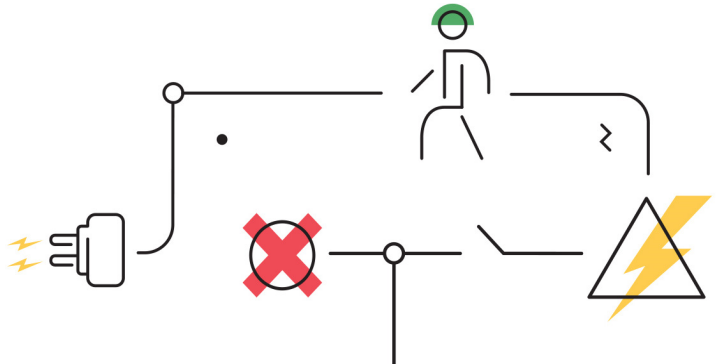
IMS DOCUMENT NUMBER: SM1311

JANUARY 2019 • SM1311 • VERSION 3.1

evoenergy



CONTENTS



Disclaimer

Whilst this document contains material relevant to the electricity industry legislation, codes of practice and standards, it is not intended to provide legal advice on how electrical contractors can meet their own statutory obligations or comply with legislation, codes of practice or industry standards such as AS/NZS 3000 (Wiring Rules). Whilst care has been taken in the preparation of this document, Evoenergy does not guarantee that the information contained in this document is accurate, complete or up to date at time of publication. To the extent permitted by the relevant legislation Evoenergy will not be responsible for any loss, damage, cost or expense incurred as a result of any error, omission or misrepresentation in relation to the information contained in this document.

Note

Printed versions of this document are “uncontrolled copies” - the latest version is available on the Evoenergy website.

Copyright

1. PURPOSE

This standard details the requirements for the attachment of third party communication equipment to Evoenergy assets.

The objective is to enable the installation of all communication equipment in a safe and efficient manner onto the Evoenergy network.

2. SCOPE

This standard specifies the acceptable positioning of both narrowband and broadband communication equipment and cables to all Evoenergy assets. These cables and equipment are generally installed to provide communication services, including cable television (CATV), telephone and interactive data services. Communication cables are both broadband and narrowband (self-supporting or integral bearer). Communication equipment will include mobile phone cells, transmitters/receivers and any other radio devices.

The requirements for working on telecommunication equipment installed on Evoenergy structures; or, working on Evoenergy structures that have telecommunications equipment are outside the scope of this standard.

Clearances, pole loadings and all other conditions must also continue to meet the requirements of this standard for the entire life cycle of the communication cable and equipment, including during maintenance and removal.

3. EXPENSES

In no case will any expense or fees incurred by the BCC in the preparation of any required assessments, studies, investigations and the like associated with this standard be borne by Evoenergy.

Evoenergy will neither be responsible for, nor pay for any expense or loss, which may be incurred by the BCC.

4. REFERENCES

TABLE 1. SCHEDULE OF REFERENCES

STANDARD	DESCRIPTION
AS/NZS 7000	Overhead line design, Detailed procedures.
SM 1138	Distribution Earthing Design and Construction Manual
SM 1139	Distribution Overhead Line Design Manual
SM 4605	Evoenergy Electrical Safety Rules
SM 1114	Evoenergy Service and Installation Rules
ESAA NENS 04	National Guidelines for Safe Approach Distances to Electrical Apparatus
ENA Doc 005	Joint use of power poles – Model agreement
Drawing 390-018	Clearance Requirements Between Evoenergy Infrastructure and Telecommunication Carriers Cable Installation

It is the responsibility of the communications designer to ensure the latest version of the appropriate standards and drawings referred to in this standard is used in all designs and calculations.

5. ABBREVIATIONS AND DEFINITIONS

TABLE 2. LIST OF ACROMYMS

TERM	DEFINITION
2CTW	2 Wire Twisted (1 phase) service
4CTW	4 Wire Twisted (3 phase) service
4WL	4 Wire Lateral (open wire 3 phase) service
AAAC	All Aluminium Alloy Conductor
AAC	All Aluminium Conductor
ABC	Aerial Bundled Conductor
ACSR	Aluminium Conductor Steel Reinforced
ACT	Australian Capital Territory
ADSS	All Dielectric Self-supporting (Communications cable—optical fibre)
AHD	Australian Height Datum
Al	Aluminium
Antenna	Transmitter, such as a wire or grid, sometimes mounted within a tube or panel, that emits and receives radio signals
Authorised person	A person with technical knowledge or sufficient experience who has been approved and authorised in writing by the Company to perform the function requiring authorisation.
BAZ	Bushfire Abatement Zone
BCC	Broadband Communication Cables
CATV	Cable television, that is, television provided by means of Broadband cable.
CBL	Calculated Breaking Load. In relation to a conductor, means the calculated minimum breaking load determined in accordance with the relevant Australian/New Zealand Standard.
CLAH	Current-limiting Arcing Horn, or gapped surge arrester
Communications Hardware	Communication hardware refers to the equipment associated with the transmitting device excluding the antenna, namely, the power supply, isolation device and any auxiliary equipment.
CSA	Cross-sectional Area

TERM	DEFINITION
Cu	Copper
EMF	Electromagnetic Field
Exclusion Zone	The safe working distance that has to be achieved from an energised radio frequency transmitter, which cannot be entered by any part of the body or metal object.
GL	Ground Level
HDC	Hard Drawn Copper
HV	High Voltage
IBC	Integrated bearer cable – an overhead cable used for telephone lines consisting of a metallic supporting strand or strands and a variable number of metallic telephone pairs
MEWP	Mobile elevated working platform
Microwave Dish	Dish-shaped transmitter device, used on some cells, that emits and receives radio signals that allow the cell to communicate with the telecommunications carrier's network
Mobile Phone Cell	Communications installation that communicates between mobile phones and the telecommunications carrier's network using radio signals
NENS	National Electricity Network Safety codes, issued by ENA
OPGW	Optical Ground Wire—an overhead earth wire with internal optical fibre/s
Radio transmitter	A device used to send radio signals. Such transmitters have associated communications hardware installed on the ground or the structure supporting the antenna
SC/GZ	Steel Conductor / Galvanized
SF	Safety Factor, also Strength Factor
SL	Street lighting
UG/OH	Underground to overhead transition structure
UTS	Ultimate Tensile Strength – the maximum mechanical load, which may be applied to a conductor, beyond which failure occurs.

6. CLEARANCES, SEPARATIONS AND ATTACHMENTS

6.1 General

Ground clearances for communications cables, structures attachment clearances, clearances between communication cable/equipment and electrical infrastructure, as well as safe working distances, shall not be reduced from those specified in this standard unless agreed to in writing by Evoenergy.

In the case of poles carrying 11 kV or 22 kV mains only, the minimum safe working distance is defined by Evoenergy - refer to Evoenergy drawing 390-018.

Before any communication cables or equipment are attached to an Evoenergy pole, a full detailed assessment of the pole strength is to be performed by the telecommunications provider. The proposed additional communication cable load, when combined with the existing electrical network conductor load, shall not exceed the rating of the pole under sustained loads and ultimate wind loads.

The pole strength shall be calculated in accordance with AS/NZS 7000 where the pole identification disk is not attached to the existing pole.

Where the communication provider has doubt concerning the condition of a pole, a special pole inspection shall be arranged at the expense of the telecommunications provider. Evoenergy authorised inspectors shall only carry out drilling of timber poles for the purpose of a pole decay assessment. Evoenergy must be notified prior to such assessment is carried out.

Evoenergy requires the following communication cable ground clearances.

TABLE 3. MINIMUM CLEARANCE REQUIREMENTS

CROSSING TYPE	MINIMUM CLEARANCE
Waterways	AS 6947
Ground clearance	AS7000
Railways and other utilities crossings.	Refer to relevant standards

All other clearances for telecommunication cables shall be in accordance with Evoenergy drawing 390-018.

6.2 Midspan Clearances

Midspan clearances between communication cables and the electrical infrastructure are to be determined under worst case operating conditions.

Clearances where a telecommunication cable is installed below electrical conductors are to be determined with the electrical network at maximum operating temperature and the communication cable at 5°C.

For ADSS cables installed above low voltage networks, where approval is given, a 0.1 m mid-span clearance must be maintained with both circuits at 5°C.

Crossing of communication cables between electrical network conductors is not permitted.

6.3 MEWP Access Window

A 600 mm attachment separation is required between an ADSS cable and LV ABC, bare LV or streetlight if the MEWP access window is 1500 mm. The ADSS cable is to be attached below the other cables.

Additionally, for an attachment above the LV, a minimum 1500 mm mid-span clearance to conductors for voltages up to 22kV located above the ADSS cable must be maintained with the electrical network at maximum operating temperature as specified by Evoenergy and the ADSS at 5°C.

6.4 Mains Ground Clearance

Mains ground clearances shall be as per AS/NZS 7000. If any locations are identified where clearances are not as per the latest standards, the designer shall determine if any remediation work to the existing overhead conductors will provide suitable ground and mid-span separation clearances to allow installation of communication assets. Works to be considered covers all available options including conductor re-tensioning, service main alterations and the replacement of the Evoenergy pole. The proposed remediation work is to be submitted to Evoenergy at the design stage for approval.

6.5 Asset Spacing

As a rule, all communications cables will be located lower than electricity cables/conductors and the only exception to this requirement shall be a non-conductive system where the cable may be permitted to be located above the service mains and street light cables/conductor. All proposals for this non-standard arrangement are to be submitted to Evoenergy for approval prior to works commencement.

Minimum separation distances between conductive communications cables and service cables are set out in Evoenergy drawing 390-018. In the case where there is the requirement for a second low voltage ABC to be installed where a single ABC exists additional allowances may be required for installation of communication assets.

6.5.1 Backyard Poles

In some ACT suburbs, the electricity supply to residential or commercial properties may be installed on poles located in the backyard of the property. All communications cable shall be installed facing the property side of the pole. Where multiple properties are supplied by a single pole, the communications cable owner shall decide the cable route for the length of the installation and ensure that all clearance requirements are met. The communications cable owner shall notify Evoenergy of the selected route.

6.5.2 Street Poles

All communications cable shall be installed on the roadside of the pole. Evoenergy may give approval for the attachment on the property side where road clearance may not be met under conductor blowout conditions if attached on the roadside.

6.6 Separation

6.6.1 Evoenergy Owned Poles

Evoenergy has installed non-conductive and conductive poles (steel reinforced concrete) in the electricity distribution systems. Hazardous voltages can be present on all types of poles during abnormal system conditions including, but not limited to; equipment failure, earth faults, weather conditions, etc.

When communication equipment is installed on:

- Conductive poles, equipment must be insulated to a minimum of
  - LV Pole (BIL 15kV)
  - 11 kV (BIL 95 kV)
  - 22 kV (BIL 150 kV)
- Conductive poles separately earthed (rural and urban) the equipment must be insulated to a minimum of
  - 11 kV (BIL 6.6 kV)
  - 22 kV (BIL 6.6 kV)
- Common earthed LV, 11kV and, 22 kV conductive poles, all metallic components of the communication cable and equipment can be bonded to the pole along with LV neutral.

During the installation process, allowance must be made for the any potential rises on poles and appropriate installation methods and safe working procedures shall be adhered to when working on or near them.

6.6.2 Metallic Fittings

Evoenergy poles may have unearthed, single insulated fittings installed, which can become live through the breakdown of the primary insulation (such as steel conduit, light fittings, street light outreach brackets and lantern choke boxes).

All persons working on structures must be made aware of the possibility of metallic fittings on non-conductive (wood and composite) poles becoming alive. Safe working procedures when working near unearthed, pole mounted, metallic fitting must be employed and shall include a voltage test to ensure that the work can be safely performed.

6.6.3 Service Cables

The minimum separation between service cables and conductive aerial communications conductors is as per Evoenergy drawing 390-018. Communication providers are not allowed to connect any cables to LV cross-arms.

Generally, Evoenergy aerial service cables are attached to the pole below LV mains. These cables are usually insulated; however, the minimum clearance between overhead service mains and aerial communication conductors is 600 mm.

The following situations, however, will require attention by those installing the communications cables if it is anticipated that BCC staff will be required to work within 500 mm of such wiring:

If there is exposed live metal, such as uninsulated connectors between mains and aerial service cables, those installing the communications cable shall cover the exposed metal with an Evoenergy approved insulating tape and a weatherproofing tape.

If the insulation on the service cables has deteriorated to the point that conductors are exposed, the overhead service to the customer will need to be replaced with a multi- core aerial bundled conductor. This type of insulation failure must be reported to Evoenergy immediately for remedial work.

If the number of services taken from a pole is large, and/or the connections between service conductors and the mains are untidy, the aerial service cables may impact upon the desired BCC location. The standard Evoenergy notification and outage processes to be followed to allow Evoenergy to carryout any remedial work.

6.7 Existing Infrastructure

The Evoenergy network will continue to have enhancements carried out in order to provide a more reliable and safe electrical distribution system.

Evoenergy reserves the right to change its structures at any time. In the situation where a telecommunications carrier's cable or equipment are attached to a structure, which needs to be modified, the owner shall be notified. If Evoenergy deem the cable/equipment needs to be adjusted or removed from the structure, the telecommunication carrier shall carry out these works at their own cost.

Existing electricity and communication infrastructure, which may not comply with the latest standards, may be deemed acceptable except where a specific risk may be posed to Evoenergy staff or the public. New and replaced communication cables and constructions shall comply with the requirements of the latest standards.

6.8 Training

All persons working on Evoenergy poles near live mains must be authorised persons with appropriate accreditation for working on pole tops and with optic fibre cables.

The communications provider shall ensure that all personnel working on Evoenergy poles for the attachment of communications infrastructure would receive suitable training and familiarisation including but not limited to:

- Evoenergy Electrical Safety Rules (Bluebook)
- Evoenergy Access Permit Requirements
- Evoenergy Network Outage Notification Lead Times
- Identification of voltages and mains types
- Knowledge of the hazards associated with pole top work
- Identification of suspect and condemned poles
- Working with fibre optic cables, NENS 04-2006 safe working distances
- Knowledge of the hazards associated with stringing communication cables beneath energised electricity conductors
- Awareness and knowledge of this Standard
- Any other
- required training

Required training can be obtained from industry training centres, including Evoenergy upon request and at an appropriate charge.

6.9 Tools and Equipment

All tools and equipment shall be kept in good working condition so that they are safe to use at all times. Tools, plant and equipment that require inspection shall be current in their period of inspection and tagged/logged accordingly.

MEWP and other equipment used by communication cable owners and their contractors shall be rated in accordance with standards issued by Standards Australia. A copy of the valid test certificates for all equipment must be available on request.

Work Safe ACT's guidance note, '*Working near Overhead Powerlines'*, will be applicable for all MEWP, cranes, plant, vehicles, individual's tools and equipment used on or near Evoenergy electrical network.

6.10 Safe Approach Distances

Clearances in the Evoenergy Electrical Safety Rules must be maintained and all conductors, including insulated/covered conductors, shall be treated as energised.

6.11 Non-conductive Networks

It shall be the responsibility of the BCC system owner to satisfy Evoenergy that the system is non-conductive and provide a statement before the attachment of such a system to the Evoenergy network.

6.12 Special Situations

6.12.1 UG/OH Poles

Electricity cables rising up the pole do not pose any particular problem for the attachment of a steel catenary cable to the pole. To provide additional protection however, a non-conductive section guard is to be fitted to Evoenergy UG/OH cables centred on the BCC attachment point. This work shall be carried out by Evoenergy personnel with all costs at the communications carrier's expense. For these poles, a clearance of 150 mm from parts with single insulation or covering shall be maintained.

6.13 Restricted Constructions

6.13.1 Pole Mounted Substations and Automated Switching Equipment

No communications cables or equipment are to be installed on pole mounted substation or automated switching equipment. In these situations the communications cable must be installed on a freestanding pole providing 2200 mm clearance between the substation or automated switching equipment or pass the pole as an underground cable.

6.13.2 Air Break Switches

Where an Air Break Switch (ABS) is currently installed, the telecommunication carrier must allow for the future replacement of an ABS with an automated switching device. In these circumstances, the clearance from the top of the pole to the communication cable shall be a minimum of three meters.

6.13.3 Transmission Structures

Telecommunication equipment shall not be attached to transmission structures (33kV to 132kV inclusive). Lines built for transmission but operating at lower voltages shall be treated as transmission lines for the purpose of this standard.

6.13.4 Streetlight Columns

Evoenergy do not own the ACT streetlight network. Any proposed telecommunications cable or equipment connection to a streetlight must be approved by the asset owner.

6.13.5 Aerial Splices

All splices shall be located in an underground pit. No splices shall be installed on the overhead network, due additional load on poles/structures, visual impact of splicing equipment and impediment to access for maintenance and operation of the Evoenergy distribution network.

6.13.6 Communication Equipment

Communications associated equipment must not be located on conductive poles without explicit written permission from Evoenergy for each pole. The telecommunications provider shall assess each concrete pole separately.

6.13.7 Private Poles

Evoenergy cannot provide approval to telecommunication carriers to install cable and equipment on these poles. The telecommunication carrier must negotiate directly with the owner of the pole to arrange access.

Notwithstanding this, the requirements of this standard still apply with respect to clearances and positioning of communications equipment relative to Evoenergy distribution mains or service cables/conductors.

6.14 Communication Hardware Attachment

6.14.1 Wood Poles

BCC infrastructure generally will be attached to the pole clamping the steel catenary to a king bolt on wood poles.

The communications cable, network amplifiers, and service tap boxes (which service individual customers) are attached to the catenary at a distance approximately 1.2 metres from the pole.

For non-conductive systems, the cable shall be supported by LV ABC hook-bolts and suspension clamps mounted on the pole. Connection to the LV cross-arm will only be allowed for Evoenergy ADSS. Cable terminations/strain constructions shall be attached to the poles by means of either LV ABC hook-bolts or eyebolts.

6.14.2 Other Poles

All connections on composite poles should be by means of an approved catenary clamp. Care must be taken to prevent any damage to the gel-coating during the installation of communication equipment. Under no circumstances, shall communications cabling/equipment installers drill any holes in to concrete, steel or composite poles.

On conductive pole, the communications cable will be attached in a manner agreed to by Evoenergy, such as stainless steel strapping around the pole.

Table 4 provides the acceptable methods of attachment.

TABLE 4. METHOD OF ATTACHMENT

POLE MATERIAL TYPE	TELECOMMUNICATIONS CABLING	TELECOMMUNICATIONS HARDWARE
Wood	Support Bracket attached with bolts. These fixtures shall be UV stabilised and not be affected by temperature cycle brittleness	Attached by 12mm x 75mm long galvanised coach bolts.
Fibre-Reinforced Composite (FRC)	Support Bracket attached with stainless steel straps. These fixtures shall be UV stabilised and not be affected by temperature cycle brittleness	Attached by stainless steel straps.
Steel	Support Bracket attached with stainless steel straps. (kingbolt hole not available) These fixtures shall be UV stabilised and not be affected by temperature cycle brittleness	Attached by stainless steel straps. (where a kingbolt hole is not available)
Concrete	Support Bracket attached with stainless steel straps. (kingbolt hole not available) These fixtures shall be UV stabilised and not be affected by temperature cycle brittleness	Attached by stainless steel straps. (where a kingbolt hole is not available)

POLE MATERIAL TYPE	TELECOMMUNICATIONS CABLING	TELECOMMUNICATIONS HARDWARE
Other Information	Catenary shall be isolated from HV Conductive Poles with an insulator capable of withstanding the Pole's EPR under all weather and pollution conditions – with the following specs: - Wet power frequency withstand voltage of 28kV for 1 minute; - Dry power frequency withstand voltage of 28kV for 1 minute; - Lightning impulse withstand voltage of 95kV; - Flashover distance > 120mm; - Creepage distance > 230mm; - Cantilever strength of 6 kN. The catenary shall be attached to wooden Poles via an insulator where that Pole carries a HV earth conductor down the Pole, i.e. cable screen, switch earth, surge arrester earth etc.	All metallic equipment shall be either hot dipped galvanised or treated by other Evoenergy approved methods to prevent corrosion. The attachment brackets, clamps, ancillary hardware and equipment must not interfere with existing installation and the Operations. The attachment brackets, clamps, ancillary hardware and equipment must also be able to be detached from the Pole with the use of standard hand tools.

6.15 Earthing of Communication Equipment

When the communication cable system installed adjacent to electricity aerial mains has metallic components such as sheath and catenary, these are required to be earthed at regular intervals. The External Telecommunications Carrier must design, install and maintain the earthing system to be sufficiently robust and well configured to maintain safety from hazardous voltages.

Evoenergy Earthing standard requires compliance with allowable step and touch potential as per AS/NZS7000. Evoenergy may permit BCC (including sheath and catenary) to be connected to the MEN system (LV neutral) to form one earthing system for electricity and BCC systems. This earth sharing arrangement is only allowed in common earthed areas where the LV neutral (MEN) is connected with a large number of customer's MEN.

Any situation that would not comply with this earthing requirement shall be brought into line with this standard or removed at the expense of the BCC installer.

6.16 Mechanical Protection of Communications UG/OH Cables

Communication cable shall be mechanically protected with a non-conductive material where it is likely that it will be damaged due to Evoenergy operations. Evoenergy takes no responsibility for damage to any unprotected cables during Evoenergy's normal operational activities.

Mechanical protection is required on all poles for all cables forming part of an overhead to underground connection, as follows:

- Suitable mechanical protection is required to be attached to the pole from a depth of 500 mm below ground to 4 m above ground level.
- Connection pits in the ground near poles must be a minimum of 1500 mm from pole.

Mechanical protection (conduit, U guard or similar) is required to protect telecommunications cables that run up the pole where a ladder or pole platform may be placed for work on the pole, its equipment or mains.

This is required from 500 mm below the highest electricity mains on the pole to at least 2500 mm below the lowest electricity mains on the pole.

6.17 Hazards

6.17.1 Safety Hazards

Evoenergy may restrict the attachment of communications equipment to its network at any location deemed unsafe. This includes condemned or nailed poles, poles in a less than satisfactory state of repair or condition, and termite affected poles. This may be due to:

- Access, maintenance or operational difficulty
- Environmental risk
- Visual amenity or other community impact
- Future capital works
- Future customer connection or relocation works

6.17.2 Electrical

Electrical hazards that could be associated with the installation of communications infrastructure include:

- earth return paths through coaxial cable screens due to open circuit neutrals or shared return paths during LV short circuits
- elevated neutral voltages
- power voltage injection
- voltage back-feed through communications system power supply transformers
- down earths on poles

Appropriate design, safety, training and risk management practices shall be implemented to prevent the exposure of these potential hazards to all staff, the community and equipment.

6.18 BCC Identification

The BCC owner shall at each pole, clearly identify the cable by an Evoenergy approved sign. Where a sign is installed for this purpose, it shall comply with the following requirements:

1. Up to a six (6) letter word or acronym identifying the owner of the cable only
2. A clear code to indicate the nature of the cable, NC for a non-conductive cable, and C for a conductive cable
3. Mounting of signs will be according to the methods set out in Table 4. Attachment using cable ties is not acceptable. Attachment to poles to be approximately 100mm below the cable
4. The sign material shall be aluminium sheet with an edge sealer
5. Reflective Class 2 individual numbers and letters, 30 mm high, are required.
6. The sign shall not impact any works to be carried out on Evoenergy assets by Evoenergy staff.

6.19 Make Ready Preparation Requirements

In some instances, there will be a requirement for redressing or replacement of some Evoenergy aerial facilities before they will be suitable for the attachment of communication infrastructure. The communication cable owner is responsible for all costs associated with this make ready work.

6.19.1 Pole Replacements

The agreements between various communication cable owners and Evoenergy define the process to be followed by both Evoenergy and the communication cable owners' staff. In general, Evoenergy staff are not permitted to interfere with the communication cable owners' equipment and cabling. The communication cable owner will make arrangements for the relocation of their assets where reasonable notice of the proposed works is given. The current arrangement with telecommunication provider's equipment is that Evoenergy staff will remove equipment from existing poles and tie/strap it to the new pole. Evoenergy will notify the relevant telecommunications provider who shall affix it as per the requirements of this standard. Replacement poles will generally be installed in the same position as the previous poles.

The BCC owner shall meet any requirement for the replacement of a pole for either clearance requirements or mechanical loadings due to the attachment of communication infrastructure, the cost of the pole replacement and associated works. In addition, any requirement to straighten leaning poles prior to the attachment of communication infrastructure shall be the responsibility of the communication cable owner.

The installation of a communication cable onto the electrical network shall utilise the existing poles where possible. Any requirement for the installation of additional network poles and stay poles is to be avoided and will only be approved if no other practical alternative arrangement is available

The conditions as stated in the agreements between various communication cable owners and Evoenergy set out the process to be followed by both Evoenergy staff and the various communication cable owners' staff.

6.19.2 Evoenergy Requirements

If Evoenergy choose to remove an overhead section of overhead mains line and replace it with an underground section the telecommunication has two options:

- BCC owner can take ownership of the pole
- Augment the telecommunications line underground

Any cost associated with the changes will be for the account of the communications owner.

Any upgrading of the network proposed by the BCC owner shall allow for any future proposal that Evoenergy may have for that structure. Evoenergy's right to install a structure on public land is dependent upon its use for electricity distribution. Undergrounding of all electrical circuits may require removal of the pole, or transfer of its ownership to the carrier.

6.19.3 Pole Movement with Existing Communication Cables

The variable nature of ground conditions and pole footings may prevent their accurate assessment at the time of assessing a pole's suitability for carrying communication cables. All costs are to be borne by the communication cable owner in the case where any corrective action is required to any infrastructure following the installation of communications cables.

6.20 General Requirements

6.20.1 Network Records

The communication cable owner shall provide GIS data in electronic format of the proposed alteration and additions in a form compatible with the Evoenergy GIS.

Annual rental received by Evoenergy is determined from Evoenergy network data and mapping records, which contain details of the communications networks. Evoenergy is to be informed within 30 business days when attachments occur to ensure the correct rental assessment.

6.20.2 Tree Trimming

Evoenergy maintenance crews do not make allowance for communication cables in the extent of the tree trimming undertaken. Any requirement by communications infrastructure owners for the trimming of trees, if any, will only be done if payment for such work is negotiated separately.

6.20.3 Aesthetics

Evoenergy is aware that its overhead electricity network will be implicated in any adverse community reaction due to the addition of communication infrastructure and accordingly, the telecommunications owner and Evoenergy staff involved in this exercise are to ensure the completed network is as aesthetically pleasing as possible.

The communication cable owner shall obtain the required approvals from the relevant authority and inform the residents before proceeding with the installation of any communications equipment. Evoenergy shall be provided this information prior to any works commencing.

7. ATTACHMENT OF COMMUNICATION TRANSMITTERS

7.1 Suitability of Structures

In order to ensure the minimum disruption to its customers Evoenergy retains the right to use its structures primarily for the purpose of the distribution of electricity.

The suitability of an Evoenergy structure for communication equipment will depend upon but not limited to the following:

- The possible impact of the equipment on Evoenergy ability to perform its operation of its network
- Evoenergy's future plans for augmentation, relocation and maintenance of the electricity network
- The proposed additional loading due to the communication equipment and the mechanical strength of the pole structure. All designs and calculations shall be submitted with all application showing the structure can support the additional mechanical load as per AS/NZS 7000

In addition to the above, some sites may have further restrictions and limitations due to unavoidable emergency outages, higher voltage and higher power capacity sites tend to be more critical.

The carrier's application shall include consideration of voltage rise, the imposed step and touch potentials due to fault conditions on the electricity network at the structure and the impact on the communications asset and their staff during installation and operation of the equipment.

7.2 Pole and Column Requirements

7.2.1 General Conditions

All carrier installations shall be designed so not to unduly interfere with Evoenergy activities during construction and maintenance of electricity networks. If an antenna is installed beneath an Evoenergy assets or streetlight outreach arms and connections, these locations could be subject to outages due to regular maintenance activities.

All designs shall be as per AS/NZ 7000 and as per the requirements of Evoenergy Standards.

Special design for the mounting of a transmitter may be required where an antenna is mounted below a mains circuit in order to provide access to Evoenergy assets by ladder for maintenance purposes. Permission for these installations will be on a case-by-case basis.

Any future corrective action required on the structure, due to pole foundation movement that has been established as caused by the addition of a carrier's equipment, shall be for the carrier's expense.

TABLE 5. SCHEDULE OF REFERENCES

VOLTAGE	INSULATION	LOCATION OF TRANSMITTER	CLEARANCE FROM TRANSMITTER TO THE LOWEST CIRCUIT
33 kV – 132 kV	Not allowed	Not allowed	Not allowed
11 kV – 22 kV	Bare, ABC and CCT	Below	2.1 m
LV and Street lights	Bare, ABC and Insulated Street Light	Below	0.75 m
BCC	Insulated	Above or below	0.3 m

Notes: Antennas are not permitted above bare conductors on tower structures.

7.2.2 Multi Circuit Poles

The antenna shall be installed below the lowest circuit and the clearance of this circuit, as indicated in Table 5, shall apply.

7.3 Attachment of Line Power Supplies

Where it is necessary to provide line power supplies to drive amplifiers and it need to be powered by the low voltage electricity system, this will be subject to an Evoenergy supply agreement.

Any devices that are required for the cable TV network will need to be powered by the low voltage electricity system, and will be subject to a special supply agreement with Evoenergy.

It is critical that the location of these devices is recorded in Evoenergy network data system. The communication hardware and associated power supply equipment shall be located:

- Outside the vertical exclusion zone distance for the type of antenna installed
- A minimum of 3.0 metres from the bottom of the equipment and ground. If this cannot be achieved, the hardware may be installed lower, however, a clearance of 3.0 metres above the equipment is required.

7.4 Prohibited Locations

- Antenna and associated equipment shall not be installed in the following situations:
- On conductive structures
- On hinged streetlight columns
- Where the non-industry worker emission zone from the antenna comes within 500 mm of where a worker can be during works on Evoenergy assets.
- Pole mounted substations
- Pole mounted automated switching equipment
- Pole mounted capacitors banks
- HV switching equipment
- Tee-off and UG/OH poles
- Above bare, covered and PVC insulated conductors (not including on tower installations)
- Any Evoenergy cross-arms

Evoenergy network communications equipment associated with the electricity distribution network shall not be subject to the restrictions as listed above provided relevant clearances are maintained as per the applicable standards.

7.5 Relocation and Modification of Current Evoenergy Network

7.5.1 Cell Owner Requested

At the request and expense of the owner, Evoenergy can carry out relocation and modification works on structures. The telecommunications owner may negotiate the relocation of other assets, including communication assets, which may be already attached to the pole. The cell owner will be required to get an agreement from all owners affected.

Where no alternative structure exists, a carrier may propose a different overhead construction of an Evoenergy structure to be able to install their communications equipment. Any changes will be for the account of the cell owner

7.5.2 Evoenergy Initiated Network Changes

Evoenergy reserves the right to change its structure at any time. In the situation where a cell owner's transmitters are attached to a structure, which needs to be modified, the cell owner shall be notified and has the responsibility to disassemble and remove the transmitter(s). The undergrounding of all electrical circuits would normally require the removal of all associated poles however, where the carrier requests, the pole ownership may be transferred to that carrier.

7.5.3 Multiple Antenna

When installing additional antenna on a structure, it is the responsibility of the carrier to Negotiate with owners of existing cells.

7.5.4 Mobile Cell Identification

The carrier shall clearly identify the cell by a nameplate, attached to the pole or to hardware on the pole. The nameplate shall be readable from the ground with the following information included:

- The name of the carrier owner.
- The carrier's Network Operations Centre phone number.
- The carrier's Site Reference Number

8. VERSION HISTORY

REV	DATE	CHANGE MADE
1	22 March 2017	Initial document
2	15 September 2017	Minor amendment (Section 7.1)
3	15 January 2018	Minor amendments (Rebranding)
3.1	17 January 2019	Disclaimer, note and copyright added

APPENDIX A – DRAWING 390-018

A copy of the aforementioned documentation has been included in this appendix for information as identified within this standard. The attached documentation is current as at the date of the standard and may be subject to amendment outside of this standard. Evoenergy does not warrant the accuracy of the content. The BCC shall be responsible for obtaining the current copy of all appended information directly from Evoenergy.

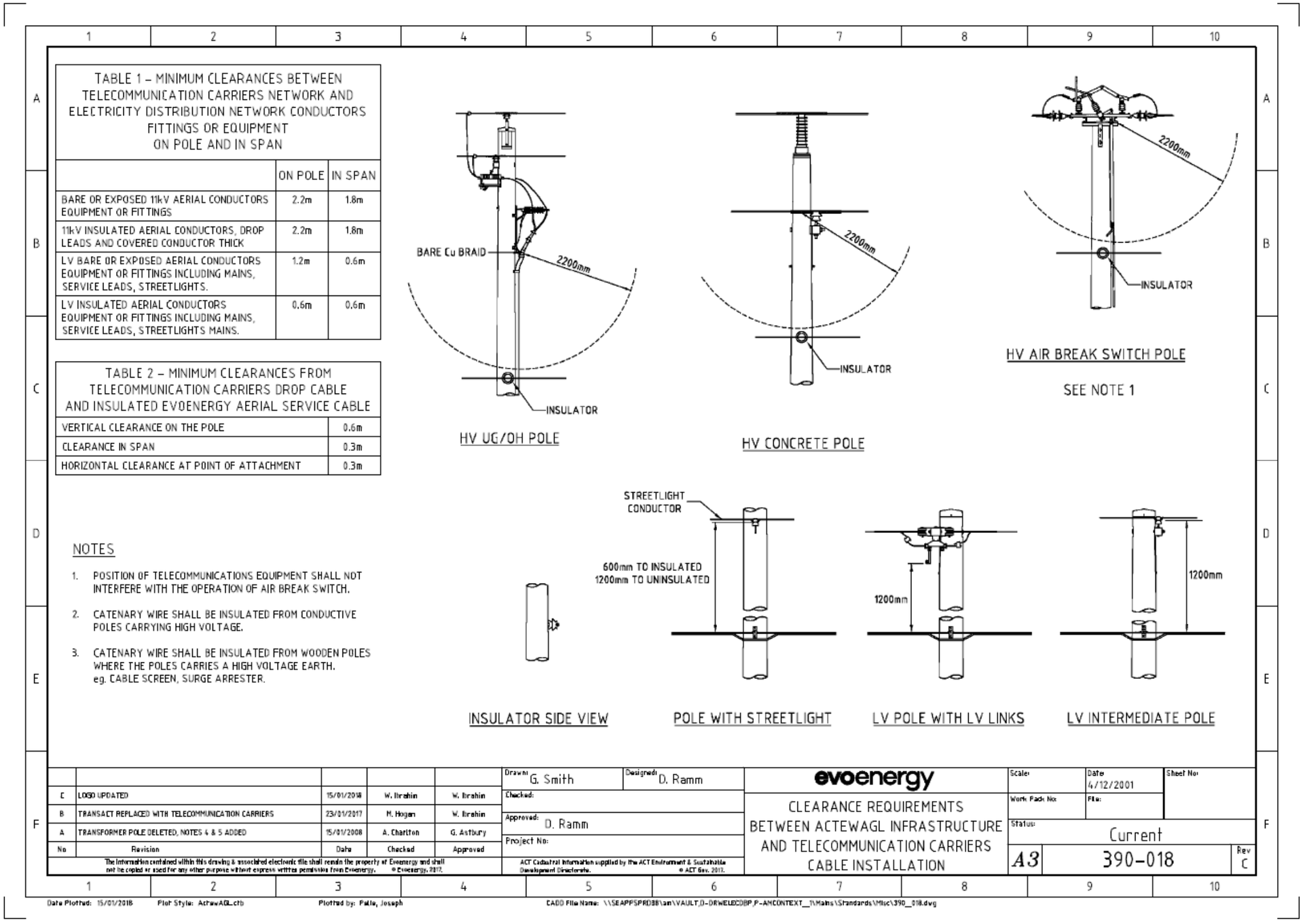


TABLE 1 – MINIMUM CLEARANCES BETWEEN TELECOMMUNICATION CARRIERS NETWORK AND ELECTRICITY DISTRIBUTION NETWORK CONDUCTORS FITTINGS OR EQUIPMENT ON POLE AND IN SPAN

	ON POLE	IN SPAN
BARE OR EXPOSED 11kV AERIAL CONDUCTORS EQUIPMENT OR FITTINGS	2.2m	1.8m
11kV INSULATED AERIAL CONDUCTORS, DROP LEADS AND COVERED CONDUCTOR THICK	2.2m	1.8m
LV BARE OR EXPOSED AERIAL CONDUCTORS EQUIPMENT OR FITTINGS INCLUDING MAINS, SERVICE LEADS, STREETLIGHTS.	1.2m	0.6m
LV INSULATED AERIAL CONDUCTORS EQUIPMENT OR FITTINGS INCLUDING MAINS, SERVICE LEADS, STREETLIGHTS MAINS.	0.6m	0.6m

TABLE 2 – MINIMUM CLEARANCES FROM TELECOMMUNICATION CARRIERS DROP CABLE AND INSULATED EVOENERGY AERIAL SERVICE CABLE

VERTICAL CLEARANCE ON THE POLE	0.6m
CLEARANCE IN SPAN	0.3m
HORIZONTAL CLEARANCE AT POINT OF ATTACHMENT	0.3m

NOTES

1. POSITION OF TELECOMMUNICATIONS EQUIPMENT SHALL NOT INTERFERE WITH THE OPERATION OF AIR BREAK SWITCH.
2. CATENARY WIRE SHALL BE INSULATED FROM CONDUCTIVE POLES CARRYING HIGH VOLTAGE.
3. CATENARY WIRE SHALL BE INSULATED FROM WOODEN POLES WHERE THE POLES CARRIES A HIGH VOLTAGE EARTH. eg. CABLE SCREEN, SURGE ARRESTER.

No	Revision	Date	Checked	Approved
C	LOGO UPDATED	15/01/2018	W. Ibrahim	W. Ibrahim
B	TRANSACT REPLACED WITH TELECOMMUNICATION CARRIERS	23/01/2017	M. Hogan	W. Ibrahim
A	TRANSFORMER POLE DELETED, NOTES 4 & 5 ADDED	15/01/2008	A. Charlton	G. Astbury

The information contained within this drawing & associated electronic file shall remain the property of Evoenergy and shall not be copied or used for any other purpose without express written permission from Evoenergy. © Evoenergy, 2017.

Drawn: G. Smith | Designed: D. Ramm | Checked: | Approved: D. Ramm | Project No:

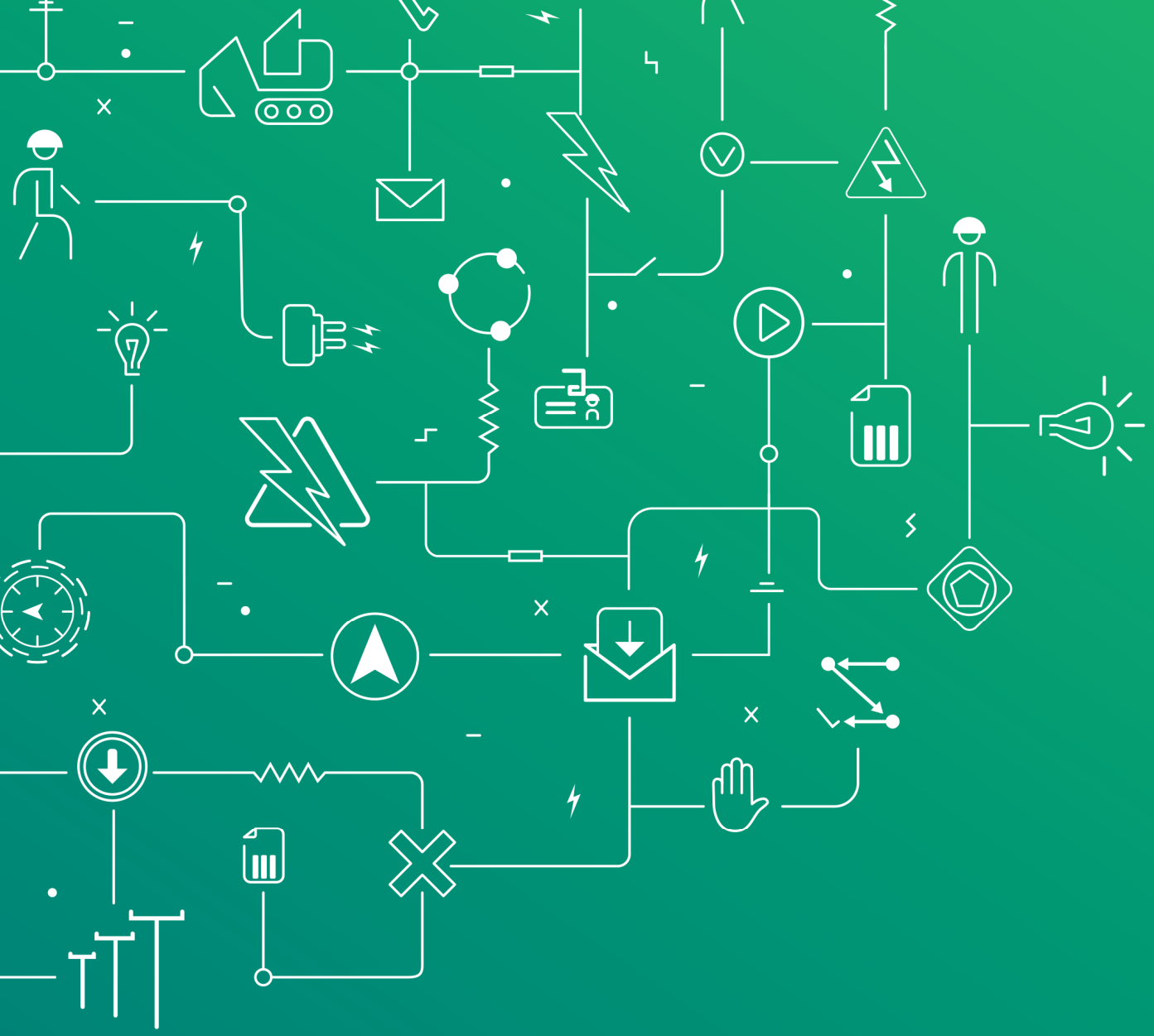
ACT Cadastral information supplied by the ACT Environment & Sustainable Development Directorate. © ACT Gov. 2017.

evoenergy

CLEARANCE REQUIREMENTS BETWEEN ACTEWAGL INFRASTRUCTURE AND TELECOMMUNICATION CARRIERS CABLE INSTALLATION

Scale: | Date: 4/12/2001 | Sheet No: | Work Pack No: | File: | Status: Current | A3 | 390-018 | Rev C

Date Plotted: 15/01/2018 Plot Style: ActewAGL.ctb Plotted by: Patle, Joseph CADD File Name: \\SEAPPSPRD38\am\VAULT,D=DRWELECDBP,P=AMCONTEXT_1\Mains\Standards\Misc\390_018.dwg



evoenergy

BLOG Fiber

Installing Aerial Fiber – What Are the Options?

Shaun Trezise 4 min read

Share:

In previous blogs we’ve covered the factors involved in choosing

- Ensure that the right-of-way is free of obstacles, like guy wires and trees.
- Gain permission from any property owners and relevant authorities if yo need to set up any equipment on private land.
- Make sure you have a properly trained and certified crew. They'll need t competent when working at heights, and have the right permits if **workin near power cables**. Also, aim to employ experienced linemen that understand the aerial environment and its particular challenges.
- Make sure all of the necessary environmental checks and provisions are addressed, including accounting for wind and ice loads, galloping and vibration.

Once you've completed the survey and gained all necessary permissions, you will need to decide whether you want to install the cable using stationary or moving reels.

Stationary Reel Placing Method

This method is generally used when cable is installed above existing lateral cable and other obstructions. The choice may also depend on the types of vehicles and

1. First, a series of temporary cable supports, chutes or tangent blocks are installed at each pole along the route.

2. Next, a pull line is threaded through the cable supports and attached to the outside of the cable using a breakaway swivel and a cable pulling grip.

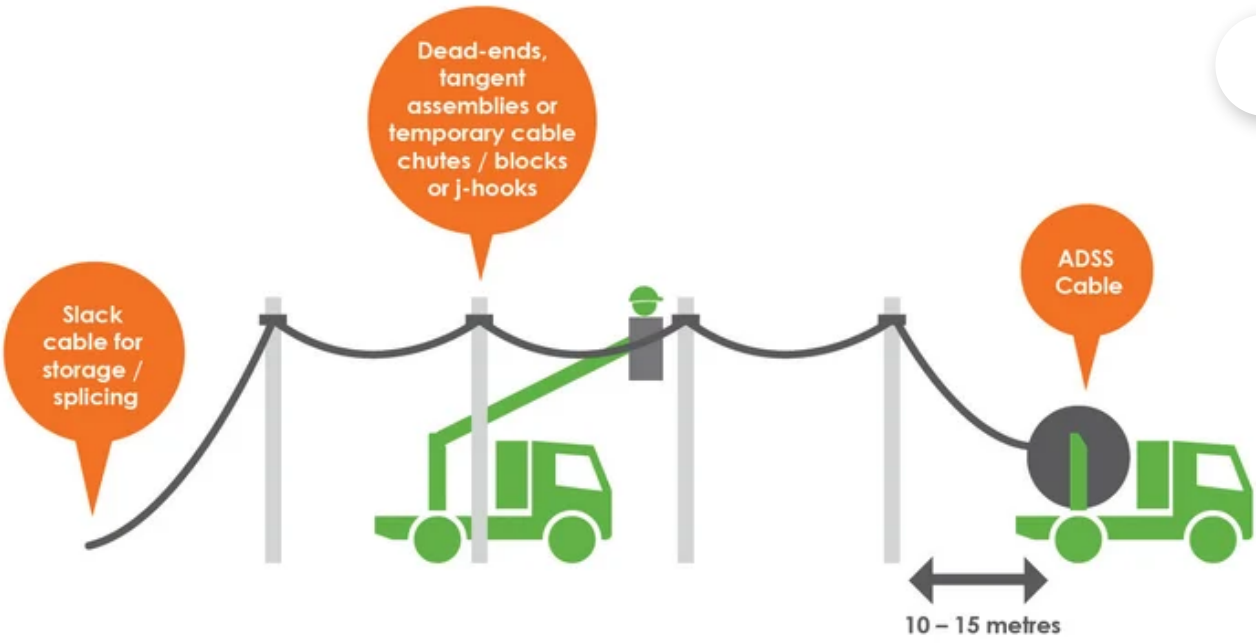
3. The pull line is then used to pull the cable through the cable blocks into position.

4. If the cable is pulled with a winch, the pulling rope or winch line must be installed through the cable supports. A non-metallic rope or winch line should then be used to pull the cable.

5. It is vital that the pulling winch be calibrated to stop the operation when the installation tension exceeds the maximum rated cable load (MRCL). If this type of winch isn't available, a dynamometer with an audible alarm or visual display should be used to monitor installation tension.

6. After the cable has been pulled into its final position, with slack for building access or for splicing, the cable should be tensioned until the correct sag level is

although often not possible for the entire cable deployment, and will invariably require some stationary reel placing. Deployment follows this sequence:



1. The cable reel should be mounted on a reel carrier on a cable trailer or aerial line truck.

2. The reel carrier should then be driven along the cable route.

What brings you to our website today?

- Product Information
- Company Information (contact, careers)
- Industry Information
- Other

7. Once the cable pay-off is an adequate distance past the next pole in the route, the cable should be raised to the required pole height and placed into a J ho temporary support.

8. The cable installation should then continue span by span until the entire ru completed and the final dead-end pole has been reached.

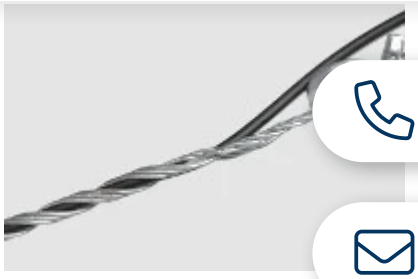
9. At this point the cable should be tensioned to the correct sag level using suitable chain hoist equipment at the "free" end of the cable, before it is dead-ended to the pole.

10. Once this has been done, the cable can be lifted out of the temporary J hooks or temporary supports and permanently fixed using tangent assemblies.

Choosing Dead-end Attachments

Perhaps the most widely used aerial hardware are dead-end attachments. Broadly speaking, there are two types - a formed wire design and the wedge anchor clamp type.

- What is the outer diameter of the cable being supported?
- What size is the overall budget for pole attachments?
- Is space prohibitive at the pole head?



Cable Termination Methods

Like every other fiber cable, aerial cable can be field spliced or deployed pre-terminated. Each method has its pros and cons. For the last drop especially, many network operators choose to use pre-terminated aerial cable because it eliminates the need for time-consuming and expensive fusion splicing. The main drawback to using pre-terminated cable is that there is almost always excess cable left over from installations.

Fusion splicing offers a high quality connection and little excess cable is left over once the process is complete. However, it is a time-consuming process and specialist equipment and experienced engineers are needed to carry it out. The whole process of preparing and splicing the fibers is made more difficult when the

Previous Post

Next Po

Related Posts

Broadband Bah Humbug? Give the Gift of Effortless Installs this Holiday Season

READ MORE

What are Hybrid Fiber Coax (HFC) Networks?

READ MORE

What brings you to our website today?

- Product Information
- Company Information (contact, careers)
- Industry Information
- Other

Dapo ADESINA

31/03/2019, 01:47:41

I find the information on your site quiet helpful. Meanwhile, I need additional information or aerial fiber route survey and deployment.

Reply to *Dapo ADESINA*

Krista Tysco

01/04/2019, 23:21:57

Thank you for your comment. Please email us at customerservice@ppc-online.com and our team would be happy to answer your questions about aerial fiber. Thank you.

Reply to *Krista Tysco*

Tactical fiber cable and reel

31/03/2023, 21:43:58

Installing aerial fiber cable is not that easy thing. When it is about various options, one needs to choose the best options for installing the cable and ensure that it is done properly. Thanks for sharing.
Tactical fiber cable and reel

What brings you to our website today?

- ◯ Product Information
- ◯ Company Information (contact, careers)
- ◯ Industry Information
- ◯ Other

marketing information related to their products, services and marketing events. I understand I may withdraw my consent at any time. Additional information regarding PPC's data privacy policies, including how to withdraw consent, is available at belden.com/privacy-policy.

Yes, I would like to receive marketing information from PPC Broadband

protected by reCAPTCHA
Privacy - Terms

SUBMIT COMMENT

SEARCH

Recent Posts

NY Governor Visits Belden, Announces Multimillion Dollar Award to Support Syracuse-based Growth Initiatives

What brings you to our website today?

- Product Information
- Company Information (contact, careers)
- Industry Information
- Other

Our monthly newsletter is the best way to keep up to date on all things PPC

SIGN UP

Posts by Topic

Fiber	(181)
Premises	(100)
Industry	(83)
Outside Plant	(51)
Coaxial	(46)
Exhibitions/Events	(41)
Corporate	(24)
Category	(6)

***W*hat brings you to our website today?**

- Product Information
- Company Information (contact, careers)
- Industry Information
- Other

SIGN UP

Products

Fiber

Coaxial

Category

Solutions

Headend / Central Office

Outside Plant

Customer Premises

Company

Our Story

Contact Us

Careers

What brings you to our website today?

- Product Information
- Company Information (contact, careers)
- Industry Information
- Other

» Forums » Telephony » Is the ISP actually required to tag the MDF?

Archive View Return to standard view

mdel I'm new here, please be nice

I have the (unfortunately well known) issue of 'hey my MDF isn't jumpered for my new connection' problem. O.P.

The problem is that there is no tag and the ISP said they did an 'electronic' connection. I assume this means the same as 'remote' connection. i.e. they didn't go anywhere near the property.

Now, I asked them what the Vertical pair number was, but they couldn't tell me (they didn't know). Now they want to send a tech out – with the warning that if 'the problem' is on my side of the MDF then it will cost me $220. Before this, I called a licensed cabler to do the jumping and he said they have to tag or provide vertical pair number.

My question is, is the ISP *required* to tag the MDF and/or provide this info by the law/regulation/rules? I've asked ACMA, but they take a few days to answer.

I want to know if I'm going to get stung for $220 if the jumping hasn't been done (which it hasn't) but couldn't have been done by a *much* less expensive tech *if* they provided the tag/pair info.

ref: posted 2015-Jul-2, 10:35 pm AEST

R4+Z In the penalty box

If there is no tag on the MDF and the ISP can't give you the pair numbers then I don't see how they can charge you. If they do simply take it to the TIO and I'm fairly sure the charges will get waived.

ref: posted 2015-Jul-2, 10:40 pm AEST

Boogmeister In the penalty box

If you have a voice service and your MDF isn't to big then your private tech should be able to find it without to much trouble (as long as it works).

Best bet is to make them send someone out to test and tag. That way it will definitely work.

Could also have you tech test and tag your side of the frame and the Telstra tech is "meant" to connect it while they are their.

ref: posted 2015-Jul-2, 11:14 pm AEST

kevinlms Whirlpool Forums Addict

Yes of course they need to either arrange to get the pair tagged or provide the information. Otherwise HOW do you expect anyone to be able to connect it up? Its like wanting work done at home, but refusing to give your home address!

Your registered cabler, is exactly right, if the information isn't provided, then he won't be able to do the job and will probably bill you for wasting his time, which is entirely fair as not his fault.

You need to be more forceful with your ISP and point out that they are the ones that need to provide the information (presumably the ISP isn't Telstra) and that normally they ask Telstra to provide it, because truly no else can know it.

Once on a Telstra line, I had the customer ring up Telstra & I got the call taker to read out all the info on her screen, until she got to the vertical & pair numbers (there were about 400 pairs – so without this information, it was impossible), but only direct Telstra customers can find out this way!

I would suggest, if your ISP plays the buck shifting game any more, that you reconsider whether they're competent and whether a naked service is the right service. You haven't SAID its naked, but you questions are typical of one!

ref: posted 2015-Jul-2, 11:21 pm AEST

Matthew Solly Whirlpool Enthusiast

> **mdel writes...**
>
> Now, I asked them what the Vertical pair number was, but they couldn't tell me (they didn't know).

The Vertical pair details aren't stored anywhere, but the service provider should have access to the termination cable, box and pair in Telstra's cable records. A certified technician will be able to find the appropriate pair at the MDF based on this.

> , is the ISP required to tag the MDF and/or provide this info by the law/regulation/rules?

The service provider is not required to leave a tag for a remote connection. If you want one placed, you'd need to pay the additional cost for a tech to visit at the time of connection (usually $125 vs $59 but it depends on the type of service you applied for).

ref: posted 2015-Jul-2, 11:35 pm AEST

spidermun Whirlpool Forums Addict

> **Matthew Solly writes...**
>
> box and pair in Telstra's cable records. A certified technician will be able to find the appropriate pair at the MDF based on this.

a service provider should tag a service at a MDF. A registered cabler should be able to find this tag and jumper the service from there to the customers premise

if the service is not tagged at the mdf and the service provider does not offer a cable pair for reference then how does one registered cabler find the service that has been provided without disconnecting other services on that MDF?

ref: posted 2015-Jul-3, 5:20 am AEST

mdel I'm new here, please be nice

Thanks for all the replies! I really appreciate them all. O.P.

It looks like the general consensus is that my original assertions have some solid ground. I've recontacted my ISP yesterday and sent them an email saying that they have left me no choice in whether a tech came out, so I won't be paying for jumpering etc.

Now all we do is wait and see if they stick to their word! :) It's looking hopeful that they will :)

ref: posted 2015-Jul-4, 9:32 am AEST

FarNear Whirlpool Enthusiast

It is very easy for someone who is experienced to find a un-tagged line as long as there is a phone line on that pair.

It's CHEAPER for the ISP to order a remote connection, so some ISP's will try to do that most of the time, an experienced tech should be able to find it with no issues.

ref: posted 2015-Jul-4, 1:23 pm AEST

waiting for nbn Whirlpool Forums Addict

> **SydNet writes...**
>
> It's CHEAPER for the ISP to order a remote connection,

I've just got to ask what a "remote connection" is?

ref: posted 2015-Jul-4, 1:30 pm AEST

Dave M Whirlpool Forums Addict

> **waiting for nbn writes...**
>
> I've just got to ask what a "remote connection" is?

connection done without a site visit

ref: posted 2015-Jul-4, 3:02 pm AEST

kevinlms Whirlpool Forums Addict

> **SydNet writes...**
>
> It is very easy for someone who is experienced to find a un-tagged line as long as there is a phone line on that pair.

Depends entirely on how many pairs there are. Its quite practical on a 10 pair, but if there is 100s? But wouldn't it be simpler for the ISP, to get the Vertical & Pair number off Telstra? The ISP, should stop be so lazy & cheap.

ref: posted 2015-Jul-4, 4:16 pm AEST

rdrr Whirlpool Forums Addict

Provided that the Telstra tech bothers to record it. I've seen too many instances in shopping centres with hundreds of tenancies and stuff all (accurate) notes or tags

ref: posted 2015-Jul-4, 6:07 pm AEST

spidermun Whirlpool Forums Addict

> **SydNet writes...**
>
> It is very easy for someone who is experienced to find a un-tagged line as long as there is a phone line on that pair.

you take this theory into a large MDF with say 300 pairs incoming with no tag , and hundreds of dead jumpers on the frame ?

ref: posted 2015-Jul-4, 6:19 pm AEST

Wan Guru Forum Regular

this may sound silly but if you have more than one telephone socket in your premises your service may be connected to the one you havent tried – try plugging your telephone into every socket and see if you get dial tone – if you get dial tone that will be the socket that is connected to your MDF

ref: posted 2015-Jul-4, 6:29 pm AEST

FarNear Whirlpool Enthusiast

> **waiting for nbn writes...**
>
> I've just got to ask what a "remote connection" is?

It's a line which was previously active on the MDF

(A line that has been disconnected by a user but still has dial tone on the MDF).

They then just activate that remotely, or tell the ISP to re-activate that previously activated DSLAM port.

ref: posted 2015-Jul-4, 6:51 pm AEST

drekkus Whirlpool Forums Addict

> **Matthew Solly writes...**
>
> but the service provider should have access to the termination cable, box and pair in Telstra's cable records. A certified technician will be able to find the appropriate pair at the MDF based on this.

Plenty of split pair range MDF's out there with no accurate record books , if any, for a cabler to use. And thats assuming there are no transposition in play as well. With a voice service you have a chance but a naked service makes it so much harder. Small frame and a cooperative ISP then it can be pinned down but time is money for a private tech. Large frame you can probably forget it.
Not sure how an ISP can request a remote connection with an MDF unless they have a disconnected number all the way through to the apartment/unit to work off. Sounds like a silly idea bound to end in tears otherwise. Generally for a naked service it requires proving through to the network boundary , testing and in the case of an MDF tagging. The tech then clears the job off with the vertical and pair numbers and when the tech can get through to the ISP for testing they give them that info as well as the location of the MDF if asked.

ref: posted 2015-Jul-4, 9:24 pm AEST

Adam Cleary **Telaustralia** ISP Representative

Generally ..... for business premises...

Reconnecting an existing line, Telstra dont usually go to the site unless testing is required and the install cost should be about $80.

If a tech site visit is required, some Techs will and some Techs wont tag the line at the MDF. The Service provider can request the line be tagged at the MDF and in that case the fee to connect the line will be about $150.

The service provider can also provide the pair cable if/when the customers requests it.

ref: posted 2015-Jul-6, 2:03 pm AEST

spidermun Whirlpool Forums Addict

> **Adam Cleary writes...**
>
> Reconnecting an existing line,

this is not an "existing line " thou for this thread

Its a new connection

> **Adam Cleary writes...**
>
> If a tech site visit is required, some Techs will and some Techs wont tag the line at the MDF. The Service provider can request the line be tagged at the MDF and in that case the fee to connect the line will be about $150.

do you instruct them not to tag it when they are suppose to do you ?

ref: posted 2015-Jul-6, 4:00 pm AEST (edited 2015-Jul-6, 6:16 pm AEST)

drekkus Whirlpool Forums Addict

> **Adam Cleary writes...**
>
> If a tech site visit is required, some Techs will and some Techs wont tag the line at the MDF.

It should be tagged regardless if the provider has asked for it. Its part of the site visit. Otherwise you'll get a provider ringing up saying the service can't be found on the MDF and another visit will ensure which can't be charged for. Especially important for a naked service.

ref: posted 2015-Jul-6, 6:05 pm AEST

kevinlms Whirlpool Forums Addict

> **Adam Cleary writes...**
>
> If a tech site visit is required, some Techs will and some Techs wont tag the line at the MDF. The Service provider can request the line be tagged at the MDF and in that case the fee to connect the line will be about $150.

So you are saying its extra to put a tag on it, if the tech is already there?

ref: posted 2015-Jul-6, 6:43 pm AEST

spidermun Whirlpool Forums Addict

> **kevinlms writes...**
>
> o you are saying its extra to put a tag on it, if the tech is already there?

i thought it was only me who saw that lol

ref: posted 2015-Jul-6, 7:32 pm AEST

drekkus Whirlpool Forums Addict

> **kevinlms writes...**
>
> So you are saying its extra to put a tag on it, if the tech is already there?

Maybe poorly worded or is someone adding something on top of the Telstra charge of $125 ?

ref: posted 2015-Jul-6, 8:17 pm AEST

FarNear Whirlpool Enthusiast

> **drekkus writes...**
>
> It should be tagged regardless if the provider has asked for it.

That isn't true. A lot of ISP's including telstra will order in-place lines in some circumstances.

They are lines which were previously active on the MDF, they just re-use old lines.

This is the case for both Telstra and TPG lines and other carriers too.

If the tech has been trained properly they can find the line with no issue, I personally can find a line on any MDF. If the tech can't find an in-place line in the MDF they need more training and I believe they shouldn't be paid if they don't know how to do it.

Naked DSL lines (eg Internode) are always tagged.

ref: posted 2015-Jul-7, 7:22 pm AEST

kevinlms Whirlpool Forums Addict

> **SydNet writes...**
>
> If the tech has been trained properly they can find the line with no issue, I personally can find a line on any MDF. If the tech can't find an in-place line in the MDF they need more training and I believe they shouldn't be paid if they don't know how to do it.

As I pointed out before, if its a small number of pairs, then yes it can be found, but what if there are many pairs? Also you're over looking the possibility that despite the carrier's claims, it may not actually be working, due to a cable pair in the street having been reused, or any number of other causes?
But why can't the OP's ISP provide the information as to which pair its allegedly on? If its on pair 76, why not say so? After all it is supposed to be an intact service.
I suspect that the ISP's call taker, doesn't know enough to ask Telstra the question, so fobbed it off.

ref: posted 2015-Jul-7, 8:34 pm AEST

drekkus Whirlpool Forums Addict

> **SydNet writes...**
>
> That isn't true. A lot of ISP's including telstra will order in-place lines in some circumstances.

I was referring to jobs which require a site visit. Even an inplace if it has generated a truck roll other than an exchange jumper task must be proved to the MDF and tagged. ie a Task40 job.

> If the tech has been trained properly they can find the line with no issue, I personally can find a line on any MDF. If the tech can't find an in-place line in the MDF they need more training and I believe they shouldn't be paid if they don't know how to do it.

WIthout knowing what cable pair that has been assigned then a large frame , say a shopping centre, is going to become a very time consuming job. If its a naked service or it actually doesn't get there then good luck in finding it.

ref: posted 2015-Jul-7, 9:29 pm AEST

Dylwah Forum Regular

> **SydNet writes...**
>
> Naked DSL lines (eg Internode) are always tagged.

My Internode Naked line was not tagged last month. The tech I found listed on the Internode website found my un-tagged pair in a very large MDF (250+ unit tower above a shopping centre) without any trouble. He did say that the line was direct from the exchange and that it was probably not tagged because the Telstra tech didn't need to attend the building.

Somehow seeing hundreds of pairs of red and white wires all tangled randomly together didn't seem very high-tech and really shouldn't be how people are forced to connect to the Internet in the 21st century.

ref: posted 2015-Jul-7, 10:07 pm AEST

spidermun Whirlpool Forums Addict

> **SydNet writes...**
>
> If the tech has been trained properly they can find the line with no issue, I personally can find a line on any MDF. If the tech can't find an in-place line in the MDF they need more training and I believe they shouldn't be paid if they don't know how to do it.

ok no worries. SO when my next job in a shopping centre with 400 pairs incoming i will send you a message to come and help to do it. With no tag it should be easy for you with the hundreds of dead jumpers left on the frame.....

ref: posted 2015-Jul-7, 10:51 pm AEST

kevinlms Whirlpool Forums Addict

> **Dylwah writes...**
>
> He did say that the line was direct from the exchange and that it was probably not tagged because the Telstra tech didn't need to attend the building.

Yes, but your ISP probably advised the cable pair, thus making it easy. I've done the same.

ref: posted 2015-Jul-7, 11:41 pm AEST

kevinlms Whirlpool Forums Addict

> **Dylwah writes...**
>
> Somehow seeing hundreds of pairs of red and white wires all tangled randomly together didn't seem very high-tech and really shouldn't be how people are forced to connect to the Internet in the 21st century.

They aren't random, there is a system.

Well perhaps you may have heard of something called the NBN?

ref: posted 2015-Jul-7, 11:44 pm AEST

waiting for nbn Whirlpool Forums Addict

Just to put this thread back on track, I doubt ISPs are responsible for tagging a service on an MDF, unless they are using their own infrastructure. Most new connections for ISPs will be via Telstra wholesale. In reality the ISP would not be involved in providing the service to the MDF, therefore the tagging of the MDF would be a Telstra responsibility. Telstra is required to provide a tag to facilitate the connection to the customer by a third party, a registered cabler. By law unless that tag exists, registered cabler cannot legally connect that service to the customer cabling.

As for inplace services, technically Telstra should attend site and tag the service if it doesn't connect through to the customer for the reasons stated above.

ref: posted 2015-Jul-10, 6:17 pm AEST

FarNear Whirlpool Enthusiast

> **spidermun writes...**

> ok no worries. SO when my next job in a shopping centre with 400 pairs incoming i will send you a message to come and help to do it. With no tag it should be easy for you with the hundreds of dead jumpers left on the frame.....

You ask the ISP to lookup the O pair details, they'll give it to you.

You can easily estimate the location of the line using that.

Worst case scenario you have 40 pairs to search with your oscillator receiver (while ringing the number) until you find the click.

It's not very hard at all.

ref: posted 2015-Jul-10, 6:48 pm AEST

kevinlms Whirlpool Forums Addict

> **SydNet writes...**
>
> You ask the ISP to lookup the O pair details, they'll give it to you.

Why not read the OP where the OP has asked that question & the ISP was unable to do so. Perhaps then you'll realise the difficulty!

ref: posted 2015-Jul-10, 7:41 pm AEST

Astarath Forum Regular

It must be either tagged or your ISP can request the vertical pair info from Telstra for the A side of the MDF (Telstra side is the A side, customer side is the B side)

Telstra provisioning will have that info, it's part of the completion advice, I've had to get this dozens of times from Telstra wholesale. If your ISP can't get it for you, someone doesn't know how to do their job. Sometimes there's a bit of confusion in the bigger Westfield shopping centres where there are multiple MDFs, but that's uncommon.

ref: posted 2015-Jul-10, 7:52 pm AEST

spidermun Whirlpool Forums Addict

> **SydNet writes...**
>
> You ask the ISP to lookup the O pair details, they'll give it to you.

Oh dear, maybe read the Ops post. Says "could not be given"

> It's not very hard at all.

yes it is, as i have continually stated with my posts that not all scenarios are easy. Maybe a 10 pair incoming without details from the ISP.

my example of say 400 pairs in a shopping centre that i have posted before it seems you believe even that is easy without a cable pair or no tag.....

ref: posted 2015-Jul-10, 8:26 pm AEST (edited 2015-Jul-10, 8:42 pm AEST)

drekkus Whirlpool Forums Addict

> **SydNet writes...**
>
> Worst case scenario you have 40 pairs to search with your oscillator receiver (while ringing the number) until you find the click.

Unless its a naked service which hasn't been tagged for some reason.

ref: posted 2015-Jul-10, 8:42 pm AEST

Jett Brooks Whirlpool Forums Addict

> **SydNet writes...**
>
> Naked DSL lines (eg Internode) are always tagged.

1 out of a 100 iiNet NDSL lines are tagged, usually the termination details are available which is then not a problem, but having it tagged ensures the service actually makes it to the MDF. In-place ordering that iiNet does (and I'm sure a lot of other ISP's do it too) never gets tagged. The only ISP that I see consistently tagged is Amcom/Amnet, they obviously pay for this!

ref: posted 2015-Jul-11, 10:40 am AEST

drekkus Whirlpool Forums Addict

> **theguyoverthere writes...**
>
> 1 out of a 100 iiNet NDSL lines are tagged, usually the termination details are available which is then not a problem, but having it tagged ensures the service actually makes it to the MDF. In-place ordering that iiNet does (and I'm sure a lot of other ISP's do it too) never gets tagged.

All site visits require an ULL service to be tagged at the MDF. If someone has a number working to the socket then I guess you have a reasonable chance of just an exchange job being successful but there is no guarantee that the existing path will be used. Going that way simply on the basis that the records say that service should get there is fraught with danger imo especially if there is a large frame involved. The ISP involved may be able to tell you what pair Telstra has in their records but it may very well not be on that pair as someone in the past has changed pairs and not updated the records. Or the frame has some weird arse range going to it and no record book.

ref: posted 2015-Jul-11, 11:09 am AEST

Archive View Return to standard view

Network Standard

NETWORK	Document No	: NW000-S0088
	Amendment No	: 8
	Approved By	: Head of AEP&S
	Approval Date	: 01/10/2020

Minor amendments approved 10/11/2022

NW000-S0088 **NS130 LAYING UNDERGROUND CABLES UP TO AND INCLUDING 11KV**

ISSUE

For issue to all Ausgrid and Accredited Service Providers' staff involved with the design and installation of underground cables and conduits, and is for reference by field, technical and engineering staff.

Ausgrid maintains a copy of this and other Network Standards together with updates and amendments on www.ausgrid.com.au.

Where this Standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document.

DISCLAIMER

As Ausgrid's Standards are subject to ongoing review, the information contained in this document may be amended by Ausgrid at any time. It is possible that conflict may exist between Standard documents. In this event, the most recent Standard shall prevail.

This document has been developed using information available from field and other sources and is suitable for most situations encountered in Ausgrid. Particular conditions, projects or localities may require special or different practices. It is the responsibility of the local manager, supervisor, assured quality contractor, accredited service provider and the individuals involved to make sure that a safe system of work is employed and that statutory requirements are met.

Ausgrid disclaims any and all liability to any person or persons for anything done or not done, as a result of this Standard.

All design work, and the associated supply of materials and equipment, must be undertaken in accordance with and consideration of relevant legislative and regulatory requirements, latest revision of Ausgrid's Network Standards and specifications and Australian Standards. Designs submitted shall be declared as fit for purpose. Where the designer wishes to include a variation to a Network Standard or an alternative material or equipment to that currently approved the designer must obtain authorisation from the Network Standard owner before incorporating the variation to a Network Standard or alternative material into a design. All designers including external designers authorised as Accredited Service Providers will seek approval through the approved process as outlined in NS181 Approval of Materials and Equipment and Network Standard Variations. Seeking approval will ensure Network Standards are appropriately updated and that a consistent interpretation of the legislative framework is employed.

Notes: 1. Compliance with this Network Standard does not automatically satisfy the requirements of a Designer Safety Report. The designer must comply with the provisions of the Work Health and Safety Regulation 2017 (NSW - Part 6.2 Duties of designer of structure and person who commissions construction work) which requires the designer to provide a written safety report to the person who commissioned the design. This report must be provided to Ausgrid in all instances, including where the design was commissioned by or on behalf of a person who proposes to connect premises to Ausgrid's network, and will form part of the Designer Safety Report which must also be presented to Ausgrid. Further information is provided in Network Standard (NS) 212 Integrated Support Requirements for Ausgrid Network Assets.

2. Where the procedural requirements of this document conflict with contestable project procedures, the contestable project procedures shall take precedent for the whole project or part thereof which is classified as contestable. Any external contact with Ausgrid for contestable works projects is to be made via the Ausgrid officer responsible for facilitating the contestable project. The Contestable Ausgrid officer will liaise with Ausgrid internal departments and specialists as necessary to fulfil the requirements of this Standard. All other technical aspects of this document which are not procedural in nature shall apply to contestable works projects.

INTERPRETATION

In the event that any user of this Standard considers that any of its provisions is uncertain, ambiguous or otherwise in need of interpretation, the user should request Ausgrid to clarify the provision. Ausgrid's interpretation shall then apply as though it was included in the Standard, and is final and binding. No correspondence will be entered into with any person disputing the meaning of the provision published in the Standard or the accuracy of Ausgrid's interpretation.

KEYPOINTS

This Standard has a summary of content labelled "KEYPOINTS FOR THIS STANDARD". The inclusion or omission of items in this summary does not signify any specific importance or criticality to the items described. It is meant to simply provide the reader with a quick assessment of some of the major issues addressed by the Standard. To fully appreciate the content and the requirements of the Standard it must be read in its entirety.

AMENDMENTS TO THIS STANDARD

Where there are changes to this Standard from the previously approved version, any previous shading is removed and the newly affected paragraphs are shaded with a grey background. Where the document changes exceed 25% of the document content, any grey background in the document is to be removed and the following words should be shown below the title block on the right hand side of the page in bold and italic, for example, Supersedes – document details (for example, "Supersedes Document Type (Category) Document No. Amendment No.").

KEY POINTS OF THIS STANDARD

Scope and Risks Addressed

This network standard NS130 provides the requirements for trenching, laying and reinstatement of underground conduits and cables, for distribution circuits up to and including a nominal 11kV in Ausgrid's supply area. The standard is limited to scope identified below and provides controls for associated risks as listed below:

- ☐ The needs of Ausgrid, developers, customers, Roads and Maritime Services, local councils and other service utilities have been addressed in this standard.
- ☐ This standard frequently references NATSPEC 1152 – Road Openings and restorations (Utilities) document.

Where to for more information?

Section 1, 2, 3

Project Planning, Design and Excavation

This standard includes the following topics in relation to project planning and design and the excavation works required:

- ☐ The client is responsible for obtaining all development consents (refer NS104 Specification for Electrical Network Project Design Plans).
- ☐ General design requirements outlined for new residential subdivisions, CBD projects, roadway, driveway and rail track crossings.
- ☐ Also outlined is the requirement for cable easements on private property, provision of detailed designs, Ausgrid site inspections, and provision of field book recordings.

Where to for more information?

Section 4, 5, 6 & 7

Installation of Conduits, Power Cables, Pillars and Pits, Jointing

Construction requirements may include references to safety and construction management processes:

- ☐ Describes details of Joint pits, bays, vaults and concrete construction work.
- ☐ Describes installation requirements of conduits, power and control cables, thermally stable bedding material.
- ☐ Specifies Standard depth of cover and reduced depth of cover requirements

Where to for more information?

Section 8, 9, 10, 11, 12 & 13

Tools and Forms

Annexure F

Backfilling & Restoration

Where there are post construction requirements that need to be considered they should be summarised here.

- ☐ Describes the requirements of backfilling of excavations and reinstatement of pavements and pathways.

Where to for more information?

Section 14 & 15

Network Standard
NS130
Laying Underground Cables up to and including 11kV

Contents

1. PURPOSE

This Network Standard provides the requirements for trenching, laying and reinstatement of underground conduits and cables, for distribution cables up to and including 11kV in Ausgrid's network.

2. SCOPE

This Network Standard specifies the requirements for Trenching, Laying Conduits and Reinstatement that have been established to meet the particular needs of Ausgrid, developers, customers, Roads & Maritime Services (RMS), local councils and other service utilities.

Refer to NS168 for underground sub-transmission cables above 11kV.

3. NATSPEC 1152

This Network Standard frequently refers to the 1152 document which is an industry specification dealing with road openings and restoration. It is managed by NATSPEC, and supersedes AUS-SPEC#2, 306U, which was previously used in this regard.

The method used in this Network Standard to call up a specified Clause in the NATSPEC 1152 document is as follows, 1152.1.10 Subheading where 1.10 is the section number and Subheading is the title of the relevant paragraph (generally a bold heading in 1152) if necessary.

A copy of the NATSPEC 1152 - Road Openings and Restorations (Utilities) document is available from NATSPEC via their website.

4. PROJECT PLANNING AND DESIGN

4.1 General

The Client must comply with the requirements of Ausgrid's Network Standard NS104, Specification for Electrical Network Project Design Plans. Attention is drawn to Section 5 of that Network Standard, regarding responsibility for obtaining consent from other parties. The Client must comply with any special requirements of other authorities.

4.2 New residential subdivisions

In new residential subdivisions, the electricity network shall generally be installed underground in accordance with Ausgrid's current Network Standards (refer to document 'Policy for ASP/1 Premises Connections' clause 6.3 Infrastructure Design, for overhead and underground policy details). The Client is responsible for the reticulation of the subdivision in accordance with Ausgrid's document Connection Policy, which provides for contestability of customer connections and some system augmentation.

4.3 Central business district (CBD) projects

HV and LV cable installations in Sydney's Central Business District are generally pit and duct (pit and conduit) configurations. Specific details relating to conduit configuration, number, size etc depend on the purpose of the project and shall be provided on a project-by-project basis.

Where obstructions of service congestion prevent the installation of a ductline in accordance with Annexure H, the matter shall be referred to the designer for advice. Alternatives such as constructing a 5 x 3 ductline may be considered.

4.4 Roadway crossings

All distribution cables shall be laid in approved conduits across or along roadways to allow for future system alterations/augmentations with minimal civil works. Refer to Section 10 for construction requirements. Additional spare conduits in roadway crossings may also be required by Ausgrid. This will be specified on the Design Information.

Due to the requirements of certain Roads Authorities (e.g. RMS and Local Councils), open trenching across certain roadways and other public thoroughfares may not be permitted without specific approval. Refer to Clause 4.7 Trenchless Technology.

Once an installation is completed, all conduits shall be tested in accordance with Clause 13.2 Testing of Conduits.

4.5 Driveway crossings

Where a cable route crosses concrete formed or paved driveways, special precautions shall be taken to ensure minimal damage to such driveways. Trenchless methods of crossing these driveways shall be considered to minimise the impact of cable laying on the local community, and to reduce the overall cost of cable laying.

Once an installation is completed, all conduits shall be tested in accordance with Clause 13.2 Testing of Conduits.

4.6 Railway track crossings

An agreement must be obtained from the appropriate railway authority.

All new rail crossings (overhead or underground) should allow for all poles or the ends of conduit banks to be located OFF rail property.

Poles must be located in the road reserve either side of a rail crossing, provided Rail's technical requirements on maximum span lengths etc permit this.

Conduits must be run the full width of the rail corridor, finishing just outside the rail property boundary, so that the need to enter rail land for works is minimised. The cable installation across the railway tracks shall be made by trenchless methods in accordance with the requirements of the Rail Authority concerned. Note that a bore across the entire width of rail land may not be necessary.

Where new works on existing crossings permit, the opportunity to extend conduit banks or relocate poles should be considered.

4.7 Trenchless technology

For information on using trenchless technologies refer to NS159 Installation of Cables and Conduits using Trenchless Techniques.

4.8 Ausgrid’s cables in easements on private property

Where Ausgrid’s cables are to be installed on private property with the substation lease/easement site set back from the street alignment, excluding the Sydney CBD;

- The cables should be installed in conduit for the full length of the easement unless the cable route dictates otherwise; e.g. excessive conduit bends and/or jointing requirements.
- One spare conduit for each cable shall be installed at depth of cover appropriate for the cable voltage.
- The cable route along the easement shall be marked in accordance with the requirements of NS143.
- The installed conduits/cables must be surveyed to capture the correct installed location over the entire length of the easement. For contestable projects, this survey shall occur prior to electrification.

4.9 Provision of detailed design by the client

In accordance with the requirements of the Ausgrid publication, Contract for Design Related Services, the Client must submit completed designs to Ausgrid for certification prior to commencing construction.

The designs must be professional, detailed and site specific and must include details of the calculated cable pulling tensions. Annexure F is a guide to calculating cable pulling tension.

The designer shall ensure that the cable route is fully located within Ausgrid's allocation at standard cover.

4.10 Inspection by Ausgrid

Ausgrid will carry out an appropriate level of site inspection during the construction phase to ensure that the network assets, including cables and conduits, are being constructed in accordance with the certified design, Ausgrid's Network Standards, Policies and Safety requirements.

Unforeseen site conditions requiring a variation or design change must be documented and referred to the designer for amendments to the design approval and re-certification as required.

4.11 Provision of field book recordings and survey plans

4.11.1 Field recording of network assets

Information regarding the construction, modification, repair, and/or retirement of Ausgrid's network assets must be recorded in accordance with NS100 - Field Recording of Network Assets. These records must be submitted to the Data Maintenance team in accordance with NS100.

4.11.2 Survey plan (red line plan)

Where cables or substations are to be located on private property, a survey (lease/easement) plan is required in order to establish easements or a lease to cover the electrical works. A copy of this plan is to be provided to Ausgrid showing the following additions in red ink:

(a) The centreline of electricity cables (or cable conduits if used) with offsets to the easement boundaries.

(b) The location of the substation and associated access and ventilation facilities if not already shown on the original plan.

(c) Signature by the Registered Surveyor with an accompanying statement to certify that the information shown in red ink has been accurately located to their satisfaction.

4.12 Registration of easement

Refer to the following documents,

- Policy for ASP/1 Premises Connections - Clause 2.3, Leases and Easements as well as Section 10, The Connection Process, Stage 16.
- Model Standing Offer – Standard Connections Services for Contestable ASP/1 Premises Connections no greater than 11kV – Clause 4 & Clause 5
- NS143 Easements, Leases and Rights of Way

4.13 Installation of cables under waterways

Cable installation under waterways (e.g. creeks, rivers, bays) is a special project and designs should be carried out on case by case basis. These designs must be submitted to Ausgrid for certification prior to commencing construction and must also conform to the requirements of the local maritime, waterways, fisheries, environment and/or heritage authority. If a trenchless technique is used for cable installation under waterways (e.g. creeks, rivers) the installation of cables and conduits shall comply with the requirements of NS159.

Any waterway crossings associated with navigable waterways administered by NSW Roads and Maritime Services (RMS) must comply with AS6947 Crossing of Waterways by Electricity Infrastructure, the Crossings of NSW Navigable Waters: Electricity Industry Code.

All waterway crossings must be risk assessed in accordance with a methodology approved by Ausgrid. Ausgrid employees should refer to NEG OH14 – Guide to the Assessment of Waterway Crossing Risk.

5. SETTING OUT OF EXCAVATIONS

5.1 General

The limits of the proposed excavation for trenches, pits and kiosk sites must be set out in accordance with an Ausgrid approved Certified Design/Design Plan, this Network Standard, and NATSPEC 1152.

Trenches in footways which have been or will be dedicated to public use, are to be excavated in the space allocation dedicated for Electric Cables, as defined in Annexure D, except where agreements are entered into for the sharing of trenches.

It should be noted that streets in the Sydney Metropolitan area that were dedicated prior to 1 January 1991 have different footway allocations to those dedicated after 1 January 1991. New underground electricity work in streets dedicated before 1 January 1991 shall comply with the original footway allocations (i.e. those applying before 1 January 1991).

The electricity allocation in state roads shall be in accordance with the requirements of the NSW Streets Opening Coordination Council (SOCC) Guide to Codes and Practices for Streets Opening.

For minimum separation distances between Utility services, refer to NSW Streets Opening Coordination Council (SOCC) Guide to Codes and Practices for Streets Opening.

The Client shall give appropriate notice to Ausgrid to allow inspection and approval of the set out prior to commencing work.

5.2 Additional work

Local Council may request additional removal and restoration works beyond the scope of works approved by Ausgrid (see 1152.3.3):

- If the additional work is deemed non-contestable, such work will be identified and defined by Ausgrid in negotiation with the Local Council's Restoration Officer.
- If the additional work is contestable work, the Client shall consult with the Local Council's Restoration Officer concerning Council's requirements and shall make these details available to Ausgrid's Representative.

5.3 Shared trenching agreements

Ausgrid has 2 separate trench sharing agreements for new installations.

The first agreement is between The Electricity Supply Association of Australia and Australian Post Office, and it was historically the default arrangement adopted. Trenching details of this agreement are detailed in Annexure C. Where this agreement is invoked, all Telecommunication assets must be in 0 - 300mm allocation from the property boundary. This can only be used in streets dedicated prior to 1991.

The second agreement is between AGL, EnergyAustralia, Optus and Telstra “Underground Services in a Shared Trench (NSW 1998)”. This agreement will only be considered by Ausgrid for new underground developments that consist of newly dedicated roads where no other underground services exist.

Where shared trenching is proposed under this agreement, Ausgrid’s approval must be obtained and a shared trench agreement must be entered into in accordance with the “Underground Services in a Shared Trench (NSW 1998)” agreement between AGL, EnergyAustralia, Optus and Telstra (available on request from Ausgrid).

Note: No utility service shall be installed on top of any Ausgrid’s services - so as to allow future access. A minimum of 100mm horizontal separation is required unless otherwise approved by Ausgrid.

No utility service shall be within 100mm of a low voltage cable or 300mm of a high voltage cable.

Recording details of the project shall clearly define the start and finish points of the shared trench, its dimensions and the service utilities involved (sectionalised if necessary to indicate the presence or absence of certain utilities).

5.4 Dimensions of trenches

The trench size depends on the following factors:

- Number and type of cables
- Number and nominal size of conduits
- Location of trench (i.e. footpath or roadway)
- Any shared trenching arrangements agreed to with other utilities.

Unless otherwise specified, or changes have been approved by Ausgrid, the guidelines for trench dimensions given in Annexure B, and the cable layouts shown in Annexure C must be used.

5.5 Pegging of easements

The location of the easement shall be pegged by a Registered Surveyor prior to commencement of excavation work. If the pegs or marks made by the Surveyor have been disturbed or removed, excavation shall not commence until the pegs or marks have been re-established. The only time re-establishment of the pegs may not be required is if the easement boundaries have been thoroughly marked subsequent to the Surveyor pegging them, and those boundary markings are sufficient to permit the trench to be excavated and recorded relative to the easement boundaries. If it is necessary to locate any part of the trench outside the planned easement boundaries due to other obstructions, then the extent of the diversion must be clearly marked and the markings preserved until the Surveyor can return to adjust the plan.

Final ground level shall be marked on all pegs.

5.6 Set out for excavations in new subdivisions

These requirements apply to all installations in dedicated public roadways/footways and subdivisions intended to be dedicated as such.

In new subdivisions, the Client (or developer) must indicate the subdivision lot boundaries and street alignment by installing pegs either at the street alignment or at a nominated distance from that alignment (offset recovery pegs) before any excavation work takes place. Pegs showing final footpath level must also be provided by the Client. In cases where footways are elevated above the kerb and gutter level, the roadway surface near the footway will be accepted as the future final level. Pegs must be clearly visible, easily identified and undisturbed after trench excavation to facilitate accurate positioning and recording of assets.

The Client is responsible for the correct positioning of all cable trenches. Trenches in footways that have been or will be dedicated to public use are to be excavated in the Ausgrid space allocations as specified in Annexure D.

If it is necessary to occupy part of the footway usually allocated to another Authority, or part of the roadway for laying cables, the Client must first obtain the approval of Ausgrid followed by the written approval of the other Authority – or local council or road owner - before construction work commences. Road crossings and crossings of other Authorities' allocations must be at 90° to the property alignment, unless written approval is obtained from Ausgrid.

5.7 Set out for excavations in established areas

The Client shall set out the limits of the proposed excavation for trenches, pits and chambers using chalk or crayon so as to be readily understandable but without permanently defacing any surface. The set out shall minimise damage to existing surfaces.

To minimise or eliminate residual small portions of paving slabs, the set out shall be adjusted as necessary. Any adjustments will be with respect to the existing paved surfaces and joint patterns. Adjustments shall generally be in accordance with the following guidelines, and must be approved by Ausgrid before construction commences:

(a) Pathways

(i) The set out line shall be varied in accordance with the reinstatement requirements of the NSW Streets Opening Coordination Council (SOCC) Guide to Codes and Practices for Streets Opening.

- Bitumen and Concrete Paving - In accordance with the reinstatement provisions and sketches of the NSW Streets Opening Coordination Council (SOCC) Guide to Codes and Practices for Streets Opening.
- Segmental Paving Units - The set out line shall be at least one whole unit clear of both sides of the minimal alignment of the trench.
- Textured or Patterned Concrete - The set out line shall enable an aesthetically acceptable restoration of the pavement as approved by Ausgrid.

(ii) Where Ausgrid directs that certain driveways are not to be disturbed, services under these driveways shall be installed by trenchless technology where suitable and no other services are present. A risk assessment must be completed by the Constructor to ensure no damage can occur to other services if trenchless technology is to be utilised.

(b) Carriageways

(i) In asphalt pavements, the trench set out shall be at minimum width, and wherever possible, shall be at right angles to the street alignment.

(ii) In concrete pavements, the advice of the appropriate road authority and/or professional engineering advice shall be sought regarding the location of trench set-out lines.

(iii) Any trench or surface work proposed in the vicinity of Permanent or State Survey Marks shall be referred to the Land Information Centre of the Department of Lands, prior to commencement of Work, to obtain protection or relocation requirements.

Refer to 1152.3.6 for further information.

6. EXCAVATION OF TRENCHES AND OTHER SITES

6.1 General

Excavation work shall be carried out with minimal disturbance to the surrounding environment and in accordance with the requirements of the relevant Local, State, and Federal authorities (e.g. SafeWork NSW Codes of Practice, Safe Work Australia).

All excavations shall be excavated according to Ausgrid's standard widths and depths as specified in the Certified Design/Design Plan, Network Standards and/or other engineering/design drawings approved by Ausgrid.

Before conduit or cable laying commences, the excavated trench must be inspected by a Representative of Ausgrid.

6.2 Removal of pavement layers in established areas

In removing surface and sub-surface materials, maximum care shall be exercised to safeguard existing underground services and other structures within and around the work site against damage. The guidelines in 1152.3.5 shall be adhered to unless otherwise specifically approved by Ausgrid.

6.3 Locating existing services

The Constructor performing the excavation is responsible for locating all existing services that may be affected by the proposed works before any excavations take place. This includes contacting the designated underground asset information provider.

NATSPEC1152.3.6 Existing services, should be referred to for information on working in the vicinity of other utilities, along with the SafeWork NSW Work Near Underground Assets - Guide.

6.4 Precautions

All cables and conduits detailed in underground plans in the vicinity of the proposed works must be exposed. Excavations must be cleared of spoil to a minimum of 200mm around any cable covers, joints, cables or conduits.

The persons carry out the works shall also observe the requirements of Network Standard NS156 Working Near or Around Underground Cables with regards to the safety aspects of working in close proximity to underground cables.

When cutting cable covers or conduits, appropriate controls must be put in place to avoid creating a hazardous condition through the contact with live cable.

Where existing cables have been exposed and found to be non-compliant with the standard depth of cover in Table 3 and the reduced cover and backfill requirements in Table 4, Ausgrid's Representative shall be notified. The protection requirements of Table 4 should be retrospectively implemented. Where these protection requirements are impractical to implement, as a minimum, steel plates shall be installed across the full width and length of the exposed trench, above the existing cables' bedding. Details of reduced cover and backfill on existing cables shall be provided to Ausgrid as part of field book recording to enable updating asset records in Ausgrid's Geographic Information System (GIS) see Clause 4.11.

Where it is found in URD areas where driveways have been lowered so that the initial standard cover (Clause 10.11) has been reduced, the owner of the property serviced by the driveway shall be asked to meet reduced cover requirements or restore the cover to the original level.

6.5 Excavation of trenches

Trenches shall be kept as straight as possible and the bottom of an open trench shall be firm and smooth, free of rocks, pebbles, foreign matter and sharp projections. Where trenches pass from footway to roadway and a change of level is necessary, the rise and fall shall be gradual.

If the excavated material is considered by Ausgrid to be unsuitable for re-use as backfill, the material shall be removed and disposed of as specified in 1152.3.6 Unsuitable material / Contaminated or hazardous material. Unsuitable backfill materials include building materials (e.g.

concrete, bricks, pavers, rocks, roofing tiles, rubble), contaminated substances (including Hazardous Materials) and other materials that cannot achieve the required compaction (e.g. heavy clays).

If the excavated material meets the requirements of Section 14 and additionally is considered suitable by Ausgrid, the excavated material shall be reused in backfilling operations. Stockpiling of suitable excavated material shall be in accordance with NS174 and 1152.3.6 Excavated material stockpiles.

Safe and direct access to substations must not be impeded by excavation works.

6.6 Excavation of joint holes

Exposed joints and cables in joint holes must be supported at one-metre intervals and protected against damage or failure.

Open joint holes must be securely fenced off in accordance with the approved traffic management plan and Work Health & Safety requirements.

Open joint holes (including trenches or excavations) containing existing assets must not be left open or unattended unless appropriate precautions have been taken to secure and prevent unauthorised access to the excavation and Ausgrid assets (e.g. secured fencing, road plates or similar).

6.7 Excavation of substation sites

The excavation and foundation requirements for substation sites are detailed in the following Network Standards:

- NS117, Design and Construction Standards for Kiosk Type Substations
- NS141, Site Selection and Site Preparation Standards for Kiosk Type Substations
- NS165, Safety Requirements for Non-Electrical Work in and Around Live Substations.

7. BREAKING INTO AND REMOVAL OF CONCRETE ENCASED CONDUITS

The specified strength for concrete which encases conduits in roadways, including those in the Sydney Central Business District (‘the City’) is 3 to 5MPa. However, some conduits have been encased in concrete with strength well above 5MPa. Tests have identified 35MPa concrete in some conduit installations. Concrete above about 3MPa is difficult to break into without using power tools.

Conduits normally contain cables, some or all of which could be energised. When breaking into such conduits, extreme care must be taken to avoid creating hazardous conditions to personnel, and damage to equipment and loss of supply.

The persons carrying out the works shall consult with Ausgrid as to the options available for minimising the risks involved, such as de-energising live cables and/or removing cables from the conduits concerned.

In many circumstances it will not be reasonably practicable to de-energise or remove cables from a conduit, so some cables may have to remain energised while concrete is being stripped. Under these circumstances a procedure designed to minimise any risk of electric shock or flash burns to the staff involved and the general public shall be prepared by the persons carrying out the works and submitted to Ausgrid for review prior to any such work taking place. The procedure shall be:

- developed by a competent person, who has acquired through training, qualification or experience, the knowledge and skills to carry out this task; and
- carried out by competent persons having regard to the nature of the work, the nature of the risks associated with the work, and the control measures implemented.

The procedure shall also safeguard Ausgrid's assets against any mechanical damage. The persons carrying out the works shall be responsible for the costs associated with working to an approved procedure and for any damage caused.

Some of the existing conduits and troughing are made of asbestos cement and appropriate asbestos handling methods shall be used.

8. JOINTING PITS

8.1 Removal and/or reconstruction of existing jointing pits containing cables/conduits

Prior to commencing any demolition or reconstruction of existing jointing pit which contains cables or conduits, special precautions must be taken to protect the cables and any joints involved against mechanical damage.

It is critical that existing cables/conduits and associated joints are not disturbed unless specific written approval has been obtained from Ausgrid to the contrary.

All cables and associated joints in a pit that is undergoing demolition and/or reconstruction work shall be supported and protected using non-conductive structures. These structures shall be mechanically capable of supporting the cables and associated joints.

Cables shall be secured to the horizontal member of the supporting structures with non-metallic fixings at no more than 1500mm intervals. Joints shall be supported at both ends of the joint. The supported cables and joints are to be enclosed in fibre reinforced non-conductive troughings. Protective Mats (Refrasil mats) shall then be draped over the enclosed cables and supports and secured to prevent dislodgment.

Prior to removing the roof/lid of a jointing pit the Constructor shall place timber sheeting to fully cover all cables and joints to prevent damage by falling materials.

8.2 Construction of jointing pits

8.2.1 General

Construction of jointing pits shall be carried out in accordance with detailed drawings and information prepared in accordance with NS172 Design Requirements for Cable Jointing Pits and Vaults.

Precast concrete jointing pits are acceptable for use in appropriate applications. Refer to NS 172 and Ausgrid Drawing No. 249060, noting that this drawing provides typical pit details for use in the development of site specific cable pit designs.

8.2.2 Additional penetrations in cable pits

Prior to core drilling, sawing or penetrating the structure of a cable pit a structural assessment shall be conducted.

Additional penetration locations shall consider the effects for personnel access and egress and must not impede this access or egress when cable is installed in these penetrations.

The structural assessment shall include but not be limited to the following:

- the impact the proposed works have on structural integrity
- strengthening required (if applicable)
- corrosion protection
- method of waterproofing the penetration.

Structural assessment shall be coordinated through Ausgrid's Development Services Section.

Bell-mouths must be installed as per Clause 10.8.

9. CONCRETE CONSTRUCTION WORK

9.1 General

All concrete shall be in accordance with the requirements of AS3600.

(a) Cement

Cement shall be Type GP general purpose Portland cement or equivalent complying with AS3972. If requested by Ausgrid, a Certificate of Compliance with the requirements of the Australian Standard shall be provided.

(b) Fine aggregate

Fine aggregate shall be approved washed river sand or Sydney Hill Sand having clean, sharp, hard, durable grains, uniform in quality and free from harmful amounts of soft or flaky particles, dust, lumps, loam, clay, slag, organic or other deleterious substances. The material shall comply with AS2758.1.

(c) Coarse aggregate

Coarse aggregate shall comply with AS2758.1 and shall be approved crushed blue metal or washed river gravel, of 20mm gauge, graded to 6mm, uniform in quality having clean, hard, durable, uncoated particles, and free from flat, thin or elongated pieces of dust, organic or other soluble or deleterious substances. Brecciated aggregates shall not be used.

(d) Testing of aggregates

Testing of aggregates to AS1141 shall be at the discretion of Ausgrid.

(e) Water

Water shall comply with the provisions of AS3600.

(f) Reinforcement

Reinforcement shall be either steel bars complying with AS4671 or hard drawn steel wire fabric complying with AS4671. Reinforcement shall be accurately cut to size and bent to shape and shall be free from scale, oil and loose rust.

Reinforcement shall be stored so as to prevent deterioration due to rust or any other cause.

9.2 Site mixed concrete

Concrete mixing carried out on site shall be by rotating batch mixers only, unless specifically approved on a site by site basis.

The aggregates shall be gauged with approved gauge boxes only. Gauging by shovels is not permitted.

Water shall also be measured using approved containers or other approved means.

Measured batches shall be thoroughly mixed together in a rotating batch mixer for at least two minutes after all materials (including water) have been added and before any part of the batch is discharged. A suitable timer shall be used to ensure sufficient mixing time.

The batch mixing drum of the rotating mixer shall be thoroughly emptied, and cleaned immediately before and after each batch.

(a) Trial mixes

If required by Ausgrid, the correct proportions of water, cement and fine and coarse aggregates shall be determined by trial mixes, and the proportions shall be adjusted to suit the available aggregates and placing conditions. Preliminary test results of the trial mixes shall be submitted to Ausgrid for approval before any concrete is poured.

9.3 Ready mixed concrete

Ready-mixed concrete from an approved central mixing plant will be acceptable provided that both its use and properties comply with AS1379. The testing requirements of AS1379 shall be additional to those of AS3600.

The method of ordering ready mixed concrete shall be as described in AS1379.

9.4 Concrete construction

(a) Formwork

Formwork shall comply with AS3610. Forms shall conform to the shapes, lines and dimensions shown on the drawings. All forms and supports shall be of sound timber or steel, masonite, plywood or similar material of sufficient strength and be adequately tight to prevent leakage of mortar.

Formwork ties shall be used to maintain correct separation of vertical surfaces.

Timber formwork for exposed surfaces shall be dressed. All forming surfaces shall be coated with an approved form release agent before pouring commences. Coating shall be done before any reinforcement is fixed in position.

(b) Fixing of reinforcement

Reinforcement shall be accurately placed and tied at alternate intersections with 1.2mm soft iron wire so as to form a rigid cage or mat which will maintain its shape and position both before and during placing of concrete. Sufficient supporting devices shall be used to ensure the correct concrete cover as shown on the drawings or as required by the provisions of AS3600, if not shown on the drawings.

(c) Cast-in fixtures

All holding down bolts and other fixtures to be incorporated in the concrete shall be accurately fixed in position before pouring.

(d) Inspection

Before any concrete pour, the reinforcement and fixtures for that pour may be inspected by a Representative of Ausgrid. At the time of inspection, the work shall be in every respect, ready for concrete placing. This requirement includes fixing and tying of all reinforcement and cleaning out of formwork.

(e) Transporting of concrete

Concrete shall be transported to its final location as rapidly as practicable by methods which will prevent segregation or loss of ingredients. Under no circumstances shall concrete which has partially hardened, be used.

The containers used for transporting concrete shall be thoroughly cleaned before use.

Pumping of concrete will be acceptable provided the methods and equipment used are approved by Ausgrid. Pumped concrete shall comply with this Specification in all other respects.

(f) Testing of concrete

Testing of concrete shall comply with the provisions of AS3600 and the constituent parts with AS1012. Test results must be supplied to Ausgrid on request.

Test cylinders and slump tests may be taken on site as required by Ausgrid. The minimum sampling frequency shall be that specified in AS3600.

Plant-control testing will be accepted at the discretion of Ausgrid's Representative, provided that the testing is by characteristic strength and that all relevant provisions of AS3600 are met.

(g) Placing and compaction

All water and debris shall be removed from foundations and forms and any flow of water shall be diverted before any concrete is placed.

Concrete shall be thoroughly compacted using mechanical vibration. Manual compaction shall be permitted only when approved by Ausgrid. Over compaction shall be avoided. Concrete shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the formwork.

To minimise flotation or buoyancy forces on the conduits, the concrete shall have a low slump value (typically 80 – 100mm) and be placed from a minimum height, not exceeding 1.8 metres.

(h) Construction joints

Before fresh concrete is placed against hardened concrete at construction joints, the joint surface of the hardened concrete shall be cleaned by removing all loose and soft material and laitance.

The surface shall be well roughened, thoroughly wetted and covered with a coating of 1:2 sand/cement mortar, against which the fresh concrete is to be placed before the mortar has attained its initial set.

(i) Curing

All concrete work shall be fully protected and kept moist for at least seven (7) days after pouring. After initial set has occurred, all exposed surfaces shall be continuously protected against drying by covering with reinforced building paper or an approved alternative.

(j) Construction loading and stripping time

Formwork and propping shall not be removed earlier than seven (7) days after pouring. During such period, no construction loading of any type or duration shall be permitted without the specific approval of Ausgrid. This requirement prohibits the transportation of loads across concrete surfaces and stacking of materials thereon, prior to stripping of formwork and propping.

Formwork shall be removed in such a way as not to shock or jar the concrete.

(k) Concrete finishing

Unrendered off form surfaces shall comply with the tolerances and surface finish requirements described in Class 3 Formwork of AS3610. Surfaces to be rendered shall comply with Class 4 Formwork of AS3610.

Unformed surfaces shall be finished by steel trowel or equivalent. The top surface of concrete encased conduit banks need not be trowelled.

10. INSTALLATION OF CONDUITS

10.1 General conduit requirements

Where required, the number of conduits and spare conduits shall be specified on the Certified Design/Design Plan, and HV Connection diagram (HV Connection diagram applies only to High Voltage designs). Conduits shall be of the approved type and shall be installed in accordance with the requirements of the Certified Design/Design Plan, and this Network Standard.

Obstructions and other site constraints may make alterations to the Certified Design/Design Plan necessary during installation. Any proposed departures from the Certified Design/Design Plan shall first be submitted to Ausgrid for assessment prior to starting the proposed works.

10.2 Approved conduits

Ausgrid has approved a rationalised range of Unplasticised Poly Vinyl Chloride (UPVC) orange conduits for underground cabling as a minimum standard. The stockcode numbers for these conduits are listed in Annexure G. The application of the various sizes is as follows:

Table 1: Approved conduit size and application

Conduit Size	Application
40mm	Low voltage services
50mm	Low voltage services and street lighting.
63mm	Optical fibre pilot cables
80mm	Low voltage services (refer to NS224)
100mm	Low voltage services supplied from low voltage pits.
125mm	Distribution cables (high voltage including 11kV, low voltage, some street lighting and services). Low voltage cables where high voltage cables have been direct buried
150mm	11kV 500mm^2 three core cables where 125mm conduits are not considered adequate, e.g. complex cable routes with multiple bends. Sub-transmission cables, and at other locations as required by Ausgrid

The requirements for the various installation conditions are provided in Table 2. These requirements constitute a minimum standard. The use of heavier class conduits of the same nominal diameter as specified below will be at the cost of the Accredited Service Provider/Contractor and subject to the written approval of Ausgrid. Heavier duty polyethylene conduits are normally required for trenchless installation. Details are to be agreed with the trenchless contractor.

Heavier class conduits can be considered for roadways etc where the ASP has elected to use heavier compaction exceeding the minimum requirements of this Network Standard. In all cases, heavier class conduits and bends shall comply with Clause 14.7 for Testing of Conduits including the use of an approved solid mandrel. Under no circumstances shall a heavier class conduit be joined to a continuous installed length of light duty conduit as this may create issues with the testing of conduits using an approved mandrel i.e. the diameter of the standard mandrel used for the light duty conduit will be too large for the heavier class conduit.

Table 2: Conduit specification

Installation Type	Minimum Conduit Requirements
Complex cable routes with multiple bends when 500mm^2 three core cables are used and at other locations approved by Ausgrid.	150mm Light Duty (LD) UPVC (orange) conduit to AS/NZS 2053.2
Concrete encased and sand/cement encased conduits, regardless of location (e.g. CBD conduits, major roadway crossings).	125mm Light Duty (LD) UPVC (orange) conduit to AS/NZS 2053.2
All sand/cement/TSB grouted bore holes	180mm HDPE pipes to AS/NZS 4130. 125mm ID HDPE pipe is used where space constraints do not allow installation of larger pipes.
All State Roadway crossings. All CBD roadway and laneway crossings. All commercial/industrial driveway crossings.	125mm Light Duty (LD) UPVC (orange) conduit to AS/NZS 2053.2
All local and regional roadway crossings, (e.g. URD subdivisions), for high voltage, low voltage and service cables. All light traffic driveway crossings	125mm Light Duty (LD) UPVC (orange) conduit to AS/NZS 2053.2
Conduits in footways and non-roadway easements for high voltage and low voltage network cables	125mm Light Duty (LD) UPVC (orange) conduit to AS/NZS 2053.2
Conduits for low voltage services supplied from low voltage pits	100mm Light Duty (LD) UPVC (orange) conduit to AS/NZS 2053.2
Optical fibre pilot cables	63mm Heavy Duty (HD) UPVC (orange) conduit to AS/NZS 2053.2
Conduits for low voltage domestic services and street lighting cables in footpaths or non-roadway easements	50mm Heavy Duty (HD) UPVC (orange) conduit to AS/NZS 2053.2
Conduits in substation chambers and for high voltage and low voltage cables to and from substation chambers	Sizes, types and quantities are as specified in Network Standard NS113, as amended

Note: Profile wall smooth conduit type conduits shall not be used.

Ausgrid does not presently have a standard range of approved polyethylene pipes for use in trenchless technology (bores). The PE pipes to be used in bores shall generally comply with the requirements of AS4130, with the internal diameter determined in accordance with NS159 Installation of Cables and Conduits using Trenchless Techniques, and wall thickness determined in accordance with the requirements of the bore design (grouting pressure and temperatures).

10.3 Storage of conduits

Orange PVC pipe or conduit does not contain any temporary UV stabilisers. If it is exposed to UV over time, it will whiten on the surface and although it will not lose tensile strength it will become brittle and can become subject to damage from impact loads. Protection from prolonged exposure to direct sunlight can be achieved by under-cover storage, or by covering pipe stacks with an appropriate material such as Hessian. Heat entrapment should be avoided and ventilation provided. Black plastic sheeting should not be used.

10.4 Coupling of conduits

Conduits are to be coupled using spigot and socket arrangements. A suitable primer must be used first on both mating surfaces. PVC solvent cement shall then be applied to bond the primed surfaces.

All joints must be properly made to eliminate the entry of water and foreign matter into the installed conduits.

10.5 Conduit bends

Conduit bends shall be selected giving consideration to the 'during installation' minimum internal cable bending radius as detailed in Tables 7, 8 & 9 of Section 13. Excessive bending of conduits to avoid using conduit bends is not acceptable. Where obstructions require conduits to be diverted, only gradual large radius bends (minimum 2.3 metres) shall be used so as not to limit the size of cables that can be pulled through. Approved bends are listed in the Annexure G.

10.6 Installation of telecommunication conduits

Ausgrid utilises optical fibre cables to carry critical high voltage Tele-protection signals for HV in line with our legal requirements and in accordance with the National Electricity Rules (NER's).

Tele-control, building security, broadband wireless and other telecommunications services are also transmitted through the optical fibre network.

The aim of the Secondary Systems team is to increase the quality and reach of the fibre network through a process of new build and route replacement.

All planned high voltage underground conduit routes should be reviewed by the telecommunications team prior to construction in order to facilitate the objective of a more secure fibre network.

The inclusion of an orange 63mm outer diameter (OD) high density conduit to be run nested with the underground conduits, and protected by HV feeders are only installed where a route potentially forms part of a secure path between major substations.

Note: Low voltage underground installations are excluded from the requirement to install protection fibre conduits.

Where protection fibre conduits are required to be run with the feeder installation, the following Network Standards and drawings shall apply:

- NS203 Telecommunications Network: Master Policy Document.
- NS204 Communications Pits - Specification and Installation Guidelines.
- NS205 Telecommunications: Route Markers.
- NS234 Telecommunications Underground Physical Plant Installation.
- NS235 Telecommunications Underground to Overhead (UGOH) Transition.
- Standards drawing 212393 - Telecommunications Conduit Installations.
- Standards drawing 212386 - Telecommunications UGOH.

It is a mandatory requirement for the inclusion of protection fibre conduits to be installed alongside all new high voltage conduit rail crossings.

Each end of the crossing must be brought outside of rail owned land, capped, sealed and marked with frequency based marker devices as per NS205.

Should the conduit route extend beyond the rail corridor, the termination point should be confirmed through a discussion with the telecommunications team.

For further information, refer to the Manager - Secondary Systems or for contestable works, the Ausgrid officer facilitating the contestable project.

10.7 Sealing of conduits

Refer to NS171, Fire Stopping in Substations for details on Ausgrid's specification and requirements for the installation of fire stopping materials in openings in substation walls, floors and ceilings.

Conduits which are direct buried shall be sealed against the ingress of water and any foreign material which may hinder the removal and/or pulling through of cables. For conduits that form part of a pit and duct system and the pits are located in a tidal area or below the water table, the conduits need to be sealed against the ingress of water. Apart from being susceptible to blockage, unsealed conduits may cause flooding of cable pits and basement type substations and switchrooms.

Unused conduits shall be sealed using the appropriately sized conduit end cap or plug.

Used conduits (i.e. conduits with cables in them) shall be sealed using approved conduit sealing foam/putty.

10.8 Laying of conduits

The roadway conduits at street intersections and other locations should be laid as nearly perpendicular to the street as practicable, terminating at the road-side edge of Ausgrid's cable allocation. Refer to Annexure D for the cable allocation that applies in the relevant area. Minor deviations to align with offset lot boundaries on opposite sides of the road are permitted.

All conduits shall be installed so that they are true to line. The ends of conduits shall be smooth and cleanly cut, with sharp edges removed. Where conduits enter pits, bell mouths shall be installed flush with the inside of the wall.

Once installed, the manufacturer's markings on the conduits must be visible for inspection.

10.9 Banks of conduits

In busy shopping centres, pedestrian malls and the Central Business District of Sydney ('the CBD'), conduits are generally installed in multiple rows linking vaults and pits. These are usually referred to as banks of conduits. Conduit requirements and layouts are usually specified on the Certified design/ Design plan.

Banks of conduits shall be built so that their cross section is rectangular. The exit points at each end of the conduits bank shall correspond exactly without any cross-overs along the conduit lengths.

Conduit banks containing six or more power cable conduits must be installed in thermally stable bedding (TSB) in accordance with Section 11. Conduit bedding material shall be specified on the Certified design/ Design plan.

Conduit banks containing six or more power cable conduits which are short in length (e.g. for local road crossings) may not need to be installed in TSB provided the cables at both ends of the conduit bank are direct laid. In each case, the deletion of TSB shall require a rating assessment completed by the Designer as per NS272 and the rating assessment shall be submitted to Ausgrid for review and written approval.

The requirements above apply also to suburban and other areas where the design calls for conduit banks containing six or more power cable conduits. For details regarding the installation of banks of conduits on Private Property, see Clause 4.8.

10.10 Standard conduit and cable spacings

The horizontal and vertical separation between conduits, and between the outer conduits and the bottom and sides of the trench, shall be 50mm for 125mm conduit, and 70mm for 150mm and 200mm conduits. The top layer of conduits shall be covered with 100mm bedding unless otherwise required by this Network Standard.

10.11 Standard depth of cover

The depth of a trench for a conduit will depend on obstructions, the number of conduits to be installed and their orientation with respect to one another. Banks of conduits shall be installed to have a final cover in accordance with the requirements detailed in Table 3.

Table 3: Standard cover and bedding requirements for conduits

Location (Refer Note 1)	Standard Cover (mm)	Minimum Bedding Material
The carriageway of **Classified State Roads** – Low Voltage and High Voltage Conduits (Note: excluding footways)	1000	Concrete or TSB to achieve 3 to 5MPa See Figure 3
	1200	20:1 sand/cement dry mix See Figure 4
The carriageway of **Classified Regional & Unclassified Roads** and heavy commercial / industrial car parks – Low Voltage and High Voltage Conduits (Note: excluding City of Sydney Roadway or Laneway)	750	Standard bedding material as per Clause 10.16.1 See Figure 1
City of Sydney Roadway or Laneway.	750	20:1 sand/cement dry mix or TSB See Figure 1 (for sand/cement) or Figure 2 (for TSB)
Footways and driveways of Classified and Unclassified Roads, light commercial / residential car parks - High Voltage Conduits	600	Standard bedding material as per Clause 10.16.1 See Figure 5
Footways and driveways of Classified and Unclassified Roads, light commercial / residential car parks – Low Voltage Conduits	500	Standard bedding material as per Clause 10.16.1 See Figure 6

Note 1: Refer to the following RMS website link for the Schedule of Classified Roads and Unclassified Regional Roads. Local Roads are unclassified roads and therefore are not included in the Schedule.

https://www.rms.nsw.gov.au/business-industry/partners-suppliers/lgr/documents/classified-roads-schedule.pdf

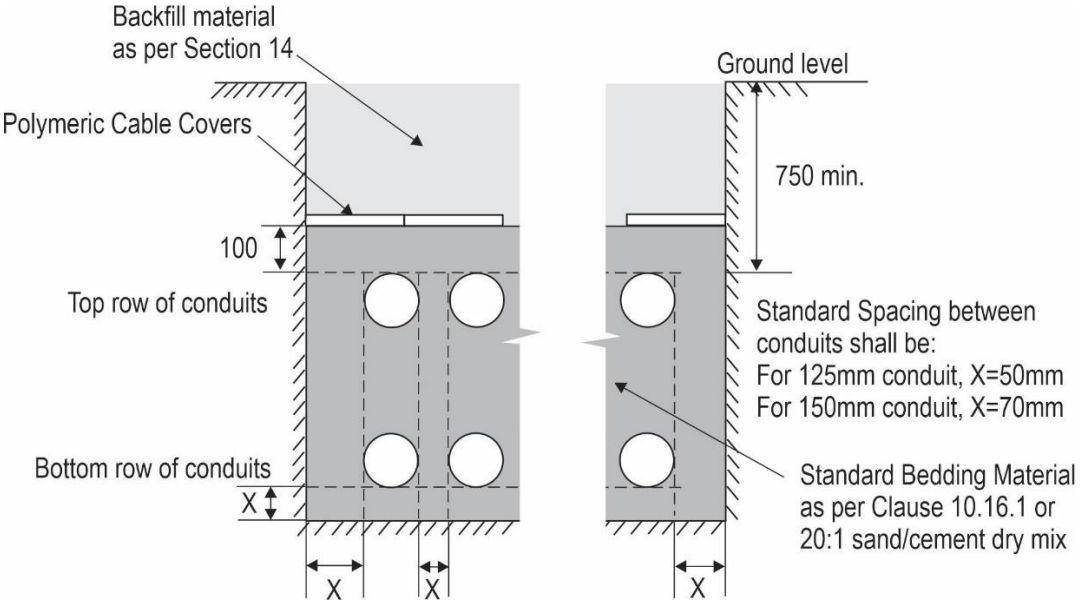


Figure 1: Standard Cover 750mm

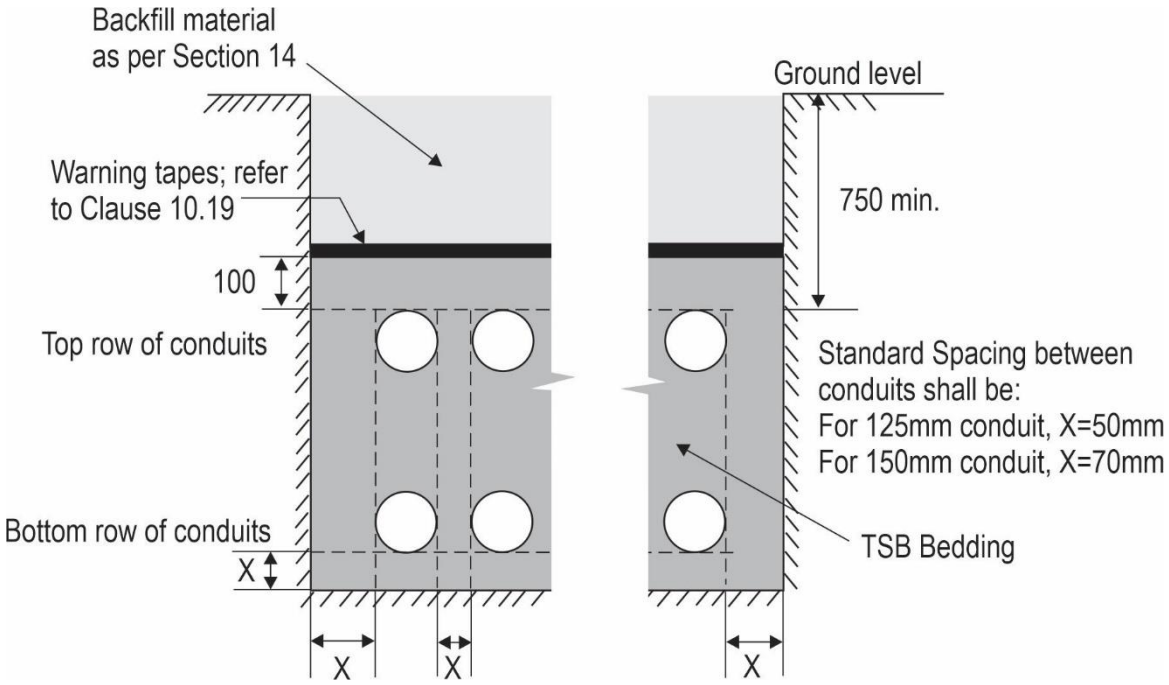


Figure 2: Standard Cover 750mm (for TSB only)

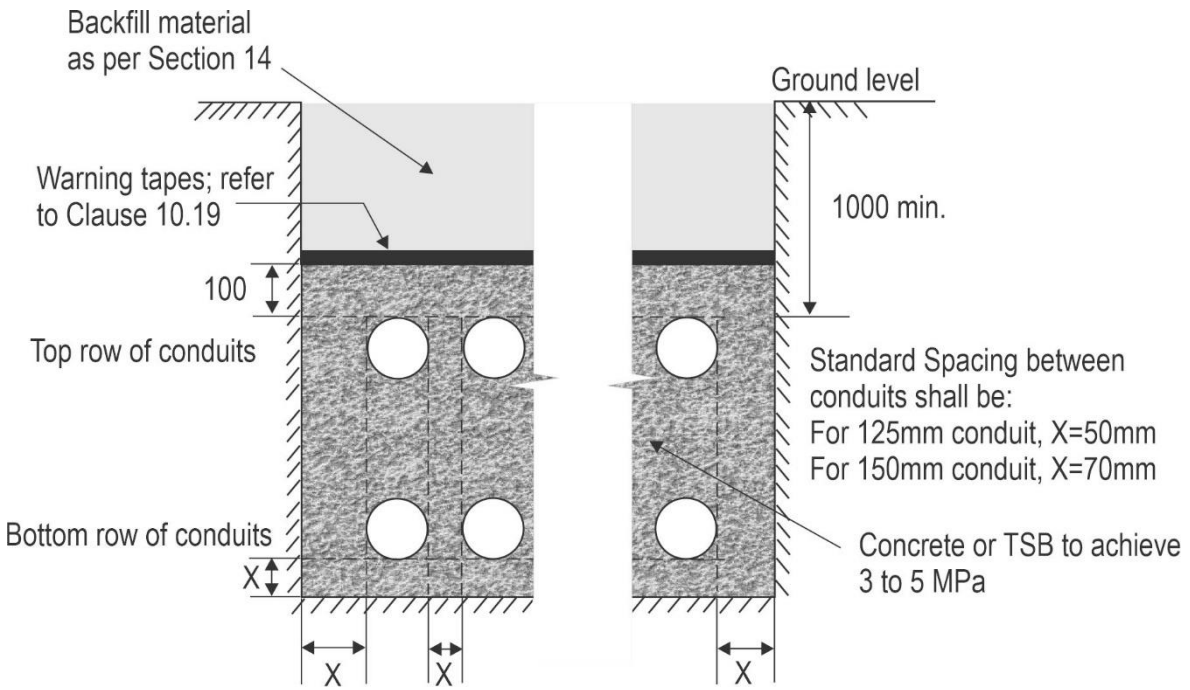


Figure 3: Standard Cover 1000mm

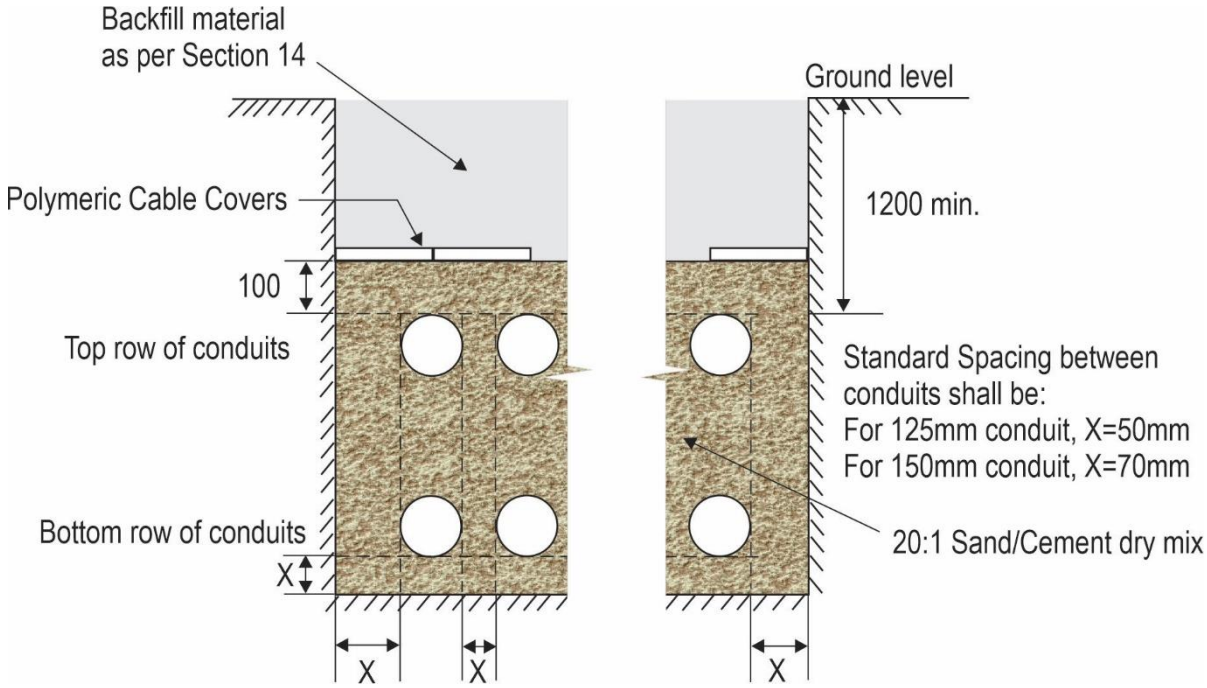


Figure 4: Standard Cover 1200mm

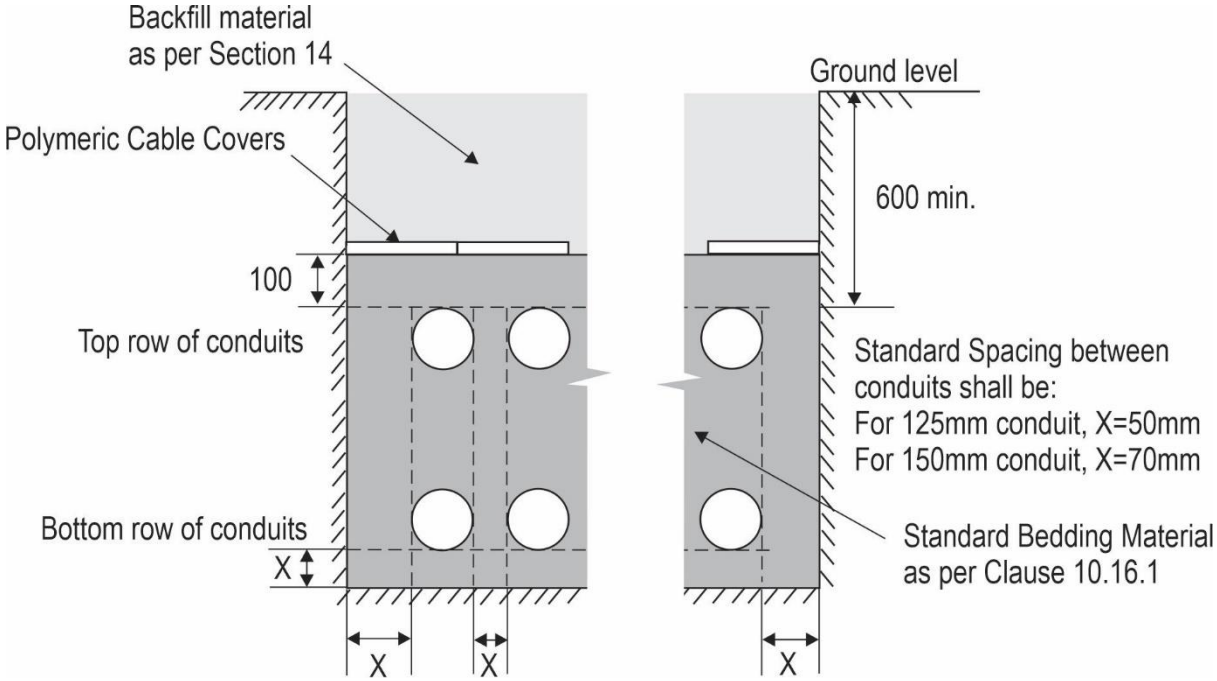


Figure 5: Standard Cover 600mm HV

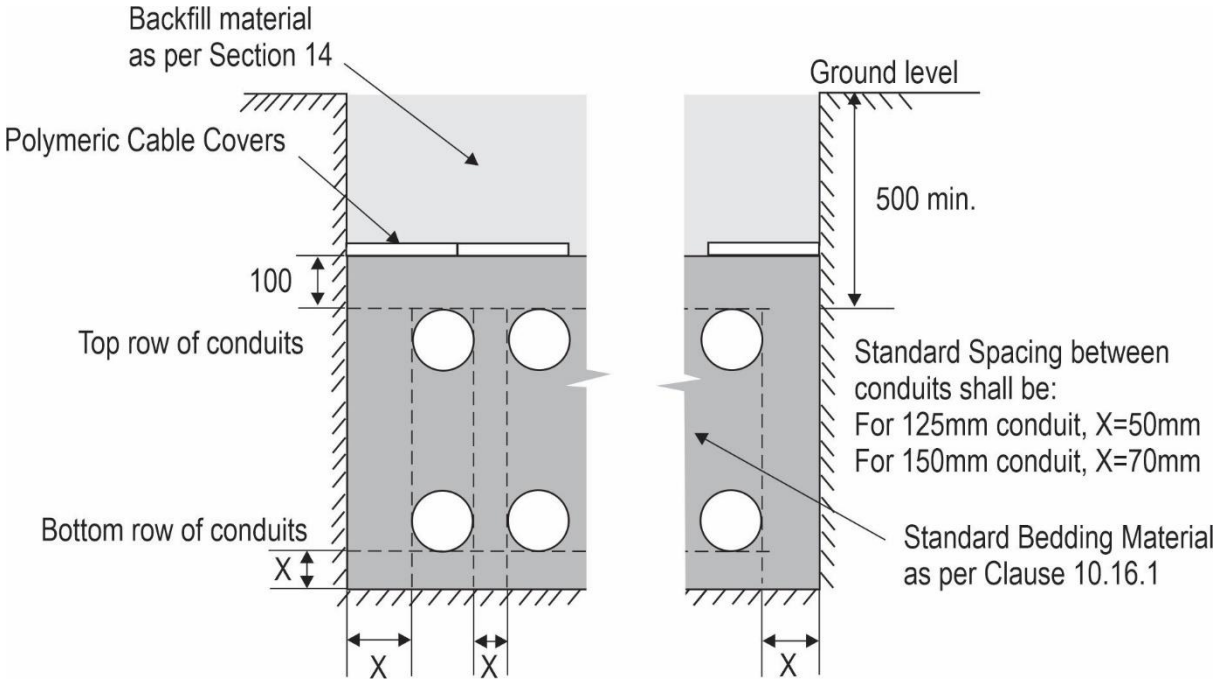


Figure 6: Standard Cover 500mm LV

If the standard depth of cover requirements cannot be met, reduced cover in accordance with the requirements of Clause 10.12 may be allowed by Ausgrid if prior approval is sought.

10.12 Reduced depth of cover

Where it is absolutely necessary to reduce cover over conduits or cables in order to overcome unavoidable site obstructions, the requirements below shall be followed, but only after consultation with an agreement by the group responsible for design and ratings within Ausgrid. It should be noted that this concession DOES NOT provide a blanket approval for reducing the depth of cover. Note also that the cover/protection requirements below generally preclude directional drilling being utilised at reduced cover.

(a) Cables must be laid in conduits.

(b) The reduced depth shall be limited to a maximum of 5 metres of continuous trench length. The total length of trenching subject to reduced depth shall not exceed 5% of the total length of trenching involved in any one project or part thereof, unless specifically approved by Ausgrid's Representative.

Where a roadway crossing involves obstructions which necessitate invoking this clause and it can be demonstrated that it would be more practical to do the full roadway crossing at the same reduced depth, Ausgrid will consider exempting the roadway crossing from the 5% rule.

(c) The transition between standard depth and reduced depth shall be gradual and shall not exceed the minimum bending radius of the cables expected to be accommodated within the conduits. For the purpose of determining the minimum bending radius of spare conduits, and in the absence of any other information, it shall be assumed that 125mm and 150mm conduits will respectively accommodate three core polymeric cables up to 400mm^2 and 500mm^2 in cross sectional areas. Refer to Clause 10.5 for further information.

(d) Trench dimensions, bedding, backfill and protection requirements shall be as specified in Table 4 below.

(e) Where it is impractical to comply with reduced cover requirements in special concrete encased cable installations e.g. bridge culverts, underneath suspended slabs, within buildings (including cable risers, walls and beams), a clearly visible permanent surface marking at 3 metre intervals along the cable route shall be centrally affixed to all surfaces (where attachments may be made or holes drilled) of the concrete encasement to warn of the presence of these cables. An example of a suitable marking is a 150mm x 65mm rectangular stainless steel warning plate with the words 'DANGER, ELECTRIC CABLE REDUCED COVER'; secured to surface by stainless steel mush head spikes. See Figure 7. Cable ratings outcome shall be maintained.

An example of a larger steel plate is similar to the above marking with 250mm x 180mm dimensions.

Figure 7: Surface marking

Table 4: Reduced cover and backfill requirements for conduits

Location	Reduced Cover (mm)	Bedding / Backfill / Protection Requirements
LV and/or HV conduits in the carriageway of **Classified State Roads** (Note: excluding footways)	Less than 1 metre and greater than 750mm Less than 750mm and greater than 500mm	Shall be negotiated with the RMS on a case-by-case basis. In addition, polymeric cable covers are to be used (refer to note 2) Shall be negotiated with the RMS on a case-by-case basis. In addition, steel plates and polymeric cable covers are to be used (refer to note 2)
LV and/or HV conduits in City of Sydney Roadway or Laneway.	500*	20:1 sand/cement dry mix or TSB (refer to Figure 8 and Note 1) Steel plates and polymeric cable covers are to be used (refer to Note 2)
LV and/or HV conduits in any other type of roadway and heavy commercial / industrial car parks	500*	Standard bedding material or 20:1 sand/cement dry mix - see Clauses 10.16.1 or 10.15.1 (refer to Figure 8) Steel plates and polymeric cable covers are to be used (refer to Note 2)
HV conduits in footway	450	Standard bedding material - see Clause 10.16.1 (refer to Figure 9) Steel plates and polymeric cable covers are to be used (refer to Note 2)
LV conduits in footway	300	Standard bedding material - see Clause 10.16.1 (refer to Figure 10) Steel plates and polymeric cable covers are to be used (NB. steel plates are considered equivalent to a concrete slab as per AS 3000) (refer to Note 2)
LV and/or HV conduits in other public access areas, e.g. light commercial / residential car parks, recreation areas.	450	Standard bedding material - see Clause 10.16.1 (refer to Figure 9) Steel plates and polymeric cable covers are to be used (refer to Note 2)

* In accordance with RMS Specification M209.

Notes:

1. For TSB mix refer to Clause 11.2.
2. Polymeric cable covers shall be laid across the full width of the trench. Refer to Clause 10.18 for installation parameters.

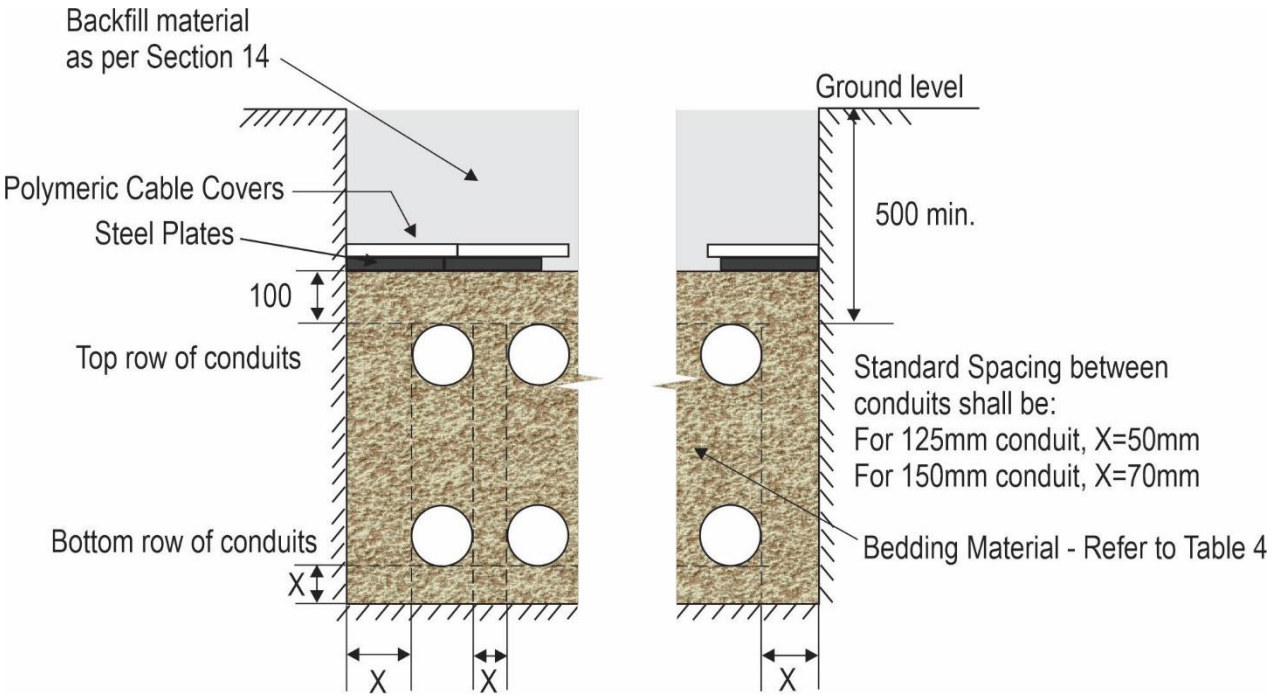


Figure 8: LV and/or HV Conduits in Roadways

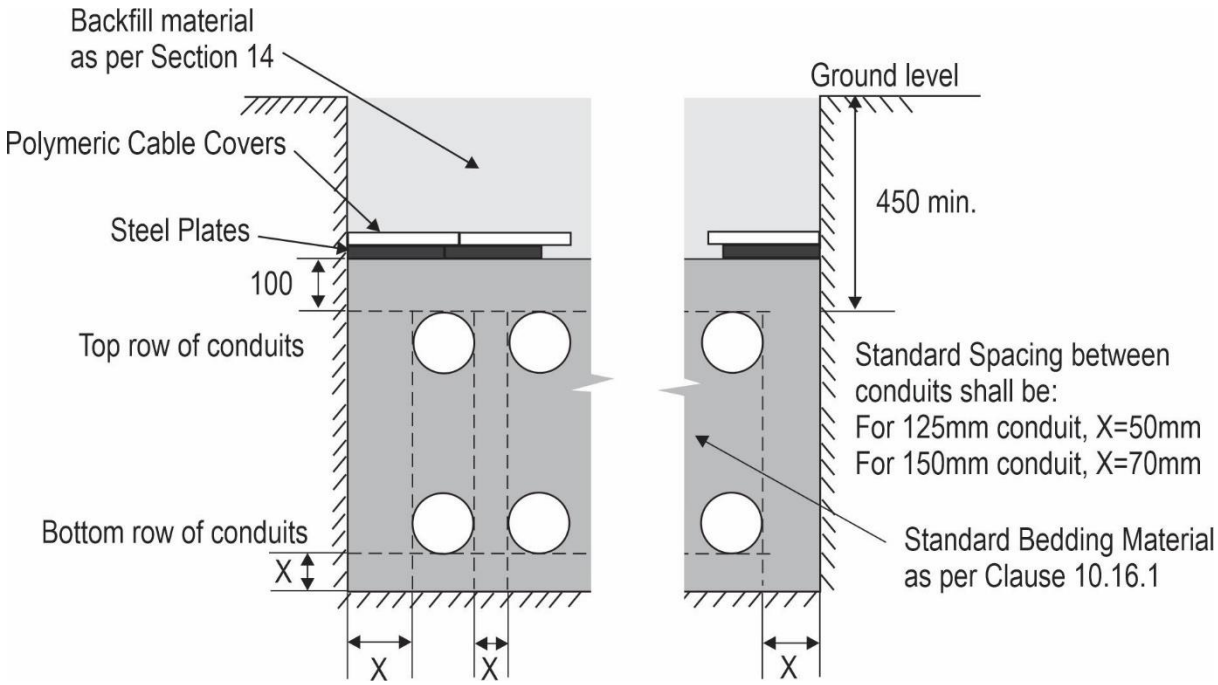


Figure 9: HV Conduits in Footway

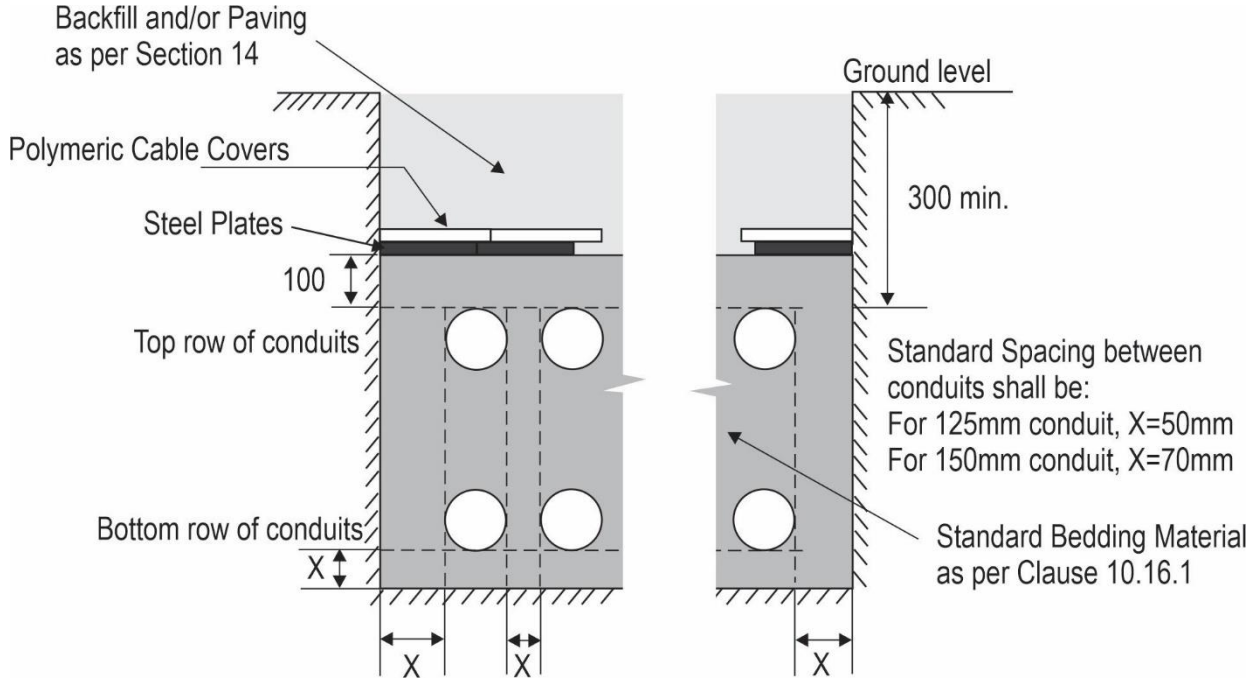


Figure 10: LV Conduits in Footway

10.13 Bedding types

Conduit bedding material shall be specified on the Certified design/ Design plan. The type of bedding material used for banks of conduits (including single conduit installations) shall be in accordance with Table 3 or Table 4.

Additionally, when conduits are installed either below or beside or above other cables or conduits, the conduits shall be encased in the same bedding material as the adjacent cables or conduits unless otherwise directed in the Design Information.

Conduit bedding material shall comprise of one of the following;

- Concrete
- TSB to achieve 1 to 2 MPa compressive strength in 28 days (refer to Table 6)
- TSB to achieve 3 to 5 MPa compressive strength in 28 days (refer to Table 6)
- 20:1 sand/cement dry mix
- Standard bedding material.

Any variations to bedding materials will require Ausgrid's approval before implementation.

10.14 Concrete encased conduits

10.14.1 General

Refer to Section 9 for information on concrete construction work in general. All concrete used for conduit encasement shall have a characteristic strength as stated in Table 3 or 4, at twenty eight (28) days. Note that in order to maintain cable ratings, concrete used for encasing conduits must not adversely affect the transfer of heat to the soil and atmosphere. In particular, the following requirements must be adopted in designing the concrete mix:

- The specific concrete specifications required for the concrete encasement of the HV conduit line is to be indicated on the drawings. Ausgrid's requirements, including those indicated below, shall be referenced.
- Admixtures in the concrete mix shall be subject to the approval of Ausgrid following the submission of a product specific data sheet. The use of accelerators to speed concrete curing or admixtures that entrain air will not be approved.
- The total fly ash in the concrete mix (by weight) shall not exceed 5% unless separately approved by Ausgrid. Fly ash reduces the thermal performance of the installed conduit bank.
- Lightweight aggregate and air entraining agents shall not be used.
- Where reinforcement is required, detailing shall be arranged to reduce the potential for induced currents. Transverse reinforcement around the conduit bank shall not form a closed loop at any location.
- ASPs or contractors wishing to vary concrete mix from approved requirements shall provide documentation demonstrating that their proposal achieves the specified thermal resistivity (TR) value without increasing the in-situ concrete curing temperature such that conduits are likely to be damaged.
- The standard thickness of the concrete encasement on the top, bottom and each side of the conduits in a conduit bank shall be as specified in Table 5 below. Where the depth of cover over the conduits has to be reduced, the requirements for encasement shall be as specified in Clause 10.12.

Table 5: Concrete encasement dimensions

	Minimum Encasement Thickness (mm)		
Conduit Size	Top	Bottom	Sides
125mm	100	50	50
150mm	100	70	70
200mm	100	70	70

Encased conduits shall be installed with suitable spacers between the conduits prior to placing the encasement material. Refer to Annexure I for further information on suitable spacers.

Where construction joints in the encasing material occur, each joint shall be provided with at least four 16mm diameter steel dowels, extending into the encasement material for 450mm on either side. Two additional dowels shall be provided for every additional row of four conduits above four installed.

Conduits should be secured to avoid flotation during the pouring of concrete. This may be achieved by tying the conduits with rope at three metre intervals and anchoring the conduits using timber stakes driven into the cable trench, or by other approved methods.

Concrete encasement should be designed to ensure the heat of hydration does not result in overheating and deformation of the conduits. Ausgrid specifies that conduits shall not be damaged by operation at 80°C.

The conduits shall be fixed in place so that the top concrete cover remains at no less than 100mm. Special attention shall be paid to recording the depth of cover (refer to NS100, Field Recording of Network Assets). The Constructor for the work shall be responsible for ensuring that the concrete cover over the top conduits is uniform, or if this is not possible, that the actual cover is accurately recorded, in accordance with NS100. Depth gauges may be used if required to measure the actual cover at critical locations.

Figure 11 shows the typical layout of a nine-way bank of conduits where 125mm conduits are installed as three layers of three. The conduit spacer shown in the illustration has stockcode which appears in Annexure G.

Figure 12 shows a nine-way bank of 150mm conduits.

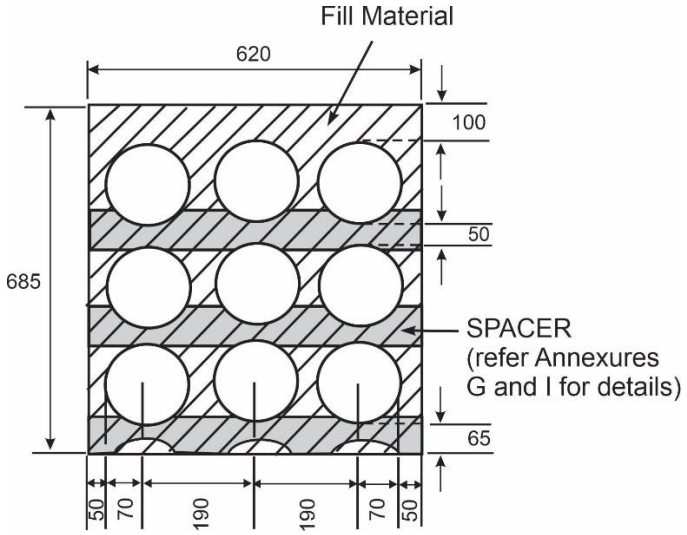


Figure 11: Nine-way bank of 125mm Conduits

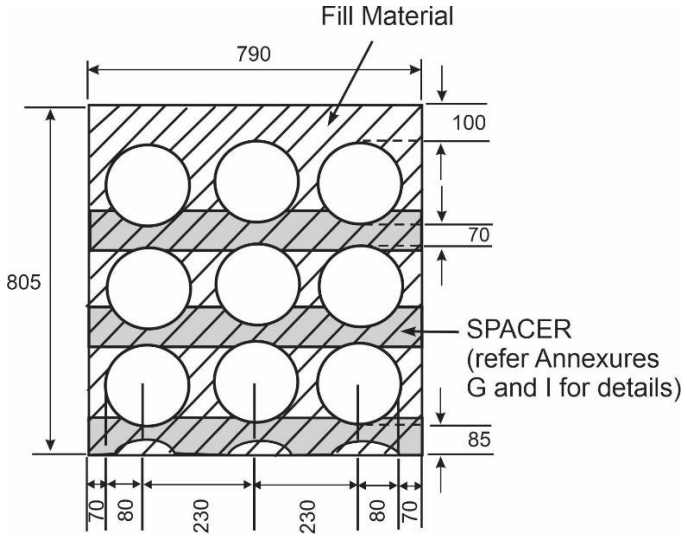


Figure 12: Nine-way bank of 150mm Conduits

10.14.2 Conduit spacers

Foam spacers

The foam conduit spacers are for dry mix TSB or for bedding material that need to be compacted.

The purpose of the conduit spacers is to keep the conduits in their correct position relative to each other and the surrounding soil. The foam conduit spacer must be installed where bedding needs to be compacted or dry mix TSB is to be installed. Foam spacers shall not be installed where TSB slurry mix or concrete slurry is to be applied.

The conduit spacers must be designed:

- not to indent or damage the conduits
- not adversely affect the thermal rating of the power cables.

Plastic spacers

The Plastic conduit spacers are for TSB slurry mix or concrete slurry material.

Plastic conduit spacers shall be used for installations to keep conduit separation based on cable rating requirements and to allow TSB slurry mix/concrete slurry to flow as required. The main purpose of the spacers is to keep the conduits in their correct position relative to each other and the surrounding soil, and to prevent them from floating as the trench is backfilled. They must be designed so as not to damage the conduits if they soften due to the heat generated by the TSB slurry mix or concrete as it cures.

Various spacer types are commercially available.

10.15 Sand/cement bedding of banks of conduits

10.15.1 Sand/cement bedding

Sand/cement dry mix used for bedding conduits shall be portioned 20 parts sand to 1 part cement and thoroughly mixed before placement to ensure that concentrations of cement do not occur. Sand/cement dry mix shall be delivered direct from the batching plant and shall not be stockpiled on site.

10.15.2 Construction procedure

Sand/cement bedded conduit banks shall be constructed using the procedure for dry bedding of conduits in Clause 10.17.

10.16 Standard bedding of banks of conduits

10.16.1 Standard bedding material

It is of paramount importance that appropriate bedding material is used for bedding conduits in an open trench. Standard bedding materials shall meet the following requirements unless specifically approved otherwise by Ausgrid:

Standard bedding materials shall be finely divided and stone free where no less than 95% by mass shall pass through a 2.36mm mesh sieve with 100% by mass passing through a 4.75mm mesh sieve. The material shall be free of glass, metal, sharp objects, slag, organic or other harmful substances. Clay that is removed during excavation work is not suitable as a standard bedding material. It must be replaced with a suitable clean bedding material. Standard bedding material must have suitable thermal resistivity to ensure the ductline meets the distribution network rating requirements.

Recycled ‘GlassSand™’ and other recycled crushed glass products are not approved bedding materials.

10.16.2 Construction procedure

The conduit banks shall be constructed using the procedure for dry bedded banks of conduits in Clause 10.17.

10.17 Procedure for dry bedded banks of conduits

The bedding compaction ratio shall be minimum 3:2.

Dry bedded banks of conduits shall be constructed using the following procedure:

For 125mm conduits:

1. Place a 75mm deep layer of approved bedding material at the bottom of the trench and compact the bedding down to 50mm.
2. Lay the first row of conduits. Maintain a minimum separation of 50mm between conduits, and 50mm between the outer conduits and the sides of the trench.
3. Place bedding material over the first row of conduits to a depth of 285mm and compact the bedding material down to 190mm.
4. Lay any additional rows, then place more bedding material and compact between the rows in the same manner.
5. Place a 150mm layer of bedding material over the top layer of conduits and compact down to 100mm.

For 150mm conduits:

1. Place a 105mm deep layer of bedding material at the bottom of the trench and compact the bedding down to 70mm.
2. Lay the first row of conduits. Maintain a minimum separation of 70mm between conduits, and 70mm between the outer conduits and the sides of the trench.
3. Place bedding material over the first row of conduits to a depth of 345mm and compact the bedding material down to 230mm.
4. Lay any additional rows, then place more bedding material and compact between the rows in the same manner.
5. Place a 150mm layer of bedding material over the top layer of conduits and compact down to 100mm.

Notes: When adding and compacting the bedding material, care shall be taken to avoid dislodging the laid conduits from their required position. Conduit spacers should be used to progressively construct the conduit bank.

The layer of bedding material over the conduits shall be carefully consolidated using hand rammers only. Under no circumstances shall mechanical rammers be used to consolidate the bedding material.

On steep inclines and other locations where scouring of the bedding material is likely to occur, bulkheads consisting of bags packed with 20:1 sand/cement mix must be installed at regular intervals.

10.18 Protection of conduits

Conduits are considered to be inherently protected from mechanical damage, provided they are installed with a standard depth of cover (refer to Clause 10.11) and are either:

- concrete encased, or
- TSB encased, or
- installed using Trenchless Technology.

These installations do not require cable protection covers unless specifically requested in writing by Ausgrid. Critical or high risk Sydney CBD installations are possible locations where additional cable protection covers may be required. Warning tapes shall be provided in accordance with Clause 10.19.

All other conduit installations, including those installed with standard or reduced depth of cover with standard bedding material or 20:1 sand/cement dry mix bedding, shall be protected against mechanical damage using Ausgrid approved cable protection covers laid directly above the bedding material.

For reduced cover installations, additional protection against mechanical damage shall also be provided in accordance with Clause 10.12.

Currently approved cable protection covers are of the polymeric type complying with Ausgrid's performance requirements. The standard sizes used and the corresponding stockcode numbers are listed in Annexure G.

Where there is a single conduit in the trench, a single 150mm or 300mm wide strip of polymeric cable cover shall be used. The single cable cover shall completely cover and be centred over that conduit.

Where 2 or more conduits are laid side-by-side, the wider 300mm size of polymeric cable cover shall be used.

If more than one strip of 150mm wide polymeric cable covers is required side by side, 300mm wide strips shall be used.

Polymeric cable cover strips laid side-by-side shall butt up against each other. Polymeric cable cover strips laid end-to-end shall overlap by approximately 20mm.

Cable covers must be immediately secured in position by covering with a 150mm thick (minimum) layer of backfill material.

10.19 Use of warning tape

Warning tape, as listed in Annexure G, shall be used in the following circumstances:

- over concrete encased conduits
- over TSB encased conduits
- where specifically required by Ausgrid.

Where used, the tape shall cover the full width of the trench, or portion thereof containing the conduits. Where two or more strips of warning tape are laid side-by-side, they shall overlap by 20mm. Warning strips shall be immediately secured in place by a 150mm minimum covering of backfill material.

10.20 Inspections by Ausgrid

Ausgrid has the right to inspect all works regarding the installation of its assets. If access to our assets is unavailable, then the constructor must provide Ausgrid access at the constructor’s expense.

10.21 Kerb marking

Permanent kerb marking must be provided (except where there is no kerb or gutter) at all roadway conduit crossings and under road borings, using the letter E (for Electricity). The markings shall be done by engraving or other approved means, and shall be positioned on the face of the kerb directly above the installed conduits at both sides of the roadway crossing.

Note: Permanent markings shall not be installed in heritage situations unless approved.

For example, permanent kerb marking may consist of an approved stainless steel ‘E’ plate anchored onto the kerb as shown in Figure 13. The supplier is Hi-Tech Horizontal Drilling. http://www.kerbmarkers.com.au

Figure 13: Approved kerb marking

10.22 Bridge crossings

Where bridge crossings are required, specific structural designs must be provided. Before any work occurs, the design must be certified, and authorisation must be obtained from the relevant bridge Authority/Owner and from Ausgrid.

The cable and cable/conduit support design shall allow for the expected bridge movements (vertical and longitudinal).

Cable design shall meet the distribution network rating requirements.

For exposed HV and LV cables and conduits, suitable measures shall be used to provide adequate mechanical protection and to restrict public access. These measures shall be subject to review and approval by Ausgrid.

For all bridge crossings, clearly visible permanent surface marking at 3m intervals along the cable route shall be provided, in accordance with Clause 10.12.

All bridge crossings shall have a rating assessment completed by the Designer as per NS272, and the rating assessment shall be submitted to Ausgrid for review and written approval.

11. THERMALLY STABLE BEDDING MATERIAL

11.1 General

Ausgrid uses the generic term Thermally Stable Bedding (TSB) in referring to any thermally stable bedding or backfill material which has been designed to achieve specific thermal characteristics.

Where Ausgrid specifies the use of TSB material, the installation shall meet the following requirements, unless specifically approved otherwise by Ausgrid.

Generally, cable design should not require the use of thermal backfill above the cable warning tapes on distribution projects as use of TSB could create an obstruction to other utility services in footpath or road crossing locations.

TSB must be used in accordance with any relevant resource recovery orders and exemptions issued by the NSW Environment Protection Authority (EPA). The coal ash order and exemption 2014 apply to products that contain fly ash.

11.2 Approved materials and mix design

TSB is available in the form of Slurry or Dry mix.

The slurry mix is the default mix. Dry mix shall only be used with the approval of the Ausgrid representative.

The following table outlines the required performance characteristics of the TSB:

Table 6: Performance characteristics of TSB mixes

Site Location	Thermal resistivity (TR) K.m/W (fully dry)	Compressive Strength (MPa) at 28 days	Compressive Strength (MPa) at 120 days
Footways, Unclassified roads & Classified Regional roads	0.9 or less	1 to 2	Less than 3
Classified State roads	0.9 or less	3 to 5	Less than 7

Any design requiring the use of TSB shall comply with the performance requirements of the above table. The Designer shall clearly specify the site location of the TSB mix in the design in the following way:

- 'TSB - Footways, Unclassified roads & Classified Regional roads', or
- 'TSB - Classified State roads'.

For the Schedule of Unclassified Roads, Classified Regional Roads and Classified State Roads, refer to the following RMS website link:

https://www.rms.nsw.gov.au/business-industry/partners-suppliers/lgr/documents/classified-roads-schedule.pdf

The Constructor shall ensure that the selected TSB mix complies with the design.

Key parameters of TSB – unless otherwise approved by Ausgrid are:

- Flyash Content - 5% max (by weight) unless approved by Ausgrid
- Course Aggregate - 10mm max size crushed gravel.
- Admixtures for Pumping etc - subject to Ausgrid approval (product specific data sheet required).
- Lightweight Aggregate - not allowed
- Air Entrainers - not allowed
- Early Strength Accelerators - not allowed.

Key components of TSB are:

- Cement
- Flyash
- Crushed gravel
- Coarse sand
- Water.

Ausgrid's Approved Material List (AML) provides a list of suppliers of TSB mixes and their product codes.

TSB mixes from other suppliers not listed in the AML can also be submitted to the Ausgrid Representative for consideration using the NS181 approval process. In this case, the Constructor shall provide the Ausgrid Representative a TR test report, Compressive Strength test report and mix design / recipe for review.

The Constructor shall provide a copy of the TSB delivery docket to the Ausgrid Representative for every batch of TSB mix supplied and shall demonstrate compliance with the AML for the approved TSB mix and site location specified in the design. If the TSB mix is not listed on the AML, the Constructor shall demonstrate compliance of this TSB mix to a design approved by Ausgrid for the site location.

Once approved, the TSB mix design shall not be modified without the further approval of Ausgrid. All materials used in the approved mix design shall continue to be sourced from the original locations to ensure consistent strength and TR values. Any change to the source of material supply will require a revised mix design, re-testing of strength and TR values, and the subsequent approval of Ausgrid.

11.3 Default slurry mix

11.3.1 General

Application: All trenches and banks of conduits requiring TSB unless otherwise authorised.

A slump of 110mm average (range 90mm to 130mm) shall be adopted as the standard for most projects. Water may only be added on site to restore the correct slump – never to speed installation.

Where vibration is required, it shall be strictly controlled in accordance with Clause 11.3.2.5 due to the risk of aggregates segregating out and reducing thermal performance.

If a lower slump is required for sloping sites and it is found that the mixture is not fully encapsulating the conduits, properly specified vibration (not more than 3 seconds in any one location of TSB) shall be used to ensure the mix is properly blended. Vibrating must be monitored to ensure it does not damage the conduits and to ensure components do not segregate out.

For typical examples of slurry mix designs that may satisfy the performance requirements, refer to Annexure M.

11.3.2 Installation of thermally stable slurry mixes

11.3.2.1 Trench preparation

The trench should be free of all debris and standing water before the bedding mix is poured. A small amount of water in the trench is acceptable.

11.3.2.2 Typical installation methodologies

The conduit installation methodology and the required trench dimensions shall be in accordance with Clause 10.14 for concrete encased conduits.

11.3.2.3 Flotation

Since thermally stable bedding mixes are a hydraulic fill, conduits may tend to float, and therefore they must be secured to the bottom of the trench. The TSB shall be placed from a minimum height that does not exceed 1.8 metres.

11.3.2.4 Placing of TSB

TSB shall be supplied and transported to site in agitator trucks. The mix should be installed by controlled pouring around the conduits or cables in accessible trench locations. Where the use of mechanical compaction/ vibration is required, it shall be strictly controlled in accordance with Clause 11.3.2.5.

11.3.2.5 Compaction of TSB

The normal TSB mix design, slump and placement techniques should be such that there is no need for additional mechanical compaction/vibration for most installations.

Where further compaction of the TSB is deemed to be required, the preferred method is by the use of immersion vibrators. Vibration of TSB shall only be undertaken by trained and experienced operators using equipment that is suitably sized for the installation. The use of vibrators shall be constantly monitored to ensure proper technique, suitable immersion times and complete coverage of the TSB installation.

In this regard, it should be noted that compaction is a two stage process that involves:

(a) Initial Consolidation – aggregate particles are set in motion and slump to fill the formed space giving a level top surface.

(b) Entrapped Air is expelled – air bubbles rise to the surface over a period of time after the surface has levelled.

Both stages need to be effectively completed to produce a dense, compacted material with minimal entrapped air voids.

Poorly monitored or excessive vibration may cause segregation of the mix aggregates and thereby reduce the thermal performance of the TSB.

11.3.2.6 Air voids

TSB slurry mixes shall be designed to minimise entrapped air voids, and reduce the need for additional mechanical compaction/ vibration where possible.

Work methods must ensure that any gaps and air voids (such as those caused by cracking of the mix or removal of shoring materials) are completely filled with either a sand /cement mix or TSB as required.

11.3.2.7 Bleed water and hardening

As the bedding mix starts to solidify, it will bleed excess water to the surface. In poorly draining native soils, provision shall be made to allow this bleed water to either drain away or be pumped away prior to the placement of any backfill material.

The bedding mix will set within 6-8 hours of it being placed. The mix shall be left for a minimum of 8 hours to cure without any disturbance and before backfilling of the trench commences.

11.3.2.8 Formwork removal

If the trenches are shored or bulkheads are used on sloping ground, the shoring should be removed during the mix pour or within one hour after the mix is poured, that is, while the mix is still in a semi fluid state. However, the mix should not to be allowed to develop cracks as it flows into the space created by removal of the shoring.

If cracks or voids are found, these shall be filled in by pouring additional TSB material into them. Limited vibration, in accordance with Clause 11.3.2.5, may be used to ensure the TSB effectively fills the void left by the shoring.

11.4 Dry mix

Application: Difficult site locations where default slurry mix is not practical (steep slopes, road crossings requiring immediate backfill). This mix must not be used unless written approval is obtained from Ausgrid.

This dry mix gives a fully dry nominal thermal resistivity value of 0.9K.m/W when compacted to 98% Standard Proctor. Refer to Clause 10.17 for suitable installation methods applicable to dry bedded banks of conduits.

Special care must be observed with thorough mixing of the ingredients, installed moisture content, and proper compaction measures.

For a typical example of a dry mix design that may satisfy the performance requirements, refer to Annexure M.

11.5 Alternative TSB materials

On any project, alternative mixes may be used, provided test results demonstrating thermal and mechanical performance are submitted to the Ausgrid representative for approval prior to use.

Once approved, the alternative mixes may be used on other projects, provided there are no unapproved changes to the mix design, and the TSB characteristics are compatible with the requirements of the other projects.

Alternative mix designs shall not be modified once approved and all materials shall continue to be sourced from the original locations as required by Clause 11.2.

11.6 Minimum coverage of thermally stable bedding

The minimum coverage of TSB around the conduits shall be 50mm on the sides and base, and 100mm above. This cover may need to be increased depending on the detailed cable design, for example installations involving a large number of conduits at zone substation outlets (to ensure they meet the distribution network rating requirements).

TSB shall not be used as backfill material (above the cable warning tapes) for installations in footpaths or road crossings, unless approved in writing by Ausgrid.

11.7 Testing

For effective TSB performance, periodic tests are required to ensure that:

- the specified mix ingredients continue to be used, and “similar” ingredients are not substituted without approval, and
- the TSB mixes achieve their designated function, including thermal and mechanical characteristics.

TSB mixes shall be tested according to the following guidelines:

- prior to delivery of the first batch of a new mix (i.e. from a new batch plant or source of supply), and
- whenever one or more ingredients are to be sourced from a different location or supplier, and
- at least every 50m length of trench or part thereof (see below).

Each test shall consist of assessment against the criteria specified in Clause 11.2. In addition, slump shall be tested prior to every installation of slurries, while compaction testing of dry mixes shall be as specified in Section 16 for testing of backfill materials at specific locations.

Testing Frequency for Trench Installations

An installation using TSB material shall have thermal resistivity (TR) and 28 day compressive strength sampling and testing performed as follows:

- Trenches <50m long - one sample per trench location
- Trenches >50m long - one sample per 50m length of trench or part thereof, with sample locations being equally spaced along the trench length.

The location/s of the sampling must be accurately recorded and provided with the TSB test results to Ausgrid no later than six (6) weeks after the sampling, who will submit them to:

- gis@ausgrid.com.au for incorporation into Ausgrid's Geographic Information System (GIS), and
- TR_and_TSB_results@ausgrid.com.au for ongoing review of the TSB performance characteristics and incorporation into Ausgrid’s ThermalRes database.

For thermal resistivity testing requirements and procedures refer to Annexure L.

12. INSTALLATION OF PILLARS AND RAG-BOLT ASSEMBLIES FOR STEEL LIGHTING POLES

12.1 Installation of pillar bases

The pillar base is installed in the footpath, square to the kerb, with the centre of the top opening 400mm in front of the street alignment, and normally in a direct line with the extension of the Lot Boundary line. For link pillars (i.e. single and double) the short edge of the pillar base shall be installed parallel to the building line and for all other pillars (i.e. solid pillars, underground SLCP pillars) the long side of the pillar base shall be installed parallel to the building line.

Refer to NS224 Low Voltage Suburban Commercial and Industrial Underground Distribution Utilising Pillars, for installation requirements of suburban commercial and industrial pillars

Use sand-filled bags, or other means, to build a stable column in the trench to support the pillar base, enclose the distributor, service cables and service conduit stubs, and cover any high voltage cables.

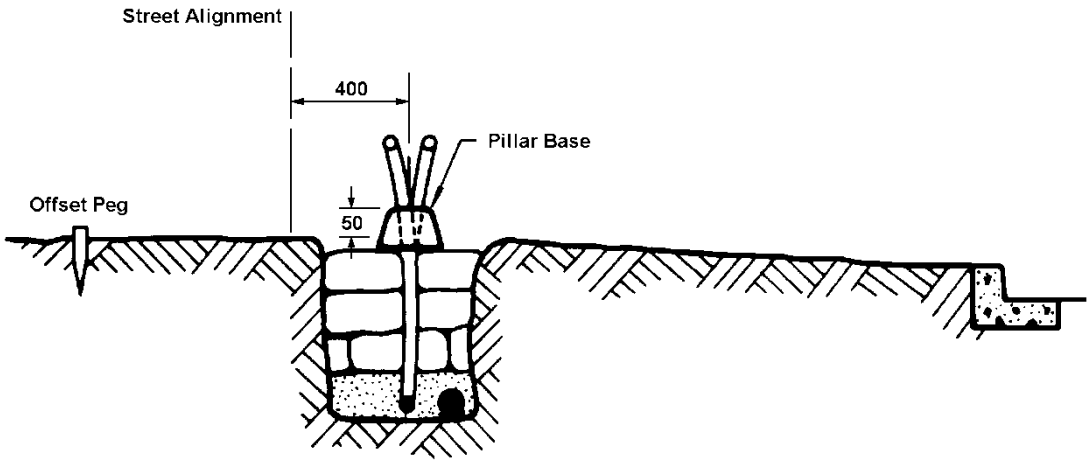


Figure 14: Pillar Base Alignment Details

Position the base so that the top is level and 50mm above the footpath level at street alignment as shown in the above figure. Allow for grass when determining the final footpath level.

Cable terminations shall be installed in accordance with NS127 Low Voltage Joints and Terminations or NS224 Low Voltage Suburban Commercial and Industrial Underground Distribution Utilising Pillars.

Once the distributor and service cables have been installed and terminated, the trench around the base and supporting structure must be backfilled with well-compacted granular soil.

12.2 Installation of rag bolt assemblies for steel lighting poles

Rag-bolt assemblies are used as mounting bases for some steel lighting poles. Rag-bolt assemblies must not be erected before the finished ground level has been ascertained from the local authority.

Unless otherwise specified, the centre line of the rag-bolt assemblies shall be positioned 400mm from the street alignment, as shown in Figure 15.

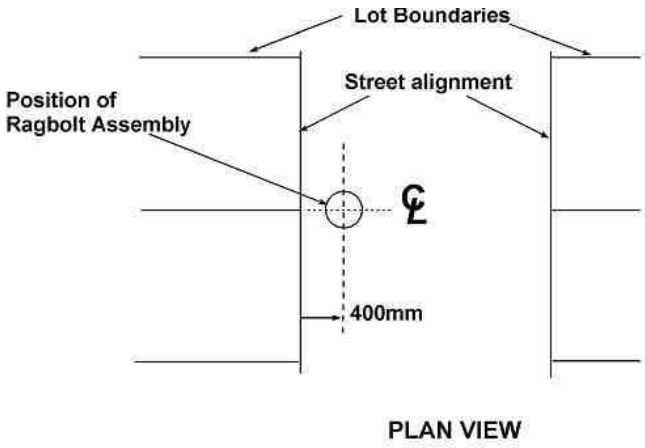


Figure 15: Rag-bolt Alignment Details

Installation of the pile footing, rag-bolt assembly and plinth shall be in accordance with Ausgrid drawing 514087, using plinth steel mould to Ausgrid drawing 514020.

The rag-bolt assembly must be installed in a 600mm diameter hole. Where unstable ground exists or shared trenching is used, a 600mm diameter former tube must be fitted to the hole.

The hole or former tube must be filled with 32MPa concrete. Any gaps around the concrete core must be filled with well compacted granular soil, and any sharp edges must be removed after the concrete has set.

Once in its final position, the rag-bolt assembly must:

- be vertically aligned in both planes
- be square to the kerb
- have its centre line 400mm from the street alignment (unless specified otherwise)
- have the top of the threaded rods 100mm above the top of the plinth steel mould in accordance with Ausgrid drawing 514087.

Once the street lighting cables have been installed and terminated in accordance with NS119 Public Lighting Design and Construction, the trench around the rag-bolt assembly must be backfilled with well compacted granular soil.

13. INSTALLATION OF POWER AND CONTROL CABLES

13.1 General requirements

Refer to NS100, Field Recording of Network Assets – External Annexure C; Cable Codes & Nomenclature.

Cables must be installed in the correct allocation, and with the specified separation from other cables and the sides of the trench. Refer to Clause 10.10 and Annexures B, C and D for further information.

13.1.1 Pilot Cables

13.1.1.1 Sydney CBD

The Sydney CBD 11kV Triplex network uses a "coloured" pilot cable system with:

- Red associated with the A, D, G, K, etc feeder
- White associated with the B, E, H, L, etc feeder
- Blue associated with the C, F, J, M, etc feeder.

Under no circumstances shall alternative coloured pilot cable be installed on the Triplex network. Placing coloured heat shrink tubes over the pilot cable or using labels to indicate the pilot's true colour is also not acceptable on the Triplex network.

The coloured pilot cable shall be installed in the same conduit as its associated Triplex feeder power cable. Any deviation from this requirement shall require prior approval from Ausgrid via NS181 processes. In cable pits, vaults, rooms, tunnels, chases, joint bays and risers, the coloured pilot should be cable tied, cleated or grouped with its associated Triplex feeder power cable.

13.1.1.2 Other than Sydney CBD

The pilot cable shall be coloured black and installed in the same conduit as the feeder cable.

13.2 Testing of conduits prior to use

Prior to the commencement of the cable installation, all conduits intended to be used, whether newly laid or pre-existing, shall be thoroughly cleaned and mandrelled in accordance with Clause 14.7.

13.3 Direct buried cables

13.3.1 General

Direct buried cables shall not be installed in carriageways.

Direct buried cables may be buried in sand or 20:1 sand-cement dry mix, depending on site-specific installation requirements. Refer to Clause 10.16.1 for standard bedding material requirements, or to Clause 10.15.1 for sand/cement bedding material requirements.

The bedding material around direct buried cables shall be placed in three or more defined layers using a minimum compaction ratio of 3:2 and shall meet the cable spacing requirements of Clause 13.3.2. Each bedding material layer shall be compacted down to 2/3 of the “loose” volume, shall have a final compacted thickness not exceeding 200mm and shall be arranged so that the final layer provides the required top cover to the direct buried cables. The layer of bedding material over the direct buried cables shall be carefully consolidated using hand rammers only. Under no circumstances shall mechanical rammers be used to consolidate the bedding material.

All direct buried cable installations shall be protected against mechanical damage using Ausgrid approved cable protection covers laid directly above the bedding material.

Concrete or TSB shall not be used as bedding material around direct buried cables.

Coarse aggregates shall not be used in trenches with direct buried cables, due to risk of damage to the cable during compaction.

Cables that are direct buried and surrounded or partially surrounded in a sand/cement mix are known as solid laid cables. When excavating around such cables extreme care must be taken to avoid creating a hazardous condition to personnel, or damage to the cables.

When solid laid cables are encountered, the constructor shall consult with Ausgrid to arrange for all solid laid cables at the work site to be de-energised before work continues. This will eliminate the possibility of hand held tools penetrating the energised cables. Alternatively, a hydro vacuum excavator can be used to expose all solid laid cables without the need for de-energisation, provided the precautions detailed in NS156 are followed.

Where the solid laid cables are de-energised, the constructor shall prepare a work procedure designed to safeguard Ausgrid's assets against any mechanical damage whilst exposing the cables.

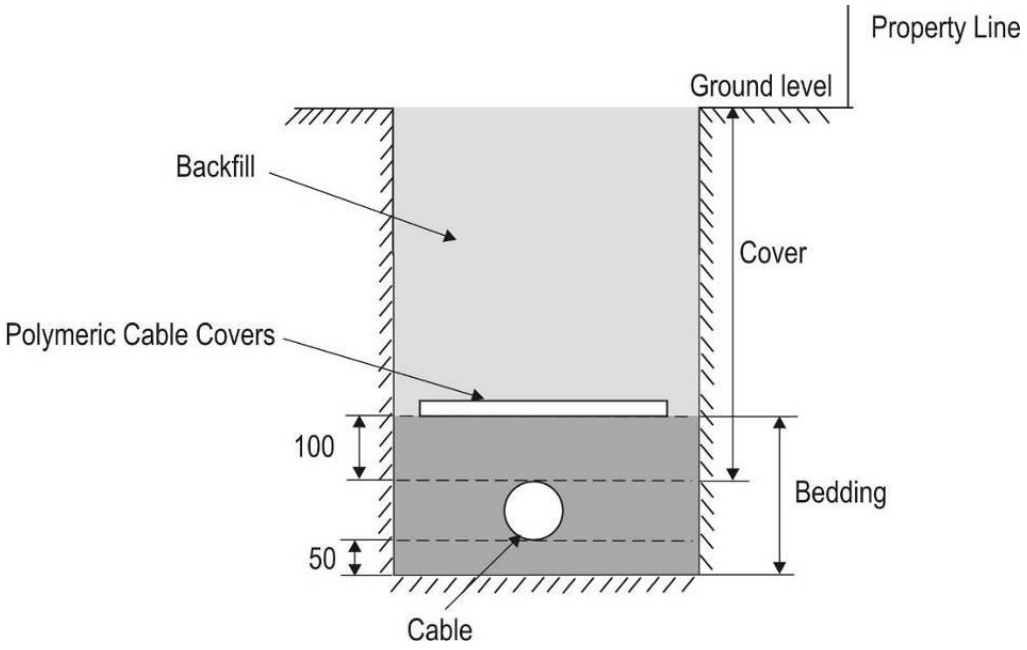


Figure 16: Cable Installation Details (Direct Buried)

13.3.2 Standard cable spacing

Direct buried cables shall have minimum 50mm horizontal and vertical separation between cables and between the outer cables and the bottom and sides of the trench. The top layer of cables shall be covered with 100mm bedding unless otherwise required by the Network Standard. The installation shall meet the distribution network rating requirements.

13.3.3 Standard depth of cover for direct buried cables

Standard depth of cover for direct buried cables is the same as in Clause 10.11. (Note: In this case, the depth of cover is to the top of the cable).

13.4 Sealing of cables

13.4.1 General

All power and control cables shall be protected against moisture ingress, including while being laid, regardless of site and/or weather conditions.

Cable ends which are not intended to be worked on immediately after laying must be electrically shorted and sealed against moisture ingress as soon as they are cut. This requirement applies to all cable ends, including cables in pillars and pillar-standards, cables intended to be abandoned or temporarily decommissioned, and cables still on cable drums.

The seals and electrical shorts must not be removed until the cables are ready to be connected. Stripping of the outer sheathing of LV service cables and connection of any of the cores must not be carried out until connection of supply is required.

Where a laid cable is found to have high moisture content due to inadequate sealing, the Constructor carrying out the works must remedy this at their own cost.

13.4.2 Method of sealing

Where LV cables/service cables enter a customer's premises, the cable shall be at least single sealed to avoid the risk of water entering the premises via the cable.

A triple end seal arrangement is required for all HV cables. A triple end seal arrangement is required for all exposed LV Distributor cables. Only a single seal cap is required for LV Distributor cables which are enclosed (e.g. cables left in a LV pillar or inside a kiosk for future connection). A list of approved triple end seal kits is given in Annexure G. The triple end seals shall be constructed in accordance with the installation instruction (ESD-3410-AU-5/03 for high voltage single core cables, ESD-3408-AU-5/03 for multicore cables and ESD-5891-AU-07/12 for low voltage single core polymeric cables) supplied in the triple end seal kit.

Completed permanent sealed ends must be laid in either suitable troughing or 1000mm lengths of UPVC conduit, and filled with sand. The sealed ends must then be buried and protected with approved polymeric cable covers. Sealed cable ends which are awaiting jointing shall be elevated clear of any free standing water in the excavation.

For polymeric insulated/polymeric sheathed service cables of cross sectional area 50 mm^2 or less, which are intended to be buried, a single heatshrink cap over the mastic tape may be used instead of the triple seal arrangement. The end caps used shall be selected from the approved range specified in Annexure G.

Note that cable surfaces which will come into contact with adhesive lined heatshrink components must be thoroughly cleaned, then degreased and abraded before applying the heatshrink components. Some older cables may have graphite coatings on the outer sheaths, which must be removed before the cable surfaces are cleaned. Refer to NS177 for the graphite removal procedure.

13.4.3 Safety precautions and first aid procedures for graphite coated cables

Graphite has been classified as having low toxicity, and is a non-carcinogenic substance. However, normal industrial safety precautions such as wearing leather gloves, safety glasses and safety boots should be observed.

First aid procedures are:

- Swallowed - Keep individual calm, do not induce vomiting, seek medical attention.
- Eye - Flush eyes with water for 15 minutes, seek medical attention if irritation persists.
- Skin - Wash with soap and water, remove contaminated clothing and launder before reuse.
- Inhaled - If affected, remove individual to fresh air, seek medical attention if breathing difficulties occur.

13.5 Shorting of cable cores

13.5.1 Multicore cables

The conductors of multicore cables shall be shorted out using clouts and 10 turns of 1.63mm tinned copper wire (Stockcode 68312). For stranded cables, the clouts shall be hammered into the strands. For solid-core cables, the clouts shall be inserted between the insulation and the solid cores.

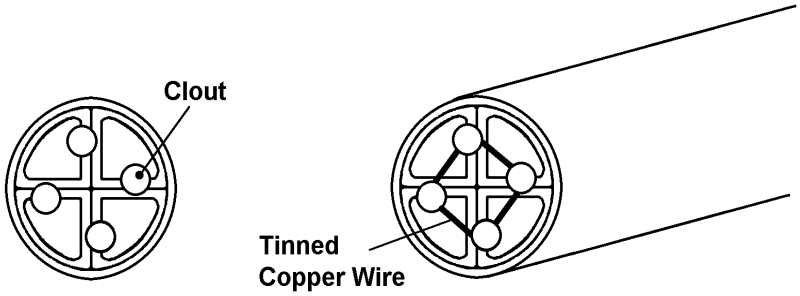


Figure 17: Shorting the cable

13.5.2 Single core neutral screened low voltage cables

Remove 35mm of the cable sheathing material and 35mm of the insulation to expose the neutral screen wires and the core conductor. Bind the concentric neutral wires to the core conductor using 10 turns of 1.63mm tinned copper wire (Stockcode 68312).

13.5.3 Single core low voltage polymeric cables 185 mm^2 and 300 mm^2

Refer to Installation Instruction ESD-5891-AU-11/11 and stockcode 182467 for the kit.

13.5.4 Single core copper wire screened high voltage cables

Remove 50mm of cable sheathing material and 50mm of the core insulation to expose the copper wire screens and the core conductor. Bind the screen wires to the core conductor using 10 turns of 1.63mm tinned copper wire (Stockcode 68312).

13.5.5 Single core metallic sheathed PILC cables

Expose 15mm of metal sheath and clean it. Short the core conductor to the metal sheath using a clout and tinned copper wire (Stockcode 68312). Apply 10 turns of the 1.63mm copper wire to the clout and metal sheath, then tie-off the copper wire around the metal sheath.

13.5.6 11kV UGOH terminations

Where the UGOH cables have been terminated onto the termination plates but are not to be immediately connected to the overhead mains, the UGOH cables must be short circuited and earthed. Insulated black cable of not less than 25mm^2 copper, lugged with M12 stud hole lugs is to be used. These connections are to be made between the top of the termination plates and the surge arrester earth bar.

13.6 Cable length and joints

13.6.1 General

Cables shall be laid in the longest lengths possible (subject to the maximum drum length and the pulling tension requirements) to ensure minimum number of joints. Having an excessive number of joints in a single cable section is not acceptable.

Where a cable section cannot be laid in one continuous length and joints are necessary, the joints shall be positioned in accessible locations clear of any obstructions that have the potential to make jointing difficult or impossible.

Cable joints shall be installed in a straight section of trench with at least 2 metres of straight cable at either side of the proposed joint location to allow the joint components to be parked whilst the joint is being constructed.

Cable installation plans, and installation of cables, must avoid the positioning of cable joints within 6 metres:

- from the ends of roadway and driveway crossing conduits,
- from concrete encased conduits,
- from street corners and similar sharp bends, and

- from other locations limiting access for future joint repair/replacement.

Cable joints that are required to be installed in the carriageway shall comply with one of the following requirements:

- Proposed joint locations subjected to high traffic volumes, and which have cables installed in conduits, shall require the cable joints to be installed within a pit to the requirements of NS172. Examples of high traffic locations include CBD areas and RMS roads.
- Proposed joint locations not subjected to high traffic volumes are permitted to have cable joints direct buried under the carriageway, at a location which takes into consideration Ausgrid's future maintenance activities as determined by the Ausgrid Representative.

If the above conditions cannot be met regarding the positioning of cable joints, then the matter shall be referred to the suitable Ausgrid Representative (i.e. for contestable projects, the Contestable Project Co-ordinator, or for all other cases, the applicable Field Manager) to make a decision based on a careful study of the local site specific conditions.

Cables are to be installed with a 1.2 metre overlap at all joint positions. Where two or more cables are installed and the joints occur in the same vicinity, joints are to be staggered by a minimum of 1 metre if space is available.

Constructors shall employ sufficient controls to ensure that no damage is caused to newly laid cables, or to existing cables and infrastructure. Particular attention shall be paid during cable pulling to sections of the new cable route where there is a significant change in direction, and where the cable enters a conduit.

13.6.2 Placement of cable joints near road crossings

11kV three-to-one straight through joints and LV joints should not be located within 6m of a road crossing due to installation issues with respect to bending radii limitations of the cables. The joints required may be for a UGOH or cable terminations at a kiosk substation. Designers are to make sure that these requirements are met wherever practicable. The joints should be located away from the exclusion zone given in yellow colour in Figure 18 below.

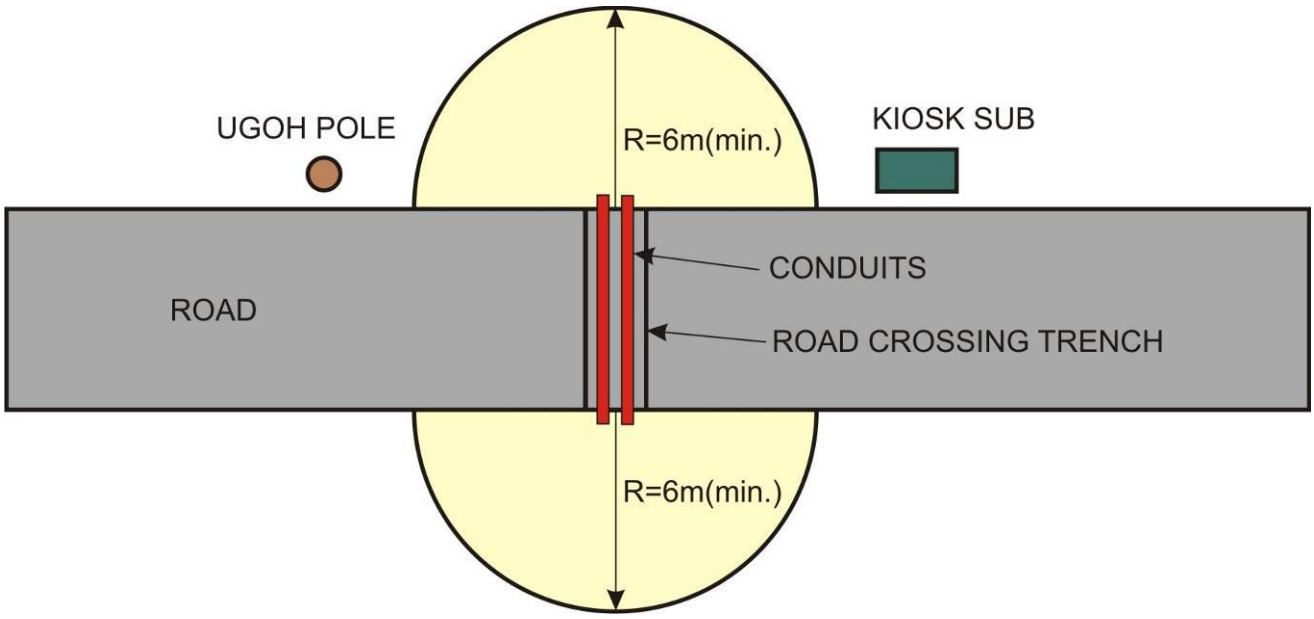


Figure 18

13.6.3 Joints within the Cable Basement of Zone Substation Buildings

Joints within the cable basement of zone substation buildings should be avoided in order to minimise the risk of a joint failure damaging adjacent cables or initiating a fire. This can be achieved by the selection of a cable type to eliminate the need for a joint altogether. Where a dedicated cable joint pit is present and space is available, all joints shall be located in the cable joint pit.

Where joints are required to be located within the cable basement, the risk of doing so shall be mitigated by application of the controls detailed in NS171 Fire Stopping in Substations. The Designer shall specify the exact location and controls for the joint to be constructed in the cable basement on their design.

A System Alteration Order shall clearly identify the cables (by panel number) that have been protected with the controls detailed in NS171.

13.7 Joint bays

Joint bays are the most likely section of a project to be re-excavated, and these locations shall be filled with compacted, well graded standard bedding material as per Clause 10.16.1.

Coarse aggregates must not be used in joint bays due to risk of damage to the cable during compaction.

Concrete or TSB shall not be used as a bedding material around direct buried cables in joint bays. Refer to Clause 13.3.

13.8 Damage to cables during construction

Cables must not be stood on, and any sharp tools or objects are to be removed from the vicinity of cables being laid in order to avoid damaging them.

Any cable or general infrastructure damages that are discovered or caused as a result of laying a new cable shall be reported immediately to Ausgrid. Once inspected, Ausgrid will determine the method of repair.

A suitable site specific risk assessment shall be completed and implemented to manage the risks associated with cable pulling activities. The risk assessment shall include prevention of harm to people, and prevention of damage to the cable being pulled and adjacent asset(s).

Ausgrid may decide, at its discretion, to carry out electrical tests on newly installed cables to check for sheath integrity if it is suspected that such cables have been damaged during cable pulling. Testing will be carried out in accordance with NS161 at the Constructor's expense.

13.9 Bending radii of cables

The internal bending radius of the cable being laid shall not be less than the cable manufacturer's specification. Table 7 is based on the cable manufacturer's specification. Nominal minimum internal bending radii are provided in Tables 8 and 9 as a guide.

The persons carrying out the works must determine the exact minimum internal bending radius for cables before they are laid if it is envisaged that the actual bending radius will be close to the nominal minimum specified in the table.

When selecting an approved conduit bend the 'during installation' minimum internal bending radius in Table 7 shall be used to calculate the minimum conduit bend radius.

Table 7: Minimum Internal Bending Radii for LV and 11kV Cables

Cable type	Minimum Internal Bending Radius	
	During Installation	After Installation
Polymeric insulated cables		
All Low Voltage cables with circular stranded conductors		
Less than or equal to 25mm diameter	6D	4D
Greater than 25mm diameter	9D	6D
All Low Voltage cables incorporating sector shaped conductors, Solid Aluminium or compacted	12D	8D
11kV HDPE sheathed cables	25D	15D
11kV Composite HDPE and PVC sheathed cables	25D	15D
11kV Triplex Composite HDPE and PVC sheathed cable		
Bundled cable	15D	10D
Phase cable	25D	15D
11kV nylon sheathed cables	30D	20D
Nylon sheathed pilot cables	30D	20D
Paper insulated cables:		
11kV multicore, lead sheathed, PVC oversheathed	18D	12D
11kV multicore, lead sheathed, HDPE oversheathed	25D	15D
11kV single core, lead sheathed, PVC oversheathed	22D	15D

Note: "D" is the overall diameter of the cable in mm or the circumscribing overall diameter of a bundled cable.

The minimum internal bending radius of each core of a three core polymeric cable after it has been trifurcated is 15D, where D is the diameter of the rejacketed individual core. Refer to Table 9 for more details.

Table 8: Nominal Minimum Internal Bending Radii for Specified Cables (Guide Only)

Cable type	Minimum Internal Bending Radius	
	During Installation (mm)	After Installation (mm)
LV XLPE insulated cables:		
185 CU1 XQ Z	145	95
185 CU1 XQ Z /COM/ 4 CABLES (Parrot cable)	270	180
240 CU4 XQ Z	675	450
240 AL4 XQ Z/SAC	590	395
300 AL4 XQ Z/SAC	655	435
300 CU1 XQ Z	270	180
500 CU1 XQ Z	335	225
11kV TRXLPE insulated cables:		
35 AL1 TRXQ 16 CU(WS) YQ	555	330
70 CU1 TRXQ 16 CU(WS) YQ	620	370
95 AL3 TRXQ 16 CU(WS) Z YQ	1380	830
150 CU3 TRXQ 35 CU(WS) Z YQ	1610	965
185 CU1 TRXQ 70 CU(WS) Z YQ	825	495
185 CU1 TRXQ 70 CU(WS) Z YQ/Triplex	1120(Bundled) 870 (Phase)	745(Bundled) 525 (Phase)
185 AL3 TRXQ 35 CU(WS) Z YQ	1700	1020
300 CU1 TRXQ 70 CU(WS) Z YQ	955	570
300 CU1 TRXQ 70 CU(WS) Z YQ/Triplex	1275(Bundled) 960 (Phase)	850 (Bundled) 575 (Phase)
300 CU1 TRXQ 150 CU(WS) Z YQ	990	595
300 AL3 TRXQ 35 CU(WS) Z YQ	1980	1190
400 AL3 TRXQ 35 CU(WS) Z YQ	2180	1305
500 AL3 TRXQ 35 CU(WS) Z YQ	2310	1385
500 CU3 TRXQ 35 CU(WS) Z YQ	2315	1390
630 CU1 TRXQ 120 CU(WS) Z YQ	1245	750
11kV Paper insulated cables:		
300 CU3 P H L YQ	760	640
Nylon sheathed Pilot cable:		
1.5CU4QQZNY/TR (Nylon Translay)	420	280

Table 9: Nominal Minimum Internal Bending Radii for the Individual Cores of the Three Core Polymeric Cable (After Trifurcation) - Guide Only

Cable type	Minimum Internal Bending Radius After Installation (mm)
11kV XLPE and TRXLPE insulated cables:	
95 AL3 TRXQ 16 CU(WS) Z YQ	410
150 CU3 TRXQ 35 CU(WS) Z YQ	440
185 AL3 TRXQ 35 CU(WS) Z YQ	490
300 AL3 TRXQ 35 CU(WS) Z YQ	535
400 AL3 TRXQ 35 CU(WS) Z YQ	580
500 AL3 TRXQ 35 CU(WS) Z YQ	630
500 CU3 TRXQ 35 CU(WS) Z YQ	660

13.10 Cable pulling equipment

The pulling tension on power cables shall not exceed the cable manufacturer's specification. Approved cable pulling lubricants may be used to reduce the cable pulling tension. Refer to Annexure E for guidelines on maximum pulling tensions, cable pulling lubricants and the use of pulling eyes.

A documented site specific cable pulling plan shall be completed by a competent person and provided to Ausgrid. The completed site specific cable pulling plan shall be implemented for the cable pull.

Where there is the potential for damage to other cables or to critical network infrastructure within the vicinity of the cable pulling equipment (if it was to fail under load), appropriate barricading and/or protective screens shall be put in place to protect the identified components.

Only load rated attachment points shall be used when pulling cables into the substation cable marshalling areas, unless otherwise approved in writing by Ausgrid.

The pulling tension being used shall not exceed the rated working load limit (WLL) of the cable pulling equipment proposed.

Appropriate rope tension fuses shall be used between the pulling rope and the stocking/pulling eye for each cable pull where a power driven winch is used. Alternatively, a strain gauge with control mechanism and logging capability shall be used.

If strain gauge is used with rope tension fuses, then the logging capability is not required as the rope tension fuses will not allow to exceed the maximum pulling tension.

If the strain gauge is used without rope tension fuses, then the control mechanism of strain gauge should ensure that the maximum pulling tension has not been exceeded throughout the entire pulling process. Applied tension values should be able to be checked during and after the pull in this method.

The cable pulling rope must be equipped with a swivel and attached to the cable by a stocking unless pulling eyes have been fitted to the cable.

The pulling rope shall be made of synthetic material. The rope shall have high strength and high abrasion resistance, e.g. Donaghy's Aquatec® rope. The selected rope must be rated to withstand the calculated pulling tension. The rope must not be tensioned beyond its design limit to avoid the risk that it may snap or damage the conduit during a cable pull (e.g. by slicing the conduit wall).

The plant used to pull cables shall be firmly anchored before a pull commences to prevent uneven tension on the cable due to winch movement. Prior to securing any floor mounted pulling equipment to the substation floor in accordance with the manufacturer's instructions, written advice shall be obtained from a competent person (i.e. a Civil / Structural Engineer) regarding the structural integrity and load capacity of the substation floor, and the suitability of the anchoring method proposed. The cable shall be drawn smoothly into position with a minimum of stops and at a maximum speed of 12-15 metres per minute. The cable drum shall be placed so that the cable is pulled from the top of the drum.

On completion of a cable pulling operation, all cable ends shall be inspected for damage. The length of cable laid shall be extended to compensate for damaged cable ends.

13.11 Use of existing spare conduits

Ausgrid has existing spare conduits as part of its underground infrastructure. The depth of cover of these conduits generally varies between 450mm and 750mm.

Spare conduits are intended to be used to get around the need to re-excavate. The depth of cover of the conduits should be consistent with the requirements of the cables being laid (refer to Section 10). Ausgrid is not responsible for or warrants the location & condition of existing spare conduits or that the existing spare conduits are fit for intended purpose.

Where high voltage conduits are not available, pulling of high voltage cables into low voltage conduits may be allowed at the discretion of Ausgrid's Representative, provided the depth of cover is consistent with the requirements for high voltage cables (refer to Section 10). Permission to use the conduits must be obtained in advance of their use.

Spare conduits shall not be used in any location where excavation is required to lay adjacent parallel cables. Ausgrid may also reject an application to use existing spare conduits if a need is foreseen to use the conduits for other purposes.

For existing conduits which have been installed under reduced cover, a case-by-case approach shall be carried out by Ausgrid to determine the suitability of the conduits (e.g. safety risk, cable ratings, mechanical loads) for cable installation.

Some of the existing conduits are made of asbestos cement and appropriate asbestos handling methods shall be used.

13.12 Excavations and cable chases

Where cables are to be installed in excavations and cable chases, cable rollers are to be used to support and guide the cables. Rollers must not be located more than 3 metres apart and positioned to prevent excessive side wall pressure on the cable. Where the cable is to be pulled around corners or angles, special corner rollers are to be used. The cable must not enter or leave any cable roller at an excessive angle, or exceed the cable manufacturer's recommendations for minimum internal bending radius.

13.13 Cable installations involving jointing pits

The maximum point load (working load) of a conventional pulling eye fitted to the wall of a jointing pit is 50kN. For cable pulls that are expected to exceed 50kN, two or more pulling eyes may be utilised (if available) with the use of slings between them. The strength of the pit wall should be checked before two eyes are installed.

Note: Cables and cable joints in jointing pits must not be walked on for safety and operational reasons.

When installing cables into or through jointing pits that have existing cables, precautions must be taken prior to commencing work to avoid damaging these cables. All existing cables are to be covered with protective mats (Refrasil mats) or any other method approved by Ausgrid, and these mats must be secured in position to prevent dislodgment.

Cables should not be damaged on the pit entry when installing cables into cable pits. Cables and joints should not rest on or make contact with other joints in the pit.

Where existing conduits have cables installed and are not fitted with bellmouths at the cable pit entry, a “split type” bellmouth should be installed where it is safe to do so. This may require cables to be de-energised and/or isolated.

Cables for which the existing supporting structure is to be removed in order to allow the new cables to be installed, shall be temporarily supported so that no movement occurs to the cable and associated cable joints while the existing support is removed. All temporary supports are to be of non-metallic materials. Refer to Clause 8.1 for further information regarding cable supporting requirements.

On completion of the cable installation, the existing supporting system is to be restored.

Consideration must be given to cable management in pits to ensure the safe and efficient access and emergency egress for personnel and equipment. This is achieved through the use of thorough job planning, and use of cable stands, tray, cleats, etc. Cable pits shall be kept clean by removing all scrap joints, cable and materials, debris, and general rubbish from the pit at the conclusion of works.

13.14 Installing cables in substations and switching stations

13.14.1 General

Refer to Ausgrid’s Electrical Safety Rules for restrictions on entering Ausgrid premises.

Where cables are to be installed in substations and switching stations, Ausgrid’s Representative must be requested to arrange access. Notice for access is required at least 7 days prior to commencing work in order to allow the necessary screens and protective devices to be installed.

All cables installed in substations and switching stations shall be designed to meet the distribution network rating requirements.

Weatherproof labels shall be attached to all cable ends installed in substations or future substation sites detailing the location of the remote cable ends (e.g. Cable 1, joint bay O/S 24 Smith St. on one end Cable 1, joint bay O/S 72 John St at the other end). Labels shall be marked with a permanent waterproof marker.

13.14.2 Cable labelling

Multiple cable installations shall have the cables identified as “cable 1”, “cable 2”, “cable 3” etc to assist identification. Labels must be removed upon commissioning of cables or modified at the new cable ends in the case of in-line joints carried out before commissioning.

During cable installation, the cables shall be labelled as shown in the design drawings. The cable identification labels must to be placed on the cable ends at the termination points and in joint bays.

For example, a design drawing will show the cable labels at termination points as follows:

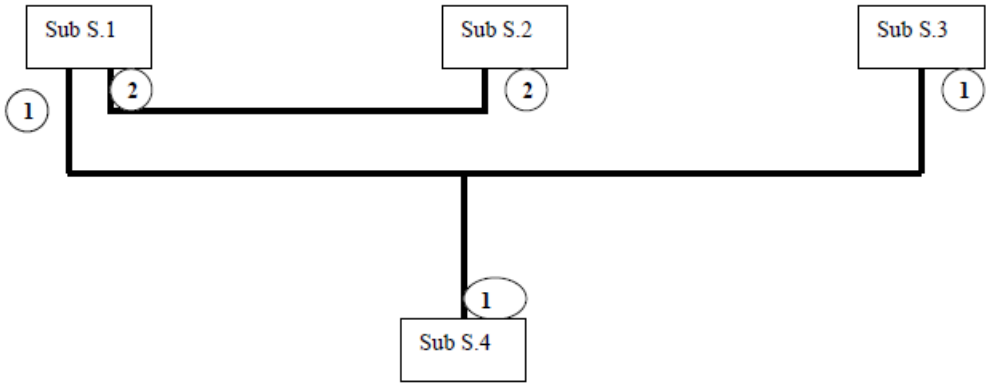


Figure 19a

Whilst the design drawing does not show the joint bay locations as they are determined at construction stage, cables must be labelled in the joint bays with respective cable labels as shown below:

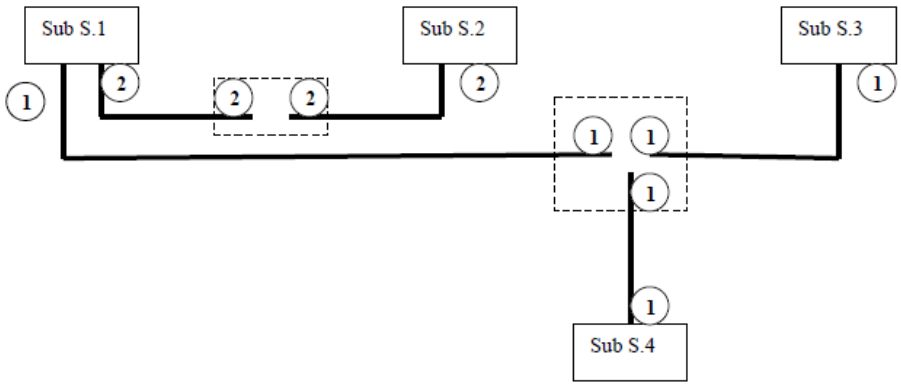


Figure 19b

The Certified design/Design drawing will include the following in the Important Note section:

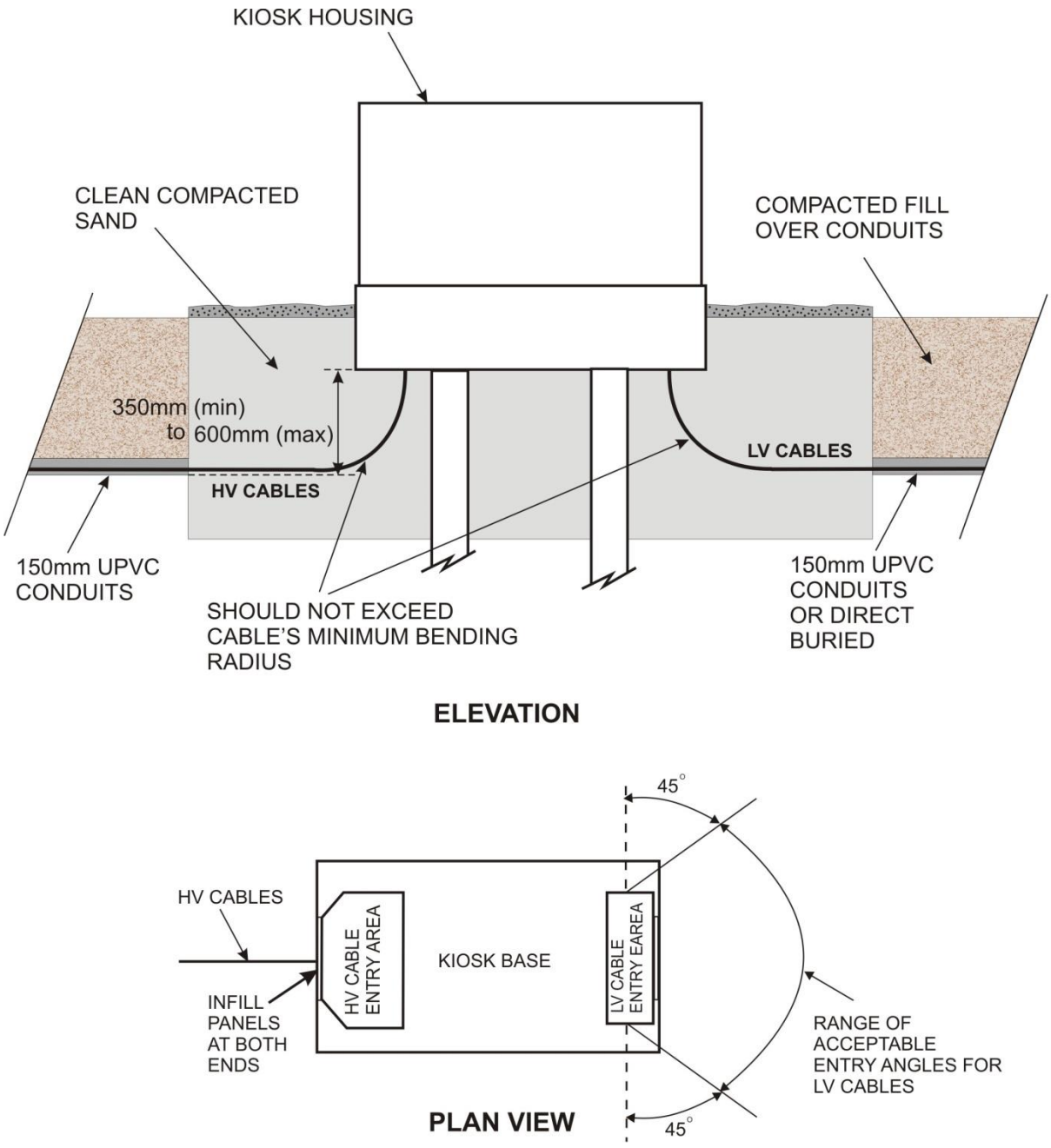
"For identification and jointing purposes, all cable ends shall be labelled at the termination locations and in joint bays during cable installation. The cables must be labelled as per certified design/design drawing."

13.14.3 Installing cables in kiosk type substations

To minimise bending of terminating cables:

- All High Voltage cables shall be laid so that they enter perpendicular to the High Voltage infill panels and vertically up inside the HV cable entry area of the kiosk. All Low Voltage cables shall be laid as per the range of acceptance entry angles as per the diagram given below.
- The internal bending radius of the cable being laid shall not be less than the cable manufacturer's specification. The cable manufacturer's specifications are based on Tables 8 & 9.

Ausgrid will not accept excessive bending of cables.



Installing cables on kiosk type substations

Figure 20

13.15 Installing cables in cable risers

Cables installed in cable risers shall be clamped at a maximum of 1 metre intervals using approved cable clamps. Clamps shall be free from sharp edges and burrs. To prevent local heating of cables caused by eddy currents, clamps shall be either made of non-ferrous materials or where they are made from ferrous material the two halves shall not touch at both sides, and shall be fixed together using non-ferrous bolts, nuts, and washers. Cable clamps can be directly bolted to cable riser walls, or to Unistrut-type supporting channels.

13.16 Clamping of 11kV paper insulated cables

Paper cables may be clamped using either hardwood or metal clamps. The internal diameter of hardwood clamps shall be chosen such that the overall diameter of the cable is marginally larger than the internal diameter of the clamp so that when the clamp is tightened the pressure is distributed evenly without deforming the cable.

13.17 Clamping of 11kV polymeric insulated cables

Cables shall be appropriately clamped to ensure that:

- they are firmly held in position;
- the clamps carry the weight of the cable(s) if the latter are not supported on trays;
- the cables are sufficiently restrained to stop them from whipping around under fault conditions;
- the clamps are not over-tightened to the extent that they damage the cable, particularly under cyclic loading.

Polymeric cables have a relatively high thermal coefficient of expansion and will soften when operating at high temperatures. If a polymeric cable is clamped too tightly when it is installed, the polymeric insulation may permanently deform when the cable heats up resulting in a reduction in the insulation thickness.

Another possible cable damage that could occur as a result of over-clamping is that the screen wires could be forced through the insulation screen and into the polymeric insulation. Therefore, clamps shall be tightened only to the extent necessary to ensure that the cables are held firmly in place.

Where single core cables are used, the cables shall be laid and clamped in a trefoil configuration unless specified otherwise. The following also applies:

- Where single core cables are clamped in a trefoil configuration, the clamps used must be sufficiently robust to withstand the potential repulsive forces acting on individual phase cables under fault conditions. Clamps utilising magnetic material can be used for clamping single core cables in a trefoil configuration, as magnetic fields generated by the three currents cancel each other out.
- Where single core cables are required to be clamped individually in a flat formation, the clamps shall be of a non-magnetic material to prevent localised heating of the cores due to the closed magnetic circuit of the clamp.

Clamps approved by Ausgrid are listed in Table 10. All cable clamps shall be used with a nitrile or neoprene rubber-cushioning strip of minimum thickness 3mm, wrapped around the cable assembly.

Other clamps may be acceptable subject to Ausgrid's Representative's approval. Examples of the approved clamps are shown in Figure 21 below.

Table 10: Cable Clamps for Polymeric Cables

	CABLE SIZE (mm^2)						
Installation Environment	**70 Cu 1**	**185 Cu 1**	**300 Cu 1**	**630 Cu 1**	**300 Al 3**	**400 Al 3**	**500 Al 3**
Flat on trays	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100
Trefoil on trays	UNISTRUT: TF27	UNISTRUT: TF37	UNISTRUT: TF41	ABB:EA-UKRB200*****	-	-	-
Flat, perpendicular to Unistruts (in substations, High-rise buildings etc)	UNISTRUT: P2031SS	UNISTRUT: P2033SS	UNISTRUT: P2035SS	UNISTRUT: P2039SS	UNISTRUT: P2049SS	UNISTRUT: P2051SS	UNISTRUT: P2055SS
Trefoil, perpendicular to Unistruts (in substations, High-rise buildings etc)	UNISTRUT: TF27	UNISTRUT: TF37	UNISTRUT: TF41	IdTechnik - KP39/53	-	-	-
Flat, at an angle to Unitstruts	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100
Trefoil, at an angle to Unitstruts	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKRB200*	-	-	-
Trefoil, freestanding	UNISTRUT: TF27	UNISTRUT: TF37	UNISTRUT: TF41	IdTechnik-KP39/53	-	-	-
Individual or trefoil on UGOHs	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKRB200*	ABB:EA-UKR100	ABB:EA-UKR100	ABB:EA-UKR100

* Note: EA-UKRB200 is supplied with one bracket. Use an additional bracket (ABB part number EA-B200) on trefoils of large cables such as 630 mm^2 polymeric cable.

ABB: EA–UKR100

ABB: EA–UKRB200 (See *Note above)

UNISTRUT: P Series (Stainless Steel)

UNISTRUT: TF Series

IdTechnik: KP Series

Nitrile rubber liner to be used with all clamps

Figure 21: Approved Cable Clamps

13.18 Underground to overhead transition points

Low voltage underground to overhead transition points are to be installed in accordance with NS127, Low Voltage Cable Joints and Terminations.

High voltage underground to overhead transition points are to be installed in accordance with NS129, 11kV Joints and Terminations - Paper Insulated Lead Covered Cables and NS177, 11kV Joints (including Transition Joints) and Terminations - Polymeric Insulated Cables.

13.19 Standard depth of cover

Standard depth of cover over direct buried cables shall be in accordance with Clause 10.11. Note that Clause 4.4 requires all road crossings or cable installations in roadways to be installed in conduits, so this clause only applies to direct buried cables for footway installations.

13.20 Reduced depth of cover

The portions of cables in a cable run subject to reduced cover shall be laid in conduits, and shall comply with the requirements of Clause 10.12.

13.21 Installation of underground cables in the vicinity of poles

A 350mm exclusion zone shall be maintained between underground cables and poles. Only UGOH cables erected on the pole are to enter this zone and must leave the pole as depicted in the Figure 22 below. The purpose of the exclusion zone is to reduce any risk of damage to underground cables due to excavations for pole inspection work.

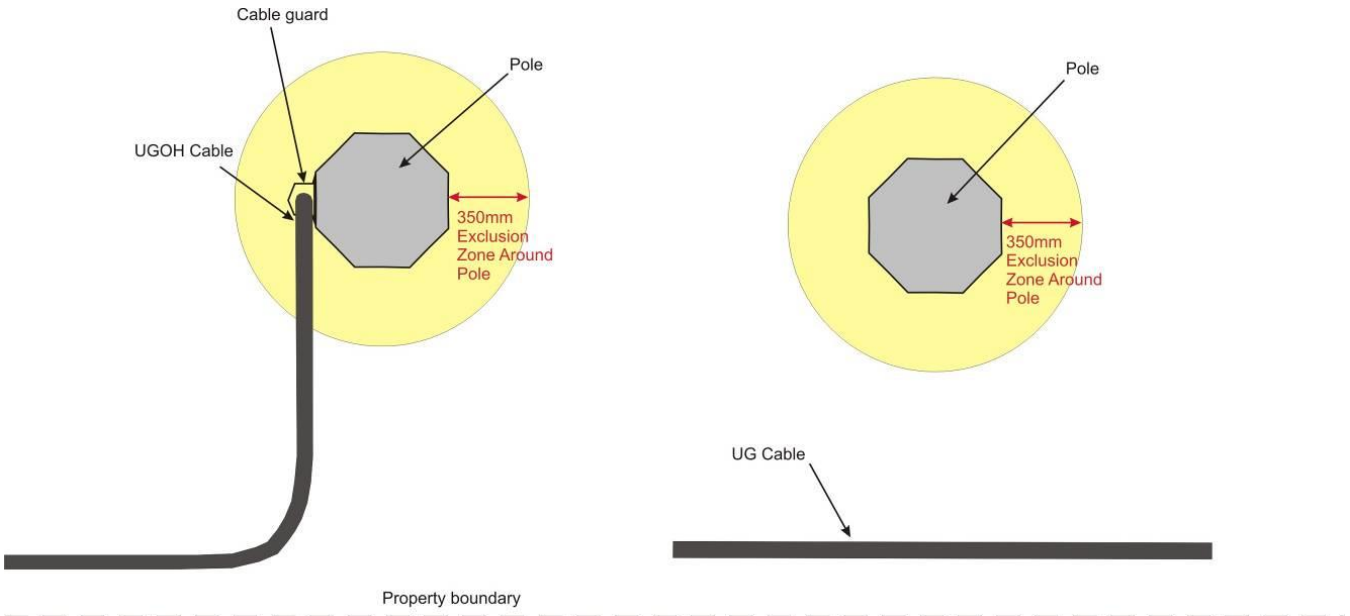


Figure 22: Installation of Underground Cables in the vicinity of poles

13.22 Clearance to other utility services

Clearances to other assets should generally be in accordance with the NSW Streets Opening Coordination Council (SOCC) Guide to Codes and Practices for Streets Opening; however, the construction of Ausgrid assets (including excavation, installation and backfill) at any time in the vicinity of other utility infrastructure must be undertaken with an appropriate risk assessment by those carrying out the work.

The onus shall be on the Constructor not to damage another utility's infrastructure. This may include consultation with the other utility.

14. BACKFILLING OF EXCAVATIONS

14.1 Backfill material

14.1.1 General

Ideally, the backfill material should restore the sub-grade to its original condition, which may be achieved by replacing the excavated materials in the same position from which they were excavated, and in the same state with regard to moisture content and compaction. This is usually difficult with "moisture unstable" soils. Where these exist under heavy traffic pavements, it will generally be required to import granular material that is capable of spreading the traffic load over a larger area of sub-soil.

14.1.2 Roads and Maritime Services requirements

In general, backfilling materials shall be to the satisfaction of the Roads Authority (Local Council or RMS). Where Ausgrid or the relevant Roads Authority considers the backfilling material unsuitable for a particular project, this material shall be removed and replaced by material which is considered suitable by that Authority.

14.1.3 Additional Ausgrid requirements

Trenching can alter or even divert existing sub-surface drainage so as to concentrate sub-surface water with disruptive scouring effects where flow occurs. In the selection of backfill material this aspect shall be taken into account in relation to the nature and topography of the particular location.

Where sub-surface water flow exists or is likely to occur (e.g. steep inclines) or where sand is used as backfill material, suitable water barriers shall be provided in the trench, spaced at regular intervals appropriate to site conditions.

Approved water barriers are bulkheads consisting of bags packed with 20:1 sand/cement mix. Persons working on the network must comply with the guidelines relating to the seepage of water found in 1152.3.8 Backfill.

14.2 Backfill in landscape areas

The Constructor must carry out backfilling in landscape areas as specified in 1152.3.8 Verge and landscape areas.

14.3 Backfill to subgrade level under footpaths, carriageways and heavy duty driveways

The Constructor must comply with the guidelines in 1152.3.8 Under footpaths, carriageways and heavy duty driveways.

14.4 Compaction of trench backfill

Compaction of trench backfill shall be carried out by the Constructor in accordance with 1152.3.9 and Annexure J.

Frequency of compaction testing shall be in accordance with Section 16.

Ausgrid reserves the right to witness any or all of the compaction tests.

14.5 Disposal of surplus materials

Surplus materials and rubbish must be disposed of lawfully.

14.6 Record keeping requirements

The Constructor shall maintain accurate records of the type and source of materials used for backfilling at every site and shall produce such records to Ausgrid on demand. The records shall be kept for a minimum period of three years after completion of the works.

14.7 Testing of conduits

After installation and backfilling of a bank of conduits, Ausgrid's Representative is to be notified to witness conduit testing.

All new conduits shall be thoroughly cleaned and an approved solid mandrel of diameter 12mm less than the internal diameter of the conduit and minimum 230mm in total length and minimum 130mm in flat length, shall be pulled by hand or with winch/machine (with suitable sized fuse) through every conduit in both directions to ensure their integrity.

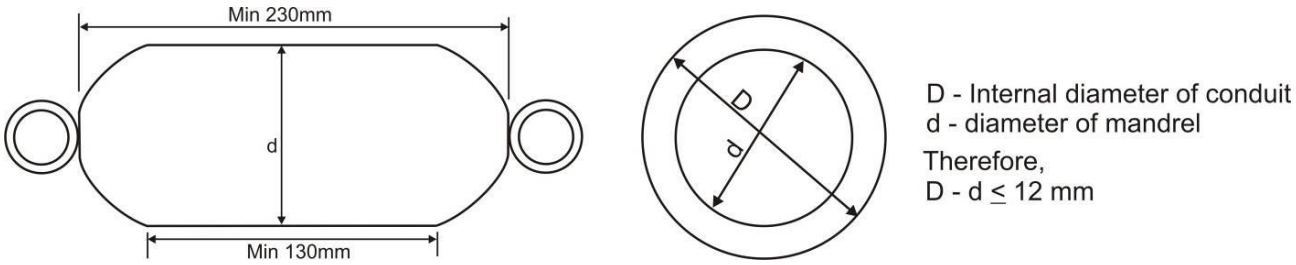


Figure 23

After passage through each conduit, the mandrel shall be thoroughly inspected for cuts or damage. If in the opinion of Ausgrid's Representative, there is any doubt as to the freedom from foreign material or any object or defect that may cause damage to the cable in the conduit, the Constructor shall repeat pass the mandrel through the conduit(s) until the Ausgrid Representative is satisfied.

Ausgrid reserves the right to request that a waste length of the cable to be installed be passed through the conduits, or video cameras be used to inspect the conduits where reasonable concern exists as to the condition of the conduits or if they have been backfilled without Ausgrid's Representative being present.

Conduits found to have defects which, in the opinion of Ausgrid's Representative, may cause damage to cables shall be repaired by the Client / Constructor at no cost to Ausgrid and at a time nominated by Ausgrid's Representative. Several commercial conduit repair systems are available.

15. REINSTATEMENT OF PAVEMENTS AND PATHWAYS

15.1 Temporary reinstatement

15.1.1 Reinstatement requirements

Unless final reinstatement is intended to be carried out immediately after completion of backfilling, temporary reinstatement of pavements and pathways shall be carried out.

All temporary restorations in carriageways and pathways must be of sufficient quality and must be maintained as such to ensure the safety of the site for pedestrians and vehicular traffic.

The Contractor shall be responsible for temporary line marking that is damaged or removed by the cable laying project. Line and road marking that is required for the safety of vehicles and the public must be installed temporarily as a minimum before the opening of the road for the carriage of traffic. The Contractor must ensure that temporary road marking is maintained and is suitable for its purpose until replaced by permanent line and road marking's.

Surfaced driveways and footpaths - Temporary reinstatement must be carried out by the Constructor in accordance with 1152.3.11 Temporary footpaths and driveways.

Surfaced roadways controlled by Local Councils (except those carrying heavy traffic) - Temporary reinstatement must be carried out by the Constructor in accordance 1152.3.11 Temporary carriageways.

Surfaced roadways controlled by the Roads & Maritime Services (RMS) of NSW - Temporary reinstatement must be carried out by the persons carrying out the works in accordance RMS Specification M209.

15.1.2 Temporary steel road plates

All steel road plates shall comply with RMS Specification M209 or the Australian Standard as applicable.

15.1.3 Road furniture

The Contractor is responsible for installation of road furniture that is damaged or removed by the cable laying project. Road furniture that is required for the safety of vehicles and the public must be installed temporarily as a minimum before the opening of the road for the carriage of traffic. All road furniture must be replaced like for like using current industry practice and approved materials and techniques and in accordance with the manufacturer's instructions. The Contractor must ensure that temporary road furniture is maintained and is suitable for its purpose until replaced by permanent road furniture.

15.2 Final reinstatement

Other than for State Roads, the Client shall arrange for permanent reinstatement which complies with 1152.3.12 – 3.14.

For State Roads, the Client shall arrange for permanent reinstatement which complies with RMS Specification M209.

16. FREQUENCY OF TESTING OF BACKFILL AND TEMPORARY RESTORATIONS

The frequency of testing of backfilling and temporary restorations shall be as specified in Table 11, unless directed otherwise by Ausgrid. Refer to Annexure J and Section 25 for definitions of the various layers.

Test reports shall be supplied to Ausgrid's Representative for approval as part of the project sign-off process.

Ausgrid may also conduct random audits on the quality of backfill and compaction. Should these audits indicate improper backfilling and compaction, Ausgrid may impose a higher level of testing.

Where final compaction tests indicate that the required percentage of maximum density has not been met, the Constructor must perform further compaction tests at one metre intervals either side of the failed test until two consecutive compaction tests pass on either side of the failed test. The Constructor must re-compact the area of the failed tests and perform the compaction tests again. This process must be repeated until the required compaction level is achieved over the entire length of failed tests.

Where there has been more than one test that has not met the required percentage of maximum density at the same Site, then the Constructor is to carry out such other number of tests that Ausgrid's Representative deems necessary, at no cost to Ausgrid.

Any defects in the quality of backfill or compaction shall be rectified by the person doing the work at no cost to Ausgrid.

Table 11: Frequency of Testing of Backfill and Temporary Restorations

Activity to be Tested	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency (see note 5)	Test Method
Materials supplied for trench backfill under carriageways, footpaths, and all joint holes	Material properties as specified	1 contract	1 per contract or source of supply for each type of material used or suppliers test certificates	As specified
Materials supplied for sub-base and base layers	Material properties as specified	1 contract	1 per contract or source of supply for each type of material used or suppliers test certificates	As specified
Trench and joint bay backfill and sub-base and base under carriageways, heavy duty vehicular crossings and car parks	Compaction	1 continuous trench or 1 joint bay or one road crossing	1 per layer, per 30 metre length per trench (see note 6)	AS 1289.5.1.1 AS 1289.5.2.1 AS 1289.5.6.1
Trench backfill and sub-base and base under footpaths, light/medium duty driveways and turfed areas	Compaction	1 project (see note 1)	1 per layer, per 100 metre length of trench or part thereof (see notes 2 and 3)	AS 1289.5.1.1 AS 1289.5.2.1 AS 1289.5.6.1
Backfilling of individual joint bays in footways (see note 3)	Compaction	1joint bay (see note 4)	1 per layer	AS 1289.5.1.1 AS 1289.5.2.1 AS 1289.5.6.1
Backfill of trial holes (Including location of conduit ends) (see note 3)	Compaction	1 trial hole	1 per layer	AS 1289.5.1.1 AS 1289.5.2.1 AS 1289.5.6.1

Activity to be Tested	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency (see note 5)	Test Method
Materials supplied for temporary road surface (or sealing material	Material properties as specified	1 contract	Supplier test certificates	As specified
Temporary road surface placement	Compaction	1 project (see note 1)	Check evenness and camber of all restored surfaces	As specified in Section 15

Notes:

1. 'Project' refers to the works executed within a reasonable timeframe by the same contractor as part of a single Certified design/Design plan. Where a Certified design/Design plan involves two or more well-defined stages, and each stage is executed separately, each stage shall be regarded as a separate project for the purpose of testing frequency.
2. The length of trench backfilled shall be taken to be the total of all discrete excavations backfilled together by the same Constructor.
3. Joint bays and trial holes backfilled and compacted concurrently with cable trenches shall be regarded as cable trenches for the purpose of testing frequency.
4. Individual joint bays shall be taken as those which were part of a cable trench but were backfilled separately from this trench, or any discrete joint bays which were not associated with any other cable trenches.
5. A layer is defined in 1152 or RMS Specification M209 depending on the location.
6. Every separate trench in a roadway or carriageway must have at least one compaction test. For example; if there is a requirement for two road crossings of 10m each, a compaction test is required for each road crossing.

17. CABLE JOINTING

Jointing work on the electrical distribution system and details of the joints and terminations required, are referenced in NS127 LV Cable Joints and Terminations, NS129 11kV Joints and Terminations - Paper Insulated Lead Covered Cables and NS177 11kV Joints (including Transition Joints) and Terminations - Polymeric Insulated Cables.

18. CABLE TESTING REQUIREMENTS

On completion of the works and immediately before the transfer of works to Ausgrid, all cabling involved in the project must be tested in accordance with Ausgrid's publication NS161 Testing of Underground Cables after installation.

Any defects identified by the tests must be rectified at the Constructor's cost, and the cables must be re-tested.

The Constructor must coordinate the works and tests to allow transfer and/or commissioning immediately after passing final testing.

The provisions of Section 19 of this Network Standard concerning protection of exposed underground construction shall be observed at all times.

19. PROTECTION OF EXPOSED UNDERGROUND CONSTRUCTION

Access permits* for work on 5kV or 11kV underground cables shall not be signed off and withdrawn, whether for testing, commissioning or re-energisation of the cables, unless:

- All new or repaired cable joints are backfilled or sand-bagged, and
- Excavations in the immediate proximity of substations are backfilled, and
- All other excavations are safely barricaded and protected, and arrangements are put in place for regular checking to ensure that they remain safely barricaded and protected.

(*Ausgrid's Electrical Safety Rules cover access permit procedures and requirements).

20. CABLE TUNNELS

For dedicated Ausgrid cable tunnels, specific fire engineering solutions shall be provided that deal with cable type, cable joints, fire detection, fire suppression, ventilation, emergency response and other aspects. Installed cables within dedicated Ausgrid cable tunnels will generally include an additional layer of low smoke zero halogen (LSOH) material over the normal HDPE over-sheath, to retard the spread of fire and smoke.

The design of cable installations in cable tunnels shall be approved by Ausgrid prior to proceeding with construction works.

20.1 Shared Cable Tunnels

This clause outlines the requirements for Ausgrid cables used in shared services tunnels. These are locations where other authorities (e.g. water, sewer, gas, communications), or other parties, use the tunnel void to carry their services, and have shared access arrangements for the tunnel.

The preferred approach for Ausgrid cables in shared services tunnels is to implement the requirements of Annexure K for the installation of network ductlines through buildings. This will ensure that adequate security and protection measures are provided for Ausgrid’s assets, and that any potential Ausgrid impacts on other services will be minimised.

Where this approach is not reasonably practicable, it will be necessary to address the risk of fire propagation in the tunnel initiated by a joint or cable failure. In this case, the following requirements are to be met:

1. Cable Type:
    - Fire retardant (low smoke, zero halogen or LSOH), HDPE sheaths shall be used on all power cables in tunnels. Where this is not feasible, a fire retardant cable wrap or cable coating shall be used to protect a conventional power cable.
    - The LSOH cable shall extend into the next underground joint bay, or into the substation, up to the terminations, as applicable.
2. Cable Support, Protection and Signage:
    - Ausgrid’s HV cables should be separated as much as possible from Ausgrid’s LV cables.
    - Ausgrid’s HV and LV cables shall be carried on dedicated cables trays (or equivalent), in an elevated location if possible, and separated as much as possible from any existing LV cables, communications cables, services etc that are owned by others.

- Where additional security/mechanical protection is required, a fixed lightweight wire cage or barrier around the cable tray that can be removed in sections should be provided. This approach is comparable to that used on accessible bridge crossings to protect major HV cables.
- Clear signage shall be provided indicating that the cables are HV and are owned by Ausgrid.

3. Cable Joints:

- Cable joints within the tunnel should be minimised.
- Where joints are essential, encapsulation and/or local protective shields shall be used in consultation with Ausgrid to minimise the risk of a joint failure damaging adjacent cables or initiating a fire in the tunnel.
- Consideration shall be given to modified joint kits for any cables using LSOH sheaths, as the standard joint kits may not be suitable.
- Localised fire retardant cable blankets or "wraps" shall be used around Ausgrid HV cables at locations that are exposed (1m -1.5m) to joints in major LV cables. Any derating of Ausgrid cables will need to be assessed and submitted to Ausgrid for approval.

Other issues that are to be considered in the design of shared services tunnels include, but are not limited to, the following:

- Control of shared access in the tunnel
- The FRL requirements of any supporting structure
- Corrosion protection of any supporting structure
- Fire rating of any spray-on fire protective coating used (e.g. Fendolite)
- Future access to conduits/cables
- Responsibility for maintenance of the supporting structure
- Maintenance and ownership of the tunnel.

21. STORES AND MATERIALS

Only approved materials and equipment may be used in the construction of infrastructure which ultimately forms part of Ausgrid’s electrical network. The approved materials and equipment contained in this Network Standard are detailed in Ausgrid's Approved Material List (AML) with manufacturer and supplier information and Ausgrid stockcodes where appropriate. Ausgrid will consider adding alternative materials and equipment to the AML in accordance with NS181 - Approval of Materials & Equipment and Network Standard Variations.

ASPs may obtain approved materials and equipment items as listed in the AML from any source. Where an ASP wishes to use alternative materials and equipment, application to have the materials or equipment considered for approval is to be made in accordance with NS181. Alternatively, where approved materials and equipment are held as stock in Ausgrid’s stores system, ASPs may purchase them from Ausgrid. All enquiries and requests for quotations shall be directed by email to aspsales@ausgrid.com.au and include the appropriate stockcode numbers.

All materials used on Ausgrid’s network must be new.

22. AUTHORITIES AND RESPONSIBILITIES

For this Network Standard the authorities and responsibilities of Ausgrid employees and managers in relation to content, management and document control of this Network Standard can be obtained from the Company Procedure (Network) – Production / Review of Engineering Technical Documents within the document repository. The responsibilities of persons for the design or construction work detailed in this Network Standard are identified throughout this Standard in the context of the requirements to which they apply.

23. RELATED DOCUMENTS

All work covered in this document shall conform to all relevant Legislation, Standards, Codes of Practice and Network Standards. Current Network Standards are available on Ausgrid's Internet site at www.ausgrid.com.au.

ASPs and other persons external to Ausgrid are responsible for sourcing the manufacturer's instructions and manuals.

23.1 Ausgrid documents

- ASP Level 1 Authorisation Agreement
- Company Procedure (Network) – Network Standards Compliance
- Connection Policy
- Contract for Design Related Services
- Electrical Safety Rules
- Electricity Network Safety Management System Manual
- ES1 Premises Connection Requirements
- ES4 Service Provider Authorisation
- Model Standing Offer (MSO) – Standard Connection Services for Contestable ASP/1 Premises Connection no greater than 11kV
- NEG OH14 – Guide to the Assessment of Waterway Crossing Risk
- NS001 Glossary of Terms
- NS100 Field Recording of Network Assets
- NS104 Specification for Electrical Network Project Design Plans
- NS113 Site Selection and Construction Design Requirements for Chamber Substations
- NS117 Design and Construction Standards for Kiosk Type Substations
- NS119 Public Lighting Design and Construction
- NS127 Low Voltage Cable Joints and Terminations
- NS129 11kV Joints and Terminations - Paper Insulated Lead Covered Cables
- NS141 Site Selection and Site Preparation Standards for Kiosk Type Substations
- NS143 Easements, Leases and Rights of Way
- NS156 Working Near or Around Underground Cables
- NS159 Installation of Cables and conduits using Trenchless Techniques
- NS161 Testing of Underground Cables

- NS165 Safety Requirements for Non-Electrical Work in and Around Live Substations
- NS171 Fire Stopping in Substations
- NS172 Design Requirements for Cable Jointing Pits and Vaults
- NS174 Environmental Procedures
- NS177 11kV Joints (including Transition Joints) and Terminations – Polymeric Insulated Cables
- NS181 Approval of Materials and Equipment and Network Standard Variations
- NS181 Approved Material List (AML)
- NS203 Telecommunications Network: Master Policy Document
- NS204 Communications Pits – Specifications and Installation Guidelines
- NS205 Telecommunications: Route Markers
- NS211 Working with Asbestos Products
- NS212 Integrated Support Requirements for Ausgrid Network Assets
- NS224 Low Voltage Suburban Commercial and Industrial Underground Distribution Utilising Pillars
- NS234 Telecommunications Underground Physical Plant Installation
- NS235 Telecommunications Underground to Overhead (UGOH) Transition
- NS272 Underground Cable Rating
- Policy for ASP/1 Premises Connections
- Public Electrical Safety Awareness Plan

23.2 Other standards and documents

- AS1012 Methods of Testing Concrete
- AS1141 Methods for sampling and testing aggregates
- AS1289.5.1.1 Method of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort
- AS1289.5.2.1 Method of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort
- AS1289.5.6.1 Method of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Density Index method for a cohesionless material.
- AS1379 Specification and Supply of Concrete
- AS1742 Manual of Uniform Traffic Control Devices
- AS2053.2 Conduits and fittings for electrical installations - Rigid Plain Conduits and Fittings of Insulating Material
- AS2758.1 Aggregates and Rock for Engineering Purposes – Concrete Aggregates
- AS3600 Concrete Structures
- AS3610 Formwork for Concrete

- AS3972 General purpose and Blended Cements
- AS4130 Polyethylene (PE) Pipes for Pressure Applications
- AS4671 Steel for the Reinforcment of Concrete
- AS6947 Crossing of Waterways by Electricity Infrastructure
- ENA Doc 001-2008 National Electricity Network Safety Code
- Memorandum of Understanding Between Ausgrid & Roads And Maritime Services & Transport For NSW
- NATSPEC1152 – Road Openings and Restorations (Utilities)
- New South Wales Specification (AUS-SPEC#2, 306U) – Road Openings and Restorations
- NSW Streets Opening Coordination Council (SOCC) Guide to Codes and Practices for Streets Opening
- Specification M209 Road Openings and Restoration
- Specification 3051 – Granular Base and Subbase Materials for Surfaced Road Pavements
- Underground Services in a Shared Trench (NSW 1998) agreement between AGL, EnergyAustralia, Optus and Telstra
- SafeWork NSW Excavation Work Code of Practice 2020
- SafeWork NSW Work Near Underground Assets - Guide

23.3 Acts and regulations

- Electricity Supply (General) Regulation 2014 (NSW)
- Electricity Supply (Safety and Network Management) Regulation 2014 (NSW)
- Protection of the Environment Operations Act 1997
- Protection of the Environment Operations (Waste) Regulation 2014 (NSW)
- Roads Act 1993
- The Coal Ash Order 2014
- The Coal Ash Exemption 2014
- Work Health and Safety Act 2011 (NSW)
- Work Health and Safety Regulation 2017 (NSW)

24. DEFINITIONS

Refer to NS001 Glossary of Terms.

25. RECORDKEEPING

The table below identifies the types of records relating to the process, their storage location and retention period.

Table 12 – Recordkeeping

Type of Record	Storage Location	Retention Period*
Approved copy of the Network Standard	Document repository Network sub process Standard – Company	Unlimited
Draft Copies of the Network Standard during amendment/creation	Work Folder for Network Standards (HPRM ref. 2014/21250/292)	Unlimited
Working documents (emails, memos, impact assessment reports, etc.)	Records management system Work Folder for Network Standards (HPRM ref. 2014/21250/292)	Unlimited

* The following retention periods are subject to change e.g. if the records are required for legal matters or legislative changes. Before disposal, retention periods should be checked and approved by the Records Manager.

26. DOCUMENT CONTROL

Content Coordinator : Head of Asset Engineering Policy & Standards

Distribution Coordinator : Manager Asset Standards

Annexure A – List of Drawings

IMPORTANT: Users must ensure that the drawings they are using are the current versions with all amendments.

Table A1- Drawings List

Number	Title
212386_1	Telecommunications External Plant Optical Fibre Construction Drawing Index
212386_2	Telecommunications External Plant Optical Fibre Construction OPGW with Subtransmission UGOH
212386_3	Telecommunications External Plant Optical Fibre Construction ADSS UGOH
212386_4	Telecommunications External Plant Optical Fibre Construction OPGW UGOH
212386_5	Telecommunications External Plant Optical Fibre Construction ADSS Termination with 11kV UGOH
212393_1	Ausgrid Fibre Network Fibre & Duct Arrangement Index Page
212393_2	Ausgrid Fibre Network Fibre Duct Arrangement Typical Size 8 Communications Jointing Pit
212393_3	Ausgrid Fibre Network Fibre Duct Arrangement Typical Pit Construction Load Classification Class C & Class D
212393_4	Ausgrid Fibre Network Fibre & Duct Arrangement Typical Communications Conduit Breakout Detail For Each Side of Route for Dual Circuit
212393_5	Ausgrid Fibre Network Fibre & Duct Arrangement Breakout Detail on Same Side of Route for Dual Circuit Arrangement A
212393_6	Ausgrid Fibre Network Fibre & Duct Arrangement Breakout Detail on Same Side of Route for Dual Circuit Arrangement B
212393_7	Ausgrid Fibre Network Fibre & Duct Arrangement Distributed Temperature Sensing (DTS) Typical Breakout Arrangement A
212393_8	Ausgrid Fibre Network Fibre & Duct Arrangement Distributed Temperature Sensing (DTS) Typical Breakout Arrangement B
212393_9	Ausgrid Fibre Network Fibre & Duct Arrangement Combined DTS & Comms Typical Breakout Arrangement A
212393_10	Ausgrid Fibre Network Fibre & Duct Arrangement Combined DTS & Comms Typical Breakout Arrangement B
212393_11	Ausgrid Fibre Network Fibre & Duct Arrangement Combined DTS & Comms Typical Lay Flat Arrangement Breakout Details
212393_12	Ausgrid Fibre Network Fibre & Duct Arrangement Combined DTS & Comms Typical Breakout To Bypass HV Jointing Pit (Single Circuit)
212393_13	Ausgrid Fibre Network Fibre & Duct Arrangement Combined DTS & Comms Typical Breakout - DTS Entering HV Jointing Pit (Single Circuit)
212393_14	Ausgrid Fibre Network Fibre & Duct Arrangement Combined DTS & Comms Typical Breakout To Bypass HV Jointing Pit (Double Circuit)
212393_15	Ausgrid Fibre Network Fibre & Duct Arrangement Combined DTS & Comms Typical Breakout - DTS Entering HV Jointing Pit (Double Circuit)
212393_16	Ausgrid Fibre Network Fibre & Duct Arrangement Fibre Cable Flow Through Typical Communications Pit
212393_17	Ausgrid Fibre Network Fibre & Duct Arrangement Combined DTS & Comms Typical Breakout 2 x 2 HV Conduit Arrangement

Number	Title
212393_18	Ausgrid Fibre Network Fibre & Duct Arrangement Inline Fibre Hauling Pit Typical Arrangement
212393_19	Ausgrid Fibre Network Fibre & Duct Arrangement In Road Comms Pit
514020	Lighting Column Concrete Plinth Steel Mould (For Use With Ragbolt Assembly)
514087	Standard Construction Street Lighting Column Pile Footing Details
49070	Cable Installations Polythene Warning Strip Details
249060	Cable Pit (Precast) Typical Indicative Details

Annexure B – Typical Trench Dimensions

Refer to Clause 10.11 for standard depth of cover.

Table B1: Conduit Trench Dimensions (125mm)

Number of Conduits	Classified Roadway Trench			Unclassified Regional and Local Roadway Trench	
(125mm PVC)	Width(mm)	Depth(mm)		Width(mm)	Depth(mm)
		Conduits protected	Conduits unprotected		
1 or 2	430	1190	1390	430	940
3	620	1190	1390	620	940
4 (2 on 2)	430	1380	1580	430	1130
6 (3 on 3)	620	1380	1580	620	1130

OD of 125mm PVC conduit is approx. 140mm

Table B2: Conduit Trench Dimensions (150mm)

Number of Conduits	Classified Roadway Trench			Unclassified Regional and Local Roadway Trench	
(150mm PVC)	Width(mm)	Depth(mm)		Width(mm)	Depth(mm)
		Conduits protected	Conduits unprotected		
1 or 2	530	1230	1430	530	980
3	760	1230	1430	760	980
4 (2 on 2)	530	1460	1660	530	1210
6 (3 on 3)	760	1460	1660	760	1210

OD of 150mm PVC conduit is approx. 160mm.

Note: “Protected” refers to concrete or TSB to achieve a compressive strength of 3 to 5 MPa. “Unprotected” refers to 20:1 sand/cement dry mix.

.

Annexure C – Typical Cable Arrangements in Footways

HV and LV Cables Laid Direct

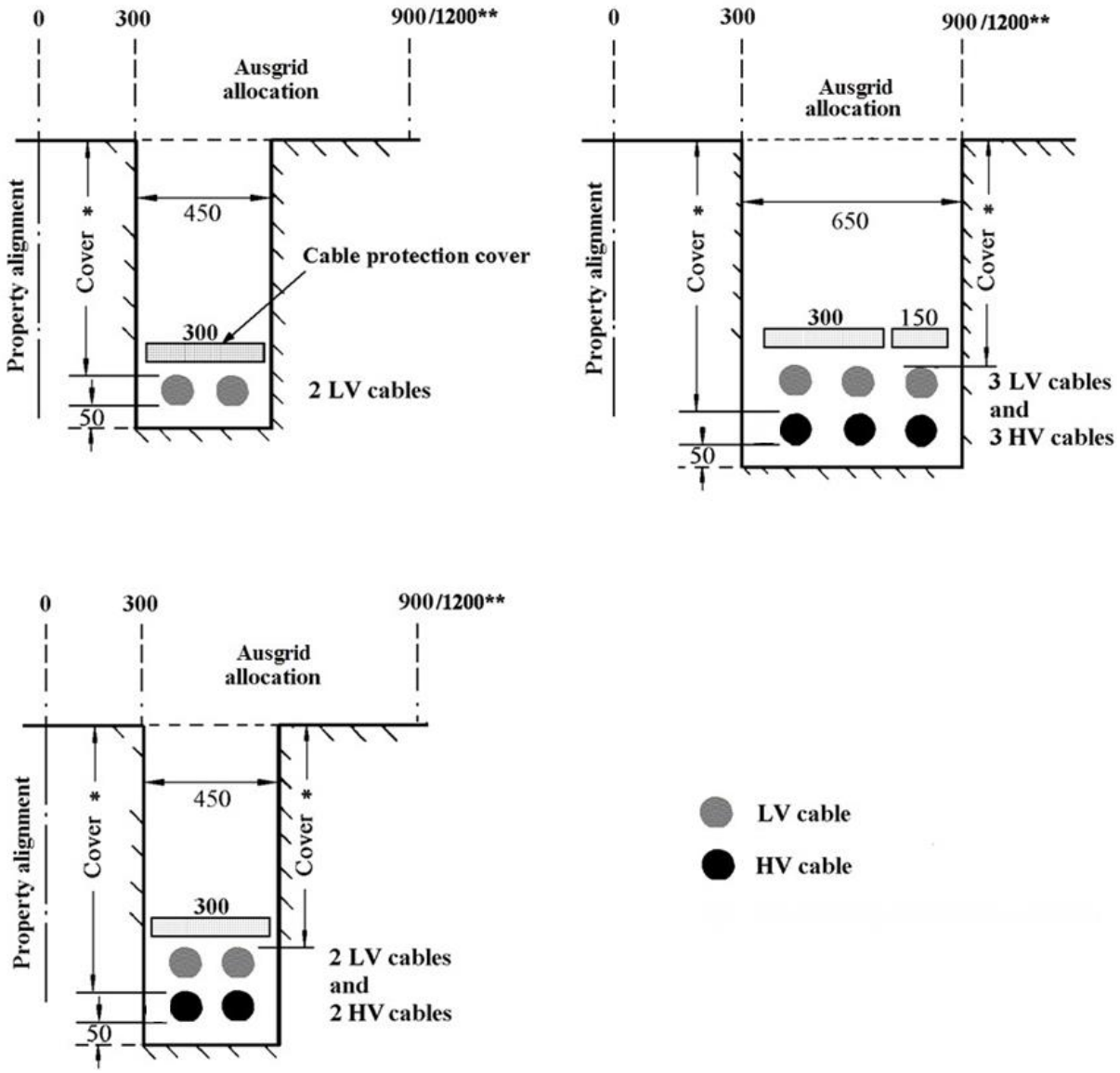


Figure C1

Cover*	500mm (minimum) over LV cables
	600mm (minimum) over HV cables
	600mm (minimum) over protection fibre conduits installed alongside a HV feeder cable / conduit
	900mm (minimum) over protection fibre conduits straying away from a HV feeder conduit / cable to enter a communications pit.
**	Width of Ausgrid allocation depends on the date of roadway dedication. Refer to Annexure D for further details.
Note:	Refer to Clause 10.10 for standard spacings.

HV and LV cables laid direct (with spare conduits)

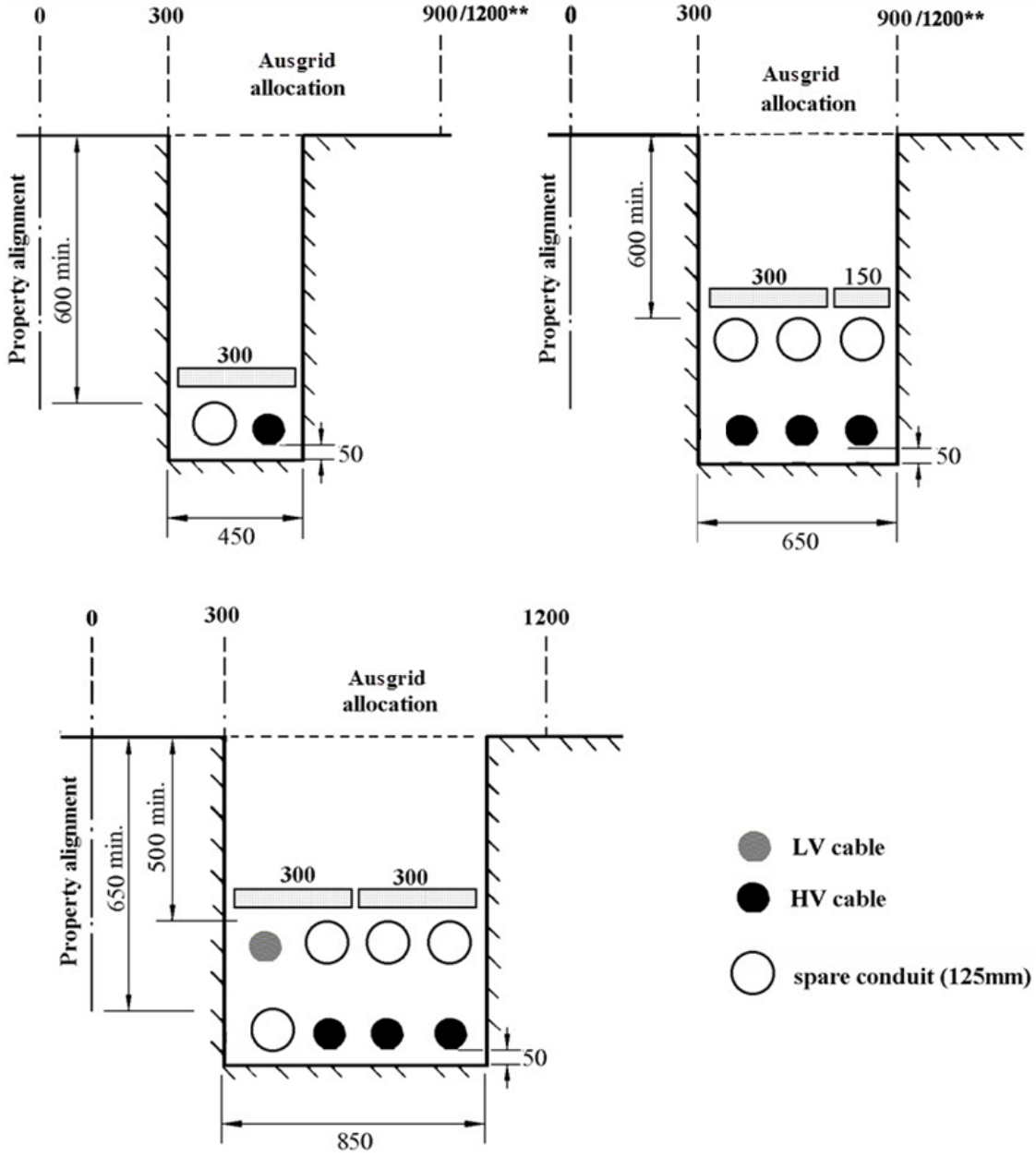
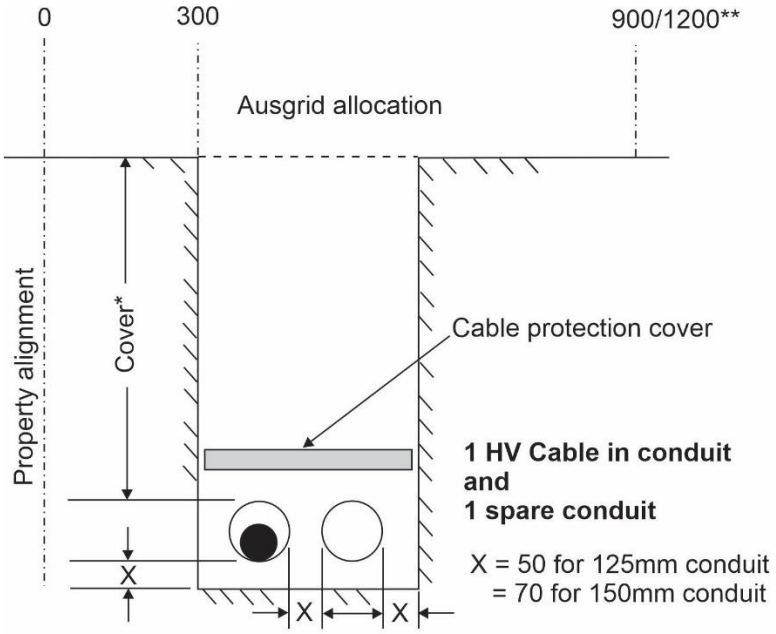


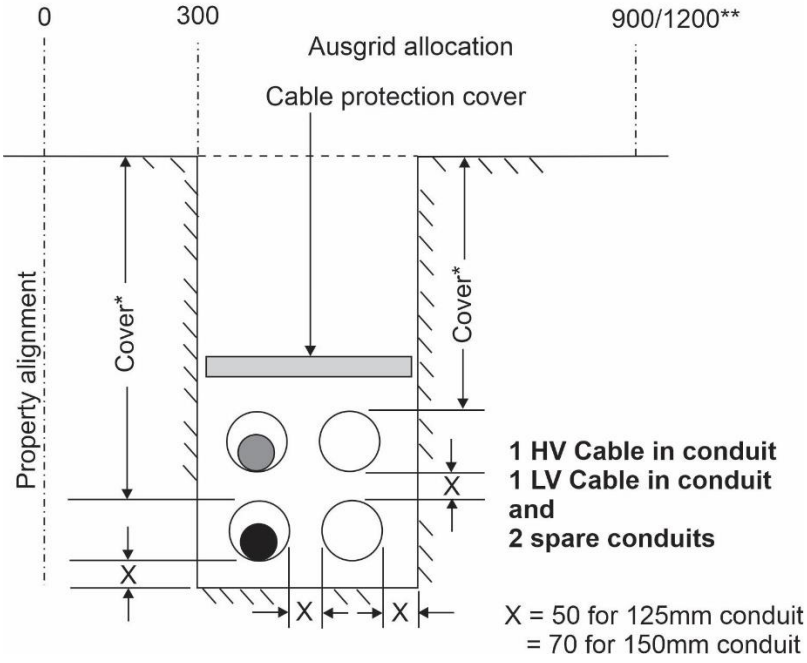
Figure C2

** Width of Ausgrid allocation depends on the date of roadway dedication. Refer to Annexure D for further details.

Note: Refer to Clause 10.10 for standard spacings.

HV and LV cables laid in conduits

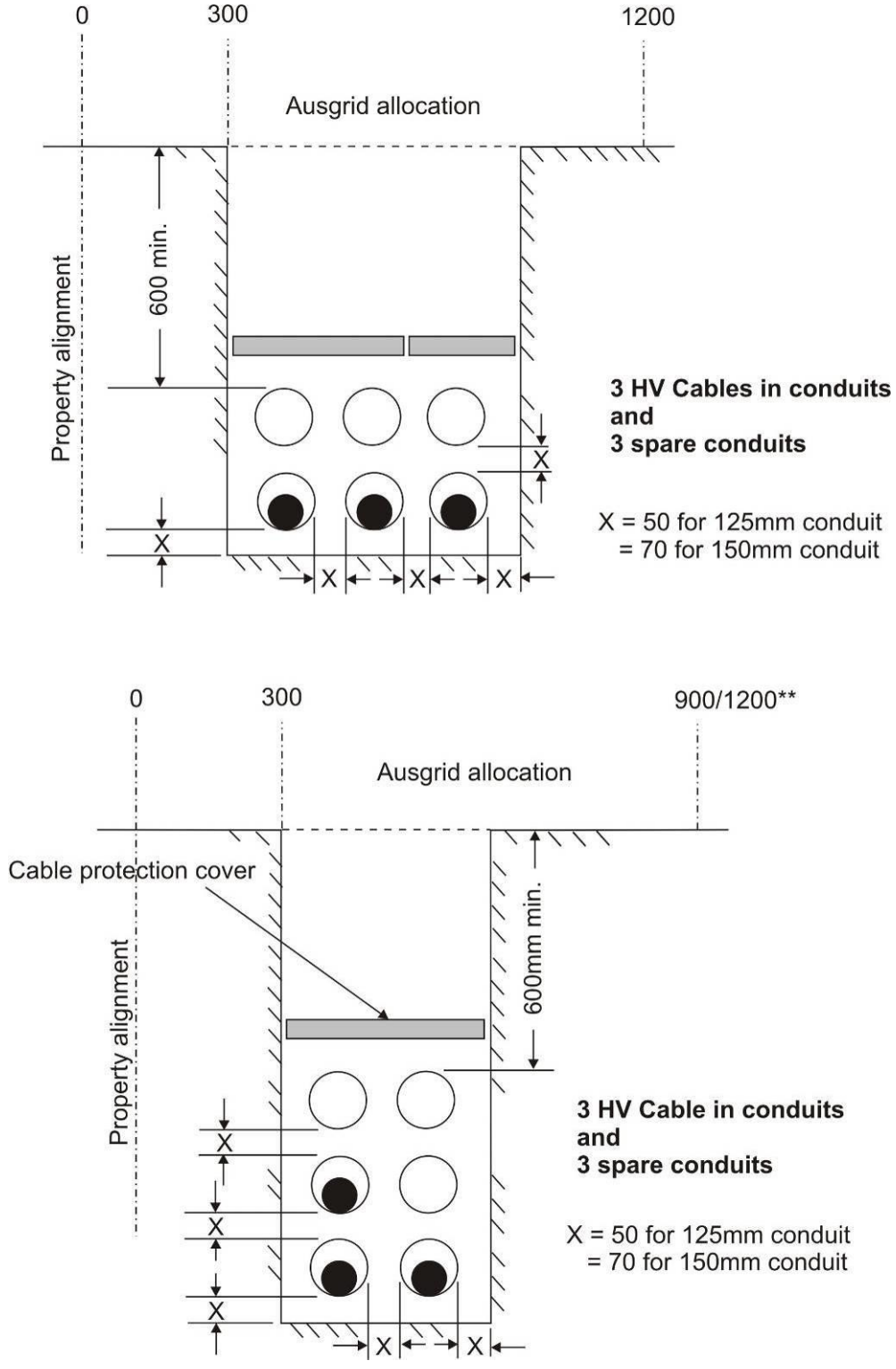




Cover* 500mm (minimum) over LV cables
600mm (minimum) over HV cables

** Width of Ausgrid allocation depends on the date of roadway dedication. Refer to Annexure D for further details.

Figure C3



** Width of Ausgrid allocation depends on the date of roadway dedication. Refer to Annexure D for further details.

Figure C4

Trenches shared with Telecommunications Carriers (default shared trench agreement)

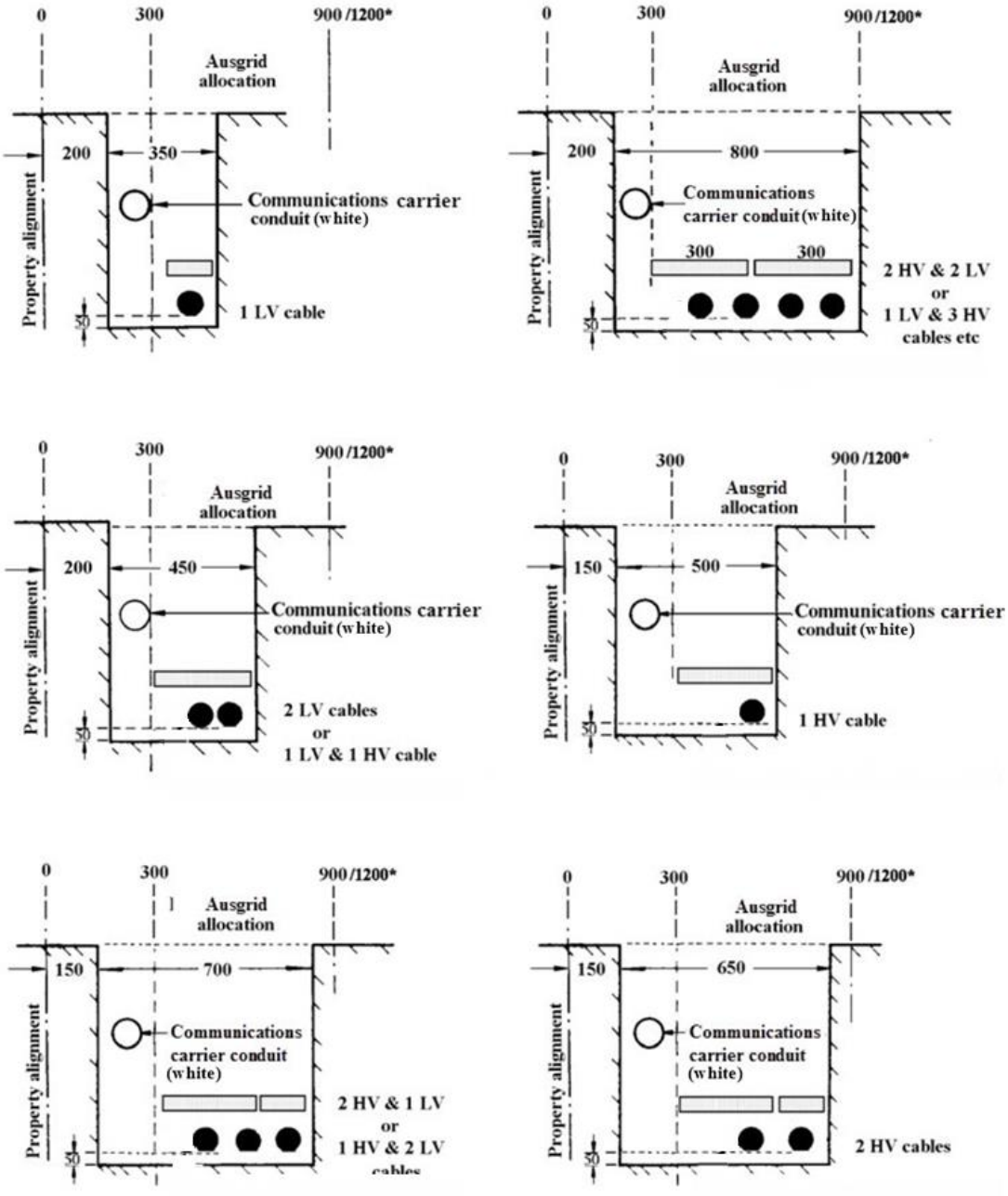


Figure C5

* Width of Ausgrid allocation depends on the date of roadway dedication. Refer to Annexure D for further details.

All trenches shall be 750mm deep. Refer to Clause 10.10 for standard spacings.

Minimum vertical separation between communications carrier and cable protection covers:

- 150mm above cable protection covers over low voltage cables or conduits
- 300mm above cable protection covers over high voltage cables or conduits

Annexure D – Footway Allocations

For footway allocations, refer to NSW Streets Opening Coordination Council (SOCC) - Guide to Codes and Practices for Streets Opening 2018 edition.

For Regional footway allocations prior to 2018, refer to NSW Streets Opening Conference - Guide to Codes and Practices for Streets Opening 2009 edition.

For footway allocations in Sydney Region prior to 1991, refer to Figure D1.

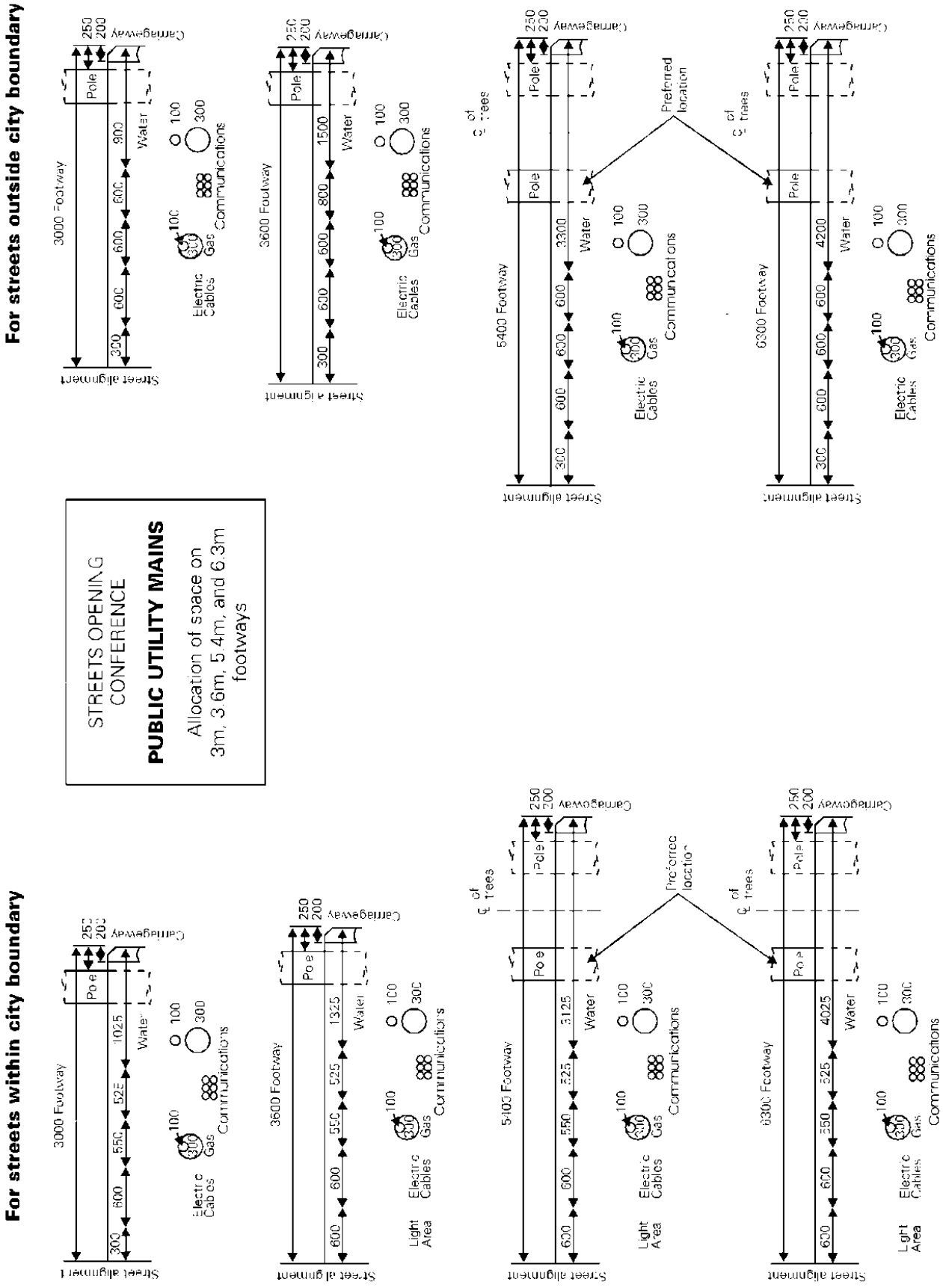


Figure D1 - Existing Footway Areas before 1.1.91 - Sydney Region

Annexure E – Guide to Maximum Pulling Tensions

E1 Using stocking grips

For the conventional methods of installation using a stocking grip and pulling on the “nose” of the cable only, the maximum allowable pulling tension is mainly a function of cable diameter. The limiting factors are related to compressibility of the sheath, bedding and insulation, and to the friction between these, rather than to the tensile strength of conductors or the cable as a whole. The table below provides a guide only to maximum pulling tensions.

The contractor shall obtain the manufacturer’s recommended maximum pulling tension before applying any mechanical load to the cables. Annexure F is guide to calculating the winching tension required to pull a cable through a trench or conduit bank route of predetermined geometry.

Table E1: Maximum Pulling Tensions when using Stocking Grips

Type of Cable**	*Max. Pull Tension (kN**)	Approximate Cable Mass (kg/m)
11kV Unarmoured Power Cables		
500 CU3 TRXQ 35 CU(WS) Z YQ	11.1	17.9
500 AL3 TRXQ 35 CU(WS) Z YQ	11.0	8.5
500 AL3 P H L YQ	19.2	13.2
400 AL3 TRXQ 35 CU(WS) Z YQ	10.5	7.3
300 AL3 TRXQ 35 CU(WS) Z YQ	9.5	6.2
300 CU3 P H L YQ	13.6	15.0
300 AL3 P H L YQ	13.6	9.3
240 AL3 P H L YQ	11.6	8.1
185 AL3 TRXQ 35 CU(WS) Z YQ	8.2	4.6
185 CU1 TRXQ 70 CU(WS) Z YQ	3.8	2.9
150 CU3 TRXQ 35 CU(WS) Z YQ	7.7	6.8
95 AL3 TRXQ 16 CU(WS) Z YQ	6.6	2.8
630 CU1 TRXQ 120 CU(WS) Z YQ	6.0	7.8
300 CU1 TRXQ 150 CU(WS) Z YQ	4.8	4.8
300 CU1 P H L Z	4.4	5.2
300 CU1 TRXQ 70 CU(WS) Z YQ	4.6	4.1
300 CU1 TRXQ 70 CU(WS) Z YQ/Triplex	13.8 (for total cable, 1 stocking required) 4.6 (for each core, 3 stockings required)	12.4
185 CU1 P H L Z	3.2	3.5
185 CU1 TRXQ CU(WS) Z YQ / Triplex	12.6 (for total cable, 1 stocking required) 4.2 (for each core, 3 stockings required)	8.9
70 CU1 G TRXQ G 16 CU(WS) YQ	2.2	1.1
35 AL1 G TRXQ G 16 CU(WS) YQ	1.7	0.5
LV Unarmoured Power Cables		
300 AL4 XQ Z/SAC	7.0	4.42
240 CU4 XQ Z	6.8	9.81
240 AL4 XQ Z/SAC	6.1	3.9
120 AL4 XQ Z/SAC	4.5	1.8
500 CU1 XQ Z	4.5	4.93
300 CU1 XQ Z	3.1	3.1
185 CU1 XQ Z	1.8	1.9
LV Service and Street Lighting Cables		
16 CU2 XQ Z	N/A	0.47
16 CU4 XQ Z	N/A	0.9
25 CU4 XQ Z	N/A	1.3
50 CU4 XQ Z	N/A	2.2

* Using stocking grips.
** 1 tonne = 10kN (approx.)
N/A Not applicable, cable to be installed by hand.
*** When pulling multiple single core cables together, the maximum pulling tension is the maximum pulling tension of one single core cable multiplied by the number of cables.

E2 Using pulling eyes

Pulling eyes allow for much larger pulling tensions than stocking grips. A guide to the maximum pulling tension that can be applied to a cable while using pulling eyes is provided in the table below.

Table E2: Maximum Safe Tensile Stress when using Pulling Eyes fitted to the Conductor

Conductor Material	Maximum Tension kN/mm^2
Copper	0.07
Stranded aluminium	0.05
Solid aluminium	0.03

Note: Maximum pulling tension is limited to 20kN. Please consult the cable manufacturer for advice if higher pulling tensions are required.

Where a pulling eye is considered necessary, the cable supplier shall be contacted for either fitting the pulling eye to the cable or providing details of approved pulling eyes.

Before pulling a cable with a pulling eye, the installer shall ascertain from the cable supplier what maximum sidewall pressure can be applied to the cable and shall ensure that this sidewall pressure is not exceeded during cable installation.

Cable ends fitted with pulling eyes shall be waterproofed to ensure water does not enter the cables during installation, regardless of the type of pulling eyes fitted. Waterproofing can be achieved by shrinking a length of mastic lined heatshrink sleeve, covering the full length of the pulling eye and overlapping the cable sheath by at least 150mm. Before installing heatshrink sleeves, the pulling eyes and associated cable ends shall be thoroughly degreased and cleaned. The heatshrink sleeves used shall be abrasion resistant and shall have a minimum wall thickness of 3mm after recovery over the pulling eye.

Particular care must be exercised when pulling at the relatively high tensions allowed by the use of pulling eyes. Large bending radii and adequate support using rollers must be provided to avoid causing flattening, distortion or other damage to the cables.

Pulling cables into conduits

Prior to pulling cables through Asbestos Cement conduits refer to the appropriate Safe Work Method Statement.

The pulling tension on cables being pulled into conduits shall not exceed 20kN, including cables fitted with pulling eyes. Please consult the cable manufacturer for advice if higher pulling tensions are required.

In addition, the maximum sidewall pressure exerted onto a cable must not exceed the following values when the conduit is installed in compacted standard bedding or 20:1 sand cement bedding:

- 3kN/m for a ‘rough bore’ conduit, e.g. fibre reinforced cement
- 5kN/m for a ‘smooth bore’ conduit, e.g. plastic conduits.

For UPVC conduits installed in TSB, dry mix or concrete encased the maximum sidewall bearing pressure exerted on the cable must not exceed the value specified by the cable manufacturer. At least 7 days is required for sufficient strength gain of the encasement around the conduits.

E3 Using Cable Pulling Lubricants

Approved cable pulling lubricants are used to lower the friction between the cable sheath and the conduit wall which reduces the cable pulling tension during the cable installation.

If the design requires the use of cable pulling lubricants, the Designer shall specify on their design plan the:

- coefficient of friction used in the calculated cable pulling tensions (refer to Clause 4.9).
- approved lubricant (product name/code) to be used.
- volume of lubricant required to achieve the desired coefficient of friction.

Ausgrid's Approved Material List (AML) provides a list of suppliers of cable pulling lubricants and their product names/codes.

The installer needs to apply the approved cable pulling lubricant strictly in accordance with the manufacturer's instructions to achieve the coefficient of friction specified on the Certified Design/Design Plan.

Annexure F – Guide to Calculating Cable Pulling Tension

F1 Equations for Calculating Cable Pulling Tensions

The following guide is extracted from Annexure A of publication C(b)2 – 1989 ESAA Guide to the Installation of Cables Underground.

APPENDIX A

CABLE PULLING TENSION

The winching tension required to pull a cable through a trench or ductline route of predetermined geometry can be calculated by using the formulae given below.

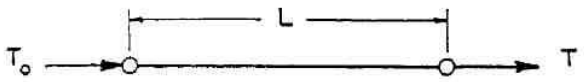
Complex route geometries must first be subdivided into simple sections, each identifiable with one of the basic shapes illustrated.

The formula accompanying each illustrated shape gives a determination of the tension (T) imposed upon the leading end of a cable as it exits from the section when the tension (T_o) at the commencement of that section is known.

SYMBOLS USED

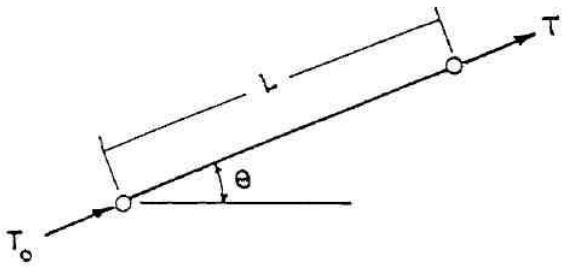
T_o = Tension at the commencement of a section [N]
T = Tension at the end of a section [N]
M = Mass of cable per unit length [kg m^{-1}]
W = Equivalent cable force per unit length = 9.81 M [N m^{-1}]
μ = Coefficient of friction in a given section
L = Length of a straight level section [m]
or length of an inclined section [m]
R = Radius of a horizontal bend [m]
θ = Angle of a subtended arc in a bend [rad]
or angle of an incline to the horizontal [rad]
F = Side wall force [N m^{-1}]

(1) STRAIGHT LEVEL SECTION



$$T = T_o + \mu WL$$

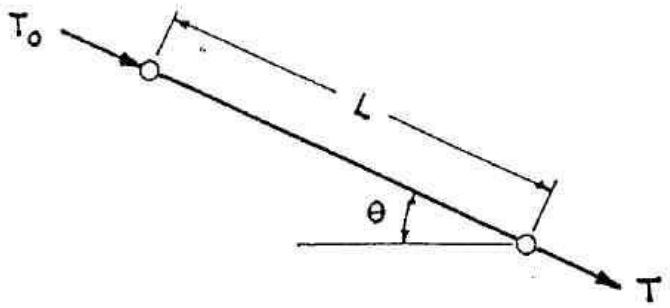
(2) UPWARD INCLINE



$$T = T_o + WL (\sin \theta + \mu \cos \theta)$$

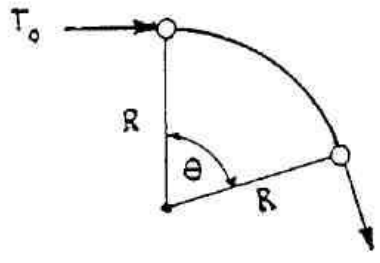
31.

(3) DOWNWARD INCLINE



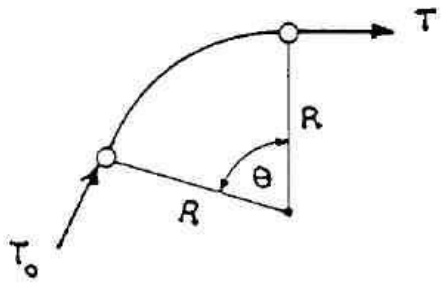
$$T = T_o - WL (\sin \theta - \mu \cos \theta)$$

(4) HORIZONTAL BEND



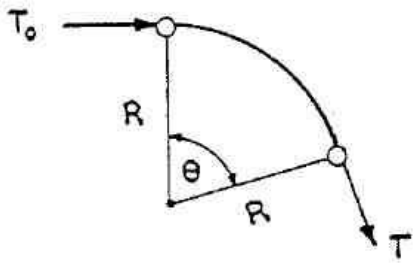
$$T = T_o \cosh (\mu\theta) + \sqrt{(T_o)^2 + (WR)^2} \sinh (\mu\theta)$$

(5) UPWARD CONVEX BEND



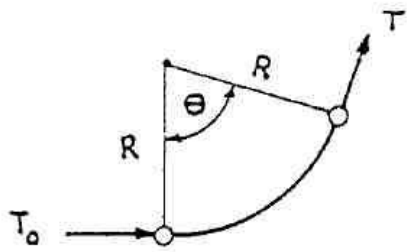
$$T = T_o e^{\mu\theta} + \frac{WR}{1 + \mu^2} [2\mu e^{\mu\theta} \sin \theta + (1-\mu^2) (1-e^{\mu\theta} \cos \theta)]$$

(6) DOWNWARD CONVEX BEND



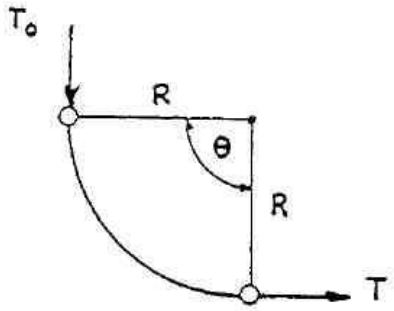
$$T = T_o e^{\mu\theta} + \frac{WR}{1 + \mu^2} [2\mu \sin \theta - (1-\mu^2) (e^{\mu\theta} - \cos \theta)]$$

(7) UPWARD CONCAVE BEND



$$T = T_o e^{\mu\theta} - \frac{WR}{1 + \mu^2} \left[2\mu \sin \theta - (1 - \mu^2)(e^{\mu\theta} - \cos \theta)\right]$$

(8) DOWNWARD CONCAVE BEND



$$T = T_o e^{\mu\theta} - \frac{WR}{1 + \mu^2} \left[2\mu e^{\mu\theta} \sin \theta + (1 - \mu^2)(1 - e^{\mu\theta} \cos \theta)\right]$$

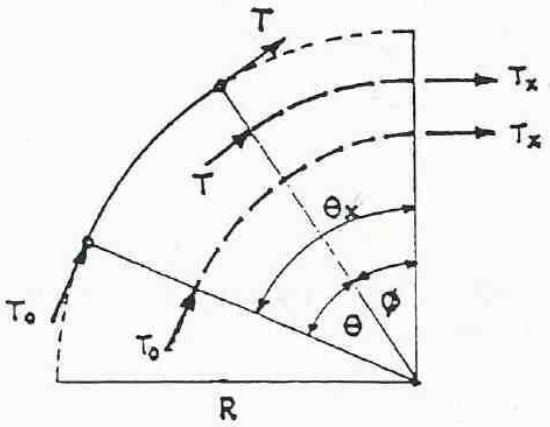
NOTE For any horizontal, convex or concave bend tension (T) can be reasonably determined by the approximate expression;

$$T = T_o e^{\mu\theta}$$

(9) OFFSET BENDS

The formulae given in (5), (6), (7) and (8) for convex and concave bends are only valid when θ is measured from a vertical axis.

If angle θ is offset from a vertical axis by some angle ø tension (T) can be calculated by the method illustrated below for an upward convex bend.



$$\theta_x = \theta + \phi$$

$$T_x = T_o e^{\mu\theta x} + \frac{WR}{1+\mu^2}\left[2\mu e^{\mu\theta x} \sin\theta_x + (1-\mu^2)(1 - e^{\mu\theta x}\cos\theta x)\right]$$

$$T = \frac{T_x - \frac{WR}{1+\mu^2}\left[2\mu e^{\mu\phi} \sin\phi + (1-\mu^2)(1 - e^{\mu\phi}\cos\phi)\right]}{e^{\mu\phi}}$$

(10) SIDE WALL FORCE

When pulling cables around bends, the side wall force is sometimes the limiting factor. The side wall force is determined from the formula:-

$$F = \frac{T}{R}$$

The maximum allowable side wall force is nominated by the cable manufacturer.

REFERENCE Electric Power Research Institute "Maximum Safe Pulling Lengths for Solid Dielectic Insulated Cables, Volume 2: Cable Users Guide", Report EL-3333-CCM, Volume 2, Research Project 1519-1, February, 1984.

F2 Coefficient of Friction – Dry Values

The following dry value coefficients of friction (COF) are extracted from EPRI Report EL-3333.

Table F1: Coefficients of Friction (*Dry Values, no Lubricant Applied*)

Conduit Material	Cable Outer Covering	Coefficient of Friction
UPVC	XLPE	0.40
	PE (Polythene)	0.40
	PVC	0.50
	HDPE	0.50
	Neoprene	0.90
	Lead	0.25
PE	XLPE	0.30
	PE	0.25
	PVC	0.40
	Neoprene	0.40
	Lead	0.25
Fibre (German Duct)	XLPE	0.30
	PE	0.25
	PVC	0.40
	Neoprene	0.40
Concrete	XLPE	0.30
	PE (Polythene)	0.35
	PVC	0.55
	Neoprene	0.50
	Lead	0.55
Fibre Cement	XLPE	0.70
	PE	0.70
	PVC	0.70
	Neoprene	1.00
Steel	XLPE	0.60
	PE	0.50
	PVC	0.65
	Neoprene	1.05

F3 Coefficient of Friction with Cable Pulling Lubricants

Lower values of COF may be used in the cable pulling calculations if approved cable pulling lubricants are specified. The actual value of COF will depend on the type of cable pulling lubricant, the quantity used, the application method and the cable sheath and conduit materials. Apply a safety factor of 50% to the manufacturer's recommended COF value to account for site conditions, before using the COF value in the cable pulling calculations,
i.e. COF for Cable Pulling Calculation = 1.5 x Manufacturer’s Recommended COF.

Annexure G – Stockcodes of Approved Items

Table G1: Approved Item Stockcodes

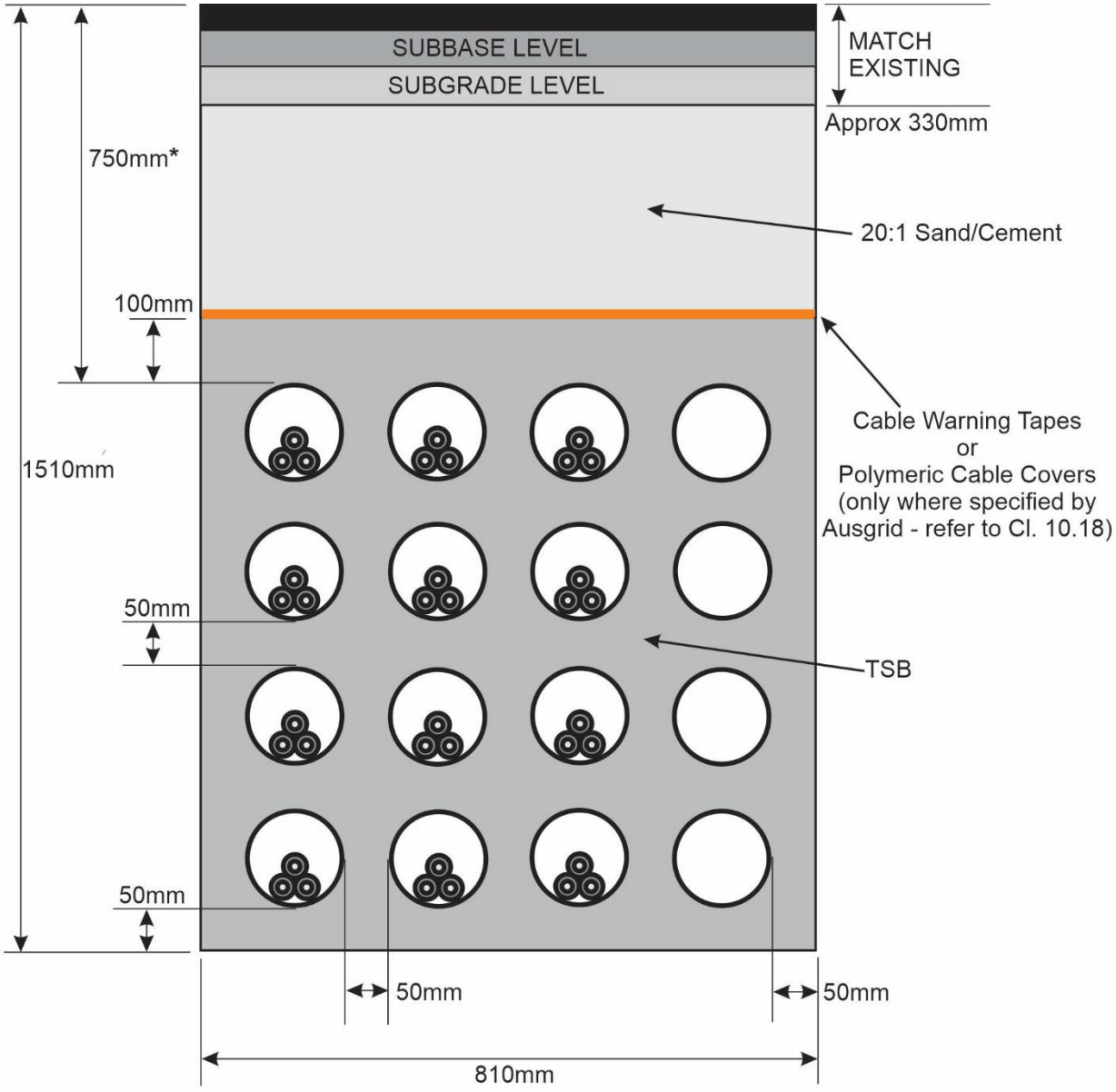
Item	Stockcode
Cables:	
11kV 500 AL3 TRXQ 35 CU(WS) Z YQ	178947
11kV 500 CU3 TRXQ 35 CU(WS) Z YQ	178813
11kV 300 CU1 TRXQ 70 CU(WS) Z YQ	177995
11kV 300 CU1 TRXQ 70 CU(WS) Z YQ/Triplex	179122
11kV 400 AL3 TRXQ 35 CU(WS) Z YQ	177562
11kV 300 AL3 TRXQ 35 CU(WS) Z YQ	177561
11kV 185 AL3 TRXQ 35 CU(WS) Z YQ	177566
11kV 150 CU3 TRXQ 35 CU(WS) Z YQ	177565
11kV 95 AL3 TRXQ 16 CU(WS) Z YQ	177564
11kV 630 CU1 TRXQ 120 CU(WS) Z YQ	90050
11kV 1000 CU1 TRXQ 120 CU(WS) Z YQ	177203
11kV 185 CU1 TRXQ 70 CU(WS) Z YQ/Triplex	181758
11kV 70 CU1 TRXQ 16 CU(WS) YQ	177568
11kV 35 AL1 TRXQ 16 CU(WS) YQ	67140
11kV 185 CU1 TRXQ 70 CU(WS) Z YQ	182311
11kV 300 CU1 TRXQ 150 CU(WS) Z YQ	177304
11kV 300 CU3 P H L YQ	1396
11kV 300 CU1 TRXQ 70 CU(WS) YQ LSZH/Triplex	182474
Pilot cable 4-core Nylon Translay 1.5CU4QQZNY/TR WHITE	78683
Pilot cable 4-core Nylon Translay 1.5CU4QQZNY/TR BLACK	78717
Pilot cable 4-core Nylon Translay 1.5CU4QQZNY/TR BLUE	78766
Pilot cable 4-core Nylon Translay 1.5CU4QQZNY/TR RED	78782
415V 300 AL4 XQ Z/SAC	185413
415V 240 AL4 XQ Z/SAC	141739
415V 240 CU4 XQ Z	H108589**
415 500 CU1 XQ Z	14258
415V 300 CU1 XQ Z	14266
415V 185 CU1 XQ Z / COM / 4 CABLES (Parrot cable)	151183
415V 185 CU1 XQ Z	61432
240V 16 CU2 XQ Z	174565
415V 16 CU4 XQ Z	148668
415V 50 CU4 XQ Z	149112
** To be used only when the design specifies	
UPVC Conduits to AS/NZS 2053.2:	
50mm nominal diameter, 4m long, heavy duty rigid UPVC orange conduit	78022
63mm nominal diameter, 4m long, heavy duty rigid UPVC orange conduit	181361
100mm nominal diameter, 3m long, light duty rigid UPVC orange conduit	78154
125mm nominal diameter, 3m long, light duty rigid UPVC orange conduit	78188
125mm nominal diameter, 6m long, light duty rigid UPVC orange conduit	78162
150mm nominal diameter, 6m long, light duty rigid UPVC orange conduit	78147

Item				Stockcode
UPVC Conduits to AS/NZS 2053.2 and AS/NZS 1477:				
200mm nominal diameter, 6m long, light duty rigid UPVC orange conduit				178771
Heavy Duty Rigid UPVC Orange Bends to AS/NZS 2053.2				
Conduit Dia (mm)	**Radius 'R' (m)**	**Angle (degrees)**	**Nominal Bend Length from coupling to coupling 'L' (mm)**	**Stockcode**
50	1.2	45	1120	179832
50	1.2	90	2060	179941
50	0.3	22.5	255	181756
50	0.3	45	350	181755
50	0.3	11.25	205	181757
63	6	30	3400	181388
63	6	15	1800	181389
63	1.2	45	1050	182446
63	1.2	90	2000	182448
63	1.2	22.5	580	182445
Light Duty Rigid UPVC Orange Bends to AS/NZS 2053.2:				
Conduit Dia (mm)	**Radius 'R' (m)**	**Angle (degrees)**	**Nominal Bend Length from coupling to coupling 'L' (mm)**	**Stockcode**
100	0.6	90	1300	77602
100	1	11.25	450	77461
100	1	22.5	700	77487
100	1	90	1950	H8503
125	1	11.25	550	77503
125	1	22.5	800	77529
125	1	90	2000	77610
125	1.8	6	550	77578
125	1.8	11.25	750	77586
125	1.8	22.5	1100	77545
125	1.8	45	1850	77552
125	1.8	90	3400	177101
125	2.3	6	600	177856
125	2.3	11.25	900	177857
125	2.3	22.5	1300	177858
125	2.3	45	2200	177859
125	2.3	90	4050	177860
150	2.5	6	650	179064
150	2.5	22.5	1400	179065
150	2.5	45	2420	179066
150	6	15	2100	178791
150	6	30	3600	181387
150	10	11.25	2100	77560

Item				Stockcode
Light Duty Rigid UPVC Orange Bends to AS/NZS 2053.2 and AS/NZS 1477:				
Conduit Dia (mm)	**Radius 'R' (m)**	**Angle (degrees)**	**Nominal Bend Length from coupling to coupling 'L' (mm)**	**Stockcode**
200	6	15	2100	178772
200	6	22.5	3100	181754
UPVC Couplings to AS/NZS 2053.2:				
50mm, light duty rigid UPVC orange coupling				179831
63mm, heavy duty rigid UPVC orange coupling				185461
100mm, light duty rigid UPVC orange coupling				H9703
125mm, light duty rigid UPVC orange coupling				179192
150mm, light duty rigid UPVC orange coupling				179191
UPVC Couplings to AS/NZS 2053.2 and AS/NZS 1477:				
200mm, light duty rigid UPVC orange coupling				179194
Conduit Reducers:				
150mm to 125mm conduit reducer, medium duty PVC white				176823
180mm to 150mm conduit reducer, UPVC Orange				180482
Heavy Duty Bellmouths:				
50mm				180004
100mm				180003
125mm				180002
150mm				180001
63mm				182449
Miscellaneous:				
Plug for 50mm heavy duty rigid conduit				179754
Plug for 125mm and 150mm light duty rigid conduit *(flower pot)*				77750
Plug for 150mm light duty rigid conduit				H85126
Plug for 63mm heavy duty rigid conduit				182450
Spacer for 125mm conduit in accordance with Annexure I of this document				65706
Spacer for 150mm conduit in accordance with Annexure I of this document				180486
PVC solvent cement				38463
Conduit sealing putty				75481
Conduit sealing foam kit				180112
Polymeric Cable Protection Covers, Steel Plates and Warning Tape:				
150mm x 1.2m slabs polymeric cable cover				151100
300mm x 1.2m slabs polymeric cable cover				151076
150mm x 20 m rolls polymeric cable cover				151084
300mm x 10 m rolls polymeric cable cover				151092
200mm x 25 m rolls polymeric cable cover				H74930
750 x 200 x 6mm Galv. mild steel plate				71464
150mm x 100 m roll orange polythene warning tape to drawing no. 49070				71233
Ragbolt Assembly:				
Ragbolt assembly				H5880

Item	Stockcode
Heatshrink End Caps:	
Heatshrink end caps (lined) for cable diameters in the range 3mm to 8mm	62232
Heatshrink end caps (lined) for cable diameters in the range 4mm to 8mm	62166
Heatshrink end caps (lined) for cable diameters in the range 8mm to 17mm	176801
Heatshrink end caps (lined) for cable diameters in the range 13mm to 22mm	62117
Heatshrink end caps (lined) for cable diameters in the range 17mm to 30mm	180005
Heatshrink end caps (lined) for cable diameters in the range 28mm to 50mm	62067
Heatshrink end caps (lined) for cable diameters in the range 38mm to 70mm	62042
Heatshrink end caps (lined) for cable diameters in the range 65mm to 95mm	62026
Heatshrink end caps (lined) for cable diameters in the range 95mm to 115mm	178062
Heatshrink end caps (unlined) for cable diameters in the range 95mm to 115mm	62208
Heatshrink Tubing:	
Heatshrink tubing `for cable diameters in the range 14mm to 31mm	60186
Heatshrink tubing for cable diameters in the range 20mm to 45mm	143776
Heatshrink tubing for cable diameters in the range 27mm to 55mm	141721
Heatshrink tubing for cable diameters in the range 50mm to 100mm	169565
Triple End Seals:	
Triple End Seal Kit for 95mm^2 to 240mm^2 Multicore Cables	178442
Triple End Seal Kit for 300mm^2 to 500mm^2 Multicore Cables	178441
Triple End Seal Kit for 185mm^2 to 300mm^2 High Voltage Single Core Polymeric Cables	178443
Triple End Seal kit for 185 to 300 mm^2 LV Single Core Polymeric Cables	182467
Cable Clamps for Polymeric Cables:	
Nitrile Rubber Liner to be used with all Cable Clamps for Polymeric Cables	179201
Single Core Cable for attachment to Unistrut – 70mm^2	179212
Single Core Cable for attachment to Unistrut – 300mm^2	179211
Single Core Cable Held in Flat Arrangement – 300mm^2	180350
Single Core Cable Held in Flat Arrangement – 185mm^2	180291
Single Core Cable Held in Quad Arrangement – 185mm^2 LV Parrot Cable	179213
Single Core Cable Held in Trefoil Arrangement – 70mm^2	179491
Single Core Cable Held in Trefoil Arrangement – 185mm^2	178988
Single Core Cable Held in Flat Arrangement – 630mm^2 to 1000mm^2	182114
Single Core Cable Held in Trefoil Arrangement – 300mm^2 to 630mm^2	178987
Single Core Cable Held in Trefoil Arrangement – 1000mm^2	182134
Stainless Steel Band Type – Part No ABB:EA-UKR100	177651

Annexure H – CBD 16 Way Conduit Line



4x4 125mm ID DUCT, TRENCH WITH TSB BEDDING - TYPICAL DETAILS

Figure H1

Details

Cable: 300mm^2 Cu Triplex

Ducts: 125mm UPVC

Backfill: 20:1 sand/cement dry mix

Bedding: thermally stable bedding slurry (TR = 0.9K.m/W or less, fully dry).

* Required cover may vary to suit Council or RMS requirements. Cover could be as high as 1.0m for RMS roads.

Annexure I – 125mm and 150mm Spacers for Conduits

125mm conduit spacer

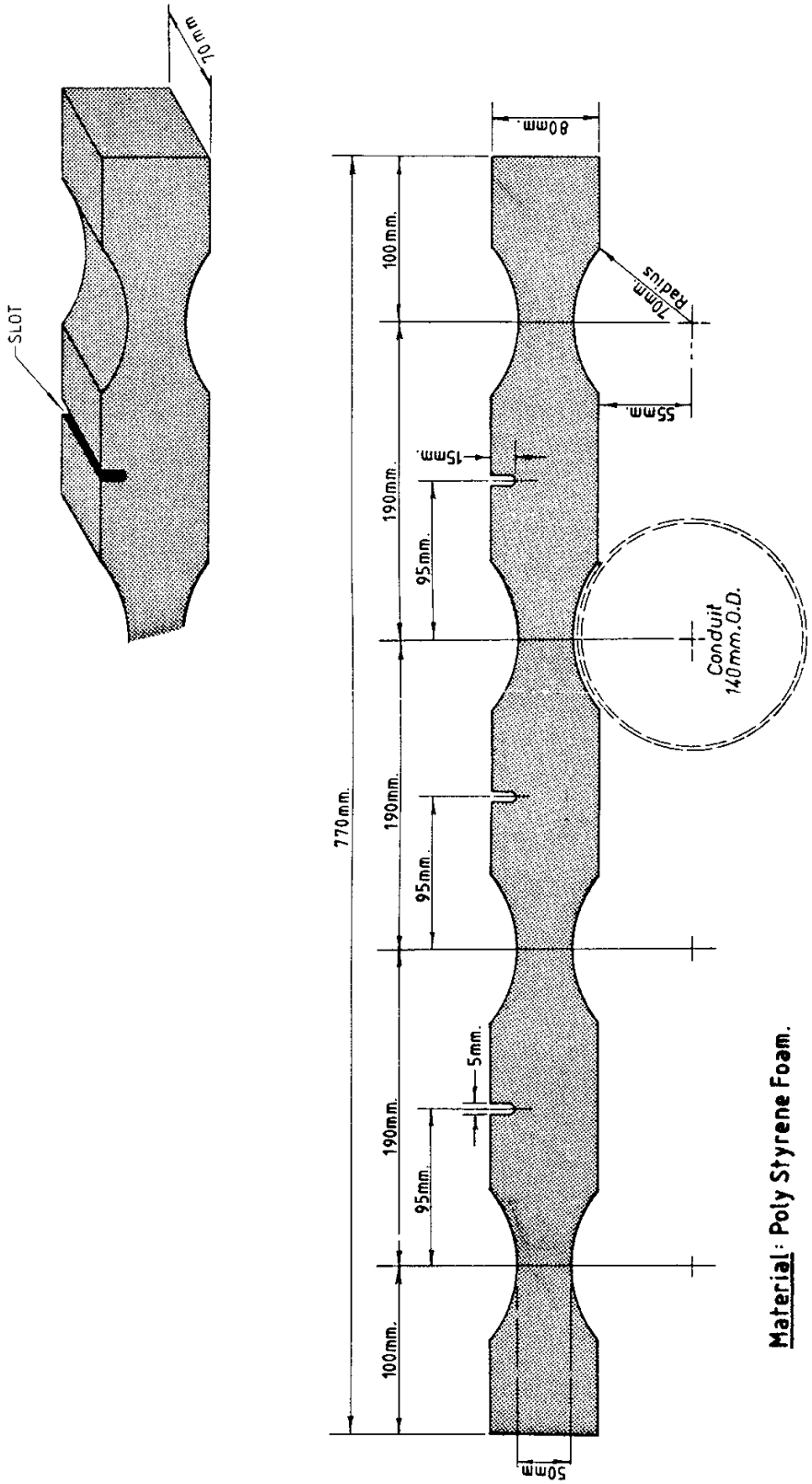


Figure I1 - 125mm conduit spacer

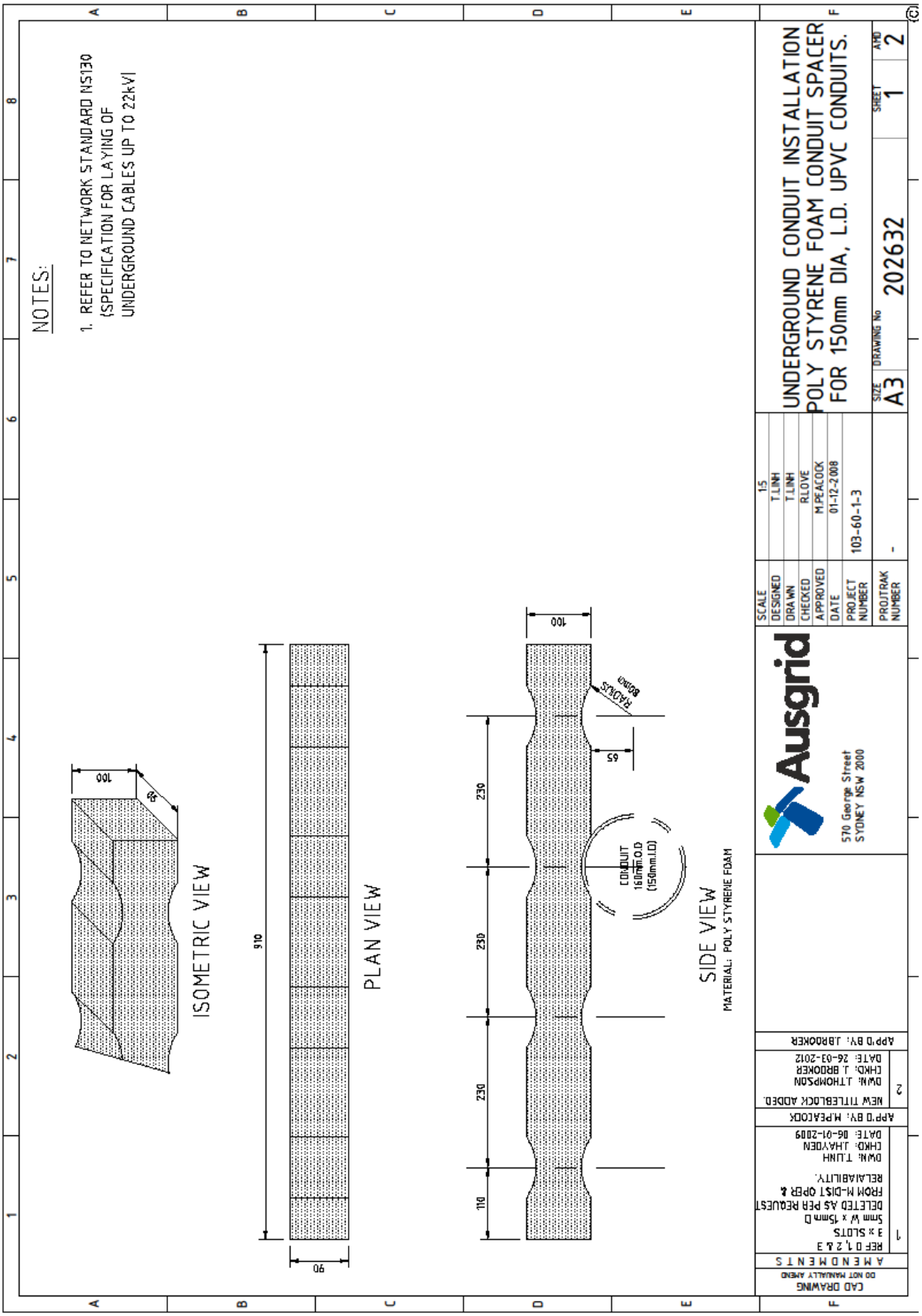
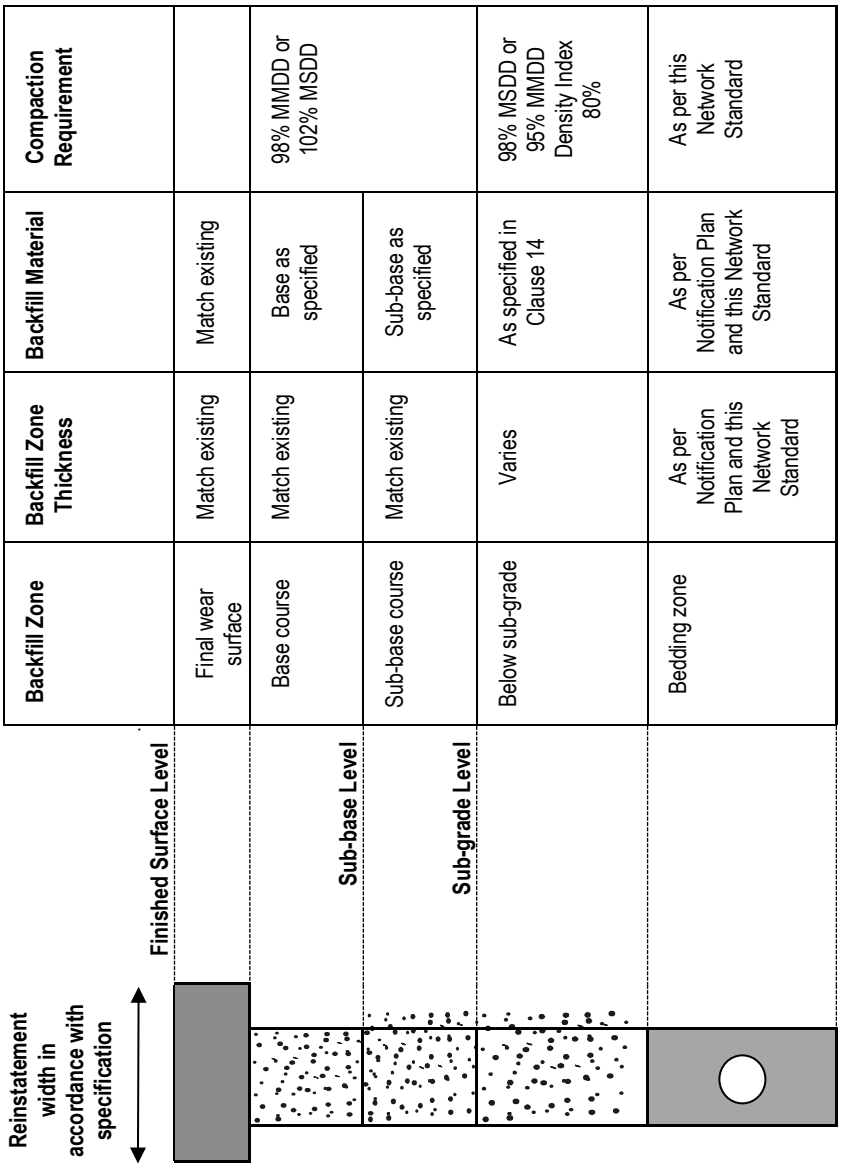


Figure I2 - 150mm conduit spacer

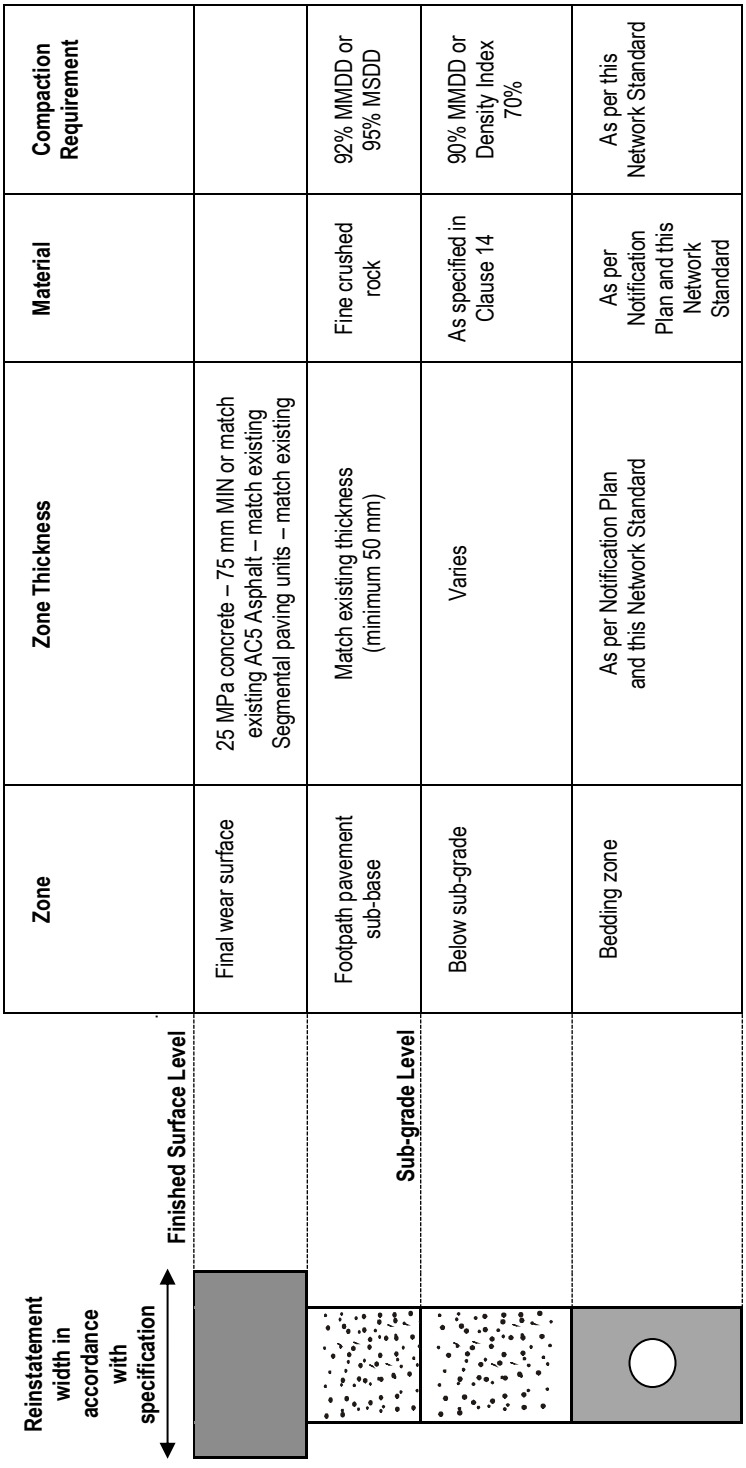
Annexure J – Typical Final Restorations

Table J1: Carriageway or Heavy Duty Vehicular Crossing



Backfill Zone	Backfill Zone Thickness	Backfill Material	Compaction Requirement
Final wear surface	Match existing	Match existing	
Base course	Match existing	Base as specified	98% MMDD or 102% MSDD
Sub-base course	Match existing	Sub-base as specified	
Below sub-grade	Varies	As specified in Clause 14	98% MSDD or 95% MMDD Density Index 80%
Bedding zone	As per Notification Plan and this Network Standard	As per Notification Plan and this Network Standard	As per this Network Standard

Table J2: Typical Restorations in Footpaths



Zone	Zone Thickness	Material	Compaction Requirement
Final wear surface	25 MPa concrete – 75 mm MIN or match existing AC5 Asphalt – match existing Segmental paving units – match existing		
Footpath pavement sub-base	Match existing thickness (minimum 50 mm)	Fine crushed rock	92% MMDD or 95% MSDD
Below sub-grade	Varies	As specified in Clause 14	90% MMDD or Density Index 70%
Bedding zone	As per Notification Plan and this Network Standard	As per Notification Plan and this Network Standard	As per this Network Standard

Annexure K – Installation of Network Conduit Lines through Buildings

Introduction

This section deals with Ausgrid's requirements where a bank of conduits is intended to carry distribution Network Cables through a building. It is anticipated that this situation would arise mainly in Central Business Districts where street congestion begins to limit the ability to effectively provide supply to all customers.

Definitions

Network Cables	415V and 11kV cables required to supply parts of Ausgrid's network other than just the building through which they are passing.
Ductline	A group or bank of conduits suitably spaced for required cable ratings and installed so that heat generated by the cables may be effectively dissipated. The cables are required to be protected from the effects of a fire in the building through which they pass, either by encasement in suitable materials or shielding and separation from sources of fire.

Property requirements

Where a bank of conduits are to be run through a privately owned building, an easement covering the route and a right of way to permit access must first be negotiated as per NS143 and applicable Property Branch documents. The easement would normally be a stratum easement, confined to the boundaries of the materials encasing and supporting the conduits.

Policy

Wherever possible, Network Cables shall be routed through public roads or reserves in accordance with NS143 *Easements and Leases* and NS130 *Laying Underground Cables up to and including 11kV*.

However, where situations arise such that it is difficult to provide supply to all customers in this manner, Ausgrid may determine that space is required through new or existing buildings for the construction of a Ductline. This new Ductline would not be intended to exclusively supply the customers in that building.

In such cases, other network customers are exposed to an additional risk of wider spread loss of supply in the uncommon event of a fire or catastrophic incident occurring within the building and impacting on the availability of the Network Cables passing through the Ductline.

It is therefore necessary that a policy be developed and requirements specified to ensure that Network Cables running through buildings are installed in such a manner that they are protected as far as possible from accidental damage and the impact of a catastrophic incident. If damaged, the Network Cables should be installed so that they are capable of being quickly restored to a serviceable condition.

Functional Requirements

The installation conditions should be such that the performance of the cables is not compromised by the additional measures required to protect them. The cable protection shall be such that the cables are capable of being quickly removed or replaced in the event of a major building failure.

Ausgrid's policy in this regard is as follows:

- Where Network Cables are to be run through a Ductline located inside a building, the Ductline shall be designed to provide at least a 3 hour fire rating (FRL 180/180/180) for the Network Cables unless special circumstances mitigate the risk of the Ductline being exposed to the fire.

- At the end of 3 hours fire exposure, it shall be possible to withdraw existing cables installed in the Ductline and to install new Network cables without difficulty.
- The Ductline and supporting structures shall be protected against a 2 kPa overpressure generated from within the building area.
- Any proposed reduction in the fire protection or overpressure requirements shall be subject to the written approval of Ausgrid.
- Where the above requirements are not fully achievable, or where there is considered a more significant potential consequence to the cables or conduits being severely damaged, the relevant section of Ductline shall be readily accessible. The conduit encasement shall be designed for ease of demolition so that it can be replaced or repaired in order to facilitate the speedy replacement of Network Cables contained in the Ductline. Alternative solutions such as the provision of an alternative back up route may also be considered acceptable.
- While adequate fire and overpressure protection is to be established for the Ductline, the form of protection proposed shall not adversely impact on the design cable ratings of the Network Cables passing through the building. In particular, the thermal resistivity (TR) of the conduit encasement shall not be greater than that specified for the project.
- Any Ductline design that may adversely impact on the designed cable ratings, shall have a rating assessment completed by the Designer as per NS 272 and the rating assessment shall be submitted to Ausgrid for review and written approval.

Minimum technical requirements

A. Internal Building Areas with LV and HV Conduits Above Ground and Exposed to Air

The following technical requirements are based on a concrete encased Ductline design. Alternative arrangements which provide the necessary protection and do not reduce cable ratings to unacceptable levels may also be submitted for consideration by Ausgrid.

1. The conduits shall be 150mm (160mm OD) heavy duty UPVC Orange and shall meet the minimum requirements of NS130 and AS 2053
2. Minimum conduit centre to centre spacing shall be 230mm
3. The conduits shall be encased in concrete with all exposed faces suitably reinforced. A high concrete density is required and lightweight aggregate and air entraining agents shall not be used.
4. A minimum three (3) hour (FRL 180/180/180) fire rating shall be achieved for the concrete encasement to the conduits and for any supporting structures. This requirement may be reduced in fire isolated areas such as fire stairs subject to approval from Ausgrid.
5. The conduit ductline and supporting structures shall be designed to sustain a minimum superimposed live load of 2 kPa overpressure, generated from within the internal building area.
6. A minimum concrete cover of 180mm to the conduits shall be provided at all exposed concrete encasement faces. This concrete cover shall be suitably reinforced and incorporate the required 3 hour fire rating. Reinforcement detailing shall be arranged to reduce the potential for induced currents in accordance with the requirements of Ausgrid.
7. A minimum concrete cover of 100mm to the conduits shall be provided at non-exposed faces of the Ductline, for example, along external basement walls. This cover may be reduced in confined locations subject to approval from Ausgrid.
8. Suitable allowance shall be made for conduit installation and support along the Ductline route.
9. The use of core filled blockwork to form the exposed faces of the ductline is not acceptable due to its higher thermal resistivity. Blockwork may be used below the Ductline for support provided a 3 hour fire rating and 2 kPa overpressure resistance is achieved by the support structure.

10. All exposed faces along the route of the internal Ductline shall have suitable marking to the requirements for reduced cover specified in NS130, and approved by Ausgrid.

11. Internal building areas through which the ductline passes shall be suitably ventilated or air conditioned to allow for effective circulation of air to all exposed faces and to remove heat generated by the cables. Design information to be provided by Ausgrid shall include the estimated heat load per metre for the Ductline being designed.

B. Internal Building Areas with LV and HV Conduits Below Ground in Trenches

1. The conduits shall be 150mm (160mm OD) heavy duty UPVC Orange and shall meet the minimum requirements of NS130 and AS 2053

2. Minimum conduit centre to centre spacing shall be 230mm

3. The conduits shall be encased in Thermally Stable Bedding (TSB) or concrete. Where concrete is used a high concrete density is required and lightweight aggregate and air entraining agents shall not be used.

4. A minimum cover of 100mm for the conduits shall be provided to the trench walls and floor. This cover may be reduced in confined locations subject to approval from Ausgrid. Minimum cover below the internal floor surface shall all be in accordance with NS130 requirements including those for reduced cover.

5. Within the building area all conduit trenches shall be provided with a reinforced concrete slab at the surface with a minimum thickness of 125mm.

6. Marking of the route of the Ductline on the floor surface shall be required as shown in NS130 and approved by Ausgrid for all internal Ductlines.

7. Internal building areas above the conduit trenches shall be suitably ventilated or air conditioned to allow for effective circulation of air and remove heat generated by the cables.

C. Concrete Requirements

Concrete used for encasement of ductlines shall be specified to ensure that it provides the required mechanical strength and fire rating, while not adversely impacting the thermal ratings of the cables. In particular, the following requirements must be adopted in designing the concrete mix:

1. The specific concrete specifications required for the concrete encasement of the Ductline are to be indicated on the drawings. Ausgrid's requirements, including those indicated below, shall be referenced.

2. The minimum concrete strength for the encasement shall be 20MPa at fire exposed locations and shall be indicated on the drawings. To limit the heat of hydration, the cement content should be minimised to the extent possible given the other design requirements.

3. A low heat of hydration cement (Type LH) and appropriate concrete mix design shall be used to reduce the risk of the UPVC conduits softening during curing. Other measures to further limit the temperature rise in the concrete encasement during curing may be acceptable subject to approval by Ausgrid.

4. Admixtures in the concrete mix shall be subject to the approval of Ausgrid following the submission of a product specific data sheet. The use of accelerators to speed concrete curing or admixtures that entrain air will not be approved.

5. The total flyash in the concrete mix (by weight) shall not exceed 5% unless separately approved by Ausgrid. Flyash reduces the thermal performance of the installed Ductline.

6. Lightweight aggregate and air entraining agents shall not be used.

7. The concrete cover to reinforcement shall comply with AS 3600 to achieve a minimum three (3) hour (180/180/180) fire rating. Ausgrid requires a minimum concrete cover of 45mm to reinforcement at any fire exposed face.

8. Reinforcement detailing shall be arranged to reduce the potential for induced currents. In particular, transverse reinforcement around the Ductline shall not form a closed loop at any location.

ASPs or contractors wishing to vary concrete mix from approved requirements shall provide documentation demonstrating that their proposal achieves the specified functional requirements including Ductline integrity and thermal resistivity (TR) value without increasing the in-situ concrete curing temperature to a level where conduits are likely to be damaged.

D. Electric and Magnetic Fields (EMFs) and Electromagnetic Interference (EMI)

The selection of the route for network ductlines through buildings should take into account the possible effects of Electric and Magnetic Fields (EMF) and Electromagnetic Interference (EMI). The adjacent, current and expected building and land uses and locations of Ductlines and cables should be evaluated for EMI.

Evaluation by an approved Electrical Engineer is to be undertaken to ensure EMI does not disrupt sensitive electronic equipment or pose a health risk to persons who continuously occupy adjacent areas for long periods of time.

An EMI report must be provided as part of the design submission for the proposed Ductline.

Areas of particular relevance include hospitals, particularly operating theatres (Refer to AS/NZS 3003), computer rooms, laboratories, general offices and apartments.

Refer to NS114 for additional requirements and guidance.

Note: Installation of EMI screening is not permitted inside any Chamber Substation, at any HVC connection, or associated chambers and cable risers. The addition of EMI screening at other locations must not interfere with access to, maintenance of, air circulation around or the efficient operation of the Ductline and related equipment.

Annexure L – Testing of Backfills: Thermal Resistivity

Background

Ausgrid has a high capital investment in underground cables.

The ratings of these buried cables are greatly affected by the thermal properties of the surrounding soils and imported thermal bedding materials.

Thermal resistivity (TR) is a major input parameter into cable rating calculations and a thorough understanding of the resulting values during construction is vital to ensure the specified cable ratings are achievable over the lifetime of installed assets.

Ausgrid wishes to ensure that the TR testing services being offered by external service providers are accurate and consistent, providing test results that can be relied on for it's determination of cable ratings.

This document has been developed with the intent that the quality of TR testing being offered by external service providers is of a standard compatible with Ausgrid's requirements. Information is included to assist Testing Laboratories experienced in soil analysis but no thermal studies to understand the basis for the requirements and procedures specified.

Thermal resistivity (TR)

Thermal resistivity (TR) is the reciprocal of thermal conductivity.

Thermal resistivity (TR) is a property of the material being tested.

Thermal resistance depends upon the TR of the material AND the geometry of the installation

TR is often measured in either Km/W or ^{o}C.m/W, the units depicting temperature rise across a given distance due to an amount of heat(power) passing through the medium.

Regardless of whether K or ^{o}C are used, the magnitude of the TR will be the same.

For a given geometry: the higher the TR the greater the resistance to the flow of heat and, for a given amount of heat the greater the temperature rise.

The formula used to calculate TR for a line heat source of infinite length within an infinite medium is:

$$\rho = \frac{4 * \pi * (T2 - T1)}{2.303 * q * \log(t2/t1)}$$

Where:

ρ	= TR in K.m/W (or ^{o}C.m/W)
T_1 and T_2	= Temperatures at the beginning and end of the test period respectively
q	= Heat dissipated by the line heat source in watts/m
t_1 and t_2	= Times at the beginning and end of the test period in minutes

The qualifying factors that apply to the above expression should be noted as:

Thermal probes are not line heat sources and have physical diameters and wall thickness. The resulting mass and specific volumetric heat of the probes causes non linear relationships between temperature and log (time differences) at the initialisation of tests.

Scope

The scope of this document covers information relating to the necessary processes for ensuring that testing of thermally stable materials or soil samples is conducted in a manner that provides accurate and consistent results regardless of the Testing Laboratory undertaking the tests. In particular, the document includes information on:

- Tests to be Undertaken on Samples
- Quality of Test Procedures
- Sample Preparation
- Storage of Samples
- The development of thermal bedding materials
- General equipment needed

Tests to be undertaken on samples

Tests to determine the thermal characteristics and performance of bedding materials for use in Ausgrid projects shall be generally in accordance with:

ASTM D5334-08 Standard Test Method for Determining the Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure.

Note that results from this method are for thermal conductivity, and it will be necessary to take the reciprocal of this value to calculate the thermal resistivity, which is the value generally used in Australia for cable installations.

Ausgrid require the following tests to be undertaken and results provided for samples for which thermal resistivity is being determined.

For native soil samples**:-**

- Thermal resistivity – as found
- Moisture content – as found
- Thermal resistivity – in the fully dried out state
- Thermal dryout curves – Thermal resistivity vs Moisture content.
- Soil density – as found

The density of native soils may not always be required. When commencing work on projects the Testing Laboratory should confirm that Ausgrid requires native soil density results.

For compacted granular thermal bedding materials (including graded sands) submitted for approval or routine testing**:**

- Thermal resistivity at a specified compaction density
- Moisture content – when compacted
- Proctor density of the compacted sample
- Thermal resistivity in the fully dried out state
- Dry Density

For flowable thermal bedding materials submitted for approval or routine testing**:**

- Thermal resistivity at commencement of testing
- Moisture content at commencement of testing
- Thermal resistivity in the fully dried out state
- Dry Density

Where the material is being submitted for approval (type testing), a dry out curve may also be required, recording moisture content and thermal resistivity at; zero moisture content, initial moisture content and at least two points in between. The initial moisture content shall be not less than 8%.

For compacted granular materials, the minimum Proctor density of samples shall be specified by Ausgrid. If not specified, the value shall be 98% Standard Proctor density. For material submitted for approval (type testing) the fully dried out TR shall also be determined at 95% and 90% standard Proctor density.

Sieve analysis may also be required when instigating projects the Testing Laboratory should confirm that Ausgrid requires sieve analysis results.

Provision of test reports

Results are to be provided to Ausgrid in an uneditable electronic format (e.g. pdf file) for storage and access by Ausgrid staff in Ausgrid's ThermalRes database.

Quality of test procedures

Notwithstanding any standard, process or equipment used the Testing Laboratory must at all times be able to demonstrate to the satisfaction of Ausgrid that the methodologies and equipment used for the determination of the thermal resistivity of soils will provide accurate and repeatable test results.

The following references shall be used in place of the comparable US standards where referenced in ASTM D5334-08:

- AS 1289 5.1.1-2003: Method of Testing Soils for Engineering Purposes – Soil compaction and dry density Tests.
- AS 1289 2.1.1-1992: Method of Testing Soils for Engineering Purposes – Soil moisture content tests
- AS 1289 1.1.1-2001: Method of Testing Soils for Engineering Purposes – Sampling and preparation of soils.
- AS 1012.3.1 – 1993: Methods of Testing Concrete. Determination of properties related to the consistency of concrete – Slump test
- AS 1379 – 1997 Specification and supply of concrete

Factors that influence test results

Test samples are also not infinite mediums (often being as small as 50mm in diameter). Boundary effects occur during tests as the heat flux reaches the outer surface of the sample where it often interfaces with air.

There are many factors that can influence test results such as:

- Moisture migration within the sample under test due to the heat from thermal needles can affect the rates of temperature rise
- Non stable sample temperatures affect the flow of heat generated by the probe
- Poor probe surface contact resistance with the surrounding aggregates can influence results due to situations such as: aggregate size, compaction, cracked samples or incorrectly installed thermal needles
- Poorly prepared samples where in the case of compacted granular materials the density of the material is inconsistent with the expected density

For these reasons when assessing the resulting values (or more fundamentally, the time periods over which analysis is to occur) a visual representation of the temperature/log time output must be referred to, to ensure initial and transient boundary effects have been considered and their effect on the TR result minimized.

Equipment

Thermal Resistivity Test Instruments.

Refer to part 5 of IEEE 442-1981 *Guide for Soil Thermal Resistivity Measurements* for general information on test equipment for use on TR testing.

Whilst the determination and analysis of TR can be achieved using relatively simple equipment, modern instrumentation usually incorporates constant current power sources and data logging facilities together with computer assistance to output a TR quantum.

Due to the effects of initial transients and edge effects, only those instruments that can demonstrate to the satisfaction of Ausgrid that these effects have been considered and eliminated in the determination of TR shall be approved for carrying out TR measurements.

Thermal needle length to diameter ratio shall be no less than: 30:1.

The contractor may be required to perform a practical demonstration of the instrumentation offered and shall be required to provide specifications for the equipment to be used for testing samples for Ausgrid.

A list of the key equipment expected to be required by Testing Laboratory in carrying out TR measurements for Ausgrid is provided in Table L1.

Sample preparation

The preparation and handling of samples has a great influence on the resulting TR.

Due to the relatively small size of commonly prepared samples the scaling effects on mix tolerances can lead to inaccuracies when specifying delivered quantities.

The measuring tolerances of equipment and methodologies used to prepare samples shall be suitably controlled to minimize scaling errors.

- The measurement accuracy of Thermal Resistivity shall be: < +/- 5%
- Routine daily calibration checks of balances shall be carried out using known test weights.
- The measurement accuracy of balances shall be: < +/- 1%
- The minimum diameter of samples to be tested shall be: 50mm
- The minimum length of sample to be tested shall be: 150mm
- Larger samples are preferred

Compacted Granular Samples

For a given material type the TR of compacted granular materials is usually quite sensitive to both compaction density and moisture content.

For results to be accurate and repeatable the compaction of samples must be well controlled.

Testing Laboratories must have systems in place to ensure:

- The positioning of test probes within the samples being prepared is controlled to prevent movement of the probes during compaction
- The density of the compacted material within the sample is consistent throughout the sample volume.
- Sample compaction is carried out at known moisture contents (as a percentage of dry weight)

For these reasons samples must be prepared in controlled layers where the mass of the material being compacted within each successive layer volume is known. Quality balances must be used to accurately measure the mass of material used within the layered samples.

Samples shall be taken from site or prepared from ingredients in accordance with AS 1289.1.1.1. When placed in the test cylinder, compaction shall be tested in accordance with AS1289.5.1.1.

Compaction rates and the densities must be referenced to standards to ensure repeatability in the field i.e. Standard Proctor Test.

Where a dryout curve is being prepared, moisture content shall be tested at the beginning and end of tests, as well as at additional points in between. Testing for moisture content shall be in accordance with the requirements of AS1289.2.1.1.

Flowable Samples

The collection and treatment of fluidised samples before solidifying can have marked effect on the TR of the sample under test. The aggregates within these high slump materials (designed such that they should flow without mechanical vibration) can easily segregate under vibration. The consistency of the collected sample under test must be representative of the material installed within the cable trench and for this reason, further movement/vibration caused by influences such as but not limited to:

- Rodding
- Transport
- Tapping the sample tube

should be avoided until the material has solidified to prevent aggregate segregation. Collected samples are usually best left on site until solidified before transporting to a test laboratory for further testing.

Probe Installation and Collection of Undisturbed Soil Samples

The installation of thermal needles/probes must be done with a view to ensuring good contact between the needle and the surrounding material without disturbing the soil.

Poor contact between the thermal needle and surrounding material will greatly affect the TR measurement.

If the sample material is so hard as to require the drilling of a hole to permit installation of the needle without damage to the needle or disturbance to the sample, the hole shall be of slightly smaller diameter than the needle to ensure that the needle maintains a good contact with the sample throughout its length.

The most common method used for collecting undisturbed samples is via driven tubes. These tubes must comply with the minimum dimensions specified above.

The tubes used must be thin walled (nominally 1.0mm) and driving operations undertaken with processes that prevent inadvertent compaction of the collected sample.

Note: Driving thermal needles and sample tubes into native soil within the field environment bring with it the risk of damaging other services. The Contractor's attention is brought to the necessity to locate services before driving probes, collection tubes or drilling holes for needles. The cost of rectification of any damage caused by the contractor in carrying out probe installation or the collection of samples shall be borne by the contractor.

Storage of samples

The Test Laboratory shall have in place suitable storage facilities for the preservation and storage of test samples.

Following final tests, samples are usually discarded, however there may be a requirement for samples to be stored for a period of time for records and/ or retest either by the Test Laboratory or by others.

The maximum time samples are required to be stored is: 6 weeks.

For samples to be stored by the Test Laboratory, Ausgrid must issue notice to the Test Laboratory no less than 2 weeks prior the commencement of testing that samples are to be stored. At the completion of the storage time the Test Laboratory may discard the samples unless within the 6 week storage period notice has been given by Ausgrid that prolonged storage of samples would be required.

- The maximum prolonged period of storage (including the initial 6 weeks) shall be 12 weeks.
- The minimum volume to be allocated for the storage of samples shall be 24m^3.

The storage facility shall be in a cool dry place with security and appropriate filing to prevent the loss and ensure proper identification of samples for the storage period.

At the end of the storage period the Test Laboratory may discard the samples and/or hand them over to Ausgrid at Ausgrid's discretion.

Development of thermal bedding materials

Once a mix design for thermal bedding or backfill material has been determined within the laboratory, and constituent components specified to a level such that variation in the delivered material prevents the resulting TR from exceeding Ausgrid's specified maximum TR for the project in hand, before it can be used on Ausgrid's network it must be type tested in the following manner.

Samples for type testing shall be collected from a batched mix of no less than 2m^3 with no less than 3 samples for TR testing being taken from the beginning, middle and end of the batched product (a total of 9 samples for thermal testing plus additional samples for compressive strength tests). The first 0.2m^3 of the batch mix shall be run off before the samples are taken.

Test reports for these materials shall include:

- Detail description of the constituent components
- Sieve analysis
- Identification of the source quarries and batching plants
- Mix design (in kg/m^3 – dry weight)
- Water content in litres/m^3 or % dry weight
- Compressive strength at 7, 28 and 120 days (with strength values to be within the ranges required by Clause 11.2) at the minimum and maximum site acceptable slump (moisture content) values.
- Thermal Resistivity in the fully dried out state in Km/W (for materials mixed at the minimum and maximum site acceptable slump (moisture content) values.
- Methods used for the sample preparation and installation to ensure the type test results are representative of the "in field installed" materials.

For compacted granular mixes only:-

- Compaction density to be used on site as a % of the Standard Proctor Density (used to achieve the type test results for compacted granular materials)

For flowable type mixes only:-

- Nominated slump (in the case of fluid type product) to be used on site
- Forecast Compressive strength @ 6, 12 and 24 months at the minimum and maximum site acceptable slump (moisture content) values.

Six cylindrical samples nominally 100mmD * 150mm long shall also be provided for inspection by Ausgrid.

The type test results (including the 28 day compressive strength results) together with work method statements (WMS) for their installation for controlled thermal bedding together with samples, shall be provided no less than 6 weeks prior to first installation.

Quality Management Plans

Testing Laboratories undertaking TR testing must have in place, accredited or approved quality systems documenting the:

- Work method statements for each of the individual processes being undertaken
- Test report formats
- Equipment list that positively identifies the equipment used and the accuracy of the instrumentation provided

- List of key personnel undertaking TR testing and sample preparation
- Methods used to calibrate instrumentation, including calibration frequency

Ownership and treatment of samples

Samples provided by Ausgrid shall remain the property of Ausgrid until testing is completed and samples are discarded.

Samples collected by the Test Laboratory or contactor for testing shall remain the property of the Test Laboratory until full payment of the testing services is received.

From the time of receipt of samples the Test Laboratory shall ensure that the samples are maintained within a controlled environment and treated such that the variation in TR results due to storage are minimized. For this reason bulk samples shall be stored in sealed enclosures to prevent moisture loss and or migration of moisture within the sample itself.

Right of access

Ausgrid reserves the right to witness any testing being carried out on its behalf, whether this testing is on site or within laboratories.

Ausgrid reserves the right to audit any testing or equipment that may be used for testing samples on its behalf. The cost of auditing will be to Ausgrid who will provide reasonable notice to the Test Laboratory for the audit.

Confidentiality

The Test Laboratory must have in place quality systems to guarantee the confidentiality of tests carried out on Ausgrid's behalf.

Table L1: Typical Equipment

Item	Equipment	Description / Use
1	TR test instrumentation	Suitable constant power sources (adjustable) with temperature/log time data logging facilities. Output results to be able to be confirmed by graphical output.
2	Thermal needles probes	Thermal probes/needles with a length to diameter ratio of > 30:1 capable of withstanding oven temperatures ≥ 105ºC. Sized to suit field and laboratory situations.
3	Forced air oven	Used for drying out and stage drying samples (at up to 105ºC ± 2.5%) as well as treating soil samples at elevated temperatures prior disposal in accordance with the NSW department of agriculture specifications.
4	Balance and calibration test weights	± 0.01% for accurately weighing component materials and mixtures.
5	Sieve / shaker -	Multistage vibrating sieve up to 25mm sieve sizes.
6	Standard proctor compaction hammer and test cell	These standardized items (to AS 1289 – Methods For Testing Soils For Engineering Purposes) are used for the laboratory compaction and density measurement of samples.
7	Field sample tubes with sealing caps	50mmd * 150mm long Stainless steel tubes for the collection of undisturbed field samples with "in-situ/natural" density or allowing uncontrolled drying out of test samples.
8	Laboratory sample tubes and compaction equipment	For accurately preparing compacted granular samples with consistent density throughout the sample.

Item	Equipment	Description / Use
9	Slump cone and tamping rod	Used for determining the standard slump of “fluid” materials.
10	Measuring cylinder	0-500ml ± 0.5ml measuring cylinder for accurately measuring the required moisture component of samples under manufacture.
11	Manuals and work instructions	Quality assurance for equipment calibration and work procedures.

Annexure M – Typical TSB Recipes

The following are typical examples of slurry mix designs that may satisfy the performance requirements of Clause 11.2:

Table M1: Regular Mix Recipes - Compressive Strength: 1 to 3MPa

Component	Wt.(kg/m^3) SSD*
Cement	20
Fly Ash	160
Coarse Aggregate - Round River Gravel	925
Fine Aggregate	985
Water	200

Table M2: Regular Mix Recipes - Compressive Strength: 3 to 5MPa

Component	Wt.(kg/m^3) SSD*
Cement	70
Flyash	100
10mm crushed river gravel	970
Coarse Sand	930
Water	190

Table M3: Dry Mix Recipe

Component	Wt.(kg/m^3) SSD*
Cement	25
Fly Ash	140
Coarse Aggregate - 10mm aggregate	725
Fine Aggregate	1095
Water	105

* SSD = Saturated Surface Dry - the condition of the aggregate in which the pores in each particle of the aggregate are filled with water but no excess water is on the particle surface.

Discipline
Engineering Standard - NSW

Category
Electrical

Title
Underground Installation Configurations for High Voltage and 1500 Vdc Cables

Reference Number
PCS 02 - (RIC Standard: EP 20 00 04 02 SP)

Document Control

Status	Date	Prepared	Reviewed	Endorsed	Approved
Issue 1 Revision 1	Mar 05	Standards and Systems	Signalling Standards Engineer	GM Infrastructure Strategy & Performance	Safety Committee
		Refer to Reference Number	T Moore	M Owens	Refer to minutes of meeting 24/01/05

Disclaimer

Australian Rail Track Corporation has used its best endeavors to ensure that the content, layout and text of this document is accurate, complete and suitable for its stated purpose. It makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems of work or operation. Australian Rail Track Corporation will not be liable to pay compensation in respect of the content or subsequent use of this document for any other purpose than its stated purpose or for any purpose other than that for which it was prepared except where it can be shown to have acted in bad faith or there has been willful default.

Document Approval

The technical content of this document has been approved by the relevant ARTC engineering authority and has also been endorsed by the ARTC Safety Committee.

Document Supply and Control

The Primary Version of this document is the electronic version that is available and accessible on the Australian Rail Track Corporation Internet and Intranet website.

It is the document user's sole responsibility to ensure that copies are checked for currency against the Primary Version prior to its use.

Copyright

About This Standard

This publication sets out the basic requirements and approved installation configurations of high voltage underground cables owned by the Australian Rail Track Corporation (ARTC) and other Utilities underground cables located on railway property.

For the purpose of this publication the term “High Voltage Cable” refers to cables for use at voltages in excess of 1000 V and includes the positive and negative cables forming part of the 1500 V dc system.

Document History

Primary Source – RIC Standard EP 20 00 04 02 SP Version 1.0

List of Amendments –

ISSUE	DATE	CLAUSE	DESCRIPTION
1.1	11/03/2005	Disclaimer	Minor editorial change

Contents

1 References

Electricity Supply Association of Australia publication C(b)2 “Guide to the Installation of Underground Cables”.

AS 4799	2000 –	Installation of underground utility services and pipelines within railway boundaries.
AS/NZS 2053.2	1995	Conduits and fittings for electrical installations.
AS/NZS 1477	1999	PVC pipes and fittings for pressure applications.
AS/NZS 4130	2001	Polyethylene (PE) pipes for pressure applications.
SAA HB 29	2000	Communications cabling handbook.
AS 4058	1992	Precast Concrete Pipes.

2 Introduction

Early cable installations used a “solid laid” system where the cables were laid in a formed wooden or concrete trough and the trough filled with bitumen around the cable. With the development of steel wire armouring and waterproof oversheaths, the “solid laid” system has mostly been replaced by the direct laid and duct laid systems. The only cables presently installed in a modified solid laid system are 1500 Vdc positive cables.

The choice of system is determined by the cable type, criticality, geographic location, future long-term requirements, expected maintenance requirements, type of reinstatement and long term economic assessment.

3 General

3.1 Cable trenches

The bottom of the trench shall be level across its width and free from any protrusions and rubble that could cause damage to the cable.

Changes of the trench gradient shall be gradual.

Where cables are laid on a gradient and there is a risk of the sand bed being washed away, a 14:1 sand cement mix shall be substituted for the clean sand except for cable crossing points where the cables shall be covered with clean sand.

3.1.1 Trench backfill

The trench is to be progressively backfilled with suitable material having good consolidating qualities. The backfill is to be installed in layers and compacted to prevent future subsidence. The top layer shall be of sufficient quality to form the base for surface restoration.

3.1.2 Warning tapes

Orange warning tapes shall be installed longitudinally in the trench backfill approximately 300 mm directly above cable encasement or concrete danger slabs. The orange warning tapes shall be distributed over the entire trench width in such a manner as to provide at least 50% coverage of the trench.

3.2 Single core high voltage cables

Single core high voltage ac cables of the same circuit shall be installed in a close trefoil formation. The trefoil formation shall be achieved by the use of trefoil clamps or a similar arrangement in the open, on cable trays and ladders and in troughing. When the single core cables are direct laid, the trefoil formation shall be achieved by separation in sand similar to Figure 3 in Section 4.2.3.

4 Cable installation configurations

The various cable installation configurations are detailed in the application matrix shown in Table 1.

	Application					
Configuration	**1500 V positive cables**	**1500 V negative cables**	**2.2.kV cables**	**11 kV cables**	**33 kV cables**	**66 kV cables**
Solid laid	✓					
Direct laid		✓	✓	✓	✓	✓
Duct laid	✓	✓	✓	✓	✓	✓

Table 1 - Application matrix.

4.1 Solid laid system

Solid laid configurations shall be installed in concrete or polycrete troughing with concrete lids as shown in drawing A3-88226. The cable troughing shall be filled with 14:1 sand / cement mix.

Only cables of the same circuit shall be installed in the same concrete or polycrete trough.

4.1.1 Minimum depth of solid laid cables

In all instances the minimum depth from the finished ground line and drain inverts to the top of the concrete lid of solid laid cables shall be:

- 1000 mm.

4.1.2 Cable installed in troughing

Cables of the same circuit shall be installed in concrete or polycrete troughing 410 mm by 210 mm over all with concrete lids. The cables are to be laid in a horizontal formation at a minimum of 150 mm centres located centrally in the troughing on a bed of 14:1 sand / cement mix a minimum of 50 mm deep. The trough is to be filled level with the top with 14:1 sand / cement mix.

A typical solid laid configuration is shown in Figure 1.

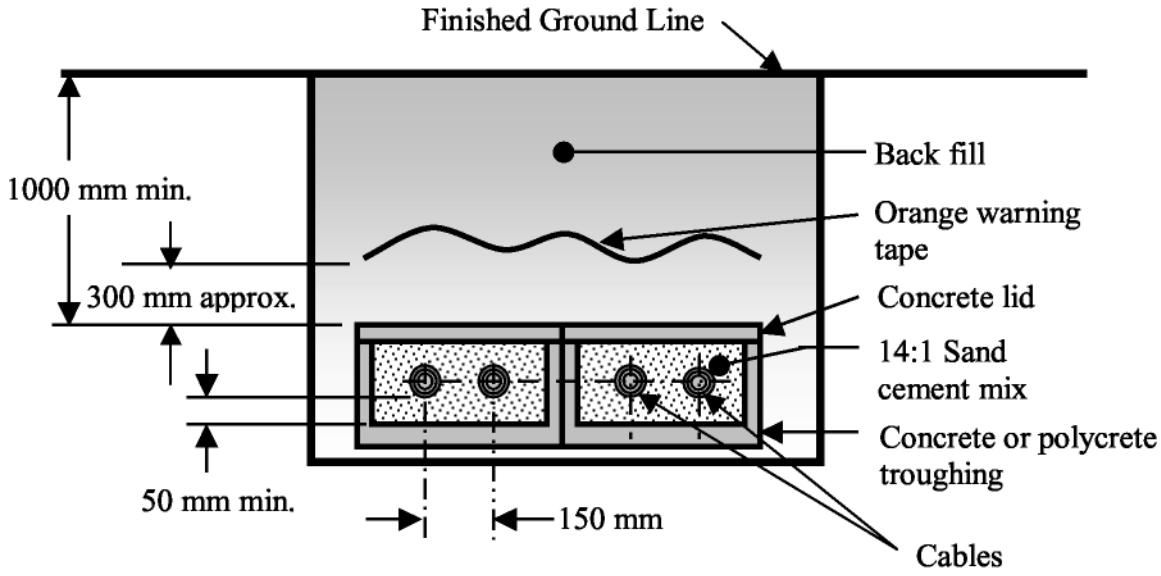


Figure 1 - Solid laid configuration

4.2 Direct laid system

In this system the cable is laid directly in the trench and the earth replaced. Concrete danger slabs are placed 100 mm to 150 mm directly above the cables for mechanical protection and an indication of the cables presence.

In areas where expensive surface restoration is involved cables should be laid in ducts as an alternative to direct laid. Examples of such areas are road and rail crossings, platform and ornamental surfaces.

1500 Vdc negative cable configuration are shown in Section 4.2.3.

A typical direct laid cable configuration is shown in Figure 2.

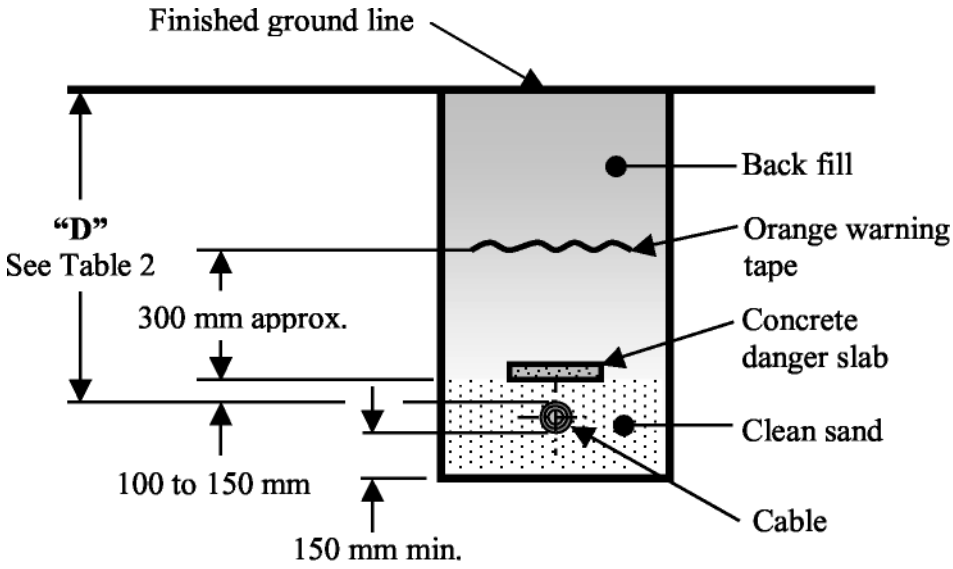


Figure 2 - Direct laid configuration

Before the cable is laid a bed of clean sand shall be prepared in the trench and shall have a minimum depth of 150 mm.

After the cable has been laid the cable shall be covered with clean sand having a cover of 100 mm to 150 mm.

4.2.1 Minimum depth of direct laid cables

The minimum depth from the finished ground line to the top of direct laid cables shall be as shown in Table 2.

Direct laid cables	Cable voltage	Min. depth "D"
Outside the railway corridor	≤ 22 kV	850 mm
	> 22 kV	1000 mm
Inside the railway corridor	≤ 22 kV	1000 mm
	> 22 kV	1000 mm

Table 2 - Minimum depth of direct laid cables

4.2.2 Cable protection

Protective concrete danger slabs manufactured to drawing No.E/55224 shall be placed directly above and completely covering the cable, on top of the sand, to provide maximum mechanical protection and as an indication of the cable's presence below the slab.

4.2.3 1500 Vdc negative cables

1500 V negative cables are to be installed in accordance with Sections 4.2, 4.2.1 and 4.2.2 and with a minimum separation of 150 mm, the bed and covering of clean sand replaced with 14:1 sand / cement mix and the standard danger slab replaced with a 410 mm wide danger slab.

Where space is limited the negative cables may be arranged as shown in Figure 3.

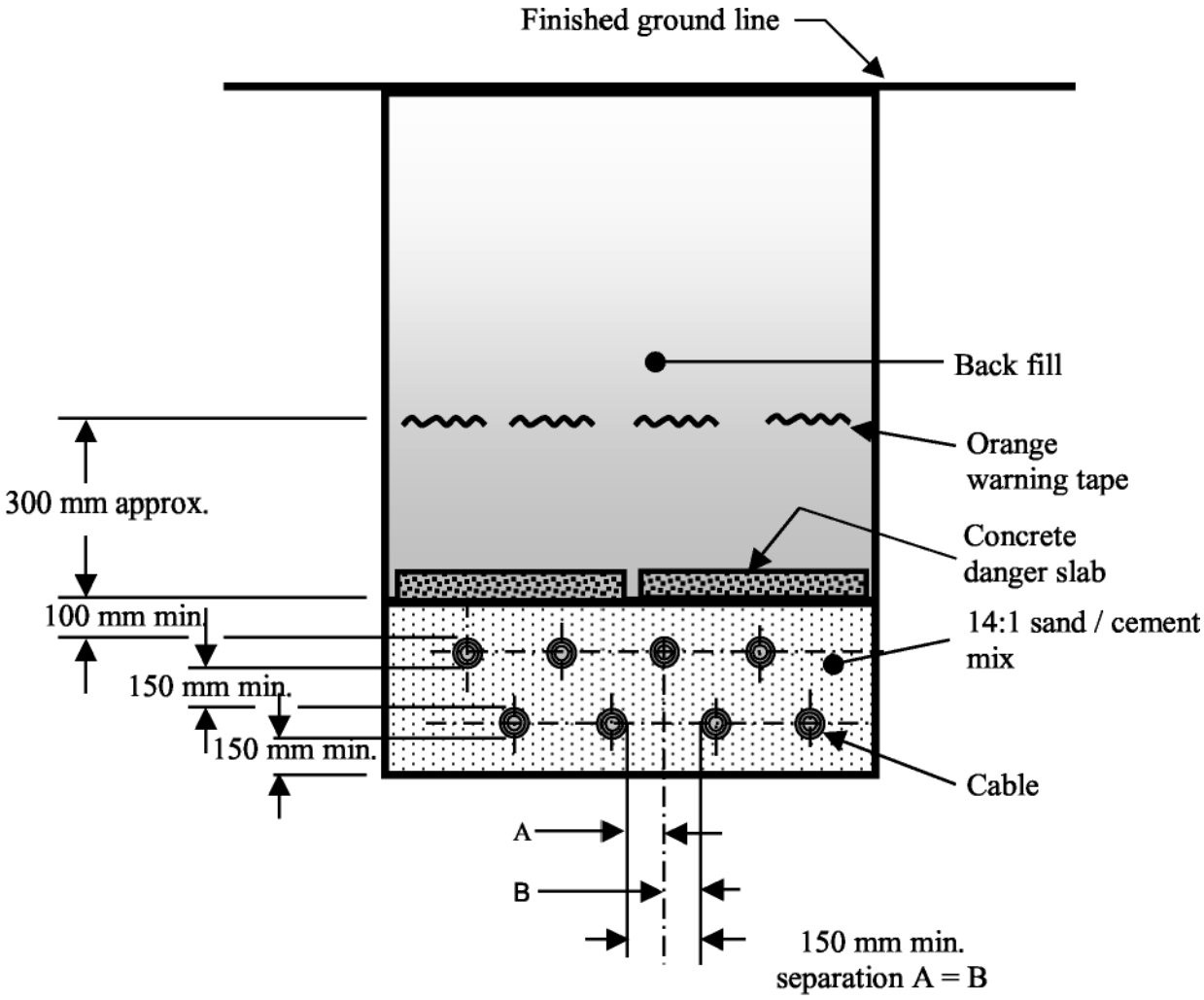


Figure 3 - Typical configuration of 1500 Vdc negative cables

4.3 Duct laid system

In locations such as city streets and other areas where excavation is expensive and inconvenient the duct laid system may be used. This method also allows the installation of additional new cables or the replacement of existing cables with minimum inconvenience.

Ducts or pipes are buried in the ground with pits installed in convenient positions to allow cables to be easily installed. The ducts shall be of a durable material, such as rigid UPVC, fibre cement, concrete or earthenware to provide protection for the cables.

On railway property in the electrified traction area and for one kilometre beyond the end of an electrified traction area, ducts shall not be of any conductive material.

PVC or concrete danger slabs are to be placed approximately 100 mm above the ducts as an indication of the cable's presence.

Ducts shall comply with AS 3000.

All PVC ducts shall be of the rigid heavy-duty type in accordance with AS 2053 or AS 1477 Class PN12.

The ducts and pits should be impervious to water, smooth on the inside and chemically inert.

The duct line shall be as straight as possible with bellmouths provided on the ducts where the ducts enter the pits.

Before cables are installed the ducts are to be rodded with a suitable scraper to remove sharp edges likely to damage the cable outer sheath.

Spare ducts are to be installed and capped to prevent the ingress of dirt and subsequent blockage.

A typical duct laid system configuration is shown in Figure 4.

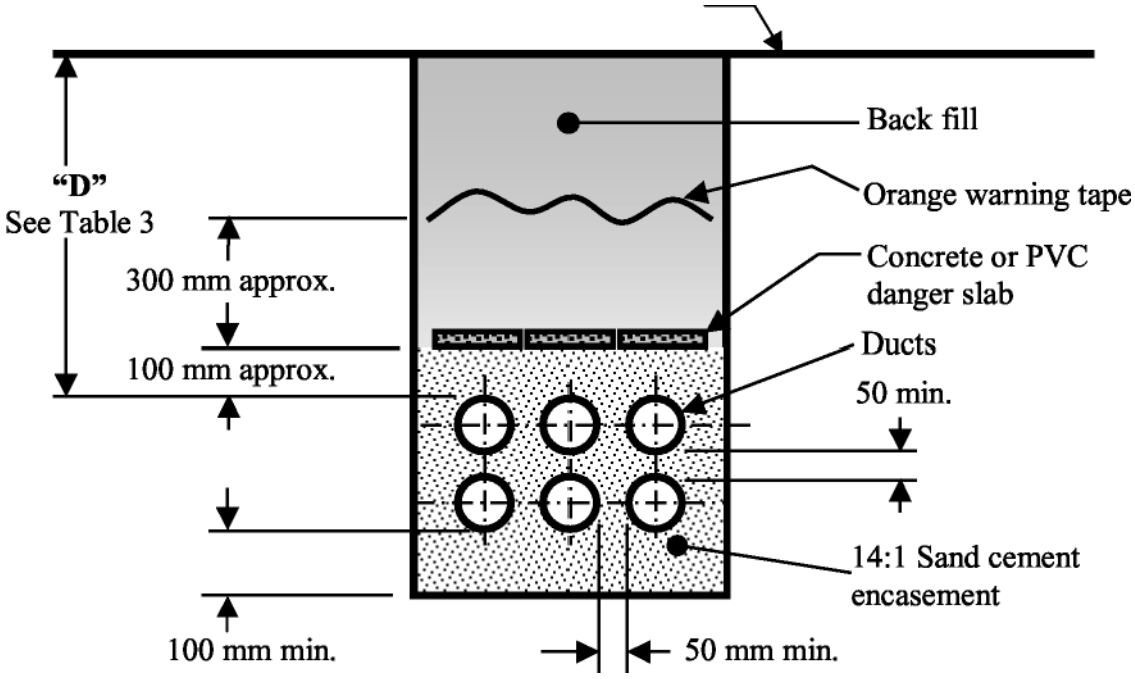


Figure 4 - Ducts laid in banks

4.3.1 Minimum duct diameter

The duct diameter shall be large enough to accommodate the largest cable contemplated taking future requirements into consideration. The cable diameter shall be limited to a maximum of 60% of the duct diameter.

4.3.2 Minimum depths of duct laid systems

On the railway corridor and on land other than the railway corridor, the minimum depth to the top of the top duct from the finished ground line or drain invert shall be as shown in Table 3.

Duct laid systems	Cable voltage	Min. depth "D"
Outside the railway corridor	≤ 22 kV	750 mm
	> 22 kV	1000 mm
Inside the railway corridor	≤ 22 kV	1000 mm
	> 22 kV	1000 mm

Table 3 - Minimum depth of duct systems

4.3.3 Duct protection

Protective concrete "DANGER" slabs manufactured to drawing No. E/55224 or PVC "DANGER" slabs shall be placed 100 mm directly above and completely covering the ducts to provide mechanical protection and an indication of the cable's presence below the slab.

The ducts, whether encased or not, shall be directly covered by concrete or PVC "DANGER" slabs.

NOTE
Old danger slabs may display SRA or RAC as the asset owner. These assets are now owned by ARTC.

4.4 Undertrack crossings

Undertrack crossings shall be installed to ARTC drawing EL 0024639 - Underground Cables, Undertrack Crossing Arrangement.

4.4.1 Encasing pipes

In existing and proposed electrified traction areas and for a distance of one kilometre beyond the end of an electrified traction area, metal or protective covered metal encasing pipes shall not be used.

Steel with a protective covering or bare metallic encasing pipes shall only be used in non electrified traction areas.

4.4.2 Depth of installation

Where power cables pass under tracks, they shall be enclosed in an appropriate "Category A" system in accordance with AS/NZS 3000. The top of the encasing pipe or conduit shall be laid at a depth of not less than 2.0 m below rail level. The depth shall be maintained for not less than 3 m beyond the outer rails measured at right angles to the centre line of the track.

4.4.3 Interface between undertrack crossing and underground installation

Where an undertrack crossing joins to the cable underground installation the immediate area for 1 m each side of this point shall be back filled with clean sand. The sand in this area is to exclude trench back fill, which may contain rocks, or similar material, that may cause damage to the cable.

4.4.4 Bored and jacked crossings

When passing under tracks, cables shall be laid in an encasing pipe. The encasing pipe shall be:

1) Larger than 150 mm nominal diameter - Class 4 reinforced concrete to AS4058 or steel pipe to AS/NZS 2053.

2) Up to 150 mm nominal diameter - Class 4 reinforced concrete to AS 4058, HD UPVC pipe to AS/NZS 2053 or AS/NZS 1477 class PN12, Polyethylene (PE) classification PN12.5 to AS/NZS 4130.

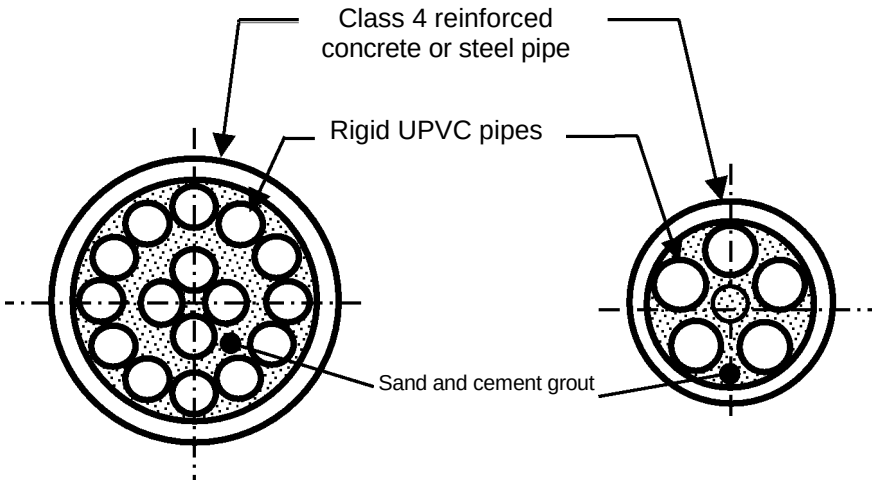
Markers are to be installed at each end of the encasing pipe to indicate the end and depth of the pipe below ground line.

The encasing pipe shall comply with the requirements of the AS 4799 and shall comply with section 4.4.2 of this document.

The selection of under track crossing configuration will depend on such factors as:

- The number of cables to be installed in the under track crossing.
- The approved construction method for the under track crossing.

Typical under track crossing configurations is shown in Figure 7.



Typical cross section of a 15 duct, bored under track crossing

Typical cross section of a 5 duct, bored under track crossing

Figure 7 - Typical under track crossing configurations

In this instance the concrete “DANGER” slabs may be omitted from the portion under the tracks and the section of the ducts protected by the encasing pipe.

4.4.4.1 Ducts in encasing pipes

All ducts installed in encasing pipes shall be rigid UPVC pipe and shall comply to the following:

- Laid in accordance with AS 4799 and AS 3000.
- All voids between the UPVC pipes and the encasing pipe to be filled with sand cement grout mixture that is suitable for use with a concrete pump.
- All UPVC pipes are to be restrained in such a manner to prevent spiralling when grouting mixture is pumped into the encasing pipe.
- All rigid UPVC pipes (Heavy duty type) are to be in accordance with AS/NZS 2053 or AS/NZS 1477 class PN12.
- All joints in rigid UPVC pipes are to be staggered 150 mm and glued.
- All UPVC pipes are to project 300 mm beyond the encasing pipe and are to be capped.

4.4.5 Cables installed in a trench under tracks

When under track crossings are constructed by trenching across the tracks, the cables may be installed in the following configurations:

- Direct laid in accordance with Section 4.2 with a minimum depth from rail level to the top of the danger slabs covering the cable of 2.0 m.
- Duct laid in accordance with Section 4.3 with a minimum depth from rail level to the top of the duct system of 2.0 m. The duct system shall be encased in concrete.
- Ducts laid in an encasing pipe in accordance with Section 4.4 with a minimum depth from rail level to the top of the encasing pipe of 2.0 m.

5 Shared trenches

Trenches may be shared with other ARTC high voltage services, signalling and communications services or services from other supply authorities and utilities.

5.1 Separation between high voltage cables

The separation between cable circuits shall not be less than 150 mm horizontally for circuits laid parallel and 225 mm vertically for cables laid mutually at right angles. Each cable circuit shall be separated by a continuous physical barrier of protective concrete danger slabs installed between each cable circuit to prevent fault damage from adjacent cables.

Where cables pass over or under other utilities cables, the cables shall be separated by not less than 300 mm.

The typical separation configuration of high voltage cables is shown in Figure 5 and Figure 6.

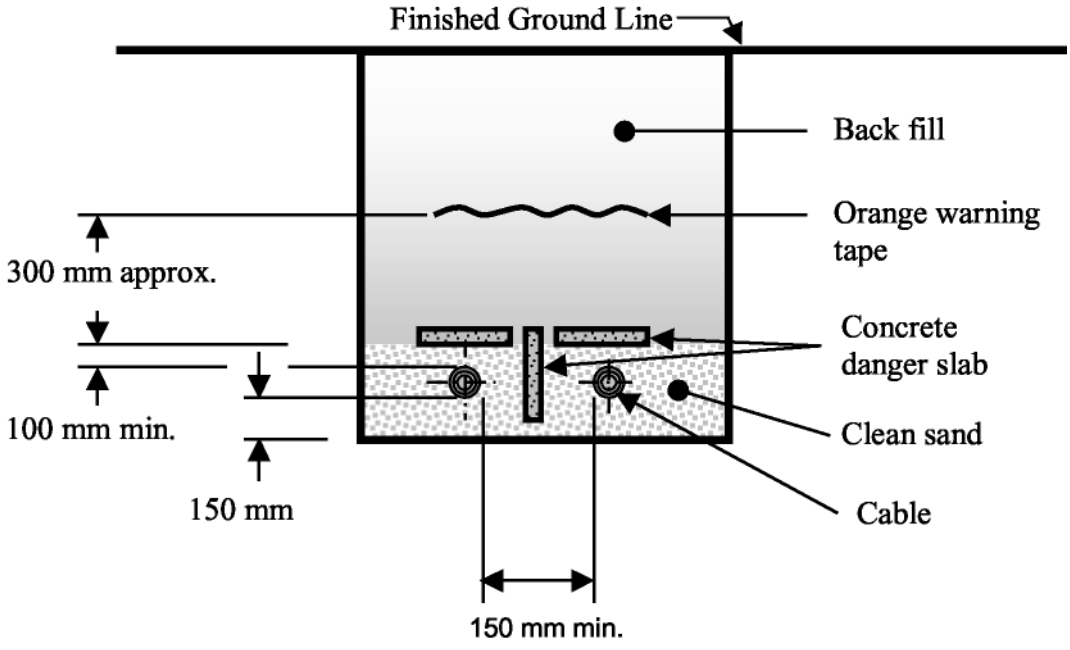


Figure 5 - Separation between high voltage cables

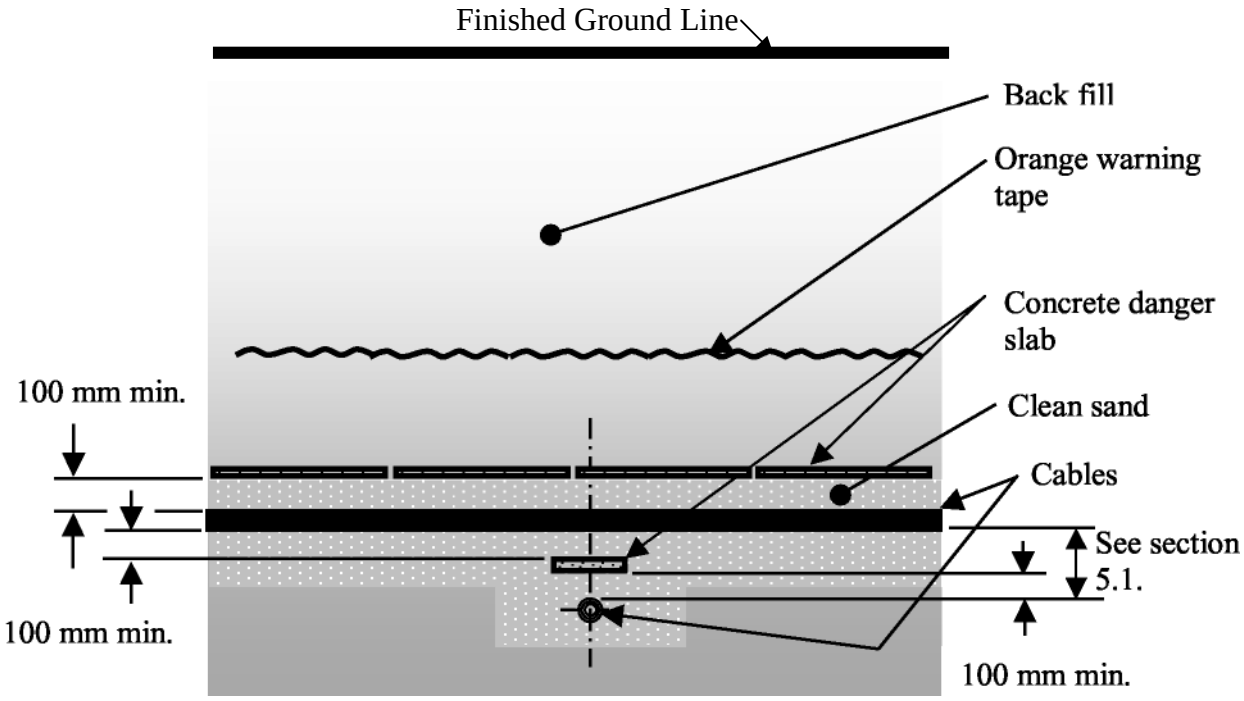


Figure 6 - Separation between cables laid mutually at right angles

5.2 Separation of high voltage cables from other services

Shared trench arrangements with services other than high voltage cables may be entered into and such arrangements may require additional conditions to those specified in this document.

Communications cables installed near high voltage cables shall comply with the requirements of SAA HB 29 - 2000 – Communications cabling handbook, Section 2.3.4. Segregation - General.

6 Cable route markers

Markers shall be provided at the location of all underground cables. A typical cable route marker, mounting post and installation requirements are shown in drawing No. A2/89781.

NOTE

Old cable route markers may display SRA or RAC as the asset owner. These assets are now owned by ARTC.

6.1 Location of markers

On the rail corridor markers shall be located above the buried cable at:

- points of entering and leaving the rail corridor.
- each point where the route changes direction except for very minor deviations.
- at not greater than 50 m intervals along the route such that at least two markers shall be visible at any point along the route.
- Markers shall not obstruct vehicle access along the side of the track or infringe structure gauge. In yard areas they shall not obstruct footpaths, walkways or vehicle access ways.

6.2 Marker requirements

Markers shall comply with the following requirements:

- comply with AS 1319 except the word “CAUTION” shall replace the word “WARNING”.
- be mounted on a post as shown in drawing No. A2/89781.
- markers shall be made from yellow colour class 1, retroreflective material to AS 1906, part 1. (3M type 3871 series or equivalent).

6.3 Wording on markers

Wording on markers shall include the following and comply with the requirements of AS 1744:

- the name of the owner.
- description of the service.
- warning not to excavate prior to obtaining authority.
- telephone number to be used in the case of emergencies.
- course of action in the event of emergency.

6.4 Orientation of markers

Cable route markers are to be orientated to face the railway tracks.

Factors Affecting
Pit Selection and Installation

Relevant Standards Affecting Pit and Cover Selection

AS3084

Australian Standard

Telecommunications installation.

AS3000

Australian Standard

SAA wiring rules.

AS1939

Australian Standard

Degrees of protection provided by enclosure for electrical equipment.

AS3996

Australian Standard

Metal access covers, road grates and frames.

AS4198

Australian Standard

Precast concrete access chambers for sewerage applications.

ACA TS008

Australian Communications Authority

Technical Standard 008

Requirements for authorised cabling products.

TS009

Austel Technical Standard 009

Installation requirements for customer cabling.

Pit Security

Where electrical pits require authorised access only, ACO provides a choice of three lockable covers:

Steel chequer plate covers can be locked by either a central cap head screw which locates into a removable locking bay, which connects to the pit body.

Alternatively, the 'military style' steel chequer plate is locked to the pit by means of a key type padlock which locks to a removable locking bar, which connects to the pit body. The padlock is protected from damage by sitting in a flush lidded pocket on the top surface of the cover.

ACO ACCESS recessed steel covers are locked into their frame by means of four cap head screws per cover corner. For areas where extreme security, such as prisons etc, is required two (2) of the locking bolts for the cover can be replaced with Bari security bolts which require a special key.

Pit Cover Lifting Keys

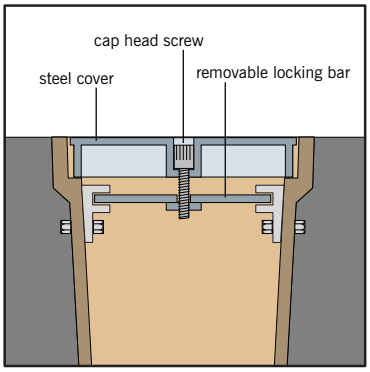
All ACO CABLEMATE pit covers can be removed by means of standard Australian lifting keys as outlined in AS3996. Locked recessed steel access covers and steel chequer plate covers are locked in place by means of an M16 socket cap head screw. To remove these screws, a 14mm across flat Allen key is required.

ACO supplies a lifting key and Allen key with each recessed steel access cover. Additional lifting keys and Allen keys are available from ACO.

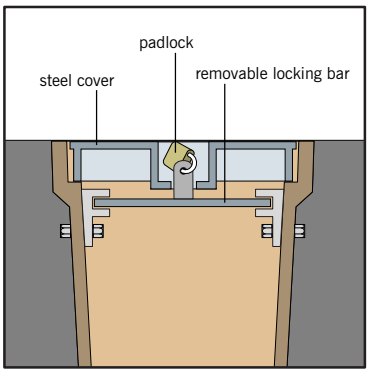
Cover Lifting Key Part No. 76684

14mm AF Allen Key Part No. 76691

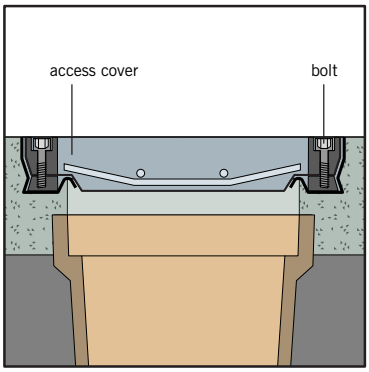
Standard cover security



'Military style' cover security



Access cover security

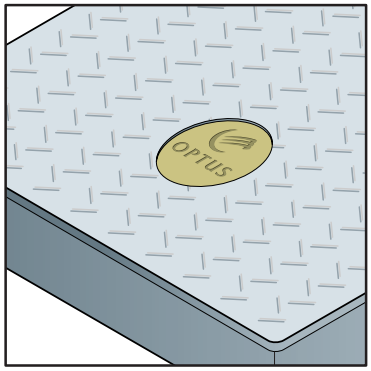


Pit Marking

The contents of an electrical pit are normally marked on the pit cover. ACO's concrete and Polymer Concrete covers have either 'Electricity' or 'Communications' cast into the cover top surface or alternatively, covers are available with no marking. Solid steel cover markings are available by means of an engraved brass plate, riveted to the top of the cover. Brass plates are engraved with either 'Electricity' or 'Communications'.

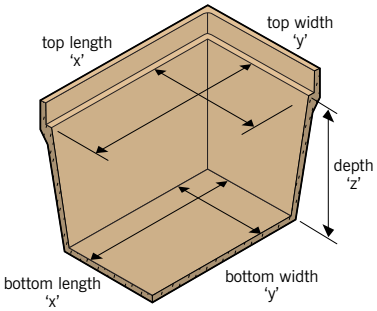
Please contact your nearest ACO office for part numbers of ACO CABLEMATE steel covers with brass identification plate attached. In installations where a discreet recessed steel ACO ACCESS cover is used, ACO can supply engraved brass plates which are set into the infill material of the cover.

For information on special cover markings, or insertion of company logos, contact ACO's sales offices.



Clear working area of Pits

Dimensions shown on the product pages of the ACO CABLEMATE catalogue refer to overall pit sizes. On occasions installers need to know the clear working area within the pit, this is the free space inside the pit with no obstruction. Most pits have tapered walls, the table below gives the maximum width and length (normally immediately below the cover rebate) and the minimum width and length (usually at the base of the pit).



Pit Type	*length 'x' mm*		*width 'y' mm*		*depth 'z' mm*
	top	*bottom*	*top*	*bottom*	*rebate to base*
Type 52	*435*	*380*	*155*	*125*	*395*
Type 63	*580*	*510*	*240*	*180*	*695*
Type 95	*890*	*845*	*435*	*385*	*520*
Type 96	*900*	*855*	*600*	*560*	*545*
Type 8	*1260*	*1120*	*460*	*320*	*840*
Type 66H	*590*	*535*	*590*	*535*	*850*
Type 33	*280*	*240*	*280*	*240*	*400*
Type 45	*435*	*385*	*435*	*385*	*535*
Type 66	*590*	*535*	*590*	*535*	*550*
Type 99	*875*	*825*	*875*	*825*	*510*
Type 53	*470*	*335*	*220*	*165*	*425*
Type 3	*440*	*395*	*240*	*210*	*465*
Type 4	*605*	*545*	*315*	*240*	*750*
Type 5	*600*	*560*	*350*	*310*	*580*
Type 7	*890*	*820*	*430*	*360*	*1070*
Type 43	*435*	*300*	*435*	*300*	*550*
Type 55	*450*	*400*	*450*	*400*	*450*
Type 77	*600*	*560*	*600*	*560*	*600*

Pit Wearing Edges

In areas where pits are subject to high loads, such as industrial units, military bases etc. a wearing edge may be required to protect the pit edge.

This can be achieved by either (a) fitting a completely separate, appropriately sized, load bearing access cover or (b) by means of a steel protecting edge which fits onto the top of the polymer concrete pit allowing the complete range of ACO CABLEMATE covers to be used.

For further information on wearing edges and their use please contact ACO's technical department.

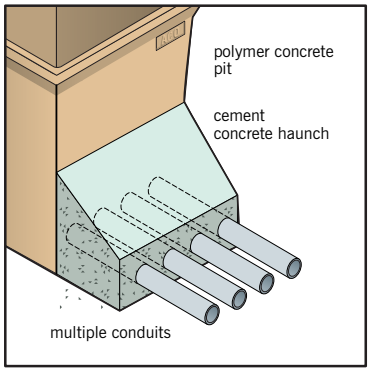
Effect of Fire on Pits

Polymer Concrete is a self extinguishing material which does not give off toxic or any other dangerous fumes. HDPE is a combustible material which will burn and disintegrate when subject to high temperature. In areas which have been subjected to fire, particular care should be taken in respect to pit covers. Cement concrete and Polymer Concrete will lose their structural integrity and should not have any loads applied to them. Steel covers will keep their strength but the seating for the covers in the pits may be damaged and subject to collapse.

Factors Affecting
Pit Selection and Installation

Multiple Conduit Entry

There is no restriction on the amount of conduits that can be connected to a pit. However, care must be taken that the pit's structural integrity is not compromised by removing excessive pit wall area. Care must be taken with multiple entry conduits in trafficable areas. To spread loads transmitted through the pit structure ACO recommends concrete haunching around conduits to prevent pit collapse.



Multiple conduit entry points to the pit should be via correctly sized holes to minimise the amount of pit wall removed.

Earthing of Pits

On occasions the pit should be connected to the earthing structure of a building or construction. In these instances a hole should be drilled through the pit and the earthing strap 'eye' connected by means of a bolt.

Cable Bending Radii

The bending radii of cables being used in relation to the electrical pit is critical. Incorrect sizing of the pit relative to the cable size can lead to damage to the cable by bending it tighter than the manufacturer's recommendation.

The table below gives examples of typical bending radii of common sizes and types of cable.

Cable Type	*Bending Radius*
Aluminium sheathed cable less than 15mm diameter	*8 x O/D*
Aluminium sheathed cable more than 50mm diameter	*18 x O/D*
2 fibre optic breakout cable	*10 x O/D*
24 fibre optic breakout cable	*10 x O/D*
Heavy duty interbuilding truck cable	*20 x O/D*

For further information relating to bending radii, the appropriate cable manufacturer should be contacted.

Depth and Separation of Cables

ACO CABLEMATE pits are manufactured in a variety of depths and sizes.

The table below gives an indication of depths and separation distances for cables.

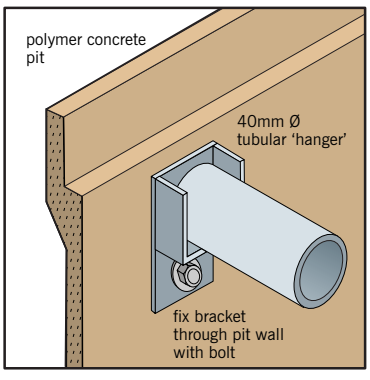
	Min Depth mm	*Min Sep. mm*
Low voltage electricity	*300*	*100*
High voltage electricity	*500*	*300*
Communications	*300*	*100*
Communications, trafficable	*500*	*100*

For further information on cable separation and depths please refer to the relevant standard.

Cable and Joint Hangers

On occasions a bar(s) is/are required to hang a joint or fuse inside an electrical pit. ACO's plastic pits have moulded sockets in the walls to hang either a 40mm diameter plastic or metal tube across the pit.

Where hangers are required on a Polymer Concrete pit, ACO manufactures a bracket (part no. 76509) which can be attached to the walls of the pit in the appropriate positions to carry the 40mm diameter bar. When hangers are required in plastic pits other than those positions moulded into the body, the ACO CABLEMATE pit bracket may be used.



Preparing for the nbn™ broadband access network

nbn™ Fibre to the Node (FTTN)

Thanks for switching to the nbn™ broadband access network

You're only a few steps from connecting to Australia's new broadband network.

This guide will provide you with useful information on your upcoming installation, and help to answer any questions you may have.

Things to know before installation day

When you contacted your phone and internet provider to connect to the **nbn**™ access network, they would have arranged a time for your home or business to be connected.

They should have also provided you with a VDSL2 compatible modem* and instructions on how to set up your equipment so that, on your scheduled installation date, you'll be all set to start enjoying services over the **nbn**™ access network.

Do I require an appointment with an nbn™ approved technician?
It depends on your circumstances. Your phone and internet provider will advise you of this.

Will I receive a new modem with my nbn™ powered plan?
Your phone and internet provider should send a modem to your premises before your installation day. If you haven't received a modem, you'll need to contact your phone and internet provider.

Old wiring
Be aware that unused alarm systems or old wiring inside your premises may impact the speeds available to you. If you have any questions about this, contact your phone and internet provider or a licensed cabler.

*Wi-Fi enabled gateway.

Your equipment setup

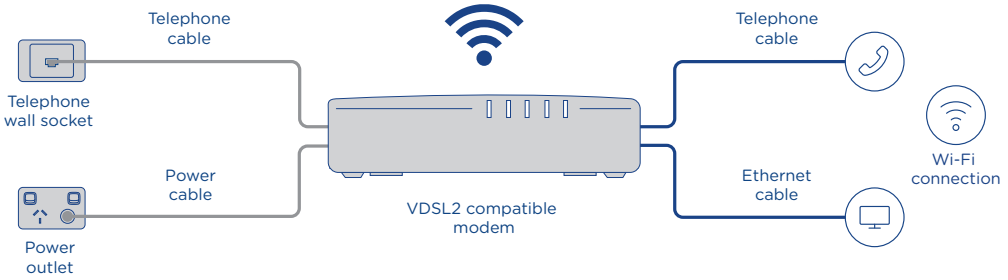
To get connected, you'll need to set up your modem.

This modem should have been supplied by your phone and internet provider. If you already have a modem, it must be VDSL2 compatible to work over the **nbn**™ access network.

Simply follow your provider's instructions to get set up.

A standard nbn™ FTTN setup

Depending on your needs, your standard setup will include some or all of the equipment shown.



Where should my modem go inside my premises?
Your modem will connect to your existing telephone wall socket, so you'll need to find a place close to this.

Setting up your phone
If you ordered a phone service with your **nbn**™ powered plan, you'll most likely need to plug your Voice over Internet Protocol (VoIP)-compatible phone directly into your modem. Speak to your provider for more detailed instructions on how to do this. You'll also need to contact them if you don't have a VoIP-compatible phone.

ADSL filters
Make sure there are no devices, such as an ADSL filter, between your modem and your telephone wall socket. These can block or limit your connection.

Connectivity options

Wireless network and Ethernet

Using your provider's (or your own) modem, you can create a wireless network in your home or business. If the Wi-Fi signal isn't strong enough to reach other rooms, you can use powerline networking adaptors, which plug into your power points and use existing wiring. Alternatively, you can have Ethernet cables installed between rooms (charges may apply).

Phone

You'll need to switch to a Voice over Internet Protocol (VoIP)-compatible phone if you currently use a landline. Check this with your phone and internet provider and let them know where you plan to use it, as you may need extra wiring or cabling (charges may apply).

Smart TV and appliances

If you watch catch-up TV or streaming services (such as Netflix), or use internet-connected appliances (such as automated lighting or a smart kitchen), discuss your needs with your phone and internet provider.

Security alarm

If you have a security alarm, discuss your needs with your phone and internet provider, as you may need additional wiring or cabling installed (charges may apply). Please also refer to the important information on page 5.

Some tips to help get the most out of your nbn™ experience

When you connect to the **nbn**™ access network, consider:

Your in-home wiring

Check your modem is connected to the first telephone socket in your home or business. This is usually the one closest to the door.

Also consider having your wiring assessed by a registered cabler. If you have more than one socket in the house, or devices still connected to the old sockets, this may degrade the achievable performance on the **nbn**™ access network.

Modem location

Place your modem in a raised, central area. Keep it clear of solid or brick walls and furniture like your TV, and don't store it in a cupboard.

Phone location

Consider where you'd like to keep your **nbn**™ compatible phone when you choose a spot for your modem, as your phone will need to connect directly to it.

Devices

Where possible, connect devices that require large amounts of data (such as gaming consoles or streaming devices) directly via an Ethernet cable.

Your modem

Make sure your new or existing modem will support the latest technology and work over the **nbn**™ access network. Ask your phone and internet provider about the different types available.

Updating old hardware and software

Consider upgrading old computers, devices and software – as old technology may not work as fast as updated versions. Devices which use older Wi-Fi standards may also impact your experience.

For some more tips to help improve your in-home setup, visit **nbn.com.au/optimisation**

Important information on equipment compatibility

Connecting to the **nbn**™ access network may affect the following equipment in your home or business*:

Monitored medical alarms, auto-diallers or emergency call buttons*

Before connecting to the **nbn**™ access network, contact your medical alarm provider and ask whether your monitored medical alarm, auto-dialler or emergency call button will work over the **nbn**™ access network, or whether you'll need to find an alternative solution.

It's also important that you register your equipment online at **nbn.com.au/medicalregister** or by calling **1800 227 300**. This helps **nbn** identify homes or businesses where support may be needed to minimise a break in service.

Phones*

Your current phone should work over a fixed line service with the **nbn**™ access network unless it is a rotary dial or pulse dial based phone. If your phone has an old connector plug, it may need a converter or a new cable. Your phone provider will be able to confirm this.

Monitored security alarms*

Call your security alarm provider to find out if your equipment will work over the **nbn**™ access network. If necessary, they can advise you on what alternative solutions are available.

EFTPOS terminals*

Call your EFTPOS provider to find out if your equipment will work over the **nbn**™ access network. Your equipment provider (such as the bank that provides your EFTPOS terminal) can advise whether it will work over the **nbn**™ access network and, if necessary, what alternative solutions are available.

Fax machines and TTY equipment*

Please check with your phone provider whether your fax and TTY equipment is supported on their phone service over the **nbn**™ access network.

Fire indicator panels*

If you have a fire indicator panel in your premises, call your fire indicator panel provider to find out if it will work over the **nbn**™ access network before connecting.

It's also important that you register your equipment online at **nbn.com.au/fireandlift** or by calling **1800 227 300**. This helps **nbn** identify homes or businesses where support may be needed to minimise disruption.

Priority Assistance

For information on Priority Assistance services:

1. Call a phone or internet provider.
2. Tell them you have a Priority Assistance service and that you need the same level of service over the **nbn**™ access network.

Talk to your phone and internet provider to find out whether your existing devices are compatible with the **nbn**™ access network. They will be able to suggest a solution to suit your situation.

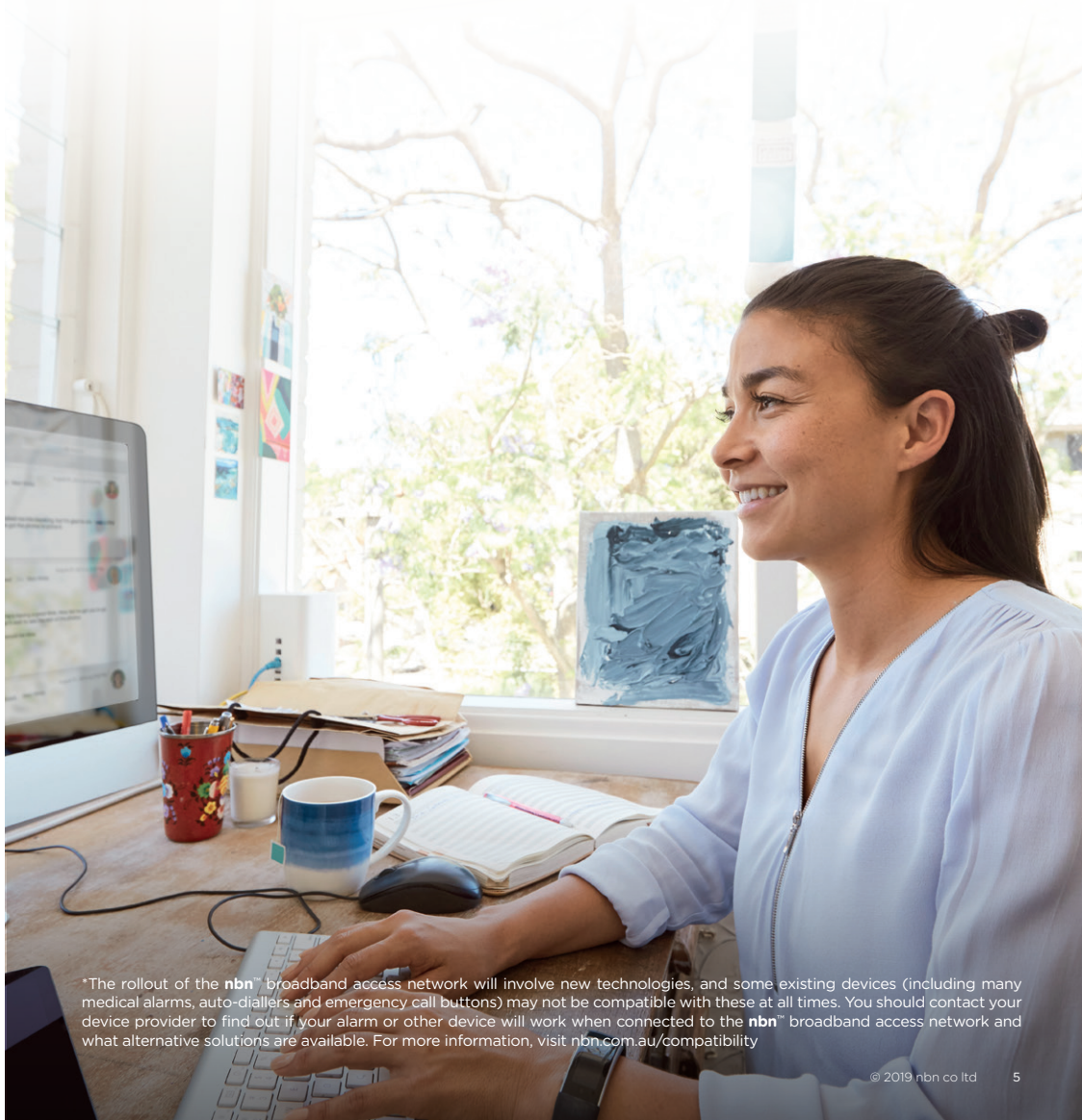
To organise in-premises wiring changes:

Call your phone and internet provider and ask:

1. If they can arrange in-premises wiring or cabling changes.
2. What the cost will be.

OR

Contact a registered cabler about connecting your telephone wall sockets to your phone service over the **nbn**™ access network (search online for 'phones & systems – installation & maintenance').



*The rollout of the **nbn**™ broadband access network will involve new technologies, and some existing devices (including many medical alarms, auto-diallers and emergency call buttons) may not be compatible with these at all times. You should contact your device provider to find out if your alarm or other device will work when connected to the **nbn**™ broadband access network and what alternative solutions are available. For more information, visit nbn.com.au/compatibility

Common questions

Will there be any interruption to my phone and internet services?

You may experience an interruption to your phone and internet services while you're being connected. If your services remain disconnected, contact your phone and internet provider.

Who do I contact if I need help?

If you have any questions or want to report a fault, contact your phone and internet provider. You can also visit **nbn.com.au** for more information.

What happens to my services in a blackout?

Equipment connected to the **nbn**™ access network will not work during a power blackout. Consider having an alternative form of communication handy (such as a charged mobile phone). If you have safety-critical equipment, such as a medical alarm, monitored fire alarm or lift emergency phone, speak to your equipment provider about alternative solutions.

Will **nbn** be providing me with new equipment?

FTTN connections do not require any equipment from **nbn**, however, it's the role of your phone and internet provider to provide you with a compatible modem.

Do I need to install any cables or outlets?

It's unlikely if you're switching from an existing broadband service. You may find you prefer wired connections, if so, you can arrange for a registered cabler to install additional network points (charges may apply).

Can I use more than one telephone wall socket?

It depends on your circumstances. Your phone and internet provider can help with this. Your modem will connect to just one wall socket, and your phone into the modem. If you'd like another socket, you may need to speak to a registered cabler (charges may apply).

Troubleshooting

If your service is not working as you'd expect following connection:

- Ask your phone and internet provider about what speed plans are available to you. If your home or business is using multiple devices at the same time, a higher speed plan may give you a better experience.*

If your service stops working following connection:

- Contact your phone and internet provider.

*An end user's experience, including the speeds actually achieved over the **nbn**™ broadband access network, depends on the **nbn**™ access network technology and configuration over which services are delivered to their premises, whether they are using the internet during the busy period, and some factors outside of **nbn**'s control (like their equipment quality, software, chosen broadband plan, signal reception, or how their provider designs its network).

Your connection checklist

- [ ] **Installation date**
  I've been informed of my installation date and have confirmed with my phone and internet provider whether I need to be there for the appointment.

- [ ] **Modem**
  I have received a modem from my phone and internet provider, or have checked the compatibility of my existing modem with them.

- [ ] **Safety registration***
  I've registered any medical and security alarms with **nbn** by visiting **nbn.com.au/compatibility** or by calling **1800 227 300**.

- [ ] **Equipment check***
  I have checked with my equipment provider/s and phone and internet provider that any equipment I rely on, such as medical and security alarms, will work over the **nbn**™ access network.

- [ ] **Equipment location**
  I've considered where I would like my **nbn**™ supplied equipment to be located in my premises.

- [ ] **Landlord consent**
  I have my landlord's consent for the installation and any new wall outlet(s) (if required).

- [ ] **My in-home setup**
  I've considered my current internet and phone setup and understand what needs to change.

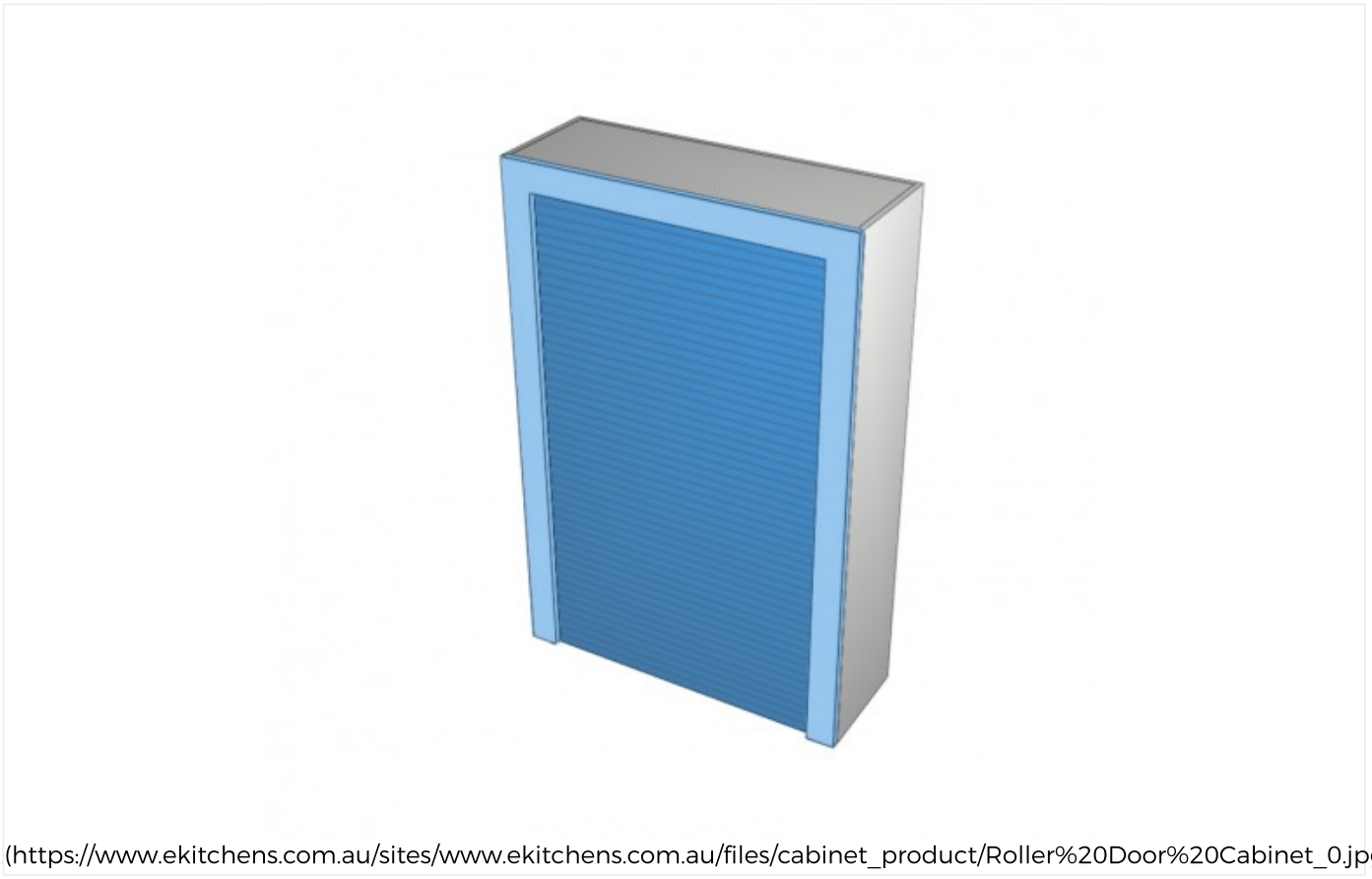
For help and support

Contact your phone and internet provider or visit **nbn.com.au**

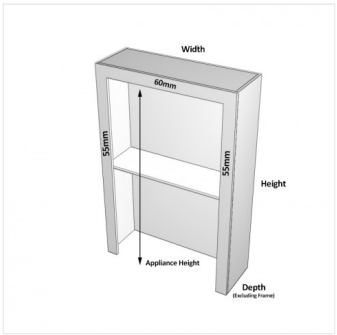
*The rollout of the **nbn**™ broadband access network will involve new technologies, and some existing equipment (including many medical alarms, auto-diallers and emergency call buttons) may not be compatible with these at all times. You should contact your equipment provider to find out if your alarm or other equipment will work when connected to the **nbn**™ broadband access network and what alternative solutions are available. For more information, visit nbn.com.au/compatibility

Disclaimer: This document provides general information about the technical requirements for connecting to the **nbn**™ access network and is correct as at August 2019. Technical connection requirements may change due to factors such as legislative and regulatory requirements as well as advances in technologies. For any queries about your particular circumstances or requirements, please consult your phone and internet provider or other supplier.

1930190_B_N



(https://www.ekitchens.com.au/sites/www.ekitchens.com.au/files/cabinet_product/Roller%20Door%20Cabinet_0.jpg)



(https://www.ekitchens.com.au/sites/www.ekitchens.com.au/files/dimensions-diagram/Roller%20Door%20Cabinet%20dimensions.jpg)

RAW MDF - APPLIANCE CABINET - FRAME AND ROLLER DOOR

$1,299.00
inc. GST

Inclusions

✓ 16mm Laminex HMR (highly moisture resistant) Cabinet
✓ Frame and Roller Door Unit
✓ Screws and Shelf Supports
✓ All Holes are Pre-Drilled
✓ Tongue and Groove Construction
✓ Custom Made to your Measurements
✓ Flat Packed or Pre-Assembled
✓ Locally Made in W.A
✓ Shipping Australia Wide Available

read more ...

Height *

1200 mm

Width *

600 mm

Depth *

400 mm

Carcass Material

Enlarge Swatches

Default Selected: Premium Laminex White Pearl HMR PB 16.5mm

Board Material

Enlarge Swatches

Default Selected: Laminex MR MDF 18mm - White Pearl on back

Edge Profile

Enlarge Swatches

Default Selected: 2mm Edge Profile

Quantity

1

Customise Product

Assemble Cabinet *

Flat Packed (included)

Additional Information (Additional charges may apply)

ADD TO CART

$1,299.00
inc. GST

Related Products

(/products/raw-mdf-appliance-cabinet-2-doors-built-microwave-opening)

Raw MDF - Appliance Cabinet - 2 Doors - Built In Microwave Opening (/products/raw-mdf-appliance-cabinet-2-doors-built-microwave-opening)

$538.00
inc. GST

VIEW (/PRODUCTS/RAW-MDF-APPLIANCE-CABINET-2-DOORS-BUILT-MICROWAVE-OPENING)

(/products/raw-mdf-appliance-cabinet-microwave-box-drawer-blum)

Raw MDF - Appliance Cabinet - Microwave Box - Drawer (Blum) (/products/raw-mdf-appliance-cabinet-microwave-box-drawer-blum)

$577.00
inc. GST

VIEW (/PRODUCTS/RAW-MDF-APPLIANCE-CABINET-MICROWAVE-BOX-DRAWER-BLUM)

(/products/raw-mdf-appliance-cabinet-2-doors-frame-and-roller-door)

Raw MDF - Appliance Cabinet - 2 Doors - Frame and Roller Door (/products/raw-mdf-appliance-cabinet-2-doors-frame-and-roller-door)

$1,869.00
inc. GST

VIEW (/PRODUCTS/RAW-MDF-APPLIANCE-CABINET-2-DOORS-FRAME-AND-ROLLER-DOOR)

(/products/raw-mdf-appliance-cabinet-microwave-box-drawer-finista)

Raw MDF - Appliance Cabinet - Microwave Box - Drawer (Finista) (/products/raw-mdf-appliance-cabinet-microwave-box-drawer-finista)

$508.00
inc. GST

VIEW (/PRODUCTS/RAW-MDF-APPLIANCE-CABINET-MICROWAVE-BOX-DRAWER-FINISTA)

Contact Us

eKitchens Forrestdale
(Head Office / Showroom)

34 Haydock Street,
Forrestdale (https://goo.gl/maps/46ddUfWFnfQMKGDg6) WA 6112

(08) 9456 3108 (tel:(08) 9456 3108) sales@ekitchens.com.au (mailto:sales@ekitchens.com.au)

Also located in:

- Osborne Park (https://goo.gl/maps/D7xYwr8Z3ZTL3BnM7)
- Midland (https://goo.gl/maps/fj6fzyQWU72PftsB9)
- Rockingham (https://goo.gl/maps/WJa4c3J49xshVNBh8)
- Joondalup (https://goo.gl/maps/KqH94YXUHLEFeLYc9)
- Bunbury (https://goo.gl/maps/jWHErLzavrM1RCk48)

CONTACT US (/CONTACT-US)

Categories

Cabinets (/shop/cabinets)
Doors & Drawer Fronts (/shop/doors)

Panels & Frames (/collections/panels-frames)

Benchtops (/shop/benchtops)

Accessories (/shop/accessories)

My Account

Login (/user)

Create Account (/user/register)

Subscribe to newsletter

Subscribe to recieve the latest news and offers

Email address... SEND

OTHER WEBSITES

Vinyl Tech (https://www.vinyl-tech.com.au/) | The Kitchen Door Company (https://www.thekitchendoorcompany.com.au)

(http://facebook.com/ekitchensAU)

(http://youtube.com/channel/UC6VW8QJyLGYUtmeDG19J3xw)

COMMUNICATIONS
ALLIANCE LTD

AUSTRALIAN STANDARD

AS/CA S008:2020

Requirements for customer cabling products

Australian STANDARD

Australian Standard – *Requirements for customer cabling products*

This Standard was issued in draft form for public comment as DR AS/CA S008:2019

First published as AS/ACIF S008:2001
Second edition as AS/ACIF S008:2006
Third edition as AS/CA S008:2010
Fourth edition as AS/CA S008:2020, published on 20 August 2020

ISBN: 1 74000 458 2

Communications Alliance Ltd (formerly Australian Communications Industry Forum Ltd) was formed in 2006 to provide a unified voice for the Australian communications industry and to lead it into the next generation of converging networks, technologies and services.

FOREWORD

General

This Standard was prepared by the *CECRP/WC18 Cabling Standards* Working Committee and most recently revised by the WC80 : *Customer Cabling Installation and Cabling Products* Working Committee. It is one of a series of Telecommunication Standards developed under the Memorandum of Understanding between the Australian Communications Authority (ACA) and the Australian Communications Industry Forum (ACIF).

Note: On 1 July 2005 the ACA became the Australian Communications and Media Authority (ACMA) and the Memorandum of Understanding continues in effect as if the reference to the ACA was a reference to ACMA.

Communications Alliance was formed in 2006 and continues the functions previously fulfilled by ACIF.

This Standard is a revision of AS/CA S008:2010 *Requirements for customer cabling products.*

This Standard is the result of a consensus among representatives on the Communications Alliance Working Committee to produce it as an Australian Standard.

The requirements in this Standard are intended to be consistent with the aims of s376 of the *Telecommunications Act 1997*. Specifically these aims are—

(a) protecting the integrity of a Telecommunications Network or Facility;

(b) protecting the health and safety of persons;

(c) ensuring access to emergency services; and

(d) ensuring interoperability with a standard telephone service.

It should be noted that some Customer Equipment (CE) may also need to comply with requirements in other Standards.

Applicable electrical safety Standards, EMC, Radiocommunications and EMR Standards may apply under Commonwealth or State/Territory laws, or both.

Intellectual property rights

Equipment which is manufactured to comply with this Standard may require the use of technology which is protected by patent rights in Australia. Questions about the availability of such technology, under licence or otherwise, should be directed to the patent holder or Australian licensee (if known) or through inquiry at IP Australia which incorporates the Patent, Trade Marks and Designs Offices. Further information can be found at www.ipaustralia.gov.au.

Standards revision

Australian Standards (AS/ACIF and AS/CA Standards) developed by Communications Alliance are updated according to the needs of the industry, by amendments or revision. Users of these Standards should make sure that they possess the latest amendments or editions. Representations concerning the need for a change to this AS/CA Standard should be addressed to—

The Project Manager
Customer Equipment and Cable Reference Panel
Communications Alliance
PO Box 444
Milsons Point NSW 1565

Regulatory notice

The 2020 version of AS/CA S008 is mandated by the *Telecommunications Technical Standard (Requirements for customer cabling products – AS/CA S008) 2015* and comes into force on the date it is published. Until that date AS/CA S008:2010+Amdt No1:2014 remains in force.

Details on current compliance arrangements can be obtained from the ACMA website at https://www.acma.gov.au or by contacting ACMA at:

Australian Communications and Media Authority
PO Box 13112
Law Courts PO
Melbourne VIC 8010
Australia

Telephone: 1800 850 115 (Australia)
Telephone: +61 3 9963 6800
Facsimile: +61 3 9963 6899
Email: info@acma.gov.au

Introduction

This introduction for the AS/CA S008 ***Requirements for customer cabling products*** Standard is not an authoritative section of this Standard and is only provided as guidance for the user of the Standard to outline its objectives, the factors that have been taken into account in its development and to list the principal differences between the new and the previous edition.

The reader is directed to the clauses of this Standard for the specific requirements and to the Australian Communications and Media Authority (ACMA) for the applicable telecommunications labelling and compliance arrangements.

Note: Further information on the telecommunications labelling and compliance arrangements can be found in the *Telecommunications (Labelling Notice for Customer Equipment and Customer Cabling) Instrument 2018* (the *Instrument*). The Instrument can be obtained from the Australian Communications and Media Authority (ACMA) website at https://www.acma.gov.au/.

The objective of this Standard is to provide the requirements for Cabling Products and related Customer Equipment for safety and interoperability in order to meet the regulatory arrangements in Australia.

The objective of this revision is to update the requirements of Customer Cabling Products to reflect product supply in Australia and to update referenced Standards that have been revised since the previous edition of this Standard.

The principal differences between this edition of AS/CA S008 and the previous edition are—

(i) the References section has been restructured, with publications only referred to in notes and informative appendices relocated to a new Bibliography.

(ii) all references to regulatory and other publications have been updated, including the revised AS 1049.1-2014 telecommunications cable materials Standard.

(iii) defined terms used in the requirements are now displayed in 'Leading Capitals' for ease of identification.

(iv) new voltage, electrical energy source (ES1, ES2, ES3) and related terminology used in AS/NZS 62368.1 has been introduced. Appendix D specifies how equivalence between AS/NZS 62368.1 and AS/NZS 60950.1 is to be implemented, together with a table comparing AS/NZS 60950.1 and AS/NZS 62368.1 terms.

(v) new definitions, including *generic cabling*, *mains supply*, *pit or access hole product* and *registered engineer*.

(vi) prohibited markings for underground conduit (Clause 5.3.3.2).

(vii) requirements for optical fibre distribution devices and enclosure labelling are now only specified in AS/CA S009.

(viii) a new fitness for purpose requirement for cabling products (Clause 5.1.2).

(ix) the AS 1660.5.6 flammability requirements have been updated to the new AS/NZS IEC 60332.1 Standard (Clause 5.6.4).

(x) optical fibre cordage strain relief requirements have been aligned with IEC 61300-2-4 (Clauses 5.6.16.4 and 5.6.16.5).

(xi) blown fibre tube system requirements now include those with preinstalled elements (Clause 5.6.17).

(xii) a new specification for ES3 generic cable, including conductor resistance, sheath colour and labelling (Clause 5.6.19).

(xiii) a new compatibility recommendation for 6-position modular plugs and sockets and the use of '8P-to-6P insert' adaptors (Clause 5.7.3 and Appendix C).

(xiv) new pit and access hole requirements including cover labelling, installation methods and testing documentation. (Clause 5.8.1)

TABLE OF CONTENTS

APPENDICES

FIGURES

TABLES

1 INTERPRETATIVE GUIDELINES

1.1 Categories of requirements

This Standard contains mandatory requirements as well as provisions that are recommendations only. Mandatory requirements are designated by the words '**shall**' or '**shall not**'. All other provisions are voluntary.

1.2 Compliance statements

Compliance statements, in italics, suggest methodologies for demonstrating that Customer Cabling and related Customer Equipment comply with the requirements.

1.3 Definitions, expressions and terms

If there is any conflict between the definitions used in this Standard and the definitions used in the *Telecommunications Act 1997*, the definitions in the Act take precedence.

1.4 Notes

Text denoted as 'Note' is for guidance in interpretation and is shown in smaller size type.

1.5 Applicable editions of References

(a) Applicable editions (or versions) of other documents referred to in this Standard are specified in Section 3: REFERENCES.

(b) If a document refers to another document, the other document is a sub-referenced document.

(c) Where the edition (or version) of the sub-referenced document is uniquely identified in the reference document, then that edition (or version) applies.

(d) Where the edition (or version) of the sub-referenced document is not uniquely identified in the reference document, then the applicable edition (or version) is that which is current at the date the reference document is legislated under the applicable regulatory framework, or for a non-legislated document, the date upon which the document is published by the relevant standards organisation.

(e) A number in square brackets '[ ]' refers to a normative document listed in Section 3: REFERENCES.

(f) Either safety standard AS/NZS 60950.1 [18] or AS/NZS 62368.1 [19] may be used where reference is made in this Standard to AS/NZS 62368.1 [19]. Appendix D specifies how this equivalence is to be implemented.

1.6 Units and symbols

In this Standard the International System (SI) of units and symbols is used in accordance with ISO 80000-1 [32].

1.7 Bibliography

The bibliography contains information about other publications referred to in this Standard e.g. publications only referred to in notes and informative appendices in this Standard.

2 SCOPE

2.1 This Standard applies to Cabling Products (including Cable and related Customer Equipment) intended for connection to the customer side of the boundary of a Telecommunications Network.

2.2 This Standard does not apply to Cabling Products intended primarily for the distribution of Mains Supply.

2.3 This Standard does not apply to products intended to be used for telecommunications earthing systems or telecommunications power distribution (e.g. earthing/power conductors, earthing bars, busbars, earthing/power terminals, line tap devices, earth electrodes and associated fittings, batteries, fuses and circuit breakers).

2.4 This Standard does not apply to surge suppression devices.

Note: Requirements for surge suppression devices are specified in AS/NZS 4117 *Surge Protection Devices for Telecommunication Applications*. Refer to the ACMA *Telecommunications (Labelling Notice for Customer Equipment and Customer Cabling) Amendment Instrument 2018*.

2.5 A Cabling Product is not excluded from the scope of this Standard by reason only that it forms part of equipment that is subject to another Standard, for example, distribution frames or Cable tails that form part of Customer Access Equipment (CAE).

Note 1: The connection of Cabling Products includes connection otherwise than by means of physical contact, e.g. a connection by means of radiocommunication.

Note 2: This Standard should be read in conjunction with AS/CA S009 [20] which specifies the requirements for the installation and maintenance of fixed or concealed cabling or equipment that is connected or is intended to be connected to a Telecommunications Network.

3 REFERENCES

	Publication	Title
	Australian Standards	
[1]	AS 1049	Telecommunication cables
	AS 1049.1-2014 Amdt 1:2019	Part 1: Insulation, sheath and jacket Materials
	AS 1049.2-2008	Part 2: Insulation, sheath and jacket Test methods
	AS/NZS 1660	Test methods for electric cables, cords and conductors
[2]	AS/NZS 1660.3:1998 (R2017)	Part 3: Electrical tests (including Amdt 1: 2001 and Amdt 2:2017)
	AS/NZS IEC 60332.1	Tests on electric and optical fibre cables under fire conditions. Part 1: Test for vertical flame propagation for a single insulated wire or cable
[3]	AS/NZS IEC 60332.1.1:2017	Part 1-1: Apparatus
[4]	AS/NZS IEC 60332.1.2:2017	Part 1-2: Procedure for 1 kW pre-mixed flame
[5]	AS/NZS IEC 60332.1.3:2017	Part 1-3: Procedure for determination of flaming droplets/particles
[6]	AS/NZS 1802:2018	Electric cables – Reeling and trailing – For underground coal mining purposes
	AS/NZS 2053	Conduits and fittings for electrical installations
[7]	AS/NZS 2053.1:2001 (R2016)	Part 1: General requirements
[8]	AS/NZS 2373:2003 (R2017)	Electric cables – twisted pair for control and protection circuits
[9]	AS 2700-2011	Colour standards for general purposes
[10]	AS/NZS 3191:2008	Electric flexible cords
	AS/NZS 5000	Electric cables – polymeric insulated
[11]	AS/NZS 5000.1:2005 (R2017)	Part 1: For working voltages up to and including 0.6/1 (1.2) kV
[12]	AS/NZS 5000.2:2006 (R2017)	Part 2: For working voltages up to and including 450/750 V
[13]	AS/NZS 5000.3:2003 (R2017)	Part 3: Multicore control cables
[14]	AS & AS/NZS 11801	Information technology -- Generic cabling for customer premises
	AS/NZS 11801-1:2019	Part 1: General requirements
	AS 11801-2:2019	Part 2: Office premises
	AS 11801-3:2019	Part 3: Industrial premises
	AS 11801-4:2019	Part 4: Single-tenant homes
	AS 11801-5:2019	Part 5: Data centres

	AS 11801-6:2019	Part 6: Distributed building services
[15]	AS 60529:2004	Degrees of protection provided by enclosures (IP Code)
[16]	AS/NZS 60695.2.13:2001	Fire hazard testing – glowing/hot wire based test methods – glow-wire ignitability test method for materials
[17]	AS/NZS 60702.2:2005	Approval and test specification-Terminations and glands for mineral insulated metal-sheathed cables
	AS/NZS 60950	Information Technology Equipment
[18]	AS/NZS 60950.1:2015	Part 1: Safety General requirements
[19]	AS/NZS 62368.1	Audio/video, information and communication technology equipment – Part 1: Safety requirements
	AS/CA Standards	
[20]	AS/CA S009:2020	Installation requirements for customer cabling – Wiring Rules
	IEC Publications	
[21]	ISO/IEC 11801	Information technology -- Generic cabling for customer premises
	ISO/IEC 11801-1:2017	Part 1: General requirements
	ISO/IEC 11801-2:2017	Part 2: Office premises
	ISO/IEC 11801-3:2017	Part 3: Industrial premises
	ISO/IEC 11801-4:2017	Part 4: Single-tenant homes
	ISO/IEC 11801-5:2017	Part 5: Data centres
	ISO/IEC 11801-6:2017	Part 6: Distributed building services
[22]	IEC 60050-151:2001	International Electrotechnical Vocabulary (IEV) - Part 151: Electrical and magnetic devices
[23]	IEC 60096-0-1 (2012-10)	Radio-frequency cables. Part 0-1: Guide to the design of detail specifications – Coaxial cables
[24]	IEC 60189-1(2007-05)	Low-frequency cables and wires with PVC insulation and PVC sheath. Part 1: General test and measuring methods
[25]	IEC 60352-4(1994-08)	Solderless connections —Solderless non-accessible insulation displacement connections – General requirements, test methods and practical guidance
[26]	IEC 60512-3-1 Edition 1.0 (2002-02)	Connectors for electronic equipment - Tests and measurements - Part 3-1: Insulation tests – Test 3a: Insulation resistance
[27]	IEC 60603-7 Edition 3.1 (2011-2012)	Connectors for electronic equipment – Part 7: Detail specification for 8-way, unshielded, free and fixed connectors
[28]	IEC 60793-2:2019	Optical fibres. Part 2: Product specifications – General

[29]	IEC 60794-1-1:2015	Optical fibre cables - Part 1-1 – Generic specification – General
[30]	IEC 60794-1-22:2017	Optical fibre cables Part 1-22: Generic specification – Basic optical cable test procedures – Environmental tests methods
[31]	IEC 61300-2-4:2019	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-4: Tests - Fibre or cable retention
	International Standards	
[32]	ISO 80000-1:2009	Quantities and Units – Part 1: General
	Other References	
[33]	CFR FCC 47— Part 68.500: October 1999	Code of Federal Regulations Federal Communications Commission Title 47: Telecommunications Part 68: Connection of terminal equipment to the telephone network Sub part F: Connector Specifications. Section 68.500: Specifications U.S Government Publishing Office

4 ABBREVIATIONS AND DEFINITIONS

For the purposes of this Standard, the following abbreviations and definitions apply.

4.1 Abbreviations

AC (or a.c.)	alternating current (in r.m.s. value unless stated otherwise)
ACIF	Australian Communications Industry Forum
ACMA	Australian Communications and Media Authority
AS	Australian Standard
CAE	Customer Access Equipment
CE	Customer Equipment
CES	Communications Earth System
DC (or d.c.)	direct current
ELV	Extra-Low Voltage
ES1	Electrical Energy Source Class 1
ES2	Electrical Energy Source Class 2
ES3	Electrical Energy source Class 3
FCC	Federal Communications Commission USA
HV	High Voltage
IEC	International Electrotechnical Commission
IP	International Protection (rating) (sometimes referred to as Ingress Protection)
IPXn	rated for protection against ingress of water only (n = 0 to 8, according to the degree of protection specified)
ISDN	Integrated Services Digital Network
LAN	Local Area Network
LV	Low Voltage
MDF	Main Distribution Frame
MIMS	Mineral Insulated Metal Sheath
NTD	Network Termination Device
NZS	New Zealand Standard
PVC	Polyvinyl Chloride
SELV	Safety Extra-Low Voltage
SWA	Steel Wire Armouring
TNV	Telecommunications Network Voltage
TO	Telecommunications Outlet
TRC	Telecommunications Reference Conductor
TS	Technical Standard
UV	Ultraviolet (radiation/light)
Z_0	Characteristic Impedance

4.2 Definitions

4.2.1 aerial cable

Cable that is suspended between poles, buildings or other supporting structures external to a building.

4.2.2 cable

an assembly of one or more conductors and/or optical fibres, with a protective covering and possibly filling, insulating and protective material.

Note: The assembly may also include other elements, for example a metallic shield, a moisture barrier, a strengthener or bearer wire.

[Source: Adapted from IEC 60050-151 (MOD)] [22]]

4.2.3 cabling product

a passive device (including any Cable, Connecting Hardware, Enclosure, Conduit, factory-made pit or factory-made access hole) that is intended for use on the customer side of the boundary of a Telecommunications Network.

4.2.4 carriage service

a service for carrying communications by means of guided and/or unguided electromagnetic energy.

4.2.5 carriage service provider

if a person supplies, or proposes to supply, a listed Carriage Service to the public using—

(a) a network unit owned by one or more Carriers; or

(b) a network unit in relation to which a nominated Carrier declaration is in force;

the person is a Carriage Service Provider.

4.2.6 carrier

the holder of a Carrier licence.

4.2.7 conduit

a tube or pipe that physically accommodates Cables.

Note: In this Standard, Conduit and pipe have the same meaning. See also Duct and Trunking.

4.2.8 connecting hardware

a passive device used to join or interconnect Lines, or to connect Customer Equipment to a Line.

4.2.9 cord

a flexible Cable with a minimum of one termination (e.g. on a plug).

Note: Cords are used for connection of moveable Customer Equipment or to afford flexibility. Examples of Cords are patch Cords, fly leads and Pigtails.

4.2.10 cordage

a flexible Cable that is not fitted with connectors, which may be used in the assembly of Cords.

4.2.11 Customer Access Equipment (CAE)

Customer Equipment with multiple ports (local or network) that provides access (gateway functions) to a Telecommunications Network and is capable of switching, storage, processing, conversion, integration, line isolation/coupling or multiplexing of analogue or digital voice or voice equivalent communication

Note 1: Examples of CAE include, but are not limited to, PABX or key systems, line isolators, ISDN terminal adaptors, echo cancellers, interactive voice response systems, voice/packet gateway, integrated access devices and voice messaging systems.

Note 2: CAE was formerly referred to as CSS (customer switching system).

4.2.12 customer cable

a Cable that is used in Customer Cabling.

4.2.13 customer cabling

a Line that is used, installed ready for use or intended for use on the customer side of the boundary of a Telecommunications Network.

Note: In the context of this Standard a reference to Customer Cabling is a reference to Cable, including Cord and Cordage, and Connecting Hardware.

4.2.14 Customer Equipment (CE)

(a) any equipment, apparatus, tower, mast, antenna or other structure or thing; or

(b) any system (whether software-based or otherwise);

that—

(1) is used, installed ready for use or intended for use in connection with a Carriage Service; and

(2) under the regulations, is treated as Customer Equipment;

but does not include a Line.

Note: In the context of this Standard a reference to Customer Equipment is a reference to all products excluding Cable, Cord and Cordage.

4.2.15 distributor

a collection of components used to terminate Cables and which provide for cross-connection of Lines.

Note 1: An example of a Distributor is a jumperable distribution frame or a patch panel.

Note 2: Where cable termination equipment is used to interconnect two or more Cables without cross-connection, for the purposes of this Standard, it is not regarded as a Distributor.

Note 3: The definition of Distributor in AS/CA S009 [20] varies from the above definition. A distributor with no more than six outlets in a home is not considered to be a distributor for the purpose of the regulation of cabling work.

4.2.16 duct

a closed passage for housing and protecting Cable and conductors. See also Conduit and Trunking.

4.2.17 Electrical Energy Source Class 1 (ES1)

See Appendix D.

4.2.18 Electrical Energy Source Class 2 (ES2)

See Appendix D.

4.2.19 Electrical Energy Source Class 3 (ES3)

See Appendix D.

4.2.20 enclosure

a housing for Cable or equipment affording the type and degree of protection suitable for the intended application.

Note: Examples of uses for Enclosures may include security of cabling interconnection systems, protection against contact with ES2 and ES3, protection against fire originating within equipment.

4.2.21 facility

(a) any part of the infrastructure of a Telecommunications Network; or

(b) any Line, equipment, apparatus, tower, mast, antenna, tunnel, Duct, hole, pit, pole or other structure or thing used, or for use, in or in connection with a Telecommunications Network.

4.2.22 generic cable

is the Cable that is specified under Generic Cabling.

4.2.23 generic cabling

is cabling which meets the cabling installation conformance requirements of a cabling design document in the AS/NZS 11801 series [14] or ISO/IEC 11801 series [21] of Standards.

4.2.24 hazardous energy source

an electrical energy source which exceeds ES2 voltage and current limits existing in a circuit as defined in AS/NZS 62368.1 [19].

Note: ES3 is treated as a Hazardous Energy Source.

4.2.25 hybrid cable

a composite Cable that—

(a) uses separate telecommunications technologies; or

(b) is used simultaneously for telecommunications and an application other than telecommunications.

Note 1: The telecommunications component of a Hybrid Cable is required to meet the applicable requirements of this Standard.

Note 2: An example of a Hybrid Cable is a Cable composed of a coaxial tube and twisted pairs contained under the same sheath.

Note 3: Another example of a Hybrid Cable is a Cable that is used for distribution or connection of ES2 power and that also contains an optical fibre, coaxial tube or metallic conductors for control purposes.

4.2.26 indoor cable

Cable that is intended for use inside a building, but not underground or exposed to the elements.

4.2.27 instructed person

a person instructed or supervised by a Skilled Person as to energy sources and who can responsibly use equipment safeguards and precautionary safeguards with respect to those energy sources.

Note 1: Supervised, as used in the definition, means having the direction and oversight of the performance of others.

[Source: AS/NZS 62368.1 [19]]

4.2.28 jumper

a cable unit or cable element without connectors, typically one to four twisted pairs, either unsheathed or sheathed, used to make a cross connection within a Distributor.

4.2.29 lead-in cabling

a Carrier's Telecommunications Network cabling from the Carrier's distribution point to the boundary of a Telecommunications Network.

4.2.30 line

a wire, Cable, optical fibre, tube, Conduit, waveguide or other physical medium used, or for use, as a continuous artificial guide for or in connection with carrying communications by means of guided electromagnetic energy.

4.2.31 Main Distribution Frame (MDF)

a Distributor that provides, or is intended to provide, an electrical termination point for a Carrier's twisted pair Lead-in Cabling.

Note: There may be more than one MDF within a building.

4.2.32 mains supply

AC or DC power distribution system (external to the equipment) that supplies operating power to the equipment and is power source class 3 (PS3).

Note: Mains includes public or private utilities and equivalent sources such as motor-driven generators and uninterruptible power supplies.

[Source: Adapted from AS/NZS 62368.1 [19]]

4.2.33 multidiscipline

A Cable that is intended to be used for an application other than telecommunications but excluding any Cable normally used for distribution or connection of AC Mains Supply.

Note: An example of a Multidiscipline Cable is a Cable that may be used for telecommunications or may be used for such other things as—

(a) emergency lighting (e.g. MIMS Cable);
(b) distribution or connection of ELV power (e.g. 'figure 8' twin conductor cable);
(c) control purposes e.g. (a travelling lift or hoist Cable); or
(d) industrial robotics.

4.2.34 ordinary person

a person who is neither a Skilled Person nor an Instructed Person.

Note: This is commonly considered to be the 'user' or the end-user of the equipment, but it has a broader meaning here which includes the general public.

[Source: Adapted from AS/NZS 62368.1 [19]]

4.2.35 outdoor cable

Cable that is intended for use external to a building, either underground or exposed to the elements, including Aerial Cable.

4.2.36 pigtail

a length of metallic or optical fibre Cordage with a connector fitted at one end only. The other end is free for terminating or splicing to Customer Equipment or Customer Cabling.

4.2.37 pit or access hole product

a manufactured product which is intended to form part or all of a pit or access hole, with the exception of a cover component supplied separately from other types of pit and access hole components.

Note 1: The terms 'pit' and 'access hole' refer to in-ground chambers which are used to haul, joint and house underground communications cabling.

Note 2: Any sections of a pit or access hole which are constructed on site from building materials, for example bricks or wet concrete, are not Pit Or Access Hole Products.

Note 3: Covers, crossbars, cover gaskets, cover frames, and aesthetic cover and frame sets are examples of cover components. These components are not considered to be Pit Or Access Hole Products if they are supplied separately from a part such as a pit body or a pit riser.

4.2.38 registered structural engineer

an engineer who has formal recognition of the qualification and competency of a structural engineer and is current on an engineer register. The engineer register may be—

(a) a mandatory jurisdictional registration system for engineers (e.g. RPEQ);

(b) a National Engineering Register (e.g. NER); or

(c) a Professional Engineering Registration Organisation (e.g. Engineers Australia).

Note 1: The minimum mandatory requirement for listing on a register is—

(a) a qualification for structural engineering that complies with the requirements of the Washington Accord,

(b) accumulation of five years of relevant engineering industry experience over the past seven years; and

(c) continuing professional development of 150 hours over the past three years.

Note 2: Further information can be found at Engineers Australia at www.engineersaustralia.org.au.

4.2.39 SELV circuit

See Appendix D.

4.2.40 skilled person

a person with relevant education or experience to be able to identify hazards and to take appropriate actions to reduce the risks of injury to themselves and others [AS/NZS 62368.1] [19]

4.2.41 special application cable

a Cable that—

(a) is intended to carry steady-state or change-of-state DC signals or AC signals less than 300 Hz between devices;

(b) is intended to carry an industrial data signalling protocol, e.g. RS232 or RS485;

(c) is intended for Multidiscipline use; or

(d) is a Hybrid Cable.

Note: A Special Application Cable may include, but is not limited to—

(a) a Cable used for connection of telecommunications power (usually ES1) and associated status and alarm circuits;

(b) a MIMS, EWIS or other fire detection or fire warning system Cable;

(c) a security or control system Cable; or

(d) a travelling lift or hoist Cable.

4.2.42 telecommunications network

a system, or series of systems that is operated by a Carrier or Carriage Service Provider and which carries, or is capable of carrying, communications by means of guided and/or unguided electromagnetic energy.

Note: This includes the transfer of conducted electrical energy on telecommunications copper Cables.

4.2.43 Telecommunications Network Voltage (TNV)

See Appendix D.

4.2.44 telephone cable

a Cable with metallic conductors (including Cordage or a Cord) designed to carry signals only in the 300 Hz to 100 kHz bandwidth.

4.2.45 trunking

a tray or trough system with removable cover(s) along its length for housing and protecting Cables.

Note: See also Conduit and Duct.

4.2.46 underground cable

Cable that is intended to be buried underground either directly or in Conduit.

5 REQUIREMENTS

5.1 General

5.1.1 Physically distinguishable

Cabling Products, other than pits and access holes, **shall** be physically distinguishable from products used for distribution or connection of Mains Supply.

5.1.2 Fitness for purpose

A Cabling Product **shall** be fit for purpose for its intended use, e.g. a Category 6 Cord that meets its performance requirements.

Note: The component manufacturer should be consulted for confirmation of the intended use and/ or capabilities of the component used. Examples may include confirmation of Cable types to support remote powering (Power over Ethernet) to ensure the Cable has the ability to handle the current required by the end device.

5.1.3 Twisted pair and quad

For the purposes of this Standard, a quad is deemed to satisfy a requirement for which a twisted pair has been specified.

5.2 Markings

5.2.1 Labelling Instrument

The ACMA *Telecommunications (Labelling Notice for Customer Equipment and Customer Cabling) Instrument* (the *Instrument*) requirements apply to Customer Cabling or related CE.

Note 1: The *Instrument* does not apply to Cable and Cabling Products that are not used for Customer Cabling or related CE (see Schedule 4 of the *Instrument*).

Note 2: The *Instrument* is available from the ACMA website at www.acma.gov.au.

5.2.2 Inappropriate markings

Cabling Products intended solely for ES1 or ES2 telecommunications circuits **shall not** bear markings indicating hazardous services.

5.2.3 Additional markings (excluding cable markings)

5.2.3.1 International Protection (IP) rating

Cabling Products other than Cable, which have been assessed against the requirements of AS 60529 [15] **shall** be legibly and durably marked with the relevant International Protection (IP) rating.

Note: It is recommended that the IP rating along with other markings required by this Standard be located in a visible external or internal position after installation.

5.2.3.2 Multidiscipline telecommunications connecting hardware

Products designed for Multidiscipline use that have permanent markings to distinguish their usage **shall** have their markings positioned so that they are likely to be visible when the products are installed.

Note: This is to distinguish the Cabling Products used for telecommunications from those products used for hazardous circuits.

5.2.3.3 Marking durability

A marking that is required to comply with this Clause **shall**—

(a) be durable and easily legible after rubbing the marking by hand; and

(b) withstand being rubbed by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

Note: Petroleum spirit is defined as the aliphatic solvent hexane with a maximum aromatics content of 0.1% by volume, a Kauri-butanol value of 29, an initial boiling point of 65°C, a dry point of 69°C and a density of approximately 0.68 g/cm^3.

5.3 Underground conduit

5.3.1 Colour

Non-metallic Conduit for underground use **shall** be—

(a) coloured white; or

(b) contain an indelible, durable, continuous, visible white stripe which is incorporated as part of the manufacturing process and is not painted on or applied over the surface of a prefabricated Conduit.

5.3.2 Underground conduit properties

Underground Conduit **shall** meet the following minimum classifications in accordance with Clause 5 of AS/NZS 2053.1 [7] —

5.1	Any of the listed types of material;
5.2	Threadable or non-threadable;
5.3	Medium mechanical stresses ('medium duty');
5.4	Rigid or flexible;
5.8.1 & 5.8.2	Rated to IP66; and
5.8.5	Non-hygroscopic.

5.3.3 Underground conduit markings

5.3.3.1 Conduit identification

Non-metallic Conduit for underground use—

(a) **shall** be legibly and durably marked 'COMMUNICATIONS' at intervals of no less than 1 m and no greater than 3 m; and

(b) should be legibly and durably marked 'COMMUNICATIONS' at intervals no greater than 1.5 m.

Note 1: Conduit fittings such as bends and joiners do not need to be marked.

Note 2: Suitable methods of marking include stamping, moulding, printed labels and direct printing.

5.3.3.2 Prohibited markings

Conduit for underground use **shall not** include the word 'ELECTRICAL' or any other marking that may be confusing or misleading.

5.3.3.3 Marking durability

Required markings on Conduit for underground use **shall** comply with Clause 5.2.3.3.

5.4 Cable distribution devices

5.4.1 Common requirements

5.4.1.1 Cable entry

Cable entry holes **shall** be free of sharp edges or burrs or have a grommet of insulating material fitted.

5.4.1.2 Conductive enclosure

5.4.1.2.1 Enclosure, frame and backmount earthing

Provision **shall** be made to enable conductive Enclosures, frames and backmounts to be connected to a building electrical earthing system in accordance with the applicable requirements of AS/CA S009 [20].

5.4.1.2.2 Insulation

All parts intended to carry voltages for Customer Cabling , except Connecting Hardware that is tested separately to Clause 5.7, **shall** be electrically insulated to a minimum value of 1.5 kV a.c. (or 2121 V d.c.) without breakdown for 60 s from any conductive part of Enclosures, or terminals provided to make a connection to the Enclosure itself.

Note: Face plates and mounting hardware intended for use with generic or proprietary connectors are required to comply with this Clause.

5.4.1.3 Enclosure requirements

5.4.1.3.1 Openings

Any openings, other than cable entries, in Enclosures **shall** comply with the physical requirements for electrical Enclosures given in—

(a) Clause 4.6 of AS/NZS 60950.1[18]; or

(b) Clause 5.3.6 and Annex P of AS/NZS 62368.1 [19] for all other openings.

5.4.1.3.2 Sharp edges

An Enclosure **shall** be free from exposed sharp edges that may cause damage to Cable or injury to any person.

5.4.1.3.3 Outdoor enclosures

Enclosures intended for installation in an outdoor location to protect internal equipment from being exposed to adverse conditions **shall** provide a minimum degree of protection of IPX3 in accordance with AS 60529 [15]. The IP code **shall** be declared, however it is not a requirement to mark the IP code on the outdoor Enclosure.

Note: Clause 8 of IEC 60950-22 contains additional requirements for outdoor Enclosures which are recommended for this Standard. These requirements may be included in a future edition of AS/NZS 62368.1 [19].

Compliance *with Clause 5.4.1.3.3 should be checked* after the Enclosure has been opened and closed at least ten (10) times.

5.4.1.3.4 Shared enclosures

The conductors and terminations of a Customer Cable may be located within the same Enclosure as the conductors and terminations of a mains power cable subject to the following—

(a) The conductors and terminations of a Customer Cable **shall not** be located within the same Enclosure as the uninsulated and single-insulated conductors and terminations of a mains power cable unless—

(i) accidental access to the mains power conductors and terminations by a person working on the Customer Cable conductors and terminations is prevented by means of a physical barrier or obstruction that prevents contact with the mains power conductors or terminations by any part of the body or by any tool being used by a person;

(ii) the Customer Cable and the mains power cable are to be terminated on building control or monitoring equipment that is to be installed in a restricted access area where only persons who are qualified and authorised to install or maintain both mains power installations and Customer Cabling can gain access; or

(iii) there is provision for the Enclosure to be secured by a lock or tool.

(b) The conductors and terminations of a Customer Cable **shall** be separated from the uninsulated and single-insulated conductors and terminations of a mains power cable by either a minimum distance of 150 mm or by means of a permanent, rigidly-fixed barrier of durable insulating material or metal that is capable of being earthed in accordance with Clause 5.4.1.3.4(c), unless—

(i) the Customer Cable and the mains power cable are to be terminated on building control or monitoring equipment that is to be installed in a restricted access area where only persons who are qualified and authorised to install or maintain both mains power installations and Customer Cabling will be able to gain access;

(ii) separate cables are to be used for mains power and telecommunications; and

(iii) any telecommunications circuit that is to be terminated on the building control or monitoring equipment—

(A) will not share the same cable sheath as any other telecommunications service; and

(B) will only be connected to a Telecommunications Network via a compliant isolating interface.

(c) Where the barrier referred to in Clause 5.4.1.3.4(b) is of metallic construction, provision **shall** be made for connecting the barrier to a protective earth by a minimum 2.5 mm^2 conductor.

(d) Conductors and terminations of telecommunications Cables **shall not** be located within the same Enclosure as those of cables carrying a voltage exceeding 1000 V a.c. or 1500 V d.c.

Note: 'Compliant isolating interface' means Carrier equipment or Customer Equipment that meets the requirements of AS/NZS 62368.1 [19] for an ES2 interface. Examples are a modem or a Line Isolation Device.

5.4.1.4 Earthing or bonding bars and terminals

5.4.1.4.1 Insulation

Where an earthing/bonding bar or terminal is provided other than for the purpose of Clause 5.4.1.2.1, it **shall** be insulated from any conductive material of the Enclosure, backmount or frame to withstand a potential difference of 1.5 kV a.c. (50 Hz) for 60 s.

5.4.1.4.2 Earthing or bonding conductor connections

An earthing/bonding bar or terminal intended for connection of earthing or bonding conductors **shall** comply with the requirements of AS/CA S009 [20] for earthing/bonding bars and terminals used for connection of earthing or bonding conductors.

5.4.1.4.3 Access to earthing or bonding bars or terminals

An earthing/bonding bar or terminal **shall** be enclosed or located to prevent unintentional contact by a person who is not doing cabling work, for example an end-user.

5.4.1.5 Access to cable terminations

All telecommunications terminations **shall** be enclosed or located to prevent unintentional contact with voltages other than ES1 by a person who is not doing cabling work, for example an end-user.

Note: Although it is permissible to allow persons to come into personal contact with ES1 circuits this should be prevented where practicable.

5.4.2 Main distribution frame (MDF)

5.4.2.1 Flame propagation

The MDF Enclosure case materials **shall** be tested and meet the minimum requirements of—

(a) a resistance to heat to 120°C in accordance with AS/NZS 2053.1 [7];

(b) non-flame propagating in accordance with AS/NZS 2053.1 [7]; and

(c) if made of insulating material, the glow wire test of AS/NZS 60695.2.13 [16] at 850°C.

Note: This requirement is to allow for the installation of surge suppression fittings within the MDF, which may become a source of ignition during overvoltage conditions.

5.4.2.2 Security

The MDF **shall** have provision for securing with a key, lock or tool.

5.4.2.3 Terminations

The MDF should be suitable for mounting the Carrier's standard terminating modules for Lead-in Cabling on the Carrier's side of the Distributor.

Note: Manufacturers should be aware that the Carrier may deny access to their network if they are unable to mount their terminating modules for termination of their Lead-in Cabling in the MDF.

5.4.2.4 Space for surge suppression devices

Allowance **shall** be made for a minimum clearance of 30 mm between the Carrier's standard termination modules and the inside face of the front cover or door of the MDF in the fully closed position, to allow for the fitting of surge suppression devices.

Note: Appropriate clearance should be provided on the customer's side to fit surge suppression, test devices or other devices.

5.5 This clause is deleted

5.6 Cables

5.6.1 General

A Customer Cable **shall** meet the requirements of Clauses 5.6.2 to 5.6.10 where specified in Clauses 5.6.11 to 5.6.18 of this Standard, in addition to any other requirements specified for the particular type of Cable or cable application.

5.6.2 Conductor and optical fibre identification

A Cable that is required to comply with this Clause by any of Clauses 5.6.11 to 5.6.18 of this Standard, and which contains more than one metallic conductor, coaxial tube or optical fibre, **shall** use a system of identification such that all conductors, coaxial tubes or optical fibres within the Cable are readily distinguishable visually from one another.

Note: Examples of colour codes are set out in Appendix B.

5.6.3 Insulation and sheath material

A Cable that is required to comply with this Clause by any of Clauses 5.6.11 to 5.6.18 of this Standard—

(a) **shall** use insulation and sheath materials suitable for telecommunications purposes;

(b) where PVC insulation or sheath materials are used, they **shall** comply with the requirements of Table 1 or 2, as applicable; and

(c) where non-PVC insulation or sheath materials are used, they **shall** comply with the requirements of AS 1049 [1] for—

(i) Tensile Strength Test (Aged/Unaged);

(ii) Elongation Test (Aged/Unaged); and

(iii) Shrinkback Tests for that particular type of insulation and sheath.

5.6.4 Flammability

A Cable that is required to comply with any of Clauses 5.6.11 to 5.6.18 of this Standard **shall** pass both—

(a) the resistance to vertical flame propagation test as specified in AS/NZS IEC 60332.1.2 [4] including Annex A; and

(b) the falling flaming droplets/particles test as specified in AS/NZS IEC 60332.1.3 [5] including Annex A.

5.6.5 UV resistance

A Cable that is required to comply with this Clause by AS/CA S009 [20] or by any of Clauses 5.6.11 to 5.6.18 of this Standard **shall** meet the requirements of AS 1049 [1] for Cables exposed to UV radiation.

Note: Underground Cable is likely be exposed to UV radiation (sunlight) at points where it enters or exits the ground or if a pit or access hole cover is dislodged or damaged for an extended period.

Compliance is assessed by the manufacturer's declaration stating the basis of the declaration, which may include known properties of the material used.

Table 1

PVC insulation requirements

Property	Value	Conditions	Test method
Tensile Strength	13 MPa (minimum)	Unaged	AS 1049.2 Appendix E
Elongation at Break	100% (minimum)	Unaged	AS 1049.2 Appendix E
Elongation at break after aging	50% (minimum) of initial.	After aging, at 100 °C for 120 h	AS 1049.2 Appendix E
Volatile loss	20 g/m^2 (maximum)	After aging, at 80 °C for 120 h	AS 1049.2 Appendix Q
Volume resistivity	400 GΩ m (minimum) 0.4 GΩ m (minimum)	at 23 °C at 60 °C	AS 1049.2 Appendix Z

Table 2

PVC sheath requirements

Property	Value	Conditions	Test method
Tensile Strength	12 MPa (minimum)	Unaged	AS 1049.2 Appendix E
Elongation at Break	100% (minimum)	Unaged	AS 1049.2 Appendix E
Elongation at break after aging	75% (minimum) of initial.	After aging at 100 °C for 120 h	AS 1049.2 Appendix E
Volatile loss	20 g/m^2 (maximum)	After aging at 80 °C for 120 h	AS 1049.2 Appendix Q

5.6.6 Metallic conductors

5.6.6.1 Conductor composition

Where a Cable is required to comply with this Clause by any of Clauses 5.6.11 to 5.6.18 of this Standard, any metallic conductors, other than—

(a) copper-clad steel used as an inner conductor in coaxial Cable; or

(b) copper-clad aluminium with a centre conductor greater than 2 mm used as an inner conductor in coaxial Cable;

are to meet the following requirements. Each metallic conductor—

(1) **shall** be either plain or plated copper;

(2) may be either a single, solid conductor or multi-stranded;

(3) **shall** have a DC resistance less than the values given in Table 3; and

(4) should have a plain or tinned finish.

5.6.6.2 Electrical withstand voltage

A multi-conductor Cable that is required to comply with this Clause by any of Clauses 5.6.11 to 5.6.18 of this Standard, when tested at a frequency of 50 Hz on at least 1 m length—

(a) **shall** be able to withstand the appropriate AC voltage levels and test method listed in Table 4, without breakdown for a period of 60 s or a period of 2 s as stated; and

(b) for Test 2 and 3, all Cables/ Cordages **shall** comply to the Table 4 limits using the test specified in AS/NZS 3191 [10] Table 2.1, test number 8(a), and using test method referred in Clause 3.5.1 of AS/NZS 1660.3 [2].

Note: Alternatively, the test may be performed using a DC potential equal to the peak voltage of the prescribed AC voltage.

Table 3
Conductor resistance

Wire type	Resistance Ω/km @ 20°C
Single strand of plain annealed copper	$24/d^2$
Single strand of plated annealed copper	$26/d^2$
Bunched strands of plain or plated copper	$28/N.d^2$

where: *N* is the number of strands

d is nominal diameter of individual strands or solid single strand in millimetres

Note 1: The DC resistance is based on the diameter of the strand, or in the case of multi stranded conductors, on the number of strands and the diameter of the individual strands.

Note 2: The recommended conductor diameter for copper conductors is in the range 0.4 mm to 0.9 mm.

Table 4
Cable withstand voltages

Test number	High voltage test	Cordage (kV a.c.)	Indoor Cable (kV a.c.)	Outdoor Cable (kV a.c.)
1	Conductor to core Test voltage applied between each conductor and all remaining conductors and to shield if applicable.	0.7 (or 1.7 for 2 s)	1.5	2.0
2	Core to sheath Test voltage applied between all conductors bunched together and sheath exterior or SWA if applicable.	0.7 (or 1.7 for 2 s)	3.0	4.5
3	Shield to sheath (where applicable) Test voltage applied between shield and sheath exterior.	1.5	3.0	4.5

5.6.6.3 Mutual capacitance

Where a Cable is required to comply with this Clause by any of Clauses 5.6.11 to 5.6.18 of this Standard, the following requirements are to be met—

(a) The maximum mutual capacitance between the two wires forming a pair measured at any frequency in the range 800 Hz to 1000 Hz **shall not** exceed the relevant value given in Table 5.

(b) The measurement, referred to in Clause 5.6.6.3(a) **shall** be performed on a minimum Cable length of 100 m, in accordance with Clause 5.4 of IEC 60189-1 [24] except as varied in Clause 5.6.6.3(c) below.

(c) The mutual capacitance **shall** be corrected to a length of 1000 m by application of the following equation:

$$\text{Value corrected to 1000 m length} = \text{measured value} \times \frac{1000}{L}$$

where: *L* is the length in metres of the Cable under test

5.6.6.4 Capacitance unbalance

Where a Cable is required to comply with this Clause by any of Clauses 5.6.11 to 5.6.18 of this Standard, the following requirements are to be met—

(a) The maximum capacitance unbalance between pairs measured at any frequency in the range 800 Hz to 1000 Hz **shall not** exceed the relevant value given in Table 5.

(b) During the measurement referred to in Clause 5.6.6.4(a), all conductors, other than those under test and the metallic shield (where applicable) **shall** be connected to earth.

(c) The measurement **shall** be performed on a minimum Cable length of 100 m, in accordance with Clause 5.5 of IEC 60189-1 [24] except as varied in Clause 5.6.6.4(e) below.

(d) The capacitance unbalance between two pairs of wires with one pair designated 'A' and 'B' and the second pair designated 'C' and 'D' is given by the following expression:

$(W + Y) - (X + Z)$

where: *W* is the capacitance between the 'A' and 'C' wires

Z is the capacitance between the 'A' and 'D' wires

X is the capacitance between the 'B' and 'C' wires

Y is the capacitance between the 'B' and 'D' wires

(e) The capacitance unbalance **shall** be corrected to a length of 500 m by application of the following equation:

$$\text{Value corrected to 500 m length} = \frac{\text{measured value}}{\sqrt{L/500}}$$

where: *L* is the length in metres of the Cable under test

5.6.6.5 Insulation resistance

Where a Cable is required to comply with this Clause by any of Clauses 5.6.11 to 5.6.18 of this Standard, the minimum insulation resistance between any two conductors forming a pair, a quad or a coaxial tube—

(a) **shall not** be less than the relevant value given in Table 5;

(b) the measurement **shall** be made on a minimum length of 100 m of Cable or Cordage at a potential of 500 V d.c. ±50 V d.c. and the reading taken after the application of the voltage for 60 s; and

(c) the insulation resistance **shall** be corrected to a length of 1000 m by application of the following equation:

$$\text{Value corrected to 1000 m length} = \text{measured value} \times \frac{L}{1000}$$

where: L is the length in metres of the Cable under test

Table 5

Metallic Cable performance parameters

Cable parameter	Units	Cordage	Indoor Cable and Jumper wire	Outdoor Cable — aerial	Outdoor Cable — underground
Maximum mutual capacitance in Telephone Cable	nF/km	—	Unshielded twisted pair 80	52	49
			Shielded or parallel 120	52	49
Maximum capacitance unbalance pair to pair in Telephone Cable	pF (corrected to 500 m length)	—	2 pair/star quad Cable 1000	2 pair/star quad Cable 500	2 pair/star quad Cable 500
			> 2 pair Cable 300	> 2 pair Cable 150	> 2 pair Cable 150
Minimum insulation resistance for all metallic Cables	MΩ.km	100	1,000	10,000	10,000

5.6.7 Continuous metallic shield

Where a Cable is required to comply with this Clause by any of Clauses 5.6.11 to 5.6.18 of this Standard—

(a) any continuous metallic shield provided in the Cable **shall** be electrically conductive; and

(b) where a continuous foil shield is employed, a drain wire **shall** be placed in continuous contact with the metallic surface of the shield to ensure electrical conductivity.

Note 1: Annex N of AS/NZS 62368.1 [19] gives recommendations for avoiding certain combinations of metals that could lead to corrosion.

Note 2: Annex N of AS/NZS 62368.1 [19] is equivalent to Annex J of AS/NZS 60950.1 [18].

5.6.8 Water penetration test

A Cable that is required to comply with this Clause by AS/CA S009 [20] or by any of Clauses 5.6.11 to 5.6.18 of this Standard **shall** comply with the requirements in Clause 5, Method –F5B or F5C of IEC 60794-1-22:2017 [30].

Note 1: Water penetration refers to the effectiveness of a Cable in restricting the longitudinal movement of water or moisture along the core. This requirement is primarily intended to localise any water penetration to minimise the adverse effect on cable performance and to prevent water or moisture leaking into joints and terminations that may cause corrosion problems.

Note 2: Additionally, Cable installed underground should have a high-density compound sheath material (such as polyethylene) that provides an adequate barrier to moisture entry to the cable core. The addition of a lapped metal tape ('moisture barrier') and/or grease or gel within the core ('filled' or 'flooded' Cable) provides even higher protection against moisture entry.

Note 3: Cable susceptible to ant/termite attack or that is buried directly in the ground without Conduit should be of a type that provides additional mechanical protection against abrasion and insects such as a nylon jacket with an optional sacrificial jacket.

Note 4: Not all Cables marketed as 'outdoor' or 'indoor/outdoor' Cables meet the water penetration requirements for underground use. Manufacturers should clearly identify products intended to be installed underground.

5.6.9 Integral bearer or strengthener

A Cable that is intended for aerial use may contain an integral bearer or strengthener. Where an integral bearer/strengthener is provided—

(a) The cable sheath **shall** fit closely over, but not adhere to, the bearer/strengthener.

Note: The sheath over the integral bearer/strengthener may be of cottage-loaf (i.e. figure-of-eight) construction.

(b) The strength of the bearer/strengthener **shall** be sufficient to carry the load of the Cable under the specified conditions.

(c) The specified conditions referred to in Item (b) **shall** be stated in a product data sheet.

(d) The product data sheet **shall** state the maximum allowable span, tension, sag, wind speed, ambient temperature range, and other parameters applicable to its use.

Note: Some of the data should be provided in the form of a table specifying, for example, allowable tension/sag values at various span lengths and temperatures.

5.6.10 Cable with specific attributes

Where a Cable is claimed to have specific attributes, such as rodent or termite resistance or armouring strength, evidentiary documentation **shall** be made available on request to support the claim.

Compliance is assessed by the manufacturer's declaration stating the basis of the declaration, which may include known properties of the materials used.

5.6.11 Metallic paired cable

5.6.11.1 General requirements

Metallic paired Cable, other than Cordage, a Cord or a Special Application Cable, **shall** comply with the following Clauses:

5.6.2 Conductor and optical fibre identification
5.6.3 Insulation and sheath material
5.6.4 Flammability (if intended for use within a building)
5.6.5 UV resistance (if intended for use external to a building, including underground)
5.6.6.1 Conductor composition
5.6.6.2 Electrical withstand voltage
5.6.6.3 Mutual capacitance (if intended for use as a Telephone Cable)
5.6.6.4 Capacitance unbalance (if intended for use as a Telephone Cable)
5.6.6.5 Insulation resistance
5.6.7 Continuous metallic shield (if applicable)
5.6.8 Water penetration test (if intended for use underground)
5.6.9 Integral bearer or strengthener (if intended for aerial use without a separate catenary support)
5.6.10 Cable with specific attributes (if applicable)

5.6.11.2 Construction

A Cable intended to carry a frequency of 300 Hz or greater **shall** be shielded or of twisted pair construction.

5.6.11.3 Operating Temperature

A Cable **shall** have a minimum continuous operating temperature rating of 60 °C.

Note: Provision of remote power over Cables may increase the operating temperature above ambient.

5.6.12 Cordage with metallic conductors

5.6.12.1 General requirements

Cordage with metallic conductors **shall** comply with the following Clauses:

- 5.6.2 Conductor and optical fibre identification
- 5.6.3 Insulation and sheath material
- 5.6.4 Flammability
- 5.6.5 UV resistance (if intended for use external to a building)
- 5.6.6.1 Conductor composition
- 5.6.6.2 Electrical withstand voltage
- 5.6.6.3 Mutual capacitance (if intended for use as telephone Cordage)
- 5.6.6.4 Capacitance unbalance (if intended for use as telephone Cordage)
- 5.6.6.5 Insulation resistance
- 5.6.7 Continuous metallic shield (if applicable)
- 5.6.10 Cable with specific attributes (if applicable)

5.6.12.2 Conductor composition

Conductors in metallic Cordage should be of stranded conductor construction when frequent movement of the Cordage is anticipated.

5.6.13 Cords with metallic conductors

5.6.13.1 General requirements

A Cord with metallic conductors **shall** comply with the following Clauses:

- 5.6.2 Conductor and optical fibre identification
- 5.6.4 Flammability
- 5.6.5 UV resistance (if intended for use external to a building)
- 5.6.6.1 Conductor composition
- 5.6.6.2 Electrical withstand voltage
- 5.6.6.5 Insulation resistance
- 5.6.7 Continuous metallic shield (if applicable)
- 5.6.10 Cable with specific attributes (if applicable)

5.6.13.2 Cords exceeding a length of 10 m

A Cord with metallic conductors that exceeds a length of 10 m **shall** comply with Clause 5.6.13.1 and the following Clauses:

- 5.6.3 Insulation and sheath material
- 5.6.6.3 Mutual capacitance (if intended for use as a telephone Cord)
- 5.6.6.4 Capacitance unbalance (if intended for use as a telephone Cord)

5.6.13.3 Cord anchorage or strain relief

A Cord with metallic conductors—

(a) **shall** be secured in any plug or socket connected to a Cord by an appropriate anchorage or strain relief; and

(b) when subjected to a force of 45 N gradually applied between the Cord and the plug or socket for a period of 60 s, the Cord **shall not** be longitudinally displaced by more than 2 mm, nor show any appreciable strain at the connection.

Note: For measurement of longitudinal displacement, a mark is made on the Cord approximately 20 mm from the Cord anchorage or other suitable point before the test. The displacement of the mark is measured 60 s after the removal of the force from the Cord.

5.6.14 Metallic jumper wire and jumper cable

5.6.14.1 General requirements

Metallic Jumper wire and Jumper Cable **shall** comply with the following Clauses:

- 5.6.2 Conductor and optical fibre identification
- 5.6.3 Insulation and sheath material
- 5.6.4 Flammability
- 5.6.6.1 Conductor composition
- 5.6.6.2 Electrical withstand voltage
- 5.6.6.5 Insulation resistance
- 5.6.7 Continuous metallic shield (if applicable)
- 5.6.10 Cable with specific attributes (if applicable)

5.6.14.2 Twist rate

Metallic Jumper wire and Cable **shall** have a minimum of 13 twists/metre in each pair.

5.6.15 Coaxial cable

5.6.15.1 General requirements

Coaxial Cable **shall** comply with the following Clauses:

- 5.6.2 Conductor and optical fibre identification (if applicable, i.e. contains more than one coaxial tube)
- 5.6.3 Insulation and sheath material
- 5.6.4 Flammability (if intended for use within a building)
- 5.6.5 UV resistance (if intended for use external to a building, including underground)
- 5.6.6.1 Conductor composition
- 5.6.6.2 Electrical withstand voltage
- 5.6.6.5 Insulation resistance
- 5.6.7 Continuous metallic shield
- 5.6.9 Integral bearer or strengthener (if intended for aerial use without a separate catenary support)
- 5.6.10 Cable with specific attributes (if applicable)

Note: Coaxial Cable intended for underground use is not required to meet the water penetration test of Clause 5.6.8 but should be of the 'flooded' type.

5.6.15.2 Velocity ratio

The velocity ratio, determined according to Clause 13 of IEC 60096-0-1 [23], **shall** be a minimum of 0.65.

5.6.15.3 Characteristic impedance

The characteristic impedance, measured according to Clause 14 of IEC 60096-0-1 [23], **shall** be $Z_o \pm Z_o/25$, where Z_o is the nominal characteristic impedance specified by the manufacturer.

5.6.15.4 Attenuation

The attenuation should be less than or equal to that specified by the manufacturer at 200 MHz when measured in accordance with Clause 16 of IEC 60096-0-1 [23].

5.6.16 Optical fibre cable

5.6.16.1 General requirements

Optical fibre Cable, other than a blown fibre tube system or similar system with preinstalled elements, **shall** comply with the following Clauses:

- 5.6.2 Conductor and optical fibre identification
- 5.6.3 Insulation and sheath material (sheath requirement only)
- 5.6.4 Flammability (if intended for use within a building)

5.6.5 UV resistance (if intended for use external to a building, including underground)

5.6.8 Water penetration test (if intended for use underground)

5.6.9 Integral bearer or strengthener (if intended for aerial use without a separate catenary support)

5.6.10 Cable with specific attributes (if applicable)

5.6.16.2 Fibre requirements

Multimode and single-mode fibres **shall** meet the relevant requirements of IEC 60793-2 [28].

5.6.16.3 Mechanical and environmental performance

The supplier **shall** make available to the customer, on request, a Product Data Sheet as per the appropriate procedures in IEC 60794-1-1 [29], specifying the mechanical and the environmental performance of a particular cable design.

5.6.16.4 Optical fibre cordage used in a cord or pigtails

Optical fibre Cordage used in a Cord, including Pigtails, **shall**—

(a) be secured in any plug or socket by an appropriate anchorage or strain relief; and

(b) retain its optical performance as specified by the Cordage manufacturer.

5.6.16.5 Optical fibre cords and optical fibre pigtails

A completed optical fibre Cord or optical fibre Pigtail **shall** meet the requirements in Table 6.

After the test is complete the optical fibre Cord or optical fibre Pigtail should not show any sign of appreciable strain at the connection between the Cordage and the plug or socket.

The test method utilised **shall** be as per that outlined in IEC 61300-2-4 [31].

Table 6

Optical fibre/cable retention as per IEC 61300-2-4

Cable type	Minimum Force applied	Minimum Duration
Reinforced cables	50 N ± 2 N	120s
Secondary coated fibres (900µm)	5 N ± 0.5 N	60s
Primary coated fibres (250µm)	2 N ± 0.2 N	60s

5.6.17 Blown fibre tube systems or similar system with preinstalled elements

5.6.17.1 General requirements

A blown fibre tube system or similar system with preinstalled elements **shall** comply with the following Clauses:

- 5.6.2 Conductor and optical fibre identification
- 5.6.3 Insulation and sheath material
- 5.6.4 Flammability (if intended for use within a building)
- 5.6.5 UV resistance (if intended for use external to a building, including underground)
- 5.6.9 Integral bearer or strengthener (if intended for aerial use without a separate catenary support)
- 5.6.10 Cable with specific attributes (if applicable)

Note: A blown fibre tube system or similar system with preinstalled elements has characteristics that are distinct from those of conventional Cable and is therefore exempt from the water penetration test of Clause 5.6.8 when used underground.

5.6.17.2 Outer tube or sheath

The outer tube or sheath of an underground blown fibre tube system or similar system with preinstalled elements **shall** comply with the requirements of IPX8 of AS 60529 [15].

5.6.18 Special application cables

5.6.18.1 Compliance

A Cable intended for a special application **shall**—

(a) comply with Clauses 5.6.18.2 and 5.6.18.3;

(b) comply with Clause 5.6.10 if applicable; and

(c) have insulation, sheath and jacket material that complies with AS 1049.1 [1] when tested to AS 1049.2 [1].

5.6.18.2 General requirements

A Special Application Cable installed within a building **shall** comply with Clause 5.6.4.

5.6.18.3 Cable with metallic conductors

A Special Application Cable with metallic conductors—

(a) **shall** comply with the testing requirements of the relevant Standard, in order of priority, from Australian/New Zealand Standard or ISO/IEC Standard or other national published Standard applicable to that particular type of Cable, as listed by way of example in Table 7, to meet the requirements for its intended use; or

(b) where Clause 5.6.18.3(a) is not applicable—

(i) the Cable should comply with the following Clauses of this Standard:

5.6.6.1 Conductor composition;
5.6.6.2 Electrical withstand voltage;
5.6.6.5 Insulation resistance;
5.6.7 Continuous metallic shield (if applicable); and

(ii) where the Cable is intended to be used as a Telephone Cable, it **shall** comply with the following Clauses of this Standard:

5.6.6.3 Mutual capacitance;
5.6.6.4 Capacitance unbalance.

Table 7
Australian Standards applicable for cables used in special applications

Cable type	Standard to be tested to	Name of Standard	Additional notes
Multicore control Cables (Screened and unscreened polymeric insulated multicore control Cables)	AS/NZS 5000.3 [13]	Electrical cables – polymeric insulated. Multicore control cables	Intended for use in control, supervisory, protection and instrumentation circuits. This Standard does not apply to Cables that are used solely for telecommunications purposes.
Twisted pair control Cables (Screened polyethylene (PE) insulated twisted pair control Cables)	AS/NZS 2373 [8]	Twisted Pair Control Cables	Intended for use in control, supervisory, protection and instrumentation circuits. This Standard does not apply to Cables that are used solely for telecommunications purposes.
Fire resistant or retardant rated Cable (with polymeric materials)	AS/NZS 5000.1 [11]	Electric cables-Polymeric insulated. For working voltages up to and including 0.6/1 kV	This Standard does not apply to specialised polymeric insulated Cables for which there are separate AS/NZS Standards, e.g. flexible lift control Cables, neutral screened Cables, and aerial bundled Cables.
	AS/NZS 5000.2 [12]	Electric cables-Polymeric insulated. For working voltages up to and including 450/750 V	
Pyro MIMS (mineral-insulated metal sheathed) Cables (with copper conductors and sheaths)	AS/NZS 60702 [17]	Approval and test specification-Terminations and glands for mineral-insulated metal-sheathed cables	Often used in telecommunications installations to connect the fire alarm panel to the Carrier's network.
Reeling and trailing Cables	AS/NZS 1802 [6]	Electric cables-Reeling and trailing- For underground coal mining purposes	For underground mining purposes.
Flexible Cord, unscreened PVC insulated, multicore, sheathed or unsheathed	AS/NZS 3191 [10]	Flexible Cords	Often used in Fire Alarm situations between fire alarm panel and warning devices.
Other applications • Hybrid Cables	The relevant Standard for the non-telecommunications component of the Cable		The equivalent of double insulation is to be provided between any power component and the telecommunications component of the Cable.
• Other Cables	Clause 5.6.18.3 of this Standard		

5.6.19 ES3 generic cable

ES3 Generic Cable **shall**—

(a) comply with the requirements of Clause 5.6.11 for metallic paired Cable;

(b) have a maximum conductor resistance of 0.0938 Ω/m at 20°C;

(c) have an outer sheath colour *Homebush Gold* (as defined in AS 2700) [9]; and

(d) be clearly labelled 'ES3 circuit' every 2 m in the colour *Homebush Red* (as defined in AS 2700 [9]).

Note 1: Generic Cable may include one pair, four pair or multipair Cables.

Note 2: 0.5 mm nominal conductor diameter (24 AWG) would typically meet the requirement in Item (b).

5.7 Connecting hardware, including plugs and sockets of all designs

5.7.1 General

5.7.1.1 Insulation resistance

The insulation resistance between any two points which are required to be electrically insulated **shall** be a minimum of 100 MΩ. The insulation resistance measurement is to be made after 500 V ± 50 V d.c. has been applied for a period of 60 s.

Compliance with Clause 5.7.1.1 should be checked using the method specified in IEC 60512-3-1 [26].

5.7.1.2 Contact resistance

5.7.1.2.1 Insulation Displacement contacts

The contact resistance of the interface between a single insulated solid or stranded conductor and a single Insulation Displacement (ID) contact in Connecting Hardware other than the types of plugs and sockets covered in Clauses 5.7.2, 5.7.3 and 5.7.4 **shall** comply with the requirements of IEC 60352-4 [25] Clause 12.3.1, including Table 2 of that Clause.

5.7.1.2.2 Plug and socket connection

For connectors using a plug and socket, including the connection of shield or drain-wire conductors, other than the types of plugs and sockets described in Clauses 5.7.2, 5.7.3 and 5.7.4, the interface resistance of the overall mated connection or shield connection **shall not** exceed 50 mΩ when measured between the Cord terminated on the plug and the Cable terminated on the socket using the test method described in Clause 12.3.1 of IEC 60352-4 [25].

Note 1: Annex N of AS/NZS 62368.1 [19] gives recommendations for avoiding certain combinations of different metals, the combination of which could lead to corrosion.

Note 2: Annex N of AS/NZS 62368.1 [19] is equivalent to Annex J of AS/NZS 60950.1 [18].

5.7.1.3 Electric strength

The insulation of electrically conductive elements in Connecting Hardware **shall** have a minimum dielectric withstand capability of 1.5 kV for 60 s in accordance with Clause 6.4.2 of IEC 60603-7 [27].

5.7.1.4 Protection against contact with exposed circuits

Connectors, plugs and sockets with metallic conductors and shields **shall** comply with the blunt probe test of Clause 5.4.10.1(b) (Separation requirements) of AS/NZS 62368.1 [19].

Note: Clause 5.4.10 of AS/NZS 62368.1 [19] is equivalent to Clause 6.2.1(b) of AS/NZS 60950.1 [18].

5.7.1.5 Weather resistance

Plugs and sockets intended for use in situations exposed to weather and damp areas **shall** have a minimum degree of protection of IPX3 against the ingress of water when tested in accordance with AS 60529 [15].

Compliance with Clause 5.7.1.5 should be checked with a plug both inserted into and removed from the socket.

5.7.1.6 Access to cable terminations

All telecommunications terminations **shall** be enclosed or located to prevent unintentional contact with voltages other than ES1 by an Ordinary Person.

Note: Although it is permissible to allow an Ordinary Person to come into personal contact with ES1 circuits this should be prevented where practicable.

5.7.1.7 Prohibited arrangements

A connecting device's faceplate for telecommunications wiring **shall not** incorporate a mains power fixed socket-outlet or switch.

Note: This is also a prohibited arrangement under AS/NZS 3112.

5.7.2 Eight (8) position modular plugs and sockets

In addition to the general requirements of Clause 5.7.1, eight (8) position modular plugs and sockets **shall** comply with the following Clauses of IEC 60603-7 [27]:

6.4.2 Voltage proof

6.4.3 Current - temperature derating

6.4.4 Initial contact resistance

6.6.1 Mechanical operation (Cycle)

6.6.2 Effectiveness of a connector coupling device

5.7.3 Six (6) position modular plugs and sockets

5.7.3.1 Modular Plugs and sockets

Six (6) position modular plugs and sockets **shall**—

(a) be mechanically designed according to CFR FCC 47 Figure 68.500(a) and (b) [33]; and

(b) in addition to the general requirements of Clause 5.7.1, **shall** comply with the following Clauses of IEC 60603-7 [27]:

6.4.2 Voltage proof

6.4.3 Current - temperature derating

6.4.4 Initial contact resistance

6.6.1 Mechanical operation (Cycle)

6.6.2 Effectiveness of a connector coupling device

5.7.3.2 Modular 6P plug compatibility with 8P sockets

A six (6) position modular plug (for compatibility with eight (8) position sockets (8P8C)) should—

(a) be mechanically designed according to CFR FCC 47 Figure 68.500(a)(2)(i) including Notes 6,7,8 and 9 [33]; and

(b) to avoid possible damage to the 8P8C socket, incorporate two additional grooves/slots in the plug moulding according to CFR FCC 47 Figure 68.500(a)(3)(i) – Note 3 [33]; to suit contacts 1 and 8 of 8P8C socket CFR FCC 47 Figure 68.500(d) [33].

Note: Refer to Figure C1 in Appendix C.

5.7.3.3 Adaptor ('8P-to-6P insert')

In this clause, an 'adaptor' is a device used to align a six (6) position modular plug in an eight (8) position modular socket. The adaptor, which restricts the socket entry width to that of a six (6) position modular socket, is intended to prevent sideways or angular movement of the plug, which may damage the contacts of the wider socket.

An adaptor should be mechanically designed in accordance with Figure C2.

5.7.4 600 series plugs and sockets

600 series plugs and sockets **shall** comply with Appendix A.

Note: 600 series plugs and sockets are not recommended for new installations.

5.8 Cabling products for underground and aerial installations

5.8.1 Pits and access holes

5.8.1.1 Moisture and sunlight

The structural and mechanical integrity of a Pit Or Access Hole Product **shall not** be adversely affected by long-term exposure to moisture and sunlight (UV radiation).

Compliance should be checked on the basis of known properties of the materials used.

5.8.1.2 Labelling of covers

A cover which is a component of a Pit Or Access Hole Product, other than a cover designed to be infilled on site, **shall** be legibly and permanently labelled with the word 'Communications' or 'Comms', to distinguish the pit or access hole from pits of other services.

5.8.1.3 General product information

Illustrated information **shall** be provided for a Pit Or Access Hole Product, which is to include—

(a) the intended range of installation environments (e.g. lawn, footway, driveway, roadway, airport taxiway); and

(b) a statement from a Registered Structural Engineer describing the tests and methods used by the manufacturer to demonstrate structural integrity.

Note 1: Testing of a pit or access hole should be carried out with covers in place. If a product is supplied without covers, compatible covers should be used in testing, and the type used should be stated.

Note 2: Pit risers and other modular parts should be tested as part of a complete pit or access hole. Installation instructions for a pit riser should describe how to integrate the pit riser with a compatible pit body and covers, and give all other applicable methods and information, such as a method for integrating the top of the pit riser with the surrounding terrain.

Note 3: The structural integrity requirements in AS/CA S008:2010 have been replaced by the Registered Structural Engineer's statement as the former requirements were not suitable for all types of pit and access hole products.

Note 4: AS/CA S009 Section 18.1 [20] contains requirements for a cabling provider to obtain certification from a Registered Structural

Engineer for any pit or access hole installed or constructed in an area likely to be subject to heavy loads.

5.8.1.4 Specific methods

Information for a Pit Or Access Hole Product **shall** be provided either as an illustrated method for carrying out the operation named, or a statement that the operation is not applicable to the product, on the following topics:

(a) Installing the product in specific soil conditions.

(b) Making sealed entries for Conduits and direct buried Cables.

(c) Closing over redundant Conduit or cable entries.

(d) Interfacing the top of the product with the surrounding terrain (e.g. lawn, rolled asphalt, paving bricks) to minimise formation of trip hazards and minimise damage to the product during maintenance or alteration of the adjacent area.

(e) Adjusting the top of the product to a new level or new angle after initial installation.

(f) Installing the product over an existing Cable to provide access to the Cable.

(g) Operating and maintaining all movable parts of the product, such as covers.

(h) Attaching Cable bearers, joint mounting brackets and other supports for cabling, to the product.

Note: Recommended fixing methods for Cable bearers should take likely sources of strain into account.

5.8.1.5 Information to be provided with pits and access holes

Directions for readily obtaining the information required by Clauses 5.8.1.3 and 5.8.1.4. **shall** be provided with a Pit Or Access Hole Product.

Note: The most substantial part of the Pit Or Access Hole Product should be prominently labelled with a brand name, a model number, the words 'installation instructions' and the address of a page on the World Wide Web, a page which contains a direct link to the required information.

5.8.1.6 Compatibility information

Information should be provided about whether a Pit Or Access Hole Product is intended to be compatible with any common designs of pit, access hole, pit riser, pit collar, cover, cover gasket, cover frame, crossbar, Cabling support, or similar item.

5.8.1.7 Hazards arising from misuse or mis-installation

A description should be provided of any hazards which are likely to arise from common forms of misuse or mis-installation of a Pit Or Access Hole Product.

5.8.1.8 Supplementary product information

Supplementary product information for a Pit Or Access Hole Product should be available, as the manufacturer's standard product information may not cover every potential application for the product.

5.8.2 Underground joint/termination enclosures

The following requirements apply to underground joint/termination Enclosures:

(a) Underground Enclosures **shall** provide protection of the joint or termination of at least IPX8 in accordance with AS 60529 [15], with test conditions to simulate normal conditions of use.

(b) The test **shall** be carried out with a depth of 500 mm of water for a duration of 24 hours.

(c) Enclosures which are re-openable **shall** be opened and closed 10 times prior to the test.

(d) Terminations may form part of the Enclosure or they may be separate. In either case the terminations **shall** be protected to at least IPX8 in accordance with AS 60529 [15] when installed in the Enclosure. See Clause 5.8.2(a) above.

Note: For testing purposes, Cable may be required to be supplied by the manufacturer.

5.8.3 Underground and Aerial Cable terminations

Underground and aerial terminations **shall** comply with Clauses 5.7.1.1 to 5.7.1.4.

5.8.4 Pillars and cabinets

The following requirements apply to pillars and cabinets:

(a) The mechanical integrity of pillars and cabinets **shall not** be adversely affected by long-term exposure to moisture and sunlight (UV radiation).

Compliance with Clause 5.8.4(a) should be checked on the basis of known properties of the materials used.

(b) Pillars and cabinets **shall** provide protection of at least IPX3 in accordance with AS 60529 [15] after opening and closing 10 times prior to the test.

(c) Provision **shall** be made for locking pillars and cabinets.

(d) Terminations within pillars and cabinets **shall** comply with Clauses 5.7.1.1 to 5.7.1.4.

(e) Pillars and cabinets should be legibly and permanently labelled to distinguish them from those used for other services.

5.8.5 Aerial joint/termination enclosures

The following requirements apply to aerial joint/termination Enclosures:

(a) Aerial Enclosures **shall** provide protection of the joint or termination of at least IPX3 in accordance with AS 60529 [15].

(b) Enclosures that are re-openable **shall** be opened and closed 10 times prior to the test.

(c) Covers of aerial Enclosures should be removable to allow access to terminations when installed.

(d) Aerial Enclosures **shall** provide double insulation from internal terminations to 230 V a.c. mains grade in accordance with AS/NZS 62368.1 [19].

(e) The mechanical integrity of aerial Enclosures **shall not** be adversely affected by long-term exposure to weather and sunlight (UV radiation).

Compliance with Clause 5.8.5(e) should be checked on the basis of known properties of the materials used.

(f) Terminations may form part of the aerial Enclosure or may be separate. In either case the terminations **shall** be protected to at least IPX3 in accordance with AS 60529 [15] when installed in the Enclosure.

Note: Terminations in aerial Enclosures also need to comply with Clauses 5.7.1.1 to 5.7.1.4.

APPENDIX A (Normative)
600 SERIES PLUGS AND SOCKETS

A.1 General

600 series plugs and sockets **shall** comply with this Appendix A.2 to A.5.

Note 1: 600 series sockets are not recommended for new installations but are still supplied as spare parts for older installations. See Clause 5.7.4 of this Standard.

Note 2: Appendix C of AS/CA S009 [20] provides more information about 600 series sockets.

A.2 Contact composition

Contact metal **shall** be composed of solid Monel Alloy 400 in accordance with the standard composition of nickel copper alloy type NA 13.

A.3 Mechanical compatibility

Sockets should be designed to accept one or more of the 600 series plugs. The nominal mating dimensions of 600 series plugs and sockets **shall** be in accordance with Figure A1.

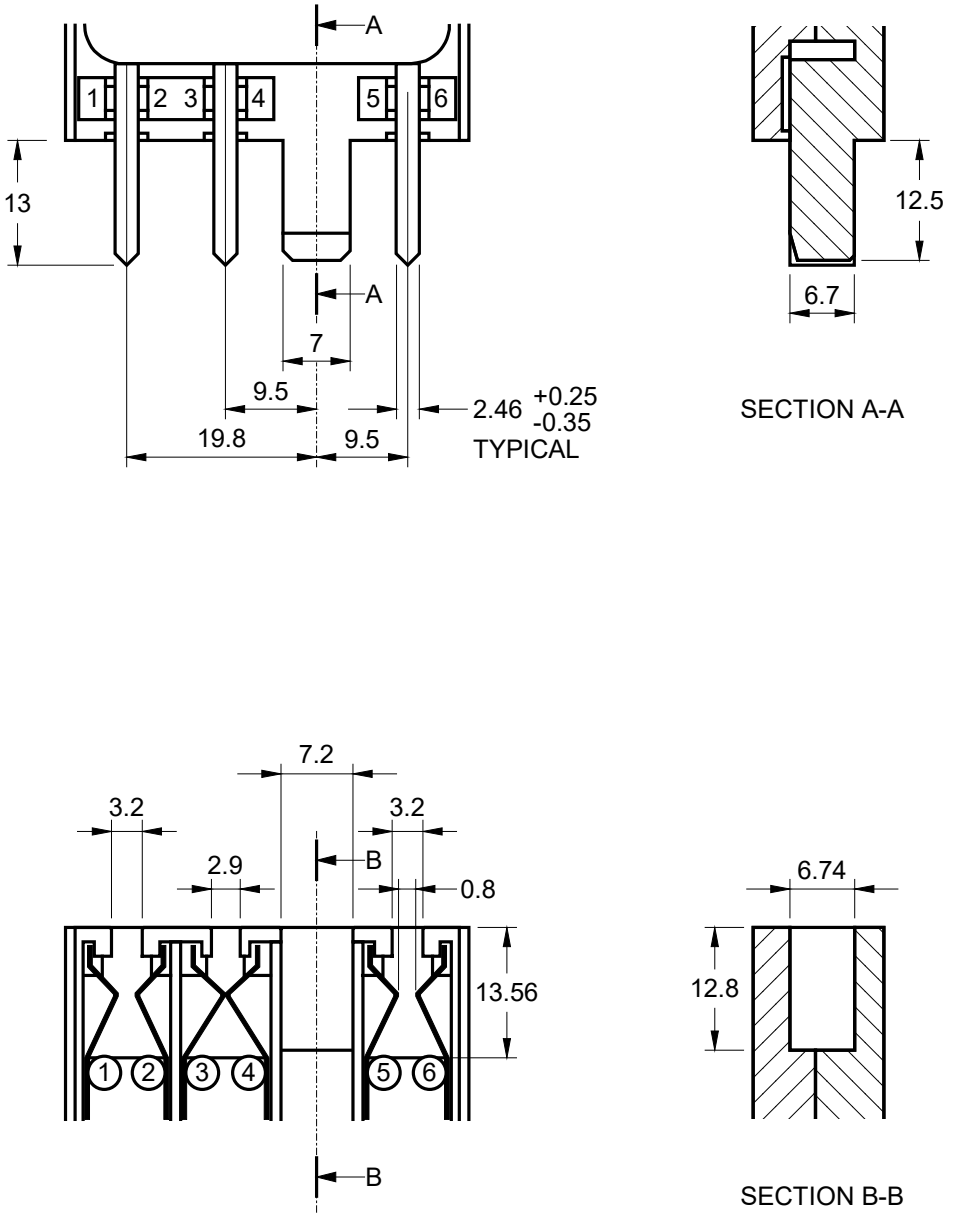
Note: Sockets may incorporate switching facilities that operate on the insertion and withdrawal of the plug.

A.4 Connections

Plugs and sockets **shall** have, as a minimum, electrical connections corresponding to contacts 2 and 6 in accordance with Figure A1.

A.5 Resistance of plug/socket combination

With the plug inserted into the socket, the maximum resistance between the Cord terminated onto the plug and the Cable terminated onto the socket **shall not** exceed 50 mΩ when tested with an applied voltage not exceeding 50 mV d.c. and an applied current not exceeding 100 mA.



Note 1: On both views, the cover has been removed for clarity.

Note 2: Dimensions are in mm.

Figure A1

Mating dimensions for 600 series plugs and sockets

APPENDIX B (Informative)
CABLE COLOUR CODES

Common colour codes for various types of Cable are described in AS/CA S009 [20] Tables B1 to B7. These tables are reproduced here to provide continuity between the Standards. Cable manufacturers usually follow these colour codes. Cables are required to use some method of coding that enables pairs and conductors to be visually distinguishable from one another (refer to Clause 5.6.2 of this Standard) but it is not mandatory for cable manufacturers to follow these colour codes.

Table B1

2-pair (quad) and 3-pair telephone cable colour code

Pair Number	Colours
1	White Blue
2	Red Black
3	Orange Green

Table B2

4-pair cable colour code

Pair number	Colour code variations		
1	White Blue	White-Blue Blue	White-Blue * Blue-White *
2	White Orange	White-Orange Orange	White-Orange * Orange-White *
3	White Green	White-Green Green	White-Green * Green-White *
4	White Brown	White-Brown Brown	White-Brown * Brown-White *
* The first-named colour is the predominant colour			

Table B3

Colour code for 5-pair to 100-pair cables (20-pair units)

Pair number	A Leg (L+)	B Leg (L-)
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	White	Blue-White
7	White	Blue-Orange
8	White	Blue-Green
9	White	Blue-Brown
10	White	Blue-Grey
11	White	Orange-White
12	White	Orange-Green
13	White	Orange-Brown
14	White	Orange-Grey
15	White	Green-White
16	White	Green-Brown
17	White	Green-Grey
18	White	Brown-White
19	White	Brown-Grey
20	White	Grey-White

Pair range	Mate colour
1-20	White
21-40	Yellow
41-60	Black
61-80	Violet
81-100	Red

Note: These Cables are normally constructed using layer stranding, with the pair count sequence commencing from the centre and progressing through successive outer layers.

Table B4

Colour code for 25-pair to 100-pair cables (25-pair units)

Pair number	Mate	Colour
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Grey
11	Black	Blue
12	Black	Orange
13	Black	Green
14	Black	Brown
15	Black	Grey
16	Yellow	Blue
17	Yellow	Orange
18	Yellow	Green
19	Yellow	Brown
20	Yellow	Grey
21	Violet	Blue
22	Violet	Orange
23	Violet	Green
24	Violet	Brown
25	Violet	Grey

Pair range	Whipping colour
1-25	Blue
26-50	Orange
51-75	Green
76-100	Brown

Note 1: 50 to 100 pair Cables are constructed with 25 pair sub-units and coloured whipping.

Note 2: The mate conductor may include a thin band of the corresponding colour, while the coloured conductor may have a thin band of the corresponding mate colour.

Table B5

Colour code for 5-pair to 100-pair cables (10-pair units)

Pair number	A Leg (L+)	B Leg (L-)
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Grey

Pair range	Whipping colour
1-10	Blue
11-20	Orange
21-30	Green
31-40	Brown
41-50	Grey
51-60	Blue-White
61-70	Orange-White
71-80	Green-White
81-90	Brown-White
91-100	Grey-White

Table B6

Colour code for 5-pair to 200-pair cables (10-pair units)

Pair number	A Leg (L+)	B Leg (L-)
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Grey

Pair range	Whipping colour
1-10	Blue-White
11-20	Orange-White
21-30	Green-White
31-40	Brown-White
41-50	Grey-White
51-60	Blue-Blue
61-70	Orange-Orange
71-80	Green-Green
81-90	Brown-Brown
91-100	Grey-Grey
101-110	White-White
111-120	Red-Red
121-130	Yellow-Yellow
131-140	Violet-Violet
141-150	Black-Black
151-160	Blue-Red
161-170	Orange-Red
171-180	Green-Red
181-190	Brown-Red
191-200	Grey-Red

Table B7 14
Optical fibre colour code

Fibre number	Colour
1	Blue
2	Orange
3	Green
4	Brown
5	Grey
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Pink
12	Aqua

Note 1: This colour code applies to both loose tube and tight buffered fibre.

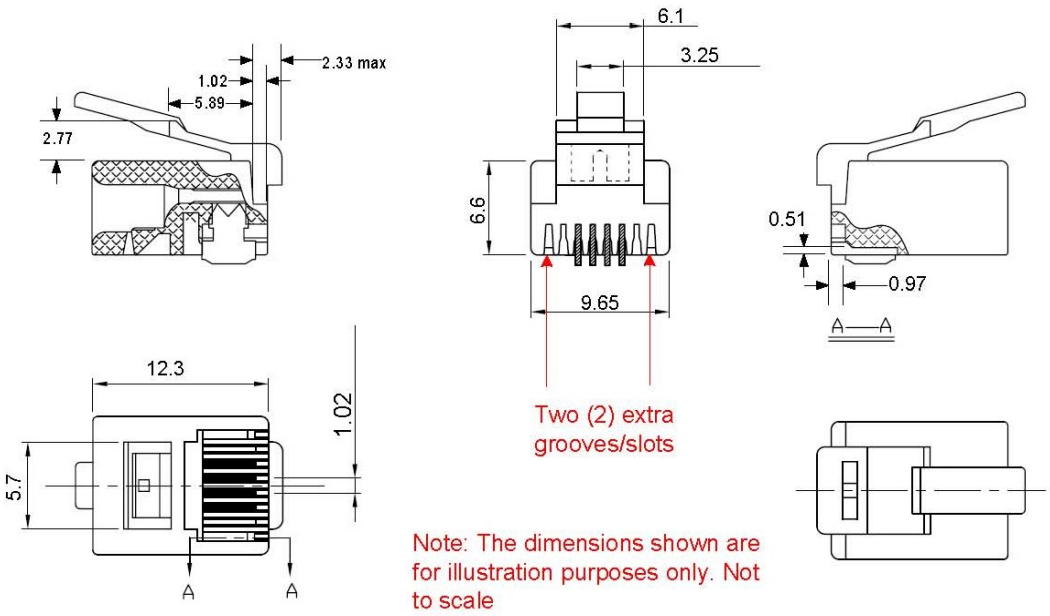
Note 2: For stranded (multiple) loose tube constructions, the tube colour sequence is the same as the fibre colour sequence.

Note 3: Units containing more than 12 fibres can be identified by combining the basic twelve colours sequence with an added identification (e.g. ring marking, dashed mark, tracer or coloured unit binders).

APPENDIX C (Informative)
MODULAR PLUGS

C.1 Six (6) position modular plugs

Figure C1 shows a six (6) position modular plug demonstrating compatibility with an eight (8) position modular socket (8P8C).



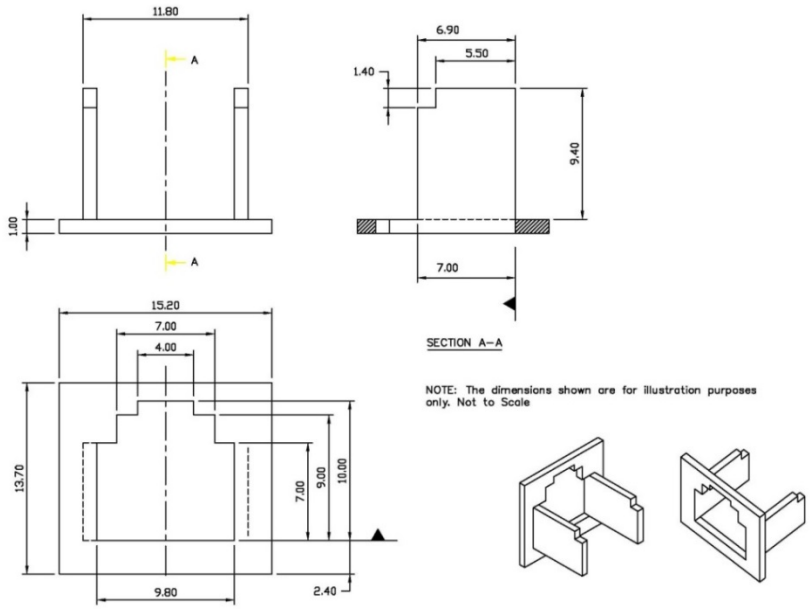
Note: Dimensions are in mm.

Figure C1

Two extra grooves/slots in six (6) position modular plug

C.2 Adaptor

Figure C2 shows an adaptor, commonly known as an '8P-to-6P insert', designed for connection of a six (6) position modular plug into an eight (8) position modular socket.



Note: Dimensions are in mm.

Figure C2
Illustration of 8P-to-6P Adaptor

APPENDIX D (Normative)
AS/NZS 60950.1 and AS/NZS 62368.1 EQUIVALENCE

D.1 General

AS/CA S008 has been revised to use the terminology and requirements of the AS/NZS 62368.1 [19] equipment safety Standard, which was published on 15 February 2018 as a replacement for AS/NZS 60950.1 [18].

As documented in the preface of AS/NZS 62368.1 [19], AS/NZS 60950.1 [18] is to be superseded four years after publication of AS/NZS 62368.1 [19]. Either Standard may be complied with during this four-year transition period, but the compliance report is to be based on requirements from only one of the two Standards.

During the transition period, references to AS/NZS 62368.1 [19] safety clauses and terminology in AS/CA S008 may be replaced with references to the equivalent clauses in AS/NZS 60950.1 [18] for a customer Cabling product that has been assessed to AS/NZS 60950.1 [18].

After the transition period, requirements of AS/NZS 60950.1 [18] may no longer be substituted for the AS/NZS 62368.1 [19] requirements and terminology in the compliance report.

AS/NZS 62368.1 [19] uses different terminology from AS/NZS 60950.1 [18]. To aid with the transition process in AS/CA S008, this Appendix specifies how equivalence between the two referenced safety Standards is implemented.

The term and definition for ELV is an exception to the above, since AS/CA S008 [15] uses the term with respect to electrical building wiring in accordance with AS/NZS 3000, even though the term is no longer used in AS/NZS 62368.1 [19].

D.2 Definitions for use with AS/NZS 60950.1 products

D.2.1 Extra-low voltage (ELV)

ELV is a voltage not exceeding 42.4 V peak or 60 V d.c.

Note: This differs from the ELV definition contained in AS/NZS 3000, which is more closely aligned to the TNV limits described below, i.e. 120 V d.c. or 70.7 V a.c. peak (50 V a.c. r.m.s.).

D.2.2 Safety Extra Low Voltage (SELV) circuit

An SELV Circuit is a secondary circuit which is so designed and protected that—

(a) under normal operating conditions, its voltages do not exceed ELV limits at any time; and

(b) under single fault conditions, its voltages do not exceed ELV limits for longer than 200 ms and, in any case, do not exceed 71 V peak or 120 V d.c. at any time.

Note 1: An example of an SELV Circuit is a power feed from a battery or a double insulated ‘plug pack’.

Note 2: Adapted from AS/NZS 60950.1 [18].

Note 3: A circuit that meets the above requirements, but which is subject to overvoltages from a Telecommunications Network or a cable distribution system, is classified as a TNV circuit.

D.2.3 Telecommunications network voltage (TNV)

TNV is a voltage not exceeding—

(a) when telephone ringing signals are not present—

(i) 71 V peak or 120 V d.c.; or

(ii) if a combination of AC voltage and DC voltage is present, the sum of the AC peak voltage divided by 71 and the DC voltage divided by 120 must not exceed 1; and

(b) when telephone ringing signals are present, voltages such that the signal complies with the criteria of either Clause M.2 or Clause M.3 of AS/NZS 60950.1 [18] (the signal is required to be current limited and cadenced).

[Adapted from AS/NZS 60950.1 [18].]

D.2.4 Hazardous voltage

A hazardous voltage is a voltage exceeding ELV limits existing in a circuit which does not meet the requirements for either a limited current circuit or a TNV circuit as defined in AS/NZS 60950.1 [18].

D.2.5 Restricted access location

A restricted access location is a locked room or Enclosure where appropriate signage is used to ensure accidental access is not obtained by persons who are not qualified or authorised to gain access.

D.3 Definitions for use with products complying with AS/NZS 62368.1

For the purposes of this Standard, ES1, ES2 and ES3 refer to voltage and current classifications only.

Voltage and current limits for ES1, ES2 and ES3 are those specified in AS/NZS 62368.1 [19].

Note: There is no voltage and current limits for ES3.

D.3.1 Electrical Energy Source Class 1 (ES1)

ES1 is a class 1 electrical energy source with touch current or prospective touch voltage levels not exceeding ES1 limits under—

(a) normal operating conditions;

(b) abnormal operating conditions; and

(c) single fault conditions of a component, device or insulation not serving as a safeguard;

and not exceeding ES2 limits under single fault conditions of a basic safeguard or of a supplementary safeguard.

ES1 may be accessible to an Ordinary Person.

Note: ES1 provides the equivalent level of safety to SELV as specified in AS/NZS 60950.1 [18].

[Source: Adapted from AS/NZS 62368.1 [19]]

D.3.2 Electrical Energy Source Class 2 (ES2)

ES2 is a class 2 electrical energy source where—

(a) both the prospective touch voltage and the touch current exceed the limits for ES1; and

(b) under—

(i) normal operating conditions;

(ii) abnormal operating conditions; and

(iii) single fault conditions;

and either the prospective touch voltage or the touch current does not exceed the limit for ES2.

At least one basic safeguard is required between ES2 and an Ordinary Person. ES2 may be accessible to an Instructed Person and a Skilled Person.

A circuit with telephone ringing signals as defined in Annex H of AS/NZS 62368.1 [19] is also considered ES2.

Note: ES2 provides the equivalent level of safety to ELV as specified in AS/NZS 60950.1 [18].

[Source: Adapted from AS/NZS 62368.1 [19]]

D.3.3 Electrical Energy Source Class 3 (ES3)

ES3 is a class 3 electrical energy source where both the prospective touch voltage and the touch current exceed the limit for ES2.

Note 1: ES3 is considered hazardous.

Note 2: ES3 provides the equivalent level of safety to Hazardous Energy Source as specified in AS/NZS 60950.1 [18].

[Source: Adapted from AS/NZS 62368.1 [19]]

D.4 Comparison of AS/NZS 60950.1 and AS/NZS 62368.1 terms

An informative comparison of terms between AS/NZS 62368.1 [19] and earlier standards can be found in Annex W of AS/NZS 62368.1 [19]. Table W.3 of

AZ/NZS 62368.1 [19] compares AS/NZS 60950.1 [18] terms with AS/NZS 62368.1 [19] terms. The following guidelines in Table D1 are provided for information only. Where terms are compared, it means that they provide equivalent safety outcomes, provided all the requirements in the applicable standard have been fulfilled. Equivalence in these cases does not mean the technical parameters are identical.

Table D1

AS/NZS 60950.1 comparison of terms with AS/NZS 62368.1

AS/NZS 60950.1	AS/NZS 62368.1	Notes
ELV	ES2	ELV (up to 42.4 V peak or 60 V d.c. in AS/NZS 60950.1 [18]) is separated from Hazardous Energy Source by basic insulation only. ELV may receive transient voltages or currents from circuits external to the building, as such it is classified as ES2 for the purposes of this Standard.
SELV	ES1	SELV (60 V d.c. or 42.4 V peak) and ES1 both have protection against Hazardous Energy Source by double or reinforced insulation (safeguards) and both may be touched by the user (Ordinary Person).
Limited current circuit	ES1	In AS/NZS 60950.1 [18] a limited current circuit is limited to 2 mA d.c. or 0.7 mA peak. AS/NZS 62368.1 [19] does not use the term 'limited current circuit' but does, have comparable requirements by way of current limits for ES1.
TNV	ES2	Telecommunications Network Voltage can be one of three levels. Generally, TNV-1 is up to 60 V d.c. but may have higher transients from circuits external to the building; TNV-2 is up to 120 V d.c. but no transients; TNV-3 is up to 120 V d.c. but may have transients. The Ordinary Person must be separated from contact with possible transient circuits. All TNV circuits are classified as ES2 unless a professional engineer advises otherwise for each situation.
Hazardous voltage	ES3	AS/NZS 62368.1 [19] does not use the term 'hazardous'. Instead it states that any electrical energy source exceeding ES2 limits is classified as ES3 and as such is classified as hazardous. ES3 circuits must not be accessible to the Ordinary Person or the Instructed Person by the use of double or reinforced safeguards. The Skilled Person may have access to ES3 for safe work but protection must be provided to guard against accidental contact with another class 3 electrical energy source.

BIBLIOGRAPHY

This bibliography contains information about documents referred to in notes and informative appendices in this Standard. Further information on the listed documents, including how to obtain copies, can be found on the following internet sites:

www.iec.ch
www.saiglobal.com
www.standards.org.au

Australian Standards

AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

AS/NZS 3112 Approval and test specification - Plugs and socket-outlets

AS/NZS 4117 Surge Protection Devices for Telecommunication Applications

International Standards

IEC 60950-22 Information technology equipment - Safety - Part 22: Equipment to be installed outdoors

PARTICIPANTS

The Working Committee responsible for the revisions made to this Standard consisted of the following organisations:

Organisation	Membership
Amazon	Voting
Australian Communications and Media Authority (ACMA)	Non-voting
Australian Digital & Telecommunications Industry Association (ADTIA)	Voting
Building Industry Consulting Service International (BICSI South Pacific)	Voting
Casa Systems	Voting
CommScope	Non-voting
Cumarsáid	Voting
nbn	Voting
National Electrical and Communications Association (NECA)	Voting
Optus	Voting
Prysmian	Voting
Siemon Company	Voting
Telstra	Voting
The University of Sydney	Voting

This Working Committee was chaired by Murray Teale of VTI Services. Mike Johns and James Duck of Communications Alliance provided project management support.

Communications Alliance was formed in 2006 to provide a unified voice for the Australian communications industry and to lead it into the next generation of converging networks, technologies and services.

In pursuing its goals, Communications Alliance offers a forum for the industry to make coherent and constructive contributions to policy development and debate.

Communications Alliance seeks to facilitate open, effective and ethical competition between service providers while ensuring efficient, safe operation of networks, the provision of innovative services and the enhancement of consumer outcomes.

It is committed to the achievement of the policy objective of the Telecommunications Act 1997 - the greatest practicable use of industry self-regulation without imposing undue financial and administrative burdens on industry.

Published by:
COMMUNICATIONS ALLIANCE LTD

Level 12
75 Miller Street
North Sydney
NSW 2060 Australia

Correspondence
PO Box 444
Milsons Point
NSW 1565

T 61 2 9959 9111
F 61 2 9954 6136
E info@commsalliance.com.au
www.commsalliance.com.au
ABN 56 078 026 507

1 74000 458 2

Safety issues that should be paid attention to in the FTTH aerial cable installation solution

Views: 38 Author: Curry Publish Time: 2023-03-09 Origin: Site

When it comes to the installation of **FTTH** (Fiber-To-The-Home) aerial cables, there are several safety issues that should be considered to ensure the safety of workers and the public. Here are a few examples:

Working at height: Aerial cable installation involves working at height, which presents a significant risk of falls. Workers should be trained in safe working at height practices, and the proper personal protective equipment (PPE) should be worn, including fall protection gear and hard hats.

Electrical hazards: Some **aerial cables** carry electrical signals, which can pose a risk
be trained in electrical safety procedures, and the cables should be clearly marked

Weather conditions: **Aerial cable installation** is often performed outdoors, which means workers may be exposed to extreme weather conditions. Workers should be trained in how to work safely in adverse weather conditions and should be provided with appropriate PPE, such as rain gear or sun protection.

Traffic control: Aerial cable installation can sometimes impact roadways or other public areas. Traffic control measures should be put in place to protect workers and the public, including the use of cones, barriers, and warning signs.

Equipment and tools: The use of **equipment and tools**, such as ladders, hoists, and cutting tools, can pose a risk of injury. Workers should be trained in the safe use of equipment and tools, and all equipment should be properly maintained and inspected regularly.

Chemical hazards: Some chemicals, such as adhesives and solvents, may be used during aerial cable installation. Workers should be trained in the safe handling and use of these chemicals, and appropriate PPE should be provided, such as gloves and eye protection.

Environmental hazards: Aerial cable installation can have an impact on the environment, such as disturbing wildlife or damaging vegetation. Workers should be trained in environmental protection procedures and should take steps to minimize any environmental impact.

By paying attention to these safety issues and implementing appropriate safety measures, the risks associated with FTTH aerial cable installation can be minimized, helping to ensure the safety of workers and the public.

FCST - Better FTTx, Better Life.

We have been designing, manufacturing and supplying passive components
for fiber optical networks since 2003. Everything we do in FCST is designed to provide efficient, simple and innovative solutions to solve complicated tasks.
We offer 4 solutions

- ·FTTH ODN Solution
- ·Underground Cable Installation Solution
- ·**Aerial Cable Installation Solution**
- ·Fiber Tools & Test Solution

As a FTTx solution supplier, we can also do ODM according to project. We will continue to innovate and contribute more to the construction of the global optical fiber network.

Previous : What are the advantages of F...

Next : Global telecommunication exhibiti...

Aerial Cable Installation | Aerial Cable Installation Solution | ODN aerial cable installation Anchoring Tension Clamp | overhead cable clamp For Aerial Cable Installation | fiber-to-the-home | Working at height | Electrical hazards | Weather conditions | Traffic control | Equipment and tools

Related Products

NF-1609 PA Wedge Clamp

NF-1671B100-200-E-J Pole Hoop With Anc...

NF-1672B100-200-2E Embr

Contact us

*Name

*Email

Tel

Company

*Message

Submit

Contact Us

+86 21 3872 6791

+86 21 3872 6792

sales@fcst.com

Rm402 block A Watts gallop tower No.2816 YiXian Rd, BaoShan District, Shanghai 200441.

Our Products

Our Products

Solution

Professional · Accurate · Prompt · Reliable
Better FTTx, Better Life.

Quick Links

Quick Links

THE UNIVERSITY OF SYDNEY

Parts List for Communications Cabling

Department	Information and Communications Technology
Version update	January 2022
Version control	8.0
Document location	sydney.edu.au/ict/university-cabling-standards.shtml

Table of Contents

1. Viewing of samples

Samples of all small parts listed below can be viewed at:

University of Sydney ICT

316 Abercrombie St

Darlington NSW 2006

Please contact ICT's Communications Infrastructure Analyst Jennifer Sayers on (02) 8627 7840 to view them.

2. Racks

Almost all new installations at the University use lab racks (open frame racks) instead of cabinets. The rack sets have vertical cable managers.

2.1. New rack sets in communications rooms

For new communications rooms and replacement of racks in existing communications rooms, these racks are to be used:

Brand	Part no.	Description	How many to supply
Argent	OSA-4501-FRAME	45RU Open Frame (rack)	*n*
Argent	OSA-45CM300-250	45RU Vertical cable manager 300mm wide × 250mm deep	*2 × n*
Argent	OSA-45CM300-450	45RU Vertical cable manager 300mm wide × 450mm deep	*2 × n*
Argent	OSA-5ARG-H-BRACKET	H bracket	*2 × n*
Argent	OSA-SPOOL-195	Cable slack spool 195mm long	*6 × n*
Argent	OSA-5ARG-89151	Hold down bracket	*2 × n*

Table 2-1: Racks parts for new and replacement rack sets

The H bracket is used to join the front and back vertical cable managers together at the top. The hold down brackets fix the vertical cable managers to the floor. The hold down brackets are marked for left and right, but should be installed reversed, so that the bracket sits underneath the cable manager, not sticking out as a trip hazard.

These 45RU racks may not fit in rooms with **low ceilings**. When they will not fit, obtain approval from ICT to supply a different model.

Some other parts are available for this rack system. These other parts may not be used unless authorised by ICT:

Brand	Part no.	Description
Argent	OSA-45CM150-250	45RU Vertical cable manager 150mm wide × 250mm deep

Table 2-2: Rack parts requiring ICT authorisation for use

These Argent racks fit into the standard comms room layout as follows:

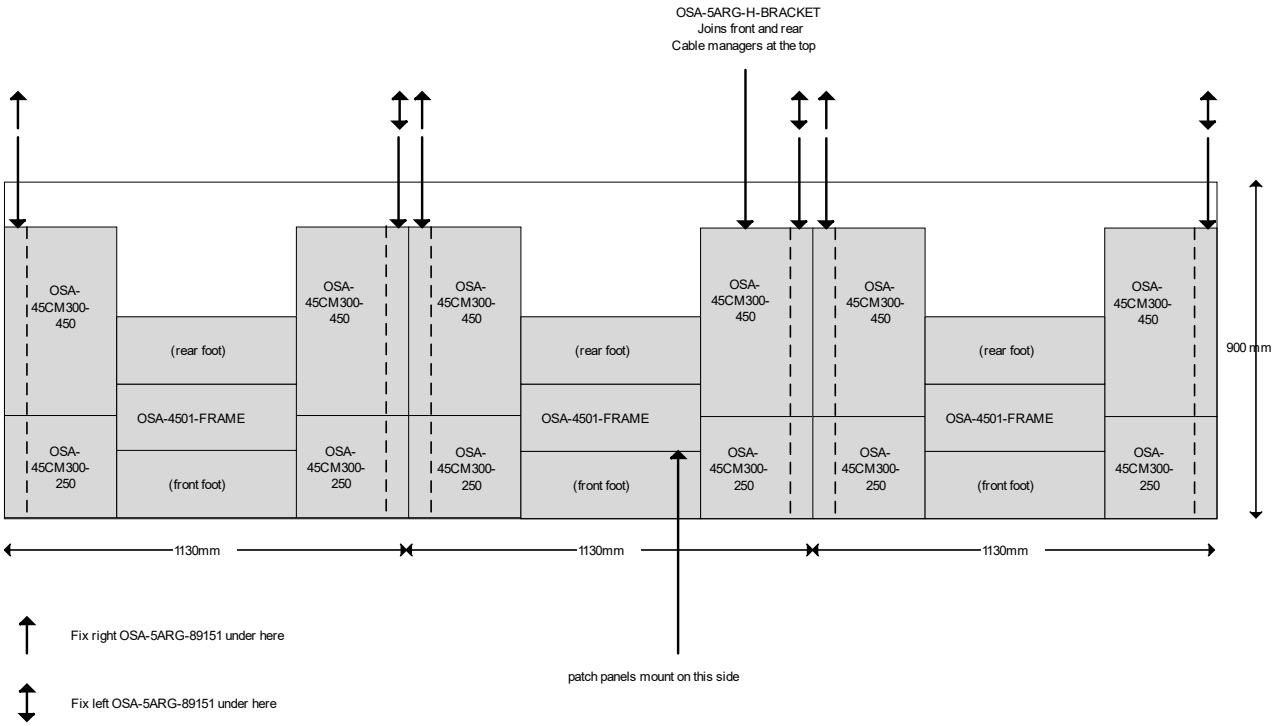


Figure 2-1: Argent racks in a standard comms room layout

Important note: This diagram shows assembly of the rack parts only. It does not show the required clearances around the rack set. Refer to the Communications and Cabling Standard for the clearances.

2.2. Expanding existing rack sets

To expand existing open frame rack sets, use matching parts. Many existing sets of racks are Rack Technologies brand.

2.3. Cabinet racks

Where a cabinet rack is required, obtain approval from ICT for the proposed model.

3. Safe Step

This is a large square plastic "box" for people to stand on.

If you are asked to install a 45RU rack, you must supply a safe step for the comms room if it does not already have one.

Part no.	Description
Jaybro 47-SSTEP	Safe Step

Table 3-1: Example of suitable “safe step”

4. Rack Power Rail

Allow for one rack power rail per rack.

Part no.	Description
Rack Technologies 9003-RB-CAP10F	10 way horizontal power rail, 10A, 2RU

Table 4-1: Rack Power Rail

5. Fibre-optic Enclosures

Most of the fibre-optic enclosures on the market will not accommodate the detailed labelling used by the University. These enclosures are approved:

Brand	Part No.	Apertures	Notes
Fibre Equipment Management	FEM-112-LCD	12	Suits a 24 core cable
Fibre Equipment Management	FEM-124-LCD	24	Suits a 48 core cable
Fibre Equipment Management	FEM-248-LCD	48	Suits a 96 core cable

Table 5-1: Approved fibre optic enclosures

These trays are stocked at Optical Solutions Australia in Silverwater.

For termination of other cable sizes, obtain approval from ICT to supply a suitable tray from this product series.

5.1. Warranty clarification

All major manufacturers give the University fibre warranties when these FOBOTs are used, as the FOBOTs do not comprise a working part of the cabling system.

6. Horizontal patch cord managers

The type to be installed depends on the type of rack.

Type of rack	Brand	Part No.	Description	How many to supply
Lab rack with covered vertical patch cord management channel	Argent	OSA-1RUCM	1RU horizontal cable manager	4 per rack
Lab rack with patch cord management channel with open metal rings	Molex Premise Networks	25.B035G	Deep ring run panel	Follow existing pattern, generally one manager per two patch panels
Cabinet (rails set back)	Molex Premise Networks	25.B035G	Deep ring run panel	Follow existing pattern, generally one manager per two patch panels

Table 6-1: Horizontal patch cord managers

A few existing cabinets have not had their mounting rails set back far enough to fit the deep Molex patch cord manager while still allowing the cabinet door to be closed. In this case, one of the following shallower patch cord managers is to be used:

Type of rack	Brand	Part No.	Description	Pattern to follow
Existing cabinet with rails not set back	Tyco	0-0558329-1	Netconnect Open Cabling Systems Panel Kit, 1.75, Cable Mgt	Follow existing pattern, generally one manager per two patch panels
Existing cabinet with rails not set back	Leviton	49253-LPM	Horizontal patch cord organizer, 1RU	Follow existing pattern, generally one manager per two patch panels

Table 6-2: Shallower patch cord managers

What not to buy:

Any horizontal patch cord managers that are not on this list. In particular, all other models of Molex patch cord manager are not approved.

7. Class EA Wiring System (Category 6A)

Category 6A wiring system components must be the **shielded** type.

Note: No further 4 pair cable of lower categories is to be installed (e.g., Category 5e and Category 6).

7.1. Cable construction

All of these cable constructions are permitted:

- F/UTP
- U/FTP
- S/FTP
- F/FTP

Unshielded Category 6A cable (“UTP”, U/UTP, "plain UTP") is not approved.

7.2. Patch panels

7.2.1. The University specification

The University specification is as follows:

- Patch panels must be designed for termination of shielded Category 6A cable.
- Patch panels must be made of metal.
- Patch panels must have a flat area extending the full width of the panel from the inner edge of the left bracket to the inner edge of the right bracket. This area must be at least 9mm in height. This is where the strips of traffolyte labelling are to be fixed. Panels with two such areas (upper and lower) are preferred.
- A patch panel must have exactly 24 ports per rack unit.
- Patch panels with little transparent windows, paper labels or perspex or plastic label covers are not acceptable.

7.2.2. Approved patch panels

It is obligatory to install **rear bars**. If the rear bar is a separate part, it must be supplied and fitted.

Brand	Unloaded patch panel	Patch panel rear bar	Patch panel jack	Label areas	Notes
Belden	AX106504-AP	AX105931 (purchased separately)	AX104562	Upper and lower	Contact Tony Hawes at Belden for information.
Clipsal	RJ/24UPPS	(Comes with patch panel)	RJ45SM6AF	Upper and lower	Contact Peter Thomassian at Schneider for information.
CommScope	1-279669-0, stocked at OSA	1711314-2 (purchased separately, must be supplied and fitted)	1711716-1 or 2153449-4. This colour variant of the 2153449-X series jack is the grey version, which we understand to be readily available.	Upper and lower	This is an AMP Netconnect panel. It is all metal. The AMP panel with the plastic inserts with groups of six jacks is the wrong one. Contact Terry Finn or James Oliver at CommScope for information.
Molex	ZPID-000002	(Comes with patch panel)	KSJ-00062-04	Lower	Contact Richard Canty-Forrest at Molex for information. Molex U/FTP cable is approved.
Multimedia Connect	BCPAN1U-AU	(Is an extension of the patch panel)	BC6AFSTL50	Upper and lower	Contact Anthony Neilson at Multimedia Connect for information. Multimedia Connect is a European brand which should not be confused with the similarly named "Connect Media" brand, which is not approved.
R & M	R795810	(Comes with patch panel)	R813513	Upper and lower	Contact Laurie Katsidis at R& M for information. R & M U/FTP cable is approved.
Siemon	TM-PNLZ-24-01	(Is an extension of the patch panel)	Z6A-S01	Double height upper	Contact Matthew Parker at Siemon for information.

Table 7-1: Approved patch panels and rear bars

7.2.3. Manufacturer sales support

The contact name for each manufacturer is of the company representative who supplies samples to the University.

When selecting a patch panel, please confirm that sufficient stock of that panel has been reserved for you in Australia.

7.2.4. Brands not in the table

Panduit's panel was evaluated but was not approved because it was not considered robust enough for the University environment.

The approved CommScope panel is an AMP Netconnect panel. The equivalent Systimax panel was not approved because it is not compatible with the University's labelling requirements.

Brands not mentioned in the table are not approved. A brand or model not already mentioned in this section may be submitted to ICT's Communications Infrastructure Analyst for consideration.

7.3. Underground grade data cable

Occasionally it is necessary to run some Category 6A cable as underground cabling or in another situation where the cable may become wet. In this case, underground grade shielded Category 6A cable is to be used. This type of cable is available from Commscope and Siemon, and may also be available from other manufacturers.

Seek approval from ICT's Communications Infrastructure Analyst for any proposal to install underground grade data cable.

7.4. Data cable to Fire and EWIS panels

Data cable installed from the communications rack to these panels is part of ICT's communications cabling installation and must therefore comply with this Parts List.

These cables are not legally part of the fire or EWIS system. The cable does not need to have a red sheath.

7.5. Patch Cords and Fly Leads

Patch cords and fly leads shall be the shielded type designated by the wiring system manufacturer as part of their Class EA shielded wiring system which complies with the latest published revision of the AS 11801 series standards.

Patch cords and fly leads shall have a conductor weight in the range 22 AWG to 26 AWG only. **"Skinny" leads with 28 AWG and 30 AWG conductor weights are not acceptable**.

Patch cords and fly leads shall have a minimum DC current carrying capacity under continuous operation of 0.75A on each conductor at operating temperatures of up to 60 degrees Celsius. (AS/NZS 11801.1:2019 Clause 6.3.3.8)

7.6. Shutters for telecommunications outlets

Shuttered TOs are generally not required and not preferred. However, they are required in some labs and in childcare centres.

If the wiring system does not offer shuttered jacks, a shuttered bezel should be used.

R & M and Commscope both offer shuttered bezels. The Commscope bezels (part 6467 1 116-07SH) are a typical "keystone" size and may suit some other brands of wiring system.

8. Faceplates for Telecommunications Outlets

Clipsal 2000 Series faceplates are mandatory. This is because there is a non-removable area where the required traffolyte labels can be fixed.

Faceplates in the HPM Excel style or the Clipsal C2000 style are unsuitable because the labels are removed from the outlet when a painter takes the cover off. This can lead to labels being lost or mistakenly transferred to a different outlet. Our Communications and Cabling Standard does not permit those types of plates.

Quad plates are not allowed because there isn't enough room on them to fit our required labelling. Only use singles, duals and triples.

Figure 8-1: Faceplates for telecommunications outlets

8.1. Angled faceplate

The **Clipsal 2032 VHA** can be used to solve bend radius problems. This plate is shown on the right in the photograph above.

This plate is only available in 2 gang. If used for a single outlet, a blank must be fitted in the unused aperture.

The 2032-VHA can be used with either rear entry or side entry jacks to bring the cable in from different directions. Facing the RJ45 pins sideways is acceptable if the reason is to solve a bend radius problem.

8.2. Faceplate for security cameras and wall phones

The **Siemon Tamperproof Faceplate** is to be used with a Siemon Cat 6A shielded jack inserted at an angle. For cameras, the faceplate is to be mounted in a visible location next to the camera. For door phones, the

faceplate sits just below the telephone handset, with the handset mounted at a height suitable for wheelchair users. The usual traffolyte labels are to be applied inside, with large font size Brother labeller repeating the information on the removable cover.

Brand	Part no.	Product	Notes
Siemon	MX-TFP-S-06-02	Tamperproof faceplate	Six colour variants are available. This part number is for white.

Table 8-1: Faceplate for security cameras and wall phones

Use Siemon blanks to block up any unused apertures in the plate.

Please ask to see our mock-up of the required setup.

8.3. Recessed faceplates for wall clocks

Outlets for wall clocks shall have a recessed faceplate similar to Lacey's TV part WPRPS02.

9. Plaster Dust Protection

You must prevent plaster dust and other foreign matter from entering RJ45 sockets during building work.

Most jacks do not come with dust caps. In this case, you must use special sticky tape to protect the socket until handover. This applies to patch panels as well as telecommunications outlets.

These products have been approved because they do not leave a sticky residue. Do not use ordinary sticky tape, packaging tape or masking tape, as it will be very difficult for you to clean the glue off the jacks afterwards.

Some cablers write temporary cable numbers on the tape with a marker pen. You are welcome to do this.

Brand	Product	Tape width
3M Scotch	#810 Magic Tape	24mm
Pritt	Invisible Tape	24mm

Table 9-1: Tape for plaster dust protection

If you need to get this tape in a hurry, there is an Officeworks store opposite the Ross Street gate of our Main Campus.

Use of electrical tape is strictly forbidden because it is extremely sticky and leaves a lot of glue residue.

10. Patch cord hanger

One to be supplied and fitted per comms room, if not already present.

The patch cord hanger is a plastic hose reel hanger from a hardware shop. It is inexpensive.

11. Voice grade cabling parts

11.1. Voice grade cable

All indoor cable terminated on an MDF, a Krone frame or any other traditional telephone distribution frame shall be standard voice grade cable with a **cream sheath** (i.e., "Austel cable", "indoor telephone cable").

11.2. Disconnection modules (“Krone blocks”) etc.

All disconnection modules for traditional telephone distribution frames shall be **genuine ADC Krone**.

All parts of the telephone frame shall also be genuine ADC Krone parts, unless otherwise approved by ICT.

11.3. Fire line connection hardware at MDF

The red-sheathed cable from the MDF to the fire panel is not a type which can be punched down on a Krone block.

ICT will free-issue the correct 2 pair block and a short piece of cream 2 pair cable to enable this connection to be made. These are the only parts which are to be used for the transition between the red cable and the telephone frame.

11.4. Patch panel for voice grade cable

Voice tie cables from the MDF to a rack (which are usually 25 pair) shall have their "rack" end terminated on the following Krone patch panel:

Brand	Part No.	Product	Label areas	Notes
ADC Krone	6653 1 677-24	PP 6CT 24 port 1 U KRO/110 W/WIRE MGT	Upper and lower	This panel is stocked by CommScope but does not appear in the current Australian catalogue. For information, contact Terry Finn or James Oliver at CommScope.

Table 11-1: 1RU patch panel for voice tie termination at racks

11.5. Lift distribution frame (Lift FDP)

This is the demarcation point between the telephone technician and the lift technician.

For existing lifts, a metal surface-mount box is to be used. For new lifts, the installation is to be flush with the surrounding wall; usually there is a little door in the cladding of the lift shaft, giving access to the frame behind the door.

All door-locking mechanisms must be compatible with the University's BiLock system.

Table 11-2 below summarises the suitable parts for the Lift Distribution Frame:

Brand	Part no.	Product	Notes
B & R	A20	Internal telecom BD, 2 module	Frame in metal enclosure for indoor surface-mount retro-fits. Also suitable for recessing in new work (use surround). Compatible with University BiLock. Product does not come with a record card - this must be obtained separately.
ADC Krone	6455 1 016-00	FDP, 20 pair with earth	Plastic frame suitable for use behind a little door which has been constructed separately. The plastic cover of the frame may be left off, provided that the back of the little door has a facility to hold the record card securely.
ADC Krone	6455 1 016-01	FDP, 20 pair without earth	(Same notes as for variant with earth.)

Table 11-2: Suitable parts for Lift Distribution Frame

For glass lifts, or outdoor lifts, obtain approval from ICT for suitable parts.

12. Underground optical fibre cable

All underground optical fibre cable is to be Prysmian SM@RTCORE external underground loosetube optical cable or approved equivalent.

Prysmian SM@RTCORE has a nylon outer jacket. It is not equivalent to an "indoor outdoor" type cable.

13. Underground conduit

All underground communications conduit is to be:

- white
- marked "Communications" or "Telecommunications"
- manufactured to Telstra conduit dimensions, not AS 2053.2 ("electrical") conduit dimensions.

For example, a Telstra "50mm" conduit has an inside diameter of 54.4mm. A white "50mm comms conduit" manufactured to "electrical" conduit dimensions has an inside diameter of only 44mm.

Telstra-dimension conduits have a wider range of conduit fittings available, including temporary plugs and pipe bushes.

www.iplex.com.au is a good reference for the different conduit sizes.

These requirements do apply to lead-in conduits cast into slabs. The lead-in conduit is to be supplied and installed by the manhole builder (see next section), not an electrical contractor.

14. Communications pits and manholes (access holes)

All communications pits and manholes are to be reinforced concrete, cast in situ, and built to current and historical PMG/Telecom Australia/Telstra designs.

All plastic pits are banned.

All pre-cast cement pit types are banned.

All products from ACO Polycrete are banned, except as spare parts.

Pits and manholes are only to be built by a specialist contractor recognised as a qualified manhole builder by Telstra. Where excavation is at a location with live communications cables running through it, "built" includes excavation as well as construction. Where no live cables are present, excavation by others shall be at the discretion of the specialist contractor.

Three suitably qualified contractors are:

Company	Contact
Consol Services Australia	Mr Paul Littlechild, 0419 118 339, pblcoms@bigpond.com
Line-tel Pty Ltd	Mr Dominic Cannon, 0418 677 809, dominic@line-tel.com.au
P & S Network Services	Mr Peter Dimovski, 0407 773 188, peterdimovski@live.com.au

Table 14-1: Table of qualified contractors

Electrical contractors, please note that the University's Communications and Cabling Standard prohibits electrical contractors from being involved in underground communications work. If an electrical contractor has been asked to price underground communications work by a builder, they must pass the job back to the builder, and ask the builder to contact a suitable Telstra manhole builder.

APPENDIX

APPENDIX A Glossary of terms

Abbreviation	Name
FDP	Final distribution point
FOBOT	Fibre Optic Break Out Tray
ICT	Information, Communications and Technology
RU	Rack unit
TO	Telecommunications outlet

6-01-140 – Utility Reference Specification – Attachment of Communication Cable Facilities on PPL Poles

Requirements for the Attachment of Communication Cable Facilities on PPL Poles

Replaces: URS-3002
URS-3004
URS-101C-304
A-157649

Reference Notes for Drawings:

General

1. The term “communication cable facility” refers to facilities installed by telephone, CATV, telecommunication, and public/private companies for voice, video, or data transmission. The owner of the communication cable facilities must follow the proper attachment permit procedures as specified by the appropriate attachment agreement. Please reference PPL Specification 6-01-160 for wireless antenna installations.

2. Any rearrangement of PPL electrical facilities or other communication facilities necessary to accommodate the attachment of communication cable facilities on PPL poles must be negotiated by the communication cable facility owner with the existing facility owner and completed prior to making the attachment.

3. All new communication cables and cabinets shall be marked at each pole in a manner such that the ownership of the facility can be determined by PPL personnel from ground level. Existing communication cables and cabinets should be marked when maintenance is performed on that facility.

4. Bolt ends must not project more than one inch beyond the nut.

Cable Attachments

5. The communication cable must be attached directly to the pole surface or attached using metallic or fiberglass offset brackets. Offset brackets should only be used to provide the required horizontal clearance to buildings, signs, trees, and similar facilities or to reduce the change in direction (angle) of the communication cable. Offset brackets should not be used to avoid required vertical clearances.

   Drilled holes in a wood pole shall be spaced a minimum of 4 inches vertically when they are parallel (in the same direction) through the pole. Drilled holes that are perpendicular (90 degrees apart) through the pole shall be spaced a minimum of 2 inches vertically.

   Attachment to metal distribution poles must be clamped or banded to the poles with stainless steel straps. The drilling of holes in a metal pole for a bolt attachment is prohibited unless the applicant first obtains written authorization due to a highly unusual circumstance. All attachments to metal poles require prior approval of PPL engineering personnel.

   Attachment to fiberglass poles should be treated like attachments to wood poles with the following exceptions:

   a) Attachment to fiberglass poles must be made using through bolts for the hardware.

   b) Lag screws are not permitted in fiberglass poles.

c) DO NOT drill the attachment hole at the same height as the pre-drilled climbing holes are located.

d) The attachment holes should have a minimum distance of 2 inches vertically from the pre-drilled holes.

e) DO NOT drill holes where the distance of the edge of that hole would be within 2 inches from the edge of any existing hole.

6. The use of wood arms for any communication cable attachments is not permitted for new installations, except with the prior written approval of PPL engineering personnel for each specific attachment location.

7. *Service Drop* – a single wired drop installed to provide communications service to an individual customer, starting at the customer's premises and extending to the closest available utility pole, without requiring any additional anchors or guying to comply with all applicable engineering standards. A communication service drop may attach in-span or directly to a single pole. When attaching a communication service drop cable to a pole, it must be submitted in the Application Portal to ensure compliance with this definition and to ensure that the communication service drop is accounted for as an attachment.

   A communication service drop may extend more than one pole, upon review and approval by PPL, when the following conditions are met:

   a) where it is necessary to maintain code required ground or roadway clearance, a second pole may be used to provide support for the single communication service drop cable; or

   b) on private property when all the following conditions are met:
      i) it is a single wired drop;
      ii) submitted in the Application Portal;
      iii) all poles associated with the service drop are on a single private property; and
      iv) the communication service drop is no more than 500' in length measured from the customer's premises

Clearance Requirements

8. Clearance between PPL electrical facilities and communication cable facilities must be in accordance with the latest edition of the National Electrical Safety Code (NESC). Use Section 23 of the NESC to determine the clearances required at the pole and in-span. It specifies that the required vertical clearances must be measured surface-to-surface, not center-to-center. Diagonal measurements do not apply to electrical clearances. Additional vertical clearance may be needed on the pole to achieve the required in-span clearances.

   Communication reinforcing straps should be considered when measuring vertical clearances between communication facilities and electrical facilities.

9. The in-span vertical clearance as specified by the NESC in Rule 235 between the lowest electrical conductor and the highest communication cable is 30 inches based on the following conditions:

   a) The upper conductor is at final sag at 120°F or the maximum conductor operating temperature and the lower conductor is at final sag at the same ambient conditions as the upper conductor without electrical loading, or

   b) The upper conductor is at final sag at 32°F with a 1/2 inch radial ice thickness and the lower conductor is at final sag at the same ambient conditions as the upper conductor without electrical loading and without ice.

   When the bottom PPL conductor is a neutral, multiplex secondary, or primary aerial cable and is bonded to the communications messenger at the intervals specified in Note 32, the in-span vertical clearance at maximum sag must not be less than 12 inches. This exception also applies to all dielectric-self-supporting fiber optics cable, which cannot be electrically bonded.

10. The minimum clearance between communication cables (center-to-center) supported by different suspension strands must be 12 inches at the pole and 6 inches in span. In most cases, this will be a vertical clearance, but when communication cables are located on opposite sides of the pole, the 12 inches vertical clearance may be reduced provided that the minimum diagonal clearance is 12 inches and the bolts are a minimum of 6 inches apart. A minimum vertical clearance of 6 inches must be maintained between any strand-mounted equipment of cable expansion loops and the communication cables below. Reduced spacing is permitted if agreed to by the existing communication cable owner and communicated to PPL in writing. Reinforcing straps should not be considered when measuring clearances at the pole between communication cable facilities.

11. The vertical clearance for communication cables facilities above ground and paved surfaces at the low point in the span must be in accordance with NESC Table 232-1, state, or local regulations (typical values given below):

   f) 9.5 feet to ground over spaces accessible to pedestrians only

   g) 15.5 feet to ground over spaces subject to truck traffic such as roads, streets, driveways, parking lots, and alleys

   h) 18 feet to travelled way and shoulders within the right-of-way of Pennsylvania state highways

   i) 23.5 feet to travelled way and shoulder within the right-of-way of the Pennsylvania Turnpike

   j) 35 feet to the top of rail of railroad tracks that may have double high container cars

12. Any in-span service drop or device mounted on a communication cable or messenger must be a minimum of 15 inches from the pole face at its nearest point to assure adequate climbing space.

13. Effectively grounded communication cable facilities passing near a PPL structure without being attached thereto shall have a horizontal clearance, without wind, from any part of such structure of not less than three feet. Ungrounded communication cable facilities shall have a horizontal clearance, without wind, from any part of such structure of not less than five feet (per NESC Rule 234B).

14. A vertical run of communication cable attached to the pole surface should be covered with a suitable non-metallic material and must have the following clearance from through bolts or other metallic objects which are associated with PPL equipment:

    a) one-eighth of pole circumference, or

    b) two inches

    Whichever value is greater

Cable Position

15. The usable space on the pole as defined by the FCC is that pole space 18 feet and higher above ground level. The top of the usable pole space is reserved for PPL electrical attachments. The middle portion of the usable pole space is reserved for third party (Telcom, CATV, and public/private) communication cable or service drop attachments. The recommended minimum height of the initial third party cable attachment is 23 feet if conditions permit. The bottom portion of the usable pole space is reserved for the communication cable or service drop attachments owned by the incumbent telephone company. The recommended maximum height for the initial telephone cable attachment is 21 feet if conditions permit or lower if possible.

16. All communication cables must be attached to the roadside side of the pole unless approved in writing by PPL. Back bolting and back attachments will not be approved on poles that are 60 feet or greater in size.

17. In limited situations, PPL may allow the use of a bolt extender and communication cable to attach on the same side of the pole as the existing communication cable as long as the owner of the proposed communication cable owns the bolt and existing communication cable. All requests to use a bolt extender must be approved by PPL in writing through the application process. No more than 2 cable attachments are permitted on a single bolt.

18. The owner of the proposed communication cable shall not “weave” its cables from one vertical position to another with respect to other communication cables on the same sides of the pole line route. “Weaving” from one side of the pole to the other along the pole line route (except where it crosses a road) is also not permitted.

Guying

19. The owner of the communication cable facility must guy unbalanced loads imposed on the pole by dead ending or changes in direction of the communication cable facility per Bellcore specifications for guying communication cables. The communication cable facility must not alter the vertical position of PPL poles or change the sag characteristics of PPL conductors.

20. The proposed communication cable facility should be installed with the proper tension so that its final sag meets clearance requirements to existing electrical and communication facilities. There should not be more than one reduced tension span, maximum 100 feet in length, in consecutive spans without PPL approval.

21. All guying must be installed prior to the installation of the communication cable facility. Guy wires may be attached to PPL poles or anchor rods provided that the PPL facility has sufficient unused strength to support the proposed communication cable facility. The number of guy wires to one anchor rod may not exceed the number of eyes on the anchor rod plus one auxiliary eye attachment.

22. If the PPL anchor rod cannot support an additional guy wire attachment, the owner of the proposed communication cable facility must make provisions to install another anchor rod at least 6 feet from the PPL anchor rod.

23. The spacing (center-to-center) between adjacent guying attachments or between adjacent communication facility and guying attachments should not be less than six inches.

Underground Communication Cable Risers

24. The number of underground (UG) electric and communication cable risers attached directly to the pole surface should be limited so that one side (180 degrees) of the pole is kept clear for climbing space and replacing the pole. UG communication cable risers should be located on the same side of the pole as their overhead communication cables are attached.

25. Riser standoff brackets may be used as necessary to provide the required 180 degrees of clear pole space. The UG communication cable risers should be on the same side of the pole as the riser standoff brackets or, if the positions are available, occupy the end conduit positions on the bracket.

26. Underground communication cable risers should not be installed on poles supporting transmission circuits operating at 69 kV and 138 kV.

Cabinets by Utility Companies

27. Cabinets and powered equipment may be mounted directly on the pole in the unusable space (defined as that pole space less than 18 feet above ground level). PPL must approve in writing the pole chosen prior to the installation of all new cabinets and powered equipment to confirm that the pole is suitable. Passive equipment, such as slack loops and splice

cases shall be suspended from the communication cable messenger. All exceptions must be approved by PPL in writing.

Do not install any new pole-mounted cabinets and service entrance equipment on:

a) Junction poles (a pole where the PPL primary line runs in four or more directions)

b) Poles that are 60 feet and greater in size or made of metal

c) Poles with transmission facilities (69 kV and 138 kV) attached

d) Poles with cabinets already installed by any communication company

e) Poles with cabinets containing controls such as fire alarm, police signal, or traffic signal

f) Poles with capacitor controls, regulator controls, recloser controls, air switch operating handles, or an existing electrical service entrance

g) Transformer poles which are not accessible to mechanized equipment

h) Poles with underground electric or communication riser conduits which are not accessible to mechanized equipment

A new cabinet can be installed on a pole with an existing cabinet if both cabinets are owned by the same company, the new cabinet is part of a rebuild project and the existing cabinet will be removed upon rebuild project completion, and no other reasons for exclusion (as listed above) exist.

28. The maximum size pole-mounted cabinet allowed is 31 inches wide x 19 inches deep x 38 inches high. Climbing aids are required when cabinets larger than 30 inches high are installed. The climbing aid can be a 3/4 inch bolt approximately 22 inches long, projecting 8 inches from each side of the mounting channel, secured by four nuts at the channel, and mounted half way up the channel. Cabinets must be mounted using externally accessible hardware. There must be only one cabinet installed on any one pole. Any metallic cabinet must be effectively grounded.

29. The minimum vertical clearance from the top of the cabinet to the lowest communication cable facility is 31 inches. The minimum vertical clearance from the bottom of the cabinet above ground must be in accordance with NESC Table 232-2 (typical values given below):

    a) 11 feet to ground over spaces accessible to pedestrians only

    b) 15 feet to ground over spaces subject to truck traffic such as streets, alleys, driveways, and parking lots

30. Install and effectively ground meter bases and disconnect switches in accordance with the latest revision of PPL “Rules for Electric Meter and Service Installations” except for the

mounting height of the meter (6-1/2 feet from centerline to ground as shown in Figures 6-01-140-C & 6-01-140-D of this specification).

31. Meter troughs, meter trough covers, and service conduit and hubs shall not be used for communication grounds.

32. On 4kV, 12kV, & 13kV multi-grounded PPL lines, the owner of the communication cable facility must install and maintain an electrical bond between the metallic communication cable or messenger and the PPL vertical pole ground wire. There must be at least four bonds per mile with not more than 1,500 feet between these bonding locations. Make the electrical bond using #6 AWG copper wire and connectors suitable for the purpose. Communication cable that is entirely dielectric (non-conductive) need not be bonded.

33. Where there is an existing vertical ground wire connected to PPL's multi-grounded neutral system, the owner of the communication cable facility shall connect the bond wire to the vertical ground wire keeping the bond wire as short as practical. Where there is no vertical ground wire, the owner of the communication cable facility shall place a coiled length of bond wire connected to its facilities and notify PPL to connect the bond wire to the multi-grounded neutral system.

34. All communication cable facility guy wires must be bonded to an effectively grounded communication cable suspension strand, the PPL vertical pole ground wire, or to an adjacent PPL guy wire if no PPL vertical pole ground wire exists.

35. On PPL lines which are not multi-grounded (normally 23kV and higher voltage circuits), the owner of the communication cable facility must **not** bond either its guy wire or its metallic communication cable to any PPL vertical pole ground wire unless specifically directed to do so by PPL engineering personnel. The owner of the communication facilities must install and maintain its' own grounding wire and grounding electrode (ground rod).

Emergency Electric Supply

36. Generators or other means for emergency electric supply to communication cable facilities are prohibited unless specifically approved by PPL engineering personnel in writing. Installations of emergency electric supply equipment must conform to the latest revision of PPL "Rules for Electric Meter and Service Installations". The type of device to be used must ensure that there cannot be an interconnection between the emergency electric supply and the PPL electric system.

Transmission Pole Attachments

37. Attachment personnel can permit cable or guying attachments to transmission pole lines without additional follow-up if the poles are located on public R/W and already have electric distribution line facilities attached. The communication cable or guying attachments must be located below the electric distribution line facilities.

38. The attachment method for communication cable facilities must first be reviewed by the local Transmission Maintenance Engineer and then by System Transmission Design, in accordance with PPL's existing Encroachment Guideline. Only after this review has been completed and written approval granted can the attachment request be permitted.

39. Transmission lines are normally located within private R/W easements that do not permit PPL to grant attachment rights to other companies. Encroachment rights on this private R/W easement must first be granted by the property owner and presented to PPL before PPL can grant the right to attach to its transmission poles or structures.

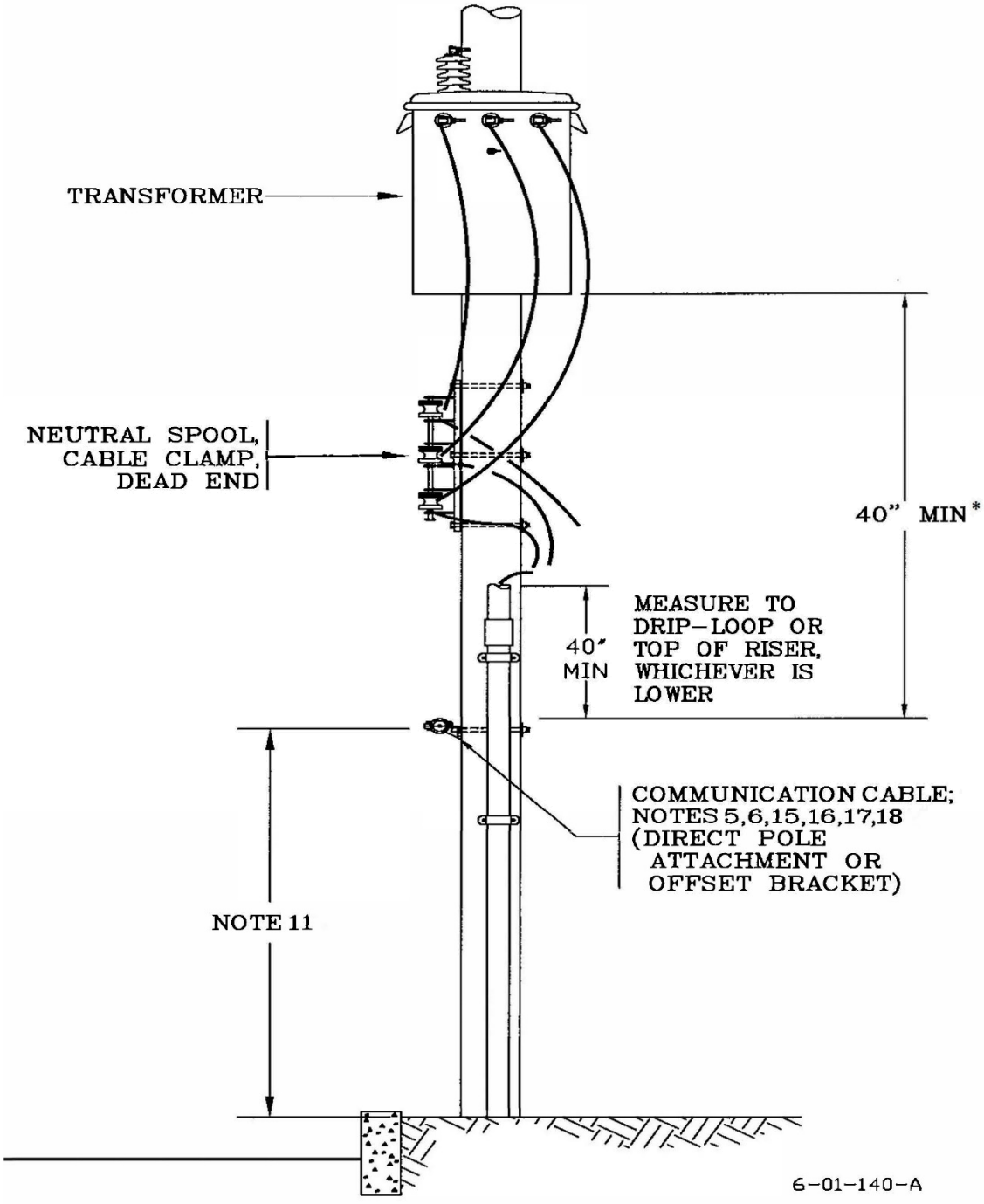
40. The attachment of communication cable facilities is not permitted on poles supporting transmission circuits operating at voltages greater than 138 kV, unless an OHGW can be replaced with an OPGW.

41. No longitudinal third party owned fiber optic cable attachments are permitted on the overhead transmission system (69 kV and above) unless it is in the communication space on an under built distribution circuit and is located within the confines of public right-of-way.

42. If there are no electric distribution line facilities attached to the transmission poles, the attachment must follow PPL's Indefeasible Right of Use (IRU) approval process.

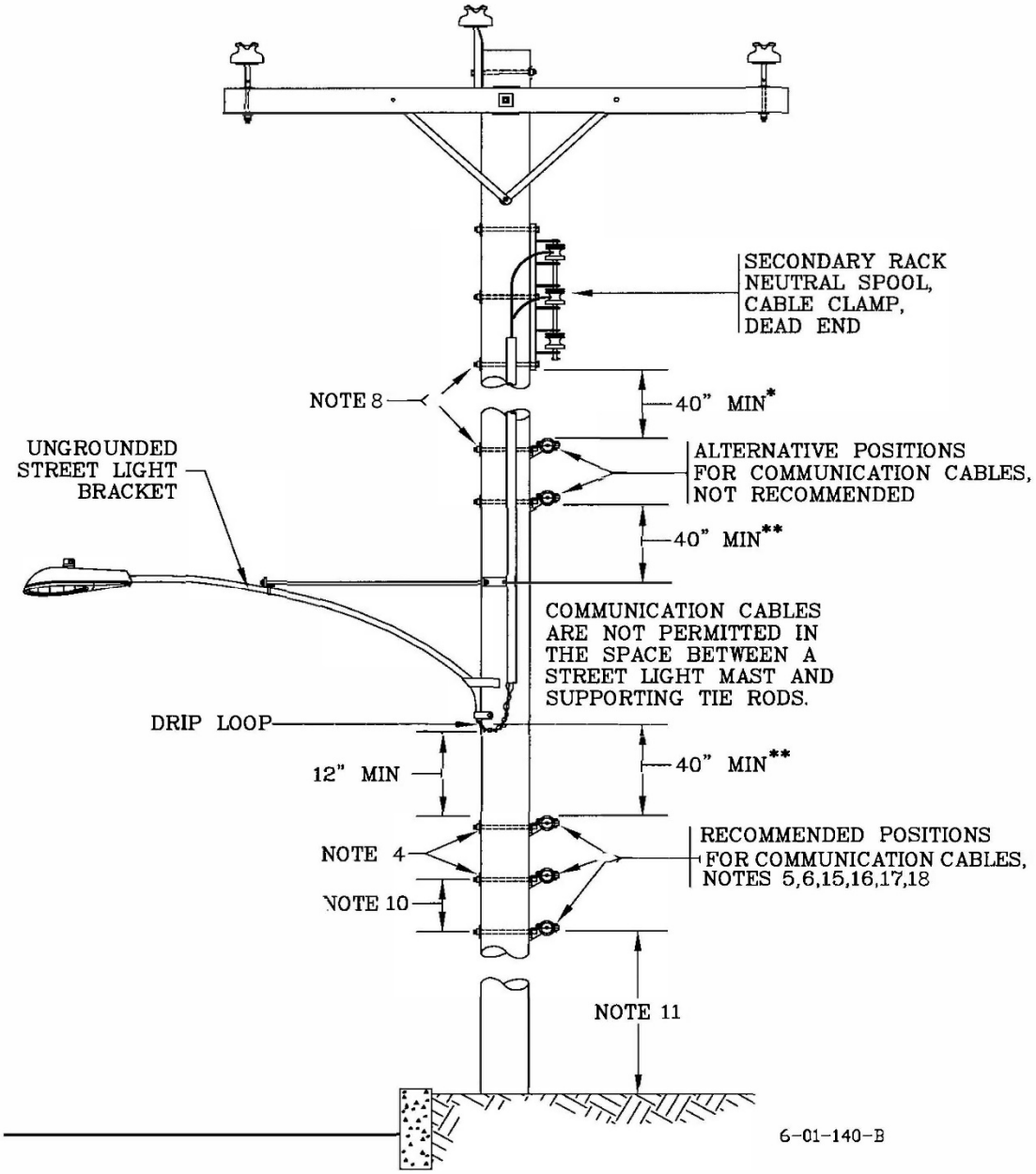
43. PPL plans to eventually replace its 69 kV and 138 kV wood poles with metal poles. Attachers must be prepared to change their method of attachment.

Attachment of Communication Cables



*Note: Can be reduced to 30" minimum to neutral, primary underground cable or primary cable assembly if attaching cable company bonds to PPL EU's vertical ground wires. See Note 31.

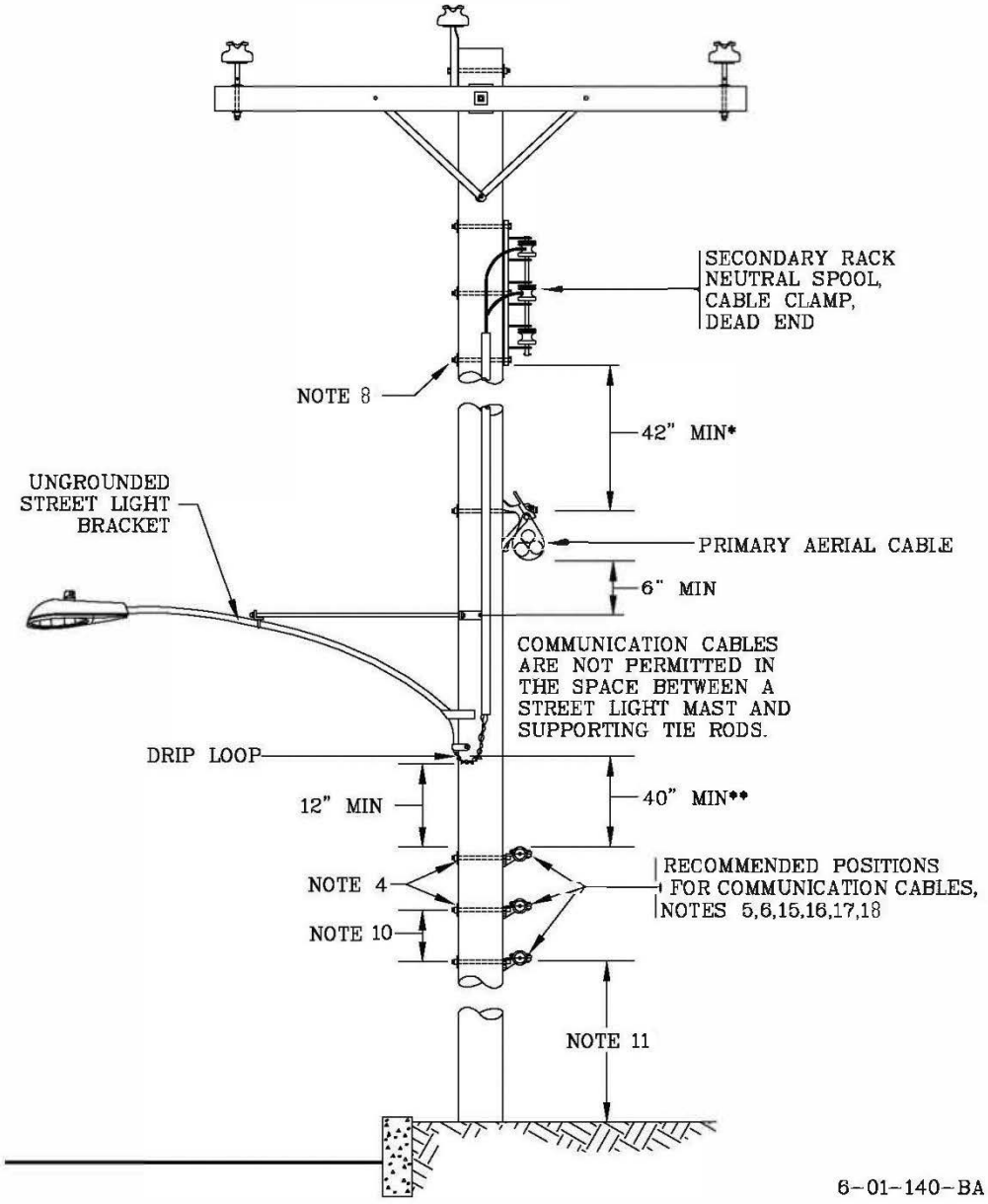
Attachment of Communication Cables



*Note: Can be reduced to 30” minimum to neutral, primary underground cable or primary cable assembly if attaching cable company bonds to PPL EU’s vertical ground wires. See Note 31.

**Note: 40” minimum may be reduced to 4” if the streetlight bracket is grounded. A minimum clearance of 12” is still required from the communication cable bracket to the streetlight drip loop. To effectively ground street light bracket, use PPL CID 1029820.

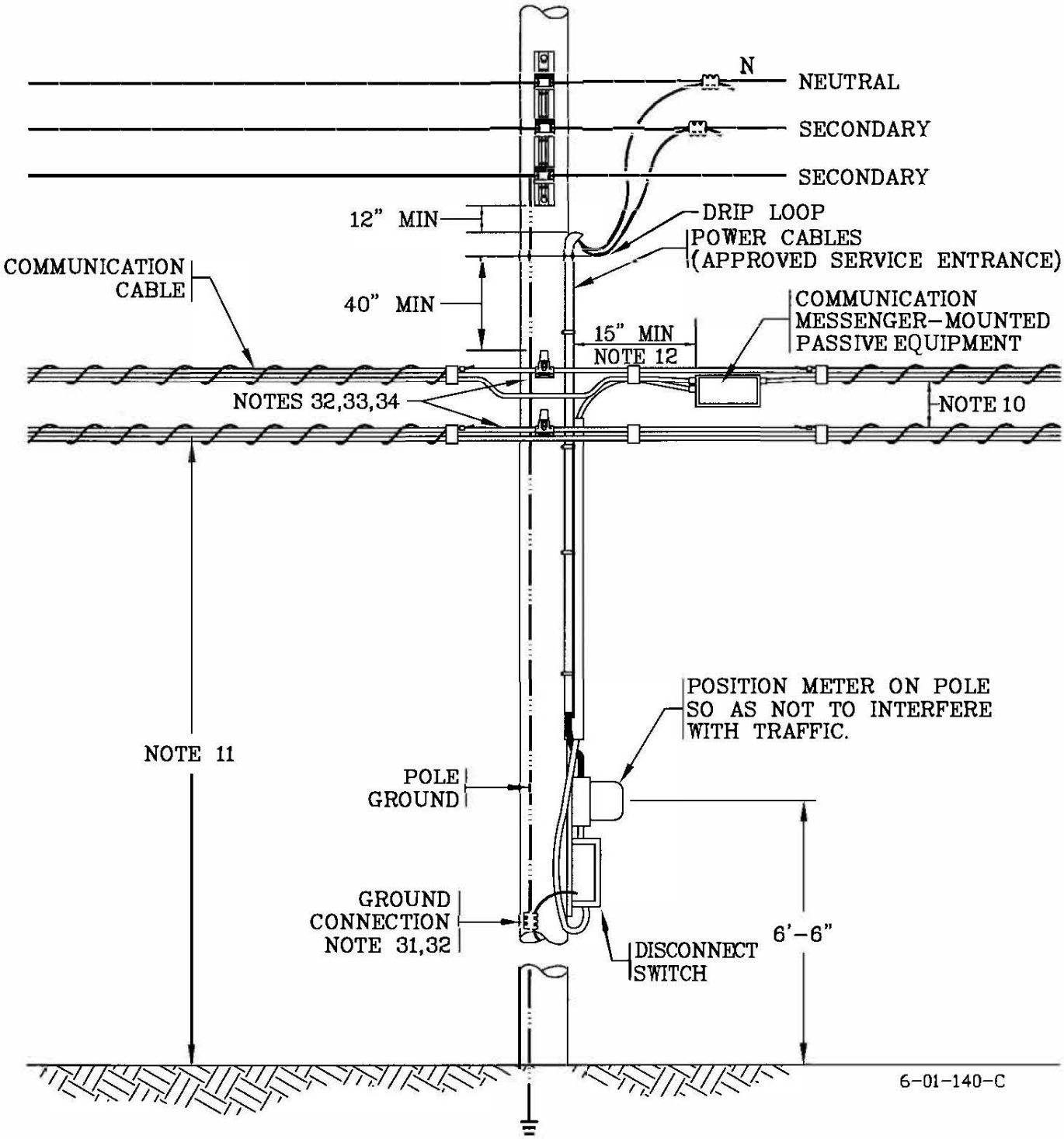
Attachment of Communication Cables



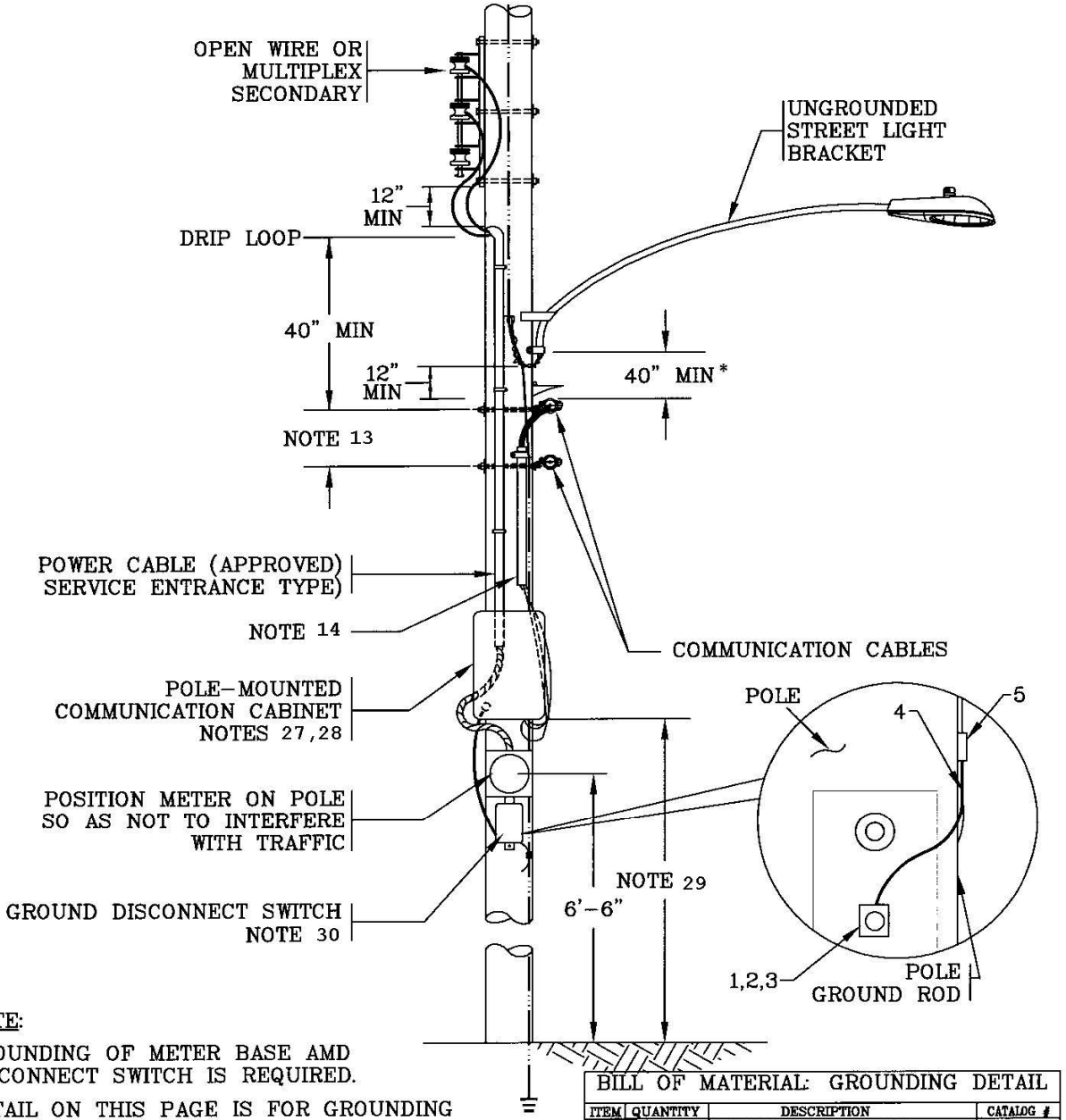
*Note: Can be reduced to 30” for spans under 175 feet.

**Note: 40” minimum may be reduced to 4” if the streetlight bracket is grounded. A minimum clearance of 12” is still required from the communication cable bracket to the streetlight drip loop. To effectively ground street light bracket, use PPL CID 1029820.

Attachment of Cabinet and Service: Strand Mounted Cabinet



Attachment of Cabinet and Service



NOTE:

GROUNDING OF METER BASE AMD DISCONNECT SWITCH IS REQUIRED.

DETAIL ON THIS PAGE IS FOR GROUNDING PROCEDURES ONLY. LOCATION AND ROUTE OF GROUND IS TO BE DETERMINED BY FIELD ON A SITE BY SITE BASIS.

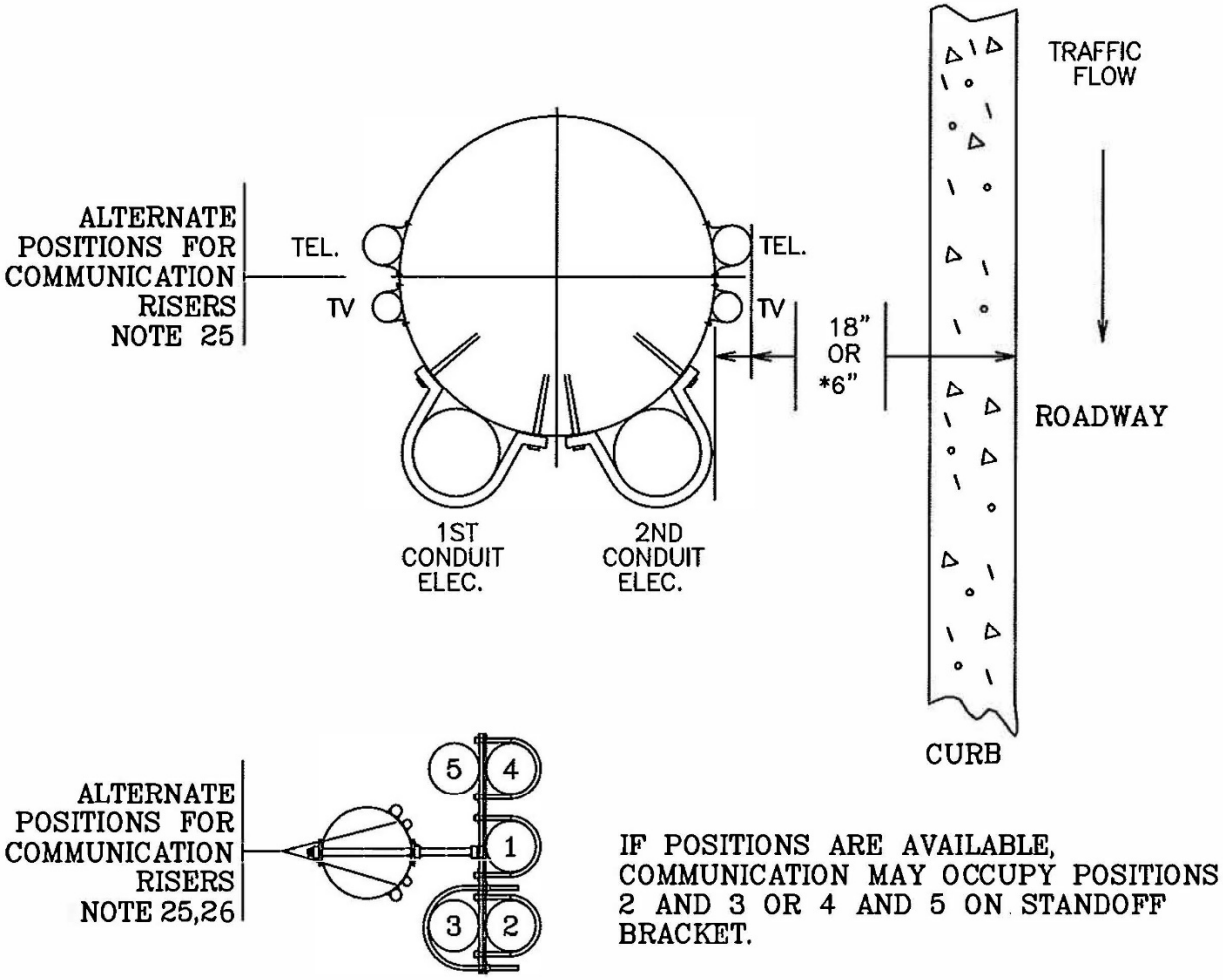
BILL OF MATERIAL: GROUNDING DETAIL

ITEM	QUANTITY	DESCRIPTION	CATALOG #
1	1	TERMINAL CONNECTOR 1/2"	110390
2	1	SPLIT SPRING LOCK WASHER 1/2"	115441
3	1	BOLT WITH NUT 1/2"	106185
4	AS NEEDED	#4 COPPER (.232"ø) GROUND WIRE	147755
5	1	H-SHAPE CONNECTOR	108902

6-01-140-D

*Note: 40" minimum may be reduced to 4" if the streetlight bracket is grounded. A minimum clearance of 12" is still required from the communication cable bracket to the streetlight drip loop. To effectively ground street light bracket, use PPL CID 1029820.

Attachment of Communication Cable Risers



6–01–140–E

Cabinets, junction boxes, pedestals, etc. must not be attached to riser poles.

*Note: Along PA-DOT roadways, 18” minimum is required. At new installations, 18” minimum is recommended. The National Electrical Safety Code requires 6” minimum clearance to both the pole and riser.

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Equipment Type	Device Description	Model	Manufacturer	Expiry Date	Note
Terminal Devices	Cisco Aironet 3700 series Access Point	AIR-CAP3702I-H-K9	CISCO system Inc.	25-Mar-21	
Terminal Devices	Cisco Aironet 1140 series Access Point	AIR-(L)AP1142N-I-K9	CISCO system Inc.	25-Mar-21	
Terminal Devices	Nokia 8110	TA-1059	HMD Global OY	25-Mar-21	
Terminal Devices	Y6 Prime 2018	ATU-L31	Huawei Technologies Co., Ltd.	25-Mar-21	
Terminal Devices	Y7 Prime 2018	LDN-L21	Huawei Technologies Co., Ltd.	25-Mar-21	
Terminal Devices	P20 Pro	CLT-L29	Huawei Technologies Co., Ltd.	25-Mar-21	
Terminal Devices	MI A1	MDG2	Xiaomi Communications Co. Ltd	25-Mar-21	
Terminal Devices	Redmi Note 5A Prime	MDG6S	Xiaomi Communications Co. Ltd	25-Mar-21	
Terminal Devices	GNSS/GSM Terminal	FMA120	TELTONIKA	25-Mar-21	
Telecommunication Equipment	Network Security Appliance	APL31-0B9	SONICWALL INC.	28-Mar-21	
Telecommunication Equipment	Network Security Appliance	1RK38-0C8	SONICWALL INC.	28-Mar-21	
Terminal Devices	Data Processing Device (Portable Terminal)	EP820-C70	Huawei Technologies Co., Ltd.	28-Mar-21	
Telecommunication Equipment	Security Appliance	FPR-4100 Series	CISCO system Inc.	1-Apr-21	
Telecommunication Equipment	Router	ASR1001-X	CISCO system Inc.	1-Apr-21	
Telecommunication Equipment	Security Appliance	FPR-2100 Series	CISCO system Inc.	1-Apr-21	
Terminal Devices	Galaxy J7 Duo	SM-J720F/DS	Samsung Electronics	1-Apr-21	
Terminal Devices	IPAD	A1954	Apple Inc.	1-Apr-21	
Passive Devices	Omni Directional Antenna	510-043	Interconnect Solutions Ltd	1-Apr-21	
Telecommunication Equipment	Network Service Platform	NFX150	Juniper Networks Inc.	3-Apr-21	
Terminal Devices	Leica Zone 20	ZENO 20	Leica Geosystems	3-Apr-21	
Telecommunication Equipment	Switch	N77-C7702	CISCO system Inc.	4-Apr-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Network Application Traffic Controller	2000, 4000	F5 Networks, Inc.	4-Apr-21	
Terminal Devices	LTE Cat9 PCI Express M.2. Module	T77W676	Hon Hai Precision Ind. Co., Ltd.	8-Apr-21	
Telecommunication Equipment	Switch	Nexus 9300-EX	CISCO system Inc.	9-Apr-21	
Telecommunication Equipment	Server	UCS C220 M4	CISCO system Inc.	9-Apr-21	
Telecommunication Equipment	Switch	WS-C3850-24P-S	CISCO system Inc.	9-Apr-21	
Telecommunication Equipment	Switch	Catalyst 4500-X Series	CISCO system Inc.	9-Apr-21	
Terminal Devices	Cisco IP Phone 7800 Series	CP-78x1-K9	CISCO system Inc.	9-Apr-21	
Terminal Devices	Smart Phone	Z90	Lava International (H.K) Limited	10-Apr-21	
Terminal Devices	Mobile Phone	CPH 1819	GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD.	15-Apr-21	
Terminal Devices	Mobile Phone	CPH 1821	GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD.	15-Apr-21	
Telecommunication Equipment	Network Security Appliance	APL30-0B8	SONICWALL INC.	15-Apr-21	
Terminal Devices	Canon Multifunction injet Device TR4540	K10483	Canon Inc.	15-Apr-21	
Terminal Devices	BlackBerry Smart Phone	BBB100-5	TCT Mobile Europe SAS	15-Apr-21	
Terminal Devices	Smart Phone	S710	Shenzhen Konka Telecommunication Technology Co., Ltd.	15-Apr-21	
Terminal Devices	Smart Phone	S750	Axiom Telecom LLC	15-Apr-21	
Terminal Devices	Smart Phone	TA-1056	HMD Global OY	15-Apr-21	
Terminal Devices	Smart Phone	5086Y	TCL Communication Limited	16-Apr-21	
Terminal Devices	Smart Phone	5059I	TCL Communication Limited	16-Apr-21	
Telecommunication Equipment	**Base Band Unit**	**BBU3910**	HUAWEI TECHNOLOGIES CO., Ltd.	16-Apr-21	**This device shall only be used by a Licensee**

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Devices	Mobile Phone	M612H	Meizu Technology Co., Ltd.	17-Apr-21	
Terminal Devices	Mobile Phone	M710H	Meizu Technology Co., Ltd.	17-Apr-21	
Terminal Devices	Mobile Phone	M712H	Meizu Technology Co., Ltd.	17-Apr-21	
Telecommunication Equipment	**PowerBeam AC**	**PBE-5AC-500**	Ubiquiti Networks Inc.	17-Apr-21	**Device is allowed under certain conditions**
Telecommunication Equipment	Network Service Platform	NFX150-C-AA	Juniper Networks Inc.	17-Apr-21	
Telecommunication Equipment	NFX LTE Mpim Card	NFX-LTE	Juniper Networks Inc.	17-Apr-21	
Telecommunication Equipment	Network Service Platform	NFX150-C	Juniper Networks Inc.	18-Apr-21	
Terminal Devices	HP525 Wireless Access Point	JG994A	Hewlett Packard Enterprise Company	21-Apr-21	
Terminal Devices	Mobile Phone	MIMO 1	Hong Kong IPRO Technology Co., Ltd	22-Apr-21	
Terminal Devices	Mobile Phone	MIMO 2	Hong Kong IPRO Technology Co., Ltd	22-Apr-21	
Terminal Devices	Smart Phone	NEO-L29	HUAWEI TECHNOLOGIES CO., Ltd.	22-Apr-21	
Terminal Devices	ATA Adapter	ATA190	CISCO system Inc.	23-Apr-21	
Terminal Devices	Cisco IP Phone 8861	CP-8861-K9	CISCO system Inc.	23-Apr-21	
Terminal Devices	Cisco Meraki MR33 Cloud Managed Access Point	MR33-HW	CISCO system Inc.	23-Apr-21	
Terminal Devices	Zabra TC75	TC75FK	Zebra Technologies Corporation	23-Apr-21	
Telecommunication Equipment	Network Security Appliance	APL29-0B6	SONICWALL INC.	24-Apr-21	
Terminal Devices	Dual Station Printer	2NR	Toshiba Global Commerce Solutions	24-Apr-21	
Terminal Devices	Printer	SP 6430DN	RICOH COMPANY, LTD.	24-Apr-21	
Terminal Devices	Vodafone MachineLink 3G	NWL-10	NetComm Wireless Limiterd	28-Apr-21	
Telecommunication Equipment	Switch	QFX5100-96S	Juniper Networks Inc.	28-Apr-21	
Terminal Devices	Access Point	APL26-0AE	SONICWALL INC.	28-Apr-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	DGS-1210 Series	DGS-1210-28	D-Link Corporation	2-May-21	
Telecommunication Equipment	DXS-1210 Series	DXS-1210-12SC	D-Link Corporation	2-May-21	
Telecommunication Equipment	D-Link DXS-3600 Series	DXS-3600-32S	D-Link Corporation	2-May-21	
Telecommunication Equipment	Fortianalyzer-400E	FAZ-400E	Fortinet, Inc.	2-May-21	
Telecommunication Equipment	Fortimanager-400E	FMG-400E	Fortinet, Inc.	2-May-21	
Telecommunication Equipment	FortiGate-1500D	FG-1500D	Fortinet, Inc.	2-May-21	
Telecommunication Equipment	FortiMail-100D	FML-1000D	Fortinet, Inc.	2-May-21	
Telecommunication Equipment	NX-6000 Series	NX-6235C	Nutniz Inc. LLC	2-May-21	
Telecommunication Equipment	NX-1000 Series	NX-1465-G4	Nutniz Inc. LLC	2-May-21	
Telecommunication Equipment	NX-1000 Series	NX-1365-G4	Nutniz Inc. LLC	2-May-21	
Terminal Devices	Cisco Aironet 1560 Series Outdoor Access Point	AIR-AP1562D-E-K9	CISCO system Inc.	2-May-21	
Terminal Devices	Smart Phone	DRA-L22	Huawei Technologies Co., Ltd.	2-May-21	
Terminal Devices	Mobile Wifi	E5573s-320	Huawei Technologies Co., Ltd.	2-May-21	
Terminal Devices	Galaxy A6+	SM-A605F/DS	Samsung Electronics	8-May-21	
Terminal Devices	Galaxy A6	SM-A600F/DS	Samsung Electronics	8-May-21	
Terminal Devices	FastBox (Smart TV BOX)	S805	Nevron	8-May-21	
Terminal Devices	Lava Mobile Phone	IRIS 65	Lava International (H.K) Limited	8-May-21	
Telecommunication Equipment	Network Security Appliance (NSA4600)	1RK26-0A3	SONICWALL INC.	8-May-21	
Terminal Devices	Cisco Wireless IP Phone 8821	CP-8821-K9	CISCO system Inc.	9-May-21	
Terminal Devices	Galaxy J6	SM-J600F/DS	Samsung Electronics	9-May-21	
Terminal Devices	Galaxy J4	SM-J400F/DS	Samsung Electronics	9-May-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Devices	Access Point	JX952-61001	Hewlett Packard Enterprise Company	12-May-21	
Terminal Devices	Lexmark Printer	MS817dn	Lexmark International Inc.	14-May-21	
Terminal Devices	Fleet Management System	FMB120	UAB Teltonika	14-May-21	
Terminal Devices	Notebook	NEO14A-2BK32	Shenzhen QR Technology Development Co., Ltd	15-May-21	
Telecommunication Equipment	**Ericsson Radio Base Station**	**KRD 901 060 / X**	Ericsson	15-May-21	**This device shall only be used by a Licensee**
Terminal Devices	Dect Cordless Handset	3730	Avaya	15-May-21	
Terminal Devices	GPS/GSM/GPRS Tracker	FMB120	TELTONIKA	15-May-21	
Terminal Devices	4G/LTE WiFi Router	B525s-23a	Huawei Technologies Co. Ltd	15-May-21	
Terminal Devices	Cisco Meraki MR20 Cloud Managed Access Point	MR20-HW	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Meraki MR70 Cloud Managed Access Point	MR70-HW	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Meraki MR53E Cloud Managed Access Point	MR53E-HW	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Meraki MR42E Cloud Managed Access Point	MR42E-HW	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1260 series Access Point	AIR-(L)AP1262N-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco 1100 Series Integrated Services Routers	C1111-xPWE	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1830 series Access Point	AIR-AP1832I-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 2800 series Access Point	AIR-AP2802x-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1700 series Access Point	AIR-CAP1702I-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 3800 series Access Point	AIR-AP3802x-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1850 series Access Point	AIR-AP1852x-E-K9	CISCO system Inc.	16-May-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Devices	Cisco Aironet 3700 series Access Point	AIR-CAP3702x-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 2700 series Access Point	AIR-CAP2702x-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1040 series Access Point	AIR-(L)AP1042N-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1130 series Access Point	AIR-(L)AP1131AG-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1140 series Access Point	AIR-(L)AP1142N-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1240 series Access Point	AIR-(L)AP1242AG-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1560 series Access Point	AIR-AP1562x-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1570 series Access Point	AIR-AP1572EAC-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1530 series Access Point	AIR-CAP1532x-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1550 series Access Point	AIR-CAP1552x-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 3500 series Access Point	AIR-CAP3502x-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 3600 series Access Point	AIR-CAP3602x-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet Hyperlocation Module	AIR-RM3010L-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 1600 series Access Point	AIR-xAP1602y-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Cisco Aironet 2600 series Access Point	AIR-xAP2602y-E-K9	CISCO system Inc.	16-May-21	
Terminal Devices	Nokia Smart Phone	TA-1063	HMD Global OY	20-May-21	
Telecommunication Equipment	Ethernet Switch	EX2300-24MP	Juniper Networks Inc.	20-May-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Ethernet Switch	EX2300-48MP	Juniper Networks Inc.	20-May-21	
Terminal Devices	Mobile Phone	M621H	Meizu Technology Co., Ltd.	20-May-21	
Telecommunication Equipment	Network Appliance	JATP700	Juniper Networks Inc.	20-May-21	
Terminal Devices	Smart Phone	CAG-L22	Huawei Technologies Co. Ltd	20-May-21	
Terminal Devices	Dect Base Station	IPBS2	Avaya Inc.	21-May-21	
Terminal Devices	IP Deskphone	9611G	Avaya Inc.	23-May-21	
Terminal Devices	Data gateway	EG9012-4LB	Guangzhou Robustel LTD	27-May-21	
Terminal Devices	Integrated Service Routers	C88xxxx	CISCO system Inc.	27-May-21	
Telecommunication Equipment	Series Switch	C9300-xxxx	CISCO system Inc.	27-May-21	
Telecommunication Equipment	Series Managed Switch	SG300xxxxx	CISCO system Inc.	27-May-21	
Terminal Devices	IP Phone	CP-9971-xxxx	CISCO system Inc.	27-May-21	
Telecommunication Equipment	Firewall	SOHO	Sonicwall Inc.	27-May-21	
Terminal Devices	Smart Phone	AUM-L29	Huawei Technologies Co. Ltd	30-May-21	
Terminal Devices	WiFi Router	R6400	Netgear	30-May-21	
Terminal Devices	Smart Phone	LND-L29	Huawei Technologies Co. Ltd	2-Jun-21	
Terminal Devices	Smart Phone	LLD-L21	Huawei Technologies Co. Ltd	2-Jun-21	
Terminal Devices	Smart Phone	COL- L29	Huawei Technologies Co. Ltd	2-Jun-21	
Terminal Devices	Smart Phone	DUA-L22	Huawei Technologies Co. Ltd	2-Jun-21	
Telecommunication Equipment	Secure Analytics Appliance	JSA7800	Juniper Networks Inc.	2-Jun-21	
Terminal Devices	Collaboration Video-conferencing phone	CP-DX650(-W)-K9	CISCO system Inc.	2-Jun-21	
Terminal Devices	GNSS Antenna	R8s	Trimble Inc.	2-Jun-21	
Terminal Devices	Printer	i-SENSYS MF426dw	Canon Inc.	2-Jun-21	
Terminal Devices	Printer	i-SENSYS MF429x	Canon Inc.	2-Jun-21	
Terminal Devices	Printer	i-SENSYS MF525x	Canon Inc.	2-Jun-21	
Telecommunication Equipment	Ethernet Switch	EX9253	Juniper Networks Inc.	2-Jun-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Platform Switch	(C1-)N9K-C93xxxx	CISCO system Inc.	5-Jun-21	
Terminal Devices	Mobile Phone - Alcatel	5033D	TCL Communication Limited	5-Jun-21	
Telecommunication Equipment	Firewall	300	Barracuda	5-Jun-21	
Terminal Devices	Conference Phone	B179	Avaya Inc.	6-Jun-21	
Terminal Devices	Video Collaboration Kit	Trio 8800	Polycom Limited	11-Jun-21	
Telecommunication Equipment	Ethernet Switch	QFX5200-48Y	Juniper Networks Inc.	13-Jun-21	
Terminal Devices	GPS/GSM/GPRS Handheld Device	TSC3	Trimble Inc.	13-Jun-21	
Terminal Devices	Smart Phone	IT-Glitter	Meizu Huihong Industry Co., Ltd.	20-Jun-21	
Terminal Devices	Smart Phone	iris 88	Lava International (H.K) Limited	24-Jun-21	
Terminal Devices	Smart Phone	iris 88s	Lava International (H.K) Limited	24-Jun-21	
Terminal Devices	Smart Phone	SM-G530H	Samsung Electronics	24-Jun-21	
Terminal Devices	Feature Phone	UN-M05	W&W Electronic Limited	24-Jun-21	
Terminal Devices	Feature Phone	UN-M06	W&W Electronic Limited	24-Jun-21	
Terminal Devices	Telematics Unit	T8	Trakm8 Ltd	24-Jun-21	
Terminal Devices	Mobile Phone	i1	Daopu ElecTechnology Co. LTD.	25-Jun-21	
Terminal Devices	Mobile Phone: Intex	IT-FLASH P1	Shenzhen Chino-E Comm. Co.	25-Jun-21	
Terminal Devices	Mobile Phone	ECO G9	Zhongshaa Hezhengxun Elec	25-Jun-21	
Terminal Devices	Access Point	AIR-AP1832I-H-K9	Cisco Systems Inc.	27-Jun-21	
Terminal Devices	Access Point	AIR-AP1852x-H-K9	Cisco Systems Inc.	27-Jun-21	
Terminal Devices	IP Phone	CP-8865(-W)-K9	Cisco Systems Inc.	27-Jun-21	
Terminal Devices	Smart Phone	SM-J810F/DS	Samsung Electronics	27-Jun-21	
Terminal Devices	IP Phone	CP-8845-K9	Cisco Systems Inc.	27-Jun-21	
Terminal Devices	Dect Cordeless Phone	A120	Gigaset Communciations GmbH Technology Co., Ltd	27-Jun-21	
Terminal Devices	Dect Cordeless Phone	C530	Gigaset Communciations GmbH Technology Co., Ltd	27-Jun-21	
Terminal Devices	Dect Cordeless Phone	A730	Gigaset Communciations GmbH Technology Co., Ltd	27-Jun-21	
Terminal Devices	Vocal Phone	GSM 5155	Silentron S.P.A	2-Jul-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Devices	Smart Phone	TA-1080	HMD Global OY	2-Jul-21	
Terminal Devices	Smart Phone: Alcatel	5034D	TCL Communication Limited	2-Jul-21	
Terminal Devices	Satellite/Terrastrial data communication mobile terminal	PT7000	ORBCOMM Inc.	2-Jul-21	
Terminal Devices	GNSS Rover	GS18(x)	Leia Geosystems	2-Jul-21	
Terminal Devices	Smart Phone	TC56DJ	Zebra Technologies Corporation	3-Jul-21	
Telecommunication Equipment	Mulitplexer	TCX1000	Juniper Networks Inc.	3-Jul-21	
Terminal Devices	IP Conference phone	B189	Avaya Inc.	4-Jul-21	
Terminal Devices	IP Deskphone	J129	Avaya Inc.	4-Jul-21	
Terminal Devices	IP Deskphone	J169	Avaya Inc.	4-Jul-21	
Terminal Devices	IP Deskphone	J179	Avaya Inc.	4-Jul-21	
Telecommunication Equipment	Firewall	SG 550	Sophos Limited	4-Jul-21	
Telecommunication Equipment	Waveserver	400G	Ciena	4-Jul-21	
Terminal Devices	GNSS receiver	OSA 5420	ADVA Optical Networking SE	4-Jul-21	
Terminal Devices	Integrated Service Routers	4331	Cisco Systems, Inc.	4-Jul-21	
Telecommunication Equipment	Switch	LB9	Quanta computer Inc.	4-Jul-21	
Telecommunication Equipment	Switch	AS3510	Edge Core Networks	4-Jul-21	
Telecommunication Equipment	Sync Server	S650	Microsemi Frequency and Time Corporation	4-Jul-21	
Telecommunication Equipment	Ethernet Switch	QFX5200-32C	Juniper Networks	4-Jul-21	
Telecommunication Equipment	Ethernet Switch	EX4300	Juniper Networks	4-Jul-21	
Telecommunication Equipment	Ethernet Switch	EX4550	Juniper Networks	4-Jul-21	
Terminal Devices	Router	2901- Series	Cisco Systems, Inc.	4-Jul-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Switch	BMS T3048-LY2A	Quanta computer Inc.	4-Jul-21	
Telecommunication Equipment	Data Center Switch	L7096	Delta Networks Inc.	4-Jul-21	
Telecommunication Equipment	Smart Managed Switch	FS750T2	Netgear International Limited	4-Jul-21	
Terminal Devices	3D Router	MX240	Juniper Networks	4-Jul-21	
Telecommunication Equipment	Switch	AS7710-32X	Edge Core Networks	4-Jul-21	
Telecommunication Equipment	Ethernet Switch	AS7760-32X	Edge Core Networks	4-Jul-21	
Terminal Devices	3D Router	MX480	Juniper Networks	4-Jul-21	
Telecommunication Equipment	Switch	SF112-24	Cisco	4-Jul-21	
Terminal Devices	Mobile phone	PAR-LX1M	Huawei Technologies	4-Jul-21	
Terminal Devices	GNSS Antenna	SPS986	Trimble Inc.	4-Jul-21	
Telecommunication Equipment	Services Gateway	SRX5400	Juniper Networks	4-Jul-21	
Telecommunication Equipment	Services Gateway	SRX5800	Juniper Networks	4-Jul-21	
Terminal Devices	Smart Phone	X1 Dual	M.B.S Mobile Privatae Limited	7-Jul-21	
Terminal Devices	Mobile phone	INE-LX1	Huawei Technologies	9-Jul-21	
Terminal Devices	Mobile phone	TA-1075	HMD Global Oy	9-Jul-21	
Terminal Devices	Access Point	E500	Cambium Networks Limited	14-Jul-21	
Terminal Devices	DECT cordless VoIP Phone	DP750	Grandstream Networks,Inc.	14-Jul-21	
Terminal Devices	4G Router	RUT240	TELTONIKA	14-Jul-21	
Terminal Devices	Wireless Controller	AIR-CT5508xxxx	Cisco Systems Inc.	15-Jul-21	
Telecommunication Equipment	Rack Server	UCS C220 M4	Cisco Systems Inc.	15-Jul-21	
Terminal Devices	Access Point	AIR-AP1562E-H-K9	Cisco Systems, Inc.	17-Jul-21	
Terminal Devices	Mobile phone	2003D	TCL communication limited	17-Jul-21	
Terminal Devices	GPS tracking device	FM-Eco4+	Ruptela JSC	17-Jul-21	
Terminal Devices	Integrated Service Routers	ISR4221xxx	Cisco Systems, Inc.	17-Jul-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Secure Mobile access	SMA 400	Sonicwall Inc.	18-Jul-21	
Terminal Devices	Universal Metro Router	ACX5448	Juniper Networks	18-Jul-21	
Terminal Devices	Renult Nissan AIVC	IVC_T_ROW1	Continental Automotive Singapore Pte Ltd	18-Jul-21	
Terminal Devices	Access Point	AIR-AP4800-H-K9	Cisco Systems, Inc.	18-Jul-21	
Terminal Devices	Access Point	AIR-(L)AP1131AG-I-K9	Cisco Systems, Inc.	18-Jul-21	
Terminal Devices	IP Phone	CP-6941-x-K9	Cisco	18-Jul-21	
Terminal Devices	IP Conference phone	CP-8832-EU-K9	Cisco	18-Jul-21	
Telecommunication Equipment	switch	MS425-xx-HW	Cisco	18-Jul-21	
Terminal Devices	Mobile phone	IS320.1	AIRCOM	23-Jul-21	
Terminal Devices	Wireless POS terminal	A90	Vanstone	23-Jul-21	
Terminal Devices	Fax Module	497K16470	Xerox	25-Jul-21	
Terminal Devices	LTE Module	T77W968	FOXCONN	31-Jul-21	
Terminal Devices	Graphic switcher	MGP 464 Pro DI	Extron electronics	1-Aug-21	
Telecommunication Equipment	switch	AS7772-32X	Edge Core Networks	1-Aug-21	
Telecommunication Equipment	switch	L7048	Delta	1-Aug-21	
Telecommunication Equipment	DAS	5000 WIDEBAND DAS	ZinWave	1-Aug-21	
Terminal Devices	Mobile phone	CPH1803	GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP.,LTD	1-Aug-21	
Telecommunication Equipment	switch	C94xxR	Cisco	1-Aug-21	
Terminal Devices	Mobile phone	L38011	Lenovo	1-Aug-21	
Terminal Devices	Mobile phone	K320t	Lenovo	1-Aug-21	
Terminal Devices	Mobile phone	K520	Lenovo	1-Aug-21	
Terminal Devices	Mobile phone	Iris 51	LAVA	1-Aug-21	
Terminal Devices	Wireless POS terminal	V71	Vanstone	1-Aug-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Devices	Mobile phone	TA-1116	hmd Global Oy	5-Aug-21	
Terminal Devices	Mobile phone	TA-1105	hmd Global Oy	5-Aug-21	
Terminal Devices	HSPA Cellular Modem	MTSMC-H5	ZELTIQ AESTHETICS,Inc.	5-Aug-21	
Telecommunication Equipment	Firewall	XG 115	SOPHOS	5-Aug-21	
Terminal Devices	mobile phone	BX	Ibritech DMCC	5-Aug-21	
Terminal Devices	mobile phone	SM-N960f/DS	Samsung Electronics	5-Aug-21	
Terminal Devices	TAB	SM-T595	Samsung Electronics	5-Aug-21	
Terminal Devices	TAB	SM-T835	Samsung Electronics	5-Aug-21	
Terminal Devices	IP phone	CP-8831(-DC)-EU-K9	Cisco	5-Aug-21	
Terminal Devices	Wireless controller	AIR-CT8540-xxxx	Cisco	5-Aug-21	
Terminal Devices	wireless sensor	Sensor6	AirMagnet Enterprise	7-Aug-21	
Terminal Devices	IP Deskphone	9641GS	Avaya	7-Aug-21	
Terminal Devices	IP Deskphone	1616-I	Avaya	7-Aug-21	
Terminal Devices	IP Deskphone	IPO 500V2	Avaya	7-Aug-21	
Terminal Devices	IP intercom	2N Helios IP Solo	2N Telekomunikace	7-Aug-21	
Terminal Devices	IP Phone	SIP-T56A	Yealink	7-Aug-21	
Terminal Devices	IP intercom	2N Indoor Touch	2N Telekomunikace	7-Aug-21	
Terminal Devices	Tracking Unit	FOX3	Falcom GmbH	13-Aug-21	
Terminal Devices	mobile phone	A6003	OnePlus Technology (Shenzhen) Co., Ltd	13-Aug-21	
Terminal Devices	mobile phone	Iris 90	LAVA international	13-Aug-21	
Terminal Devices	Mobile phone	CPH 1823	OPPO	13-Aug-21	
Terminal Devices	Access Point	AIR-AP2802x-H-K9	Cisco	14-Aug-21	
Terminal Devices	Network interface Modules	NIM-4G-LTE-GA	Cisco	14-Aug-21	
Terminal Devices	IP Video Phone	CTS-E20-K9	Cisco	14-Aug-21	
Terminal Devices	PLC	1756-xxxx	Allen Bradely	14-Aug-21	
Terminal Devices	Mobile phone	BBE100-4	TCL Communication LTD	15-Aug-21	
Terminal Devices	Mobile phone	BBF100-6	TCL Communication LTD	15-Aug-21	
Terminal Devices	Tablet	9027X	TCL Communication LTD	15-Aug-21	
Telecom Equipment	Internet security device	335W	ForcePoint	15-Aug-21	
Terminal Devices	synchronization equipment	TS 3500	symmetricom	15-Aug-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecom Equipment	Switch	JNP10002-60C \ QFX10002-60C \ PTX10002-60C	Juniper Networks	15-Aug-21	
Terminal Devices	Mobile phone	4034D	TCL Communication Ltd	15-Aug-21	
Telecom Equipment	Switch	WS-C4500xxx	Cisco	15-Aug-21	
Terminal Devices	Tracker	HPRO-100	Hitachi	27-Aug-21	
Telecom Equipment	Switch	FC5022	Lenovo	27-Aug-21	
Terminal Devices	Printer	SNPRC-1803-01 (9010 S Plus)	HP Inc.	27-Aug-21	
Terminal Devices	Printer	SNPRC-1803-02 (9020 S Premier)	HP Inc.	27-Aug-21	
Telecom Equipment	Switch	EN4093R	Lenovo	28-Aug-21	
Terminal Devices	Router	Cisco 4431	Cisco	29-Aug-21	
Terminal Devices	multimedia conferencing bridge	CTI-45xx-MCU-K9	Cisco	29-Aug-21	
Terminal Devices	multimedia conferencing bridge	CS-KITxxxx	Cisco	29-Aug-21	
Telecom Equipment	Switch	UCS-FI-6332xxxx	Cisco	29-Aug-21	
Terminal Devices	Ip Phone	CP-6911-x-K9	Cisco	29-Aug-21	
Telecom Equipment	Cloud Managed Security Appliance	MX65-HW	Cisco	29-Aug-21	
Telecom Equipment	Switch	DS-C9124-K9	Cisco	29-Aug-21	
Telecom Equipment	Switch	WS-C3560CX-xxxx	Cisco	29-Aug-21	
Terminal Devices	Handheld Computer	EF401	BlueBird Inc.	4-Sep-21	
Terminal Devices	KVM Switch	1754A1X	IBM	4-Sep-21	
Terminal Devices	Access Point	B612s-25d	Huawei Technologies Co., Ltd.	4-Sep-21	
Terminal Devices	Printer	Phaser 3330	Xerox LTD	4-Sep-21	
Terminal Devices	IP Phone	3300IP MWD5	Jiangsu Zhongxun Electronic Technology Co., Ltd.	4-Sep-21	
Terminal Devices	IP Phone	3300IPTRM	Rizhao Londai Electronic Technology	4-Sep-21	
Terminal Devices	Vehicle Tracker	ABT40-B-N	Abtrack S.R.L	4-Sep-21	
Telecom Equipment	Switch	QFX5210	Juniper Networks, Inc.	8-Sep-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Devices	Router	ISR4431xxxx	Cisco	8-Sep-21	
Terminal Devices	Access Point	AIR-AP1562I-I-K9	Cisco	12-Sep-21	
Terminal Devices	Access Point	AIR-AP1815W-I-K9	Cisco	12-Sep-21	
Terminal Devices	Mobile Phone	REDMI A2 Lite (M1804C3CG)	Xiaomi Communications	12-Sep-21	
Terminal Devices	Mobile Phone	E1 Selfie	M.B.S. Mobile Private Limited	12-Sep-21	
Terminal Devices	Mobile Phone	C1	M.B.S. Mobile Private Limited	12-Sep-21	
Terminal Devices	Mobile Phone	REDMI 6A (M1804C3CG)	Xiaomi Communications Co. LTD	12-Sep-21	
Terminal Devices	Mobile Phone	REDMI S2 (M1803E6G)	Xiaomi Communications Co. LTD	12-Sep-21	
Terminal Devices	Mobile Phone	MIA2 (M1804D2SG)	Xiaomi Communications Co. LTD	12-Sep-21	
Telecom Equipment	Switch	EX4300-48MP	Juniper Networks, Inc.	12-Sep-21	
Terminal Devices	Mobile Phone	JKM-LX1	Huawei Technologies Co., Ltd.	12-Sep-21	
Terminal Devices	Intrinsically safe mobile phones	Ex-Handy 08	Ecom Instruments GmbH	16-Sep-21	
Terminal Devices	Mobile Phone	4024D	TCL Communication Limited	16-Sep-21	
Terminal Devices	Mobile Phone	5070D	TCL Communication Limited	16-Sep-21	
Terminal Devices	Tablet	9022X	TCL Communication Limited	16-Sep-21	
Terminal Devices	Coredless Telephone	KX-TGC210UES	Panasonic	16-Sep-21	
Terminal Devices	Coredless Telephone	KX-TGC212UES	Panasonic	16-Sep-21	
Terminal Devices	Coredless Telephone	KX-TGC213UES	Panasonic	16-Sep-21	
Terminal Devices	Coredless Telephone	KX-TGB110UEB	Panasonic	16-Sep-21	
Terminal Devices	GPS and cellular TRacker	P99G	MeiTrack	16-Sep-21	
Telecom Equipment	Firewall	ASA5516-FPWR-K9	Cisco	16-Sep-21	
Terminal Devices	LTE Module	L860-GL	Fibocom Wireless Inc.	16-Sep-21	
Telecom Equipment	Switch	DGS-1210-52MP	D-link	16-Sep-21	
Telecom Equipment	Switch	DGS-1210-10P	D-link	16-Sep-21	
Terminal Devices	Access Point	LAPN 600	linksys	16-Sep-21	
Terminal Devices	Mobile Phone	A2101	APPLE Inc.	16-Sep-21	
Terminal Devices	Mobile Phone	A2097	APPLE Inc.	16-Sep-21	
Terminal Devices	Mobile Phone	A2105	APPLE Inc.	16-Sep-21	
Terminal Devices	Mobile Phone	CON-SIA-II	Peiker Acustic	24-Sep-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Devices	Printer	SNPRC-1804-02	HP Inc.	26-Sep-21	
Terminal Devices	Mobile Phone	SM-J415F/DS	Samsung Electronics Co., Ltd.	26-Sep-21	
Terminal Devices	Mobile Phone	SM-J610F/DS	Samsung Electronics Co., Ltd.	26-Sep-21	
Terminal Devices	Mobile Phone	TA-1095	HMD Global Oy	30-Sep-21	
Terminal Devices	Access Point	AP55C	SOPHOS	30-Sep-21	
Terminal Devices	Access Point	AP55	SOPHOS	30-Sep-21	
Terminal Devices	IP Phone	CP-8941-x-K9	Cisco	30-Sep-21	
Telecom Equipment	Switch	DS-C9148T-xxxx	Cisco	30-Sep-21	
Telecom Equipment	Switch	DS-C9396T-xxxx	Cisco	30-Sep-21	
Telecom Equipment	Switch	N2K-C23xxxxx	Cisco	30-Sep-21	
Telecom Equipment	Switch	SG350xxxxx	Cisco	30-Sep-21	
Telecom Equipment	Switch	SLM20xxxx-UK	Cisco	30-Sep-21	
Terminal Devices	Router	VEDGE-100B-AC-K9	Cisco	30-Sep-21	
Terminal Devices	Router	VEDGE-100M-GB-K9	Cisco	8-Oct-21	
Terminal Devices	Industrial Ethernet Tap	1783-ETAPxxx	Rockwell Automation Inc.	8-Oct-21	
Telecom Equipment	Industrial Switch	1783-BMS10CL	Rockwell Automation Inc.	8-Oct-21	
Terminal Devices	Communication modules	1794-xxx	Rockwell Automation Inc.	8-Oct-21	
Terminal Devices	Communication modules	MVI94-X	ProSoft Technology, Inc	8-Oct-21	
Terminal Devices	Ethernet/IP Adapter	1715-AENTR	Rockwell Automation Inc.	8-Oct-21	
Terminal Devices	Communication modules	MVI56Exxx	ProSoft Technology, Inc	8-Oct-21	
Terminal Devices	Repeater	1786-xxx	Rockwell Automation Inc.	8-Oct-21	
Terminal Devices	Wireless Ethernet Bridge / Serial Gateway	IP2421	Microhard Systems Inc.	8-Oct-21	
Terminal Devices	WLAN Controller	AIR-CT2504-K9	Cisco	8-Oct-21	
Terminal Devices	Mobile Phone	E10+	Energizer	10-Oct-21	
Terminal Devices	Mobile Phone	L3804	Lenovo Mobile Communication Technology Ltd.	10-Oct-21	
Terminal Devices	Printer	into	KOENIG & BAUER Coding GmbH	10-Oct-21	
Telecom Equipment	Switch	C9500-xxxx	Cisco Systems	10-Oct-21	
Terminal Devices	Media management system	CS-CODEC-PLUS	Cisco Systems	10-Oct-21	
Telecom Equipment	Switch	N3K-C30xxxxx	Cisco Systems	10-Oct-21	
Terminal Devices	Router	C89xxxxx	Cisco Systems	10-Oct-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecom Equipment	Server	ACS600xxx	Avocent Corportion	10-Oct-21	
Terminal Devices	Router	ISR4451	Cisco Systems	10-Oct-21	
Telecom Equipment	Firewall	ASA 5515	Cisco Systems	10-Oct-21	
Terminal Devices	Gateway	GX-1K	Nuera Communications	10-Oct-21	
Terminal Devices	printer	CS728de	Lexmark International	13-Oct-21	
Terminal Devices	printer	CX922de	Lexmark International	13-Oct-21	
Terminal Devices	printer	MS417dn	Lexmark International	13-Oct-21	
Terminal Devices	Card Printer	P5500S	Polaroid	13-Oct-21	
Terminal Devices	Mobile Phone	SM-A750F/DS	Samsung Electronics Co., Ltd.	13-Oct-21	
Terminal Devices	Corded Phone	Aegis-xxx-08	Scitec	13-Oct-21	
Terminal Devices	Mobile Phone	RAVOZ R4	ZOPO Technology	14-Oct-21	
Telecom Equipment	Security Gatway	FG-501E-DC	Fortinet Inc.	17-Oct-21	
Terminal Devices	Mobile Phone	BM10	SHENZEN L8STAR TECHNOLOGY Co LTD	17-Oct-21	
Terminal Devices	Mobile Phone	BM70	SHENZEN L8STAR TECHNOLOGY Co LTD	17-Oct-21	
Terminal Devices	Mobile Phone	TA-1114	HMD Global OY	20-Oct-21	
Terminal Devices	Mobile Phone	TA-1104	HMD Global OY	20-Oct-21	
Terminal Devices	Mobile Phone	MI8(M1803E1A)	Xiaomi Communications Co. Ltd	20-Oct-21	
Terminal Devices	Mobile Phone	MI MAX3 (M1804E4A)	Xiaomi Communications Co. Ltd	20-Oct-21	
Terminal Devices	Mobile Phone	NOTE 6 PRO (M1806E7TG)	Xiaomi Communications Co. Ltd	20-Oct-21	
Terminal Devices	Data Collector	NLS-MT65 (MT6550-XW)	Newland Auto-ID Tech. Co.	20-Oct-21	
Terminal Devices	Mobile Phone	REDMI 6 (M1804C3DG)	Xiaomi Communications	20-Oct-21	
Terminal Devices	Mobile Phone	COR-L29	Huawei Technologies Co.	21-Oct-21	
Terminal Devices	Mobile Phone	JSN-L22	Huawei Technologies Co.	21-Oct-21	
Terminal Devices	Mobile Phone	2053D	TCL Communication limited	21-Oct-21	
Terminal Devices	IP Phone	CP-7931G	Csico Systems	22-Oct-21	
Terminal Devices	Router	ISR4351xxxx	Csico Systems	22-Oct-21	
Telecom Equipment	Switch	SF300xxxxx	Csico Systems	22-Oct-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Devices	Mobile Phone	SM-A920F/DS (Galaxy A9)	Samsung Electronics Co., Ltd.	22-Oct-21	
Terminal Devices	Mobile Phone	TA-1119 (Nokia 8.1)	HMD Global OY	23-Oct-21	
Terminal Devices	LTE Module	NS-SDW-210-LTE-R2	CITRIX SYSTEMS, INC.	23-Oct-21	
Terminal Devices	Analog phone	9600 MWD	Telematrix	23-Oct-21	
Terminal Devices	Analog phone	TRIMLINE 69119	Jiangsu Zhongxun Digital Electronics	23-Oct-21	
Terminal Devices	Analog phone	3100 MWDS Series	Telematrix	23-Oct-21	
Terminal Devices	IP Phones	1600 IP Phone Series	Avaya Inc.	23-Oct-21	
Antenna	Indoor Omni MIMO Antenna	HPTIOC-0727-05NF2	SHENZHEN HUAPTEC	27-Oct-21	
Antenna	Indoor Omni SISO Antenna	HPTIOC-0727-05NF	SHENZHEN HUAPTEC	27-Oct-21	
Antenna	Indoor Directional MIMO Antenna	HPTODP-0727-08NF2	SHENZHEN HUAPTEC	27-Oct-21	
Antenna	Indoor Directional SISO Antenna,	HPTIOC-0727-09NF1	SHENZHEN HUAPTEC	27-Oct-21	
Terminal Devices	Tablet	9009G	TCL Communication limited	27-Oct-21	
Terminal Devices	Mobile Phone	LE9810 (R3 Note)	LAVA international	31-Oct-21	
Terminal Devices	Ipad	A1934	Apple Inc.	6-Nov-21	
Terminal Devices	Ipad	A1895	Apple Inc.	6-Nov-21	
Terminal Devices	Router	CISCO29xxxx	Cisco Systems	11-Nov-21	
Terminal Devices	Access Point	AIR-AP1562x-C-K9	Cisco Systems	11-Nov-21	
Antenna	**B46 LTE Antenna**	**KRE 105259/1 (2205)**	Ericsson	11-Nov-21	**This device shall only be used by a Licensee**
Terminal Devices	Label Printer	i7100	Brady	11-Nov-21	
Telecom Equipment	Media Switch	MX-606-HDBT-H2-v2	Wyrestorm	11-Nov-21	
Terminal Devices	Audio Digital Signal Processor	Prism 16x16	Symetrix	11-Nov-21	
Terminal Devices	ink jet printer	AX-350i	Domino	11-Nov-21	
Terminal Devices	Datacard printer	PX30	Entrust Datacard	11-Nov-21	
Terminal Devices	POS Thermal Printer	TSP 65411	Star	11-Nov-21	
Telecom Equipment	**Radio Base Station (RBS)**	**KRD 901 10 x / x**	Ericsson	11-Nov-21	**This device shall only be used by a Licensee**

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Devices	Mobile phone	CPH1903	GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP.,LTD.	21-Nov-21	
Telecom Equipment	**PTP transmition system**	**LigoPTP-5-23 Pro**	Ligowave	21-Nov-21	**This device allowed under certain conditions**
Terminal Devices	Mobile phone	LE9820	LAVA	21-Nov-21	
Terminal Devices	Printer	SNPRC-1806-01	HP Inc.	21-Nov-21	
Terminal Devices	Mobile phone	ECO MUSIC	SHENZHEN CIVICOM COMMUNICATION TECH. LTD.	21-Nov-21	
Terminal Devices	Tablet	9026X	TCL Communication Ltd.	21-Nov-21	
Terminal Devices	Defibrillator	LPCR2	Physio-Control, Inc.	21-Nov-21	
Terminal Devices	Cloud Storage	WDBVBZ0xxxJCH-NESN (MY CLOUD EX2 Ultra)	Western Digital	24-Nov-21	
Telecom Equipment	Switch	SF350-24-K9-UK	Cisco	24-Nov-21	
Terminal Devices	Thermal Printer	PP9000X	POSIFLEX TECHNOLOGY INC.	24-Nov-21	
Telecom Equipment	Switch	1920 Switch Series (HNGZA-HA00xx)	Hewlett Packard	24-Nov-21	
Telecom Equipment	Switch	J9776A	Hewlett Packard	24-Nov-21	
Terminal Devices	Printer	K10478	Canon Inc.	24-Nov-21	
Terminal Devices	Mobile Phone	5059D	TCL Communication Limited	2-Dec-21	
Terminal Devices	4G LTE Hotspot	Solis	Skyroam	2-Dec-21	
Terminal Devices	Mobile Phone	HRY-LX1MEB	Huawei Technologies Co., Ltd	2-Dec-21	
Terminal Devices	Mobile Phone	A6013 (One Plus 6T)	One Plus	2-Dec-21	
Terminal Devices	Tracking Unit	LMU-1220	Cal/Amp	2-Dec-21	
Terminal Devices	Printer	PX10	Entrust	8-Dec-21	
Telecommunication Equipment	Firewall	SG 430	Sophos Limited	8-Dec-21	
Terminal Device	FAX Module	SEOLA-1803-00	HP Inc.	8-Dec-21	
Terminal Device	Online Connectivity Unit	TLVHM3IU-E	LG Electronics Inc.	8-Dec-21	
Terminal Device	Printer	CX727de	lexmark International Inc.	8-Dec-21	
Antenna	Car Antenna	4M0 035 503 L GRU	CALEARO ANTENNA SPA	12-Dec-21	
Terminal Devices	Dual WAN Security Router	Vigor 2912	DRAYTEK CORP.	12-Dec-21	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Mobile Phone	INE-LX1r (Nova 3i)	HUAWEI TECHNOLOGIES Co.	18-Dec-21	
Terminal Device	Access Point	UAP AC LR	Ubiquiti Networks	18-Dec-21	
Telecommunication Equipment	Switch	US-8-150W	Ubiquiti Networks	18-Dec-21	
Terminal Device	Routers	AFI-HD	Ubiquiti Networks	18-Dec-21	
Telecommunication Equipment	Switch	US-24-250W	Ubiquiti Networks	18-Dec-21	
Telecommunication Equipment	Switch	US-16-150W	Ubiquiti Networks	18-Dec-21	
Telecommunication Equipment	Server Computer	E28S	Dell Inc.	18-Dec-21	
Telecommunication Equipment	Firewall	XG 105	SOPHOS Limited	18-Dec-21	
Terminal Device	Feature Phone	B1	iBRITECH DMCC	18-Dec-21	
Terminal Device	IP Phone	CP-8841-K9	Cisco Systems	18-Dec-21	
Terminal Device	IP Phone	Aqeri 96400	BorderLight / Aqeri 96400	18-Dec-21	
Terminal Device	Printer	CS410dn	lexmark International Inc.	18-Dec-21	
Terminal Device	DECT Phone	S250	CCT Tech Advanced Product	23-Dec-21	
Terminal Device	Mobile Phone	5008U	TCL Communication Ltd	23-Dec-21	
Terminal Device	Printer	SP C440DN	RICOH Company, LTD	23-Dec-21	
Terminal Device	Mobile Phone	E10	Energizer	23-Dec-21	
Terminal Device	Mobile Phone	L18081	Lenovo Mobile communication tec.	23-Dec-21	
Terminal Device	4k HDMI Matrix Switcher	DXP44 HD 4K Plus	Extron Electronics	24-Dec-21	
Telecommunication Equipment	Switch	C6832-X-LE	Cisco Systems	29-Dec-21	
Terminal Device	Access Point	AIR-CAP2702x-H-K9	Cisco Systems	29-Dec-21	
Terminal Device	R510 Acess Point	R510	RUCKUS WIRELESS INC.	29-Dec-21	
Terminal Device	Zone Director 1200	901-1205-UK00	RUCKUS WIRELESS INC.	29-Dec-21	
Telecommunication Equipment	Fiber Air	IP-20S-42	Ceragon Networks Ltd.	5-Jan-22	
Terminal Device	UniFi AC Dual-Radio Access Point	UAP-AC-PRO	Ubiquiti Networks	5-Jan-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Cordless Phone (Analogue & DECT)	digital cordless telephone	KX-TG6711UE	Panasonic	6-Jan-22	
Cordless Phone (Analogue & DECT)	digital cordless telephone	KX-TG6712UE	Panasonic	6-Jan-22	
Cordless Phone (Analogue & DECT)	Cordless Telephone	KX-TGE210UEB/N	Panasonic	6-Jan-22	
Cordless Phone (Analogue & DECT)	Cordless Telephone	KX-TGC220UES	Panasonic	6-Jan-22	
Cordless Phone (Analogue & DECT)	Cordless Telephone	KX-TGD310UEB	Panasonic	6-Jan-22	
Cordless Phone (Analogue & DECT)	Cordless Telephone	KX-TGD312UEB	Panasonic	6-Jan-22	
Cordless Phone (Analogue & DECT)	Cordless Telephone	KX-TGD320UEB	Panasonic	6-Jan-22	
Cordless Phone (Analogue & DECT)	Cordless Telephone	KX-TGH210UEB	Panasonic	6-Jan-22	
Cordless Phone (Analogue & DECT)	Cordless Telephone	KX-TGH220UEB	Panasonic	6-Jan-22	
Cordless Phone (Analogue & DECT)	Cordless Telephone	KX-TGF310UEB	Panasonic	6-Jan-22	
Terminal Device	Integrated Telephone system	KX-TSC11FXW	Panasonic	6-Jan-22	
Terminal Device	Integrated Telephone system	KX-TS880FXB/WS	Panasonic	6-Jan-22	
Terminal Device	Integrated Telephone system	KX-TS560FXB/W	Panasonic	6-Jan-22	
Terminal Device	Integrated Telephone system	KX-TS580FXB/W	Panasonic	6-Jan-22	
Terminal Device	Integrated Telephone system	KX-TS520FXB/W	Panasonic	6-Jan-22	
Terminal Device	Integrated Telephone system	KX-TS500FXB/W	Panasonic	6-Jan-22	
Terminal Device	Black & White Printer	SP8400DN	RICOH International BV	6-Jan-22	
Terminal Device	Access Point	R720	RUCKUS WIRELESS INC.	7-Jan-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Thermal Printer	MCP31L	Star Micronics Co., Ltd	8-Jan-22	
Terminal Device	Car Telmatics Device	TA4HEB-W	LG Electronics Inc.	14-Jan-22	
Terminal Device	Car Telmatics Device	TA4LEN-4	LG Electronics Inc.	14-Jan-22	
Terminal Device	Mobile Phone	Champion C1	LAVA International	15-Jan-22	
Terminal Device	Mobile Phone	LN9810	LAVA International	15-Jan-22	
Terminal Device	Mobile Phone	LH9810	LAVA International	15-Jan-22	
Terminal Device	Smart Phone	L38083	Lenovo Mobile Communication Technology Ltd.	15-Jan-22	
Terminal Device	UMTS/GSM Smartphone	5003D	TCL Communication Limited	16-Jan-22	
Terminal Device	CCTV Camera Interface	P7216	Axix Communications AB	16-Jan-22	
Terminal Device	Multifunction Printer with WiFi and Fax	K10479	Canon Inc.	19-Jan-22	
Terminal Device	Multifunction Printer with WiFi and Fax	F173302	Canon Inc.	19-Jan-22	
Terminal Device	Cellular Radtio Telematics Device	PL641V2	Caterpillar Inc.	19-Jan-22	
Terminal Device	Pocophone F1	M1805E10A	Xiaomi Communications Ltd	19-Jan-22	
Antenna	GSM/UMTS magnetic antenna	MC0114027-SMA-ST-J	MC Technologies GmbH	19-Jan-22	
Terminal Device	Wireless Access Point	AP230	Aerohive Networks	20-Jan-22	
Terminal Device	Printing cards	RX10	Entrust Datacard	20-Jan-22	
Telecommunication Equipment	Integrated voice and data gateway	VCX-IP	Frequentis AG	20-Jan-22	
Terminal Device	Huawei Y6 Prime Mobile Phone	MRD-LX1F	Huawei Technologies Co Ltd	23-Jan-22	
Terminal Device	Huawei Y7 Prime Mobile Phone	DUB-LX1	Huawei Technologies Co Ltd	23-Jan-22	
Terminal Device	GPS/GSM tracker	ST-90X	Auto Leaders	26-Jan-22	
Terminal Device	Mi 8 Lite mobile phone	Mi 8 Lite - M1808D2TG	Xiaomi Communications Ltd	28-Jan-22	
Telecommunication Equipment	JSA Secure Analytics	JSA7500	Juniper Networks Inc.	28-Jan-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Universal Access Router	ACX5048	Juniper Networks Inc.	28-Jan-22	
Telecommunication Equipment	Universal Access Router	ACX5096	Juniper Networks Inc.	28-Jan-22	
Telecommunication Equipment	Ethernet Switch	QFX5200-32C	Juniper Networks Inc.	28-Jan-22	
Terminal Device	1 Line Wall Mounted Analogue	330 TRM	Cetis Telematrix 3300	29-Jan-22	
Telecommunication Equipment	GPON Optical Line Terminal	SAN3700GPON	SINO Telecom Technology	29-Jan-22	
Telecommunication Equipment	**Antenna Integrated Radio**	**AIR 6488 - KRD 901 xxx/xxx**	Ericsson	29-Jan-22	**This device shall only be used by a Licensee**
Terminal Device	Audio / Video Streaming Router	RK-1	Pakedge	29-Jan-22	
Telecommunication Equipment	Silver Peak	EC-XS-IY	Silver Peak Systems	2-Feb-22	
Terminal Device	Smart Phone	Galazy Rize 20- SM-M205F/DS	Samsung Electronics	2-Feb-22	
Terminal Device	Smart Phone	Galaxy S10+ - SM-G975F/DS	Samsung Electronics	2-Feb-22	
Terminal Device	Smart Phone	Galaxy S10e - SM-G970F/DS	Samsung Electronics	2-Feb-22	
Terminal Device	Smart Phone	Galaxy S10 - SM-G973F/DS	Samsung Electronics	2-Feb-22	
Terminal Device	Audio Matrix Switcher	60-1512-01	Extron Electronics Middle East FZE	2-Feb-22	
Terminal Device	Fox in a box thermal printer	FIAB – PRD DTP-1/300	Silver Fox	6-Feb-22	
Terminal Device	Smart Phone	Nokia TA-1130	HMD Global Oy	10-Feb-22	
Terminal Device	Smart Phone	Nokia 210 DS - TA-1139	HMD Global Oy	10-Feb-22	
Telecommunication Equipment	**Point to Point data linkage short distance**	**LNE-5AC-GEN2**	Ubiquiti Networks	10-Feb-22	**Device is allowed under certain conditions**

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	**Point to Point data linkage short distance**	**NBE - 5AC - GEN2**	Ubiquiti Networks	10-Feb-22	**Device is allowed under certain conditions**
Telecommunication Equipment	**Point to Point data linkage medium distance**	**PBE - 5AC - 500**	Ubiquiti Networks	10-Feb-22	**Device is allowed under certain conditions**
Telecommunication Equipment	**Point to Point data linkage medium distance**	**PBE - 5AC - GEN2**	Ubiquiti Networks	10-Feb-22	**Device is allowed under certain conditions**
Terminal Device	GPRS GPS Tracker	AL7(UG)	A Track Technology	10-Feb-22	
Terminal Device	Seamless 4K scaling presentation matrix switcher	DTP Crosspoint 84, DTP crosspoint 82	Extron Electronics	10-Feb-22	
Telecommunication Equipment	Firewall - threat Prevention Security Appliance	Firewall XG 450	Sophos	10-Feb-22	
Terminal Device	Smart Phone	Nokia 9 DS - TA-1087	HMD Global Oy	12-Feb-22	
Terminal Device	Wireless Router	WI-AP510	Wireless-Tek Technology Limited	12-Feb-22	
Terminal Device	Network Switch	WI-AC150	Wireless-Tek Technology Limited	12-Feb-22	
Antenna	External Antenna	8dbi Omni Antenna	Wireless-Tek Technology Limited	12-Feb-22	
Termianl Device	Cisco Unified Wireless IP Phone 7926G	CP-7926G-W-K9	Cisco Systems, Inc.	13-Feb-22	
Termianl Device	Cisco Unified IP Phone 7965	CP-7965G	Cisco Systems, Inc.	13-Feb-22	
Termianl Device	Cisco IP Phone 8841	CP-8841(-W)-K9	Cisco Systems, Inc.	13-Feb-22	
Telecommunication Equipment	Cisco Industrial Ethernet 2000 Series Switches	IE-2000-xxxx	Cisco Systems, Inc.	13-Feb-22	
Telecommunication Equipment	Cisco Meraki MS120 Series Switches	MS120-xxx-HW	Cisco Systems, Inc.	13-Feb-22	
Terminal Device	SIP Office Phone	J139 SIP Phone	Avaya	13-Feb-22	
Telecommunication Equipment	IM7200 Infrastructure Manager	IM7232-2-DAC-LR	Opengear Inc.	13-Feb-22	
Telecommunication Equipment	Multi Band Compensor	UMTS/GSM-MMC-AG-3	Laird Dabendorf GmbH	13-Feb-22	
Terminal Device	Smart Phone	ARE-L22HN	Huawei Technologies Co. Ltd	13-Feb-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Smart Phone	JAT-L29	Huawei Technologies Co. Ltd	13-Feb-22	
Terminal Device	ID Card Printer	P3500S	Plaroid	13-Feb-22	
Terminal Device	GPS Vehicle Tracking	FMB110BBV801	onTracking	13-Feb-22	
Terminal Device	PDA Barcode Scanner with Charger Cradle	PDA 33503	Shenzhen ZKC Software Technology co LTD	13-Feb-22	
Terminal Device	Color Card Printer	HDP 5000	HID Global Corporation	13-Feb-22	
Terminal Device	Thermal Printer	Mo. ECO Park 200/VKP 8011	Auto Gard	17-Feb-22	
Terminal Device	Card printer	HDP 8500	HID UK	17-Feb-22	
Terminal Device	Dash camera GPS Vehicle Tracking	JC200	Shinzhen JIMI lot Co Ltd	17-Feb-22	
Telecommunication Equipment	**Microwave - Mini Link 6352**	**BFZ 611 xx / xxx**	Ericsson	18-Feb-22	**This device shall only be used by a Licensee**
Terminal Device	Ascom Myco Cellular with/out GMS (white & black)	SHI-ACBA, SHI-ACBB, SHI-ACBAB(black)	Ascom Sweden AB	18-Feb-22	
Telecommunication Equipment	Intergrated threat preventation and SD-WAN platform for small /medium org	01-SSC-1705	Sonic Wall	23-Feb-22	
Terminal Device	GPS Vehicle Tracking	ET200	Shinzhen JIMI lot Co Ltd	23-Feb-22	
Terminal Device	Mobile Phone	M1806E7TG	Xiaomi Communications Ltd	23-Feb-22	
Terminal Device	Mobile Phone	M1805E10A	Xiaomi Communications Ltd	23-Feb-22	
Terminal Device	Smart Phone	SM-A305F/DS	Samsung Electronics	23-Feb-22	
Terminal Device	Smart Phone	SM-A505F/DS	Samsung Electronics	23-Feb-22	
Terminal Device	Cordless Telephone	KX-TGE610UE	Panasonic Corporation	23-Feb-22	
Terminal Device	Wireless coverage access point	AIR-AP1542D	Cisco Systems, Inc.	23-Feb-22	
Terminal Device	broadband digitals transmission system	NFT 2 ac	UAB Wilibox	24-Feb-22	
Terminal Device	broadband digitals transmission system	NFT - 1N	UAB Wilibox	24-Feb-22	
Telecommunication Equipment	Network Appliance	Citrix C11500	Citrix Systems, Inc	25-Feb-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Smart Phone	BKK-LX2	Huawei Technologies Co. Ltd	25-Feb-22	
Telecommunication Equipment	HPE FF 5950 32Q28 Switch	BJNGA-AD0065 (JH321A)	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	MSR4000 Router Series	MSR4080 Router Chassis/BJNGA-BB0005	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	MSR3000 Router Series	MSR3024 Router /BJNGA-BB0007	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	MSR3000 Router Series	MSR3012 Router /BJNGA-BB0008	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	MSR2000 Router Series	MSR2003 Router /BJNGA-BB0009	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	MSR3000 Router Series	MSR3044 Router /BJNGA-BB0011	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE MSR93X Router Series - HPE MSR930	BJNGA-BB0015 (JG511A , JG511B)	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE MSR93X Router Series - HPE MSR930 3G Router	BJNGA-BB0016 (JG513B)	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE MSR93X Router Series - HPE FlexNetwork MSR931 Router	BJNGA-BB0017	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE MSR93X Router Series - MSR931 Dual 3G Router	BJNGA-BB0019	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE MSR93X Router Series - MSR930 Wireless Router	BJNGA-BB0020	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE FlexNetwork MSR935 Router	BJNGA-BB0023	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HP MSR1000 Router Series - HPE MSR1003 8	BJNGA-BB0029	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE MSR2000 Router Series - HPE MSR2004-24	BJNGA-BB0031	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE MSR1000 Router Series - HPE MSR1002-4	BJNGA-BB0034	Hewlett Packard Enterprise	25-Feb-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	HPE FlexNetwork MSR95x Router Series - HPE MSR954 1Gb SFP Router	BJNGA-BB0036	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE MSR95x Router Series - HPE MSR954-W 1GbE SFP (WW) Router	BJNGA-BB0037	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE MSR95x Router Series - HPE MSR954-W 1GbE SFP LTE (WW) Router	BJNGA-BB0039	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE FlexNetwork MSR95x Router Series - HPE MSR958 1Gb Combo Routers	BJNGA-BB0040/ BJNGA-BB0041	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE MSR95x Router Series - HPE MSR954 1GbE Dual 4G (WW) Router	BJNGA-BB0042	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	Superdome Flex	CHPF-067	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	Apollo sx40	CHPF-1102-sx40	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HP/HPE MSA 2040	FCLSE-0801	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE 1420-24G Switch	HNGZA-HA0024	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE 7500 Switch Series	HNGZA-AA0003.HNGZA-AA0004,HNGZA-AA0005,HNGZA-AA0006	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE FlexNetwork 5120 SI Switch Series -	BJNGA-AD0007/08, S5120-xxP-SI, S5120-28-HPWR-SI	Hewlett Packard Enterprise	25-Feb-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	HPE FlexNetwork 5130 EI Switch Series	BJNGA-AD0027/28/29/31/32/33/34/35/36	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE FlexNetwork 5130 HI Switch Series	BJNGA-AD0054/55/56/57	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE FlexNetwork 5510 HI Switch Series	BJNGA-AD0039	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1405 v3 Switch Series	HNGZA-HA0030 & HNGZA-HA0031	Hewlett Packard Enterprise	25-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1420 Switch Series	HNGZA-HA0026, HNGZA-HA0027, HNGZA-HA0028, HNGZA-HA0029	Hewlett Packard Enterprise	25-Feb-22	
Terminal Device	Feature phone	JAZZ 1	IBRITECH DMCC	25-Feb-22	
Terminal Device	Feature phone	COBRA	IBRITECH DMCC	25-Feb-22	
Terminal Device	Feature phone	RETRO	IBRITECH DMCC	25-Feb-22	
Terminal Device	Smart Phone	I2	IBRITECH DMCC	25-Feb-22	
Terminal Device	Smart Phone	POWER6	IBRITECH DMCC	25-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1920 Switch Series	HNGZA-HA0008/09/10/11/12/13/14/15/16	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1950 Switch Series	BJNGA-AD0033/34/35/36/67	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE SN8600B 4-slot Pwr Pack+ Dir Switch	HSTNM-041	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE SN8600B 8-slot Pwr Pack+ Dir Switch	HSTNM-042	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE 8/24 SAN Switch	HSTNM-N018	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE 8/8 Base SAN Switch and 8/8 SAN Switch Family	HSTNM-N019	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HP/HPE StorageWorks 1606 SAN Switch	HSTNM-N028	Hewlett Packard Enterprise	27-Feb-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	SN8000B 8-Slot SAN Director	HSTNM-N033	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HP/HPE SN8000B 4-Slot SAN Director Switch	HSTNM-N034	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE SN3000B Fibre Channel Switch	HSTNM-N037	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE StoreFabric SN6500B Fibre Channel Switch	HSTNM-N038	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HP/HPE SN4000B Pwr Pk+ SAN Extension Switch	HSTNM-N039	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE StoreFabric SN6600B Fibre Channel Switch	HSTNM-N040	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE SN3600B 32Gb 24/8 FC Switch	HSTNM-043	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE ProLiant DL380 GEn9 Server	HSTNS-2145	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE ProLiant DL380 Gen9 Server	HSTNS-2146	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HP/HPE ProLiant DL580 Gen8 & 9 Server/H3C Flex Server R690	HSTNS-2147	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE ProLiant DL580 Generation9 (Gen9)	HSTNS-2154	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	ProLiant DL560 Gen10 4S 2U Rack Server	HSTNS-2155	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE ProLiant DL560 Gen10 Server	HSTNS-2156	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HP/HPE ProLiant DL560 Gen9 Server	HSTNS-5175	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HHPE ProLiant DL380 Gen10 Server	HSTNS-5200	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HP MSR 9x0 Router Series	MSR 900 & MSR 920	Hewlett Packard Enterprise	27-Feb-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	HPE StoreEver 1/8 G2 Tape Autoloader	LVLDC-0501	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE StoreEver MSL6480 Scalable Base Module	LVLDC-1101-CM	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE StoreEver MSL3040 Tape Library	LVLDC-1701	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	ARUBA 5400R ZL2 SWITCH SERIES	RSVLC-0503	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE 3800 Switch Series	RSVLC-1003B	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	ARUBA 2530 SWITCH SERIES	RSVLC-1209	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	ARUBA 5400R ZL2 SWITCH SERIES	RSVLC-1301	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1820/1920S Switch Series	RSVLC-1401	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1820/1920S Switch Series	RSVLC-1402	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1820/1920S Switch Series	RSVLC-1403	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1820/1920S Switch Series	RSVLC-1404	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1820/1920S Switch Series	RSVLC-1405	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1820/1920S Switch Series	RSVLC-1406	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	ARUBA 3810 SWITCH SERIES	RSVLC-1407	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	ARUBA 3810 SWITCH SERIES	RSVLC-1408	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	Aruba 2530 8 PoE+ Internal PS Switch	RSVLC-1410	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1850 6XGT 2XGT/SFP+ Switch	RSVLC-1413	Hewlett Packard Enterprise	27-Feb-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	HPE OfficeConnect 1850 24G 2XGT Switch	RSVLC-1414	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1850 24G 2XGT PoE+ 185W Switch	RSVLC-1415	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1850 48G 4XGT Switch	RSVLC-1416	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE OfficeConnect 1850 48G 4XGT PoE+ 370W Switch	RSVLC-1417	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	Aruba 2540 Switch Series	RSVLC-1418	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	ARUBA 2930F SWITCH SERIES	RSVLC-1419	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	Aruba 2930F 8G PoE+ 2SFP+ Switch	RSVLC-1420	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	ProLiant ML10	TPS-F013	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE ProLian DL180 Gen9, HPE Network Security Processor	TPS-F014	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE ProLiant ML350 (Gen9)	TPS-F015	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE ProLiant DL160 Gen10, HA8000V DL160 Gen10; EXP336	TPS-F025	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	ProLiant ML30 Gen9	TPS-W009	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HP ProLiant DL60 Gen9	TPS-H001	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HP ProLiant DL80 Gen9	TPS-H002	Hewlett Packard Enterprise	27-Feb-22	
Telecommunication Equipment	HPE ProLiant ML110 Gen10 Server	TPS-W010	Hewlett Packard Enterprise	27-Feb-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	ProLiant DL20 Gen9; HPE DMA Capture Module 10k Usr Appl	TPS-W006	Hewlett Packard Enterprise	27-Feb-22	
Terminal Device	Table Top Touchlink Touchpanel	TLP 700TV, TLP 710TV, TLP PRO 720T, TLP PRO 725T, TLP 720T	Extron Electronics	5-Mar-22	
Terminal Device	Digital Cordless Phone	KX-TGC410UE, KX-TGC412UE,KX-TGC413UE & KX-TGC420UE	Panasonic Corporation	5-Mar-22	
Terminal Device	Printer Card Issurance System	S3400/3500	MATICA Electronics	5-Mar-22	
Terminal Device	Molex Multi Band Compensor	UMTS/GSN-MMC-AG2	Molex CVS Dabendorf GmbH	5-Mar-22	
Terminal Device	Thermal Printer	LS 24	TLS - Boca Systems	6-Mar-22	
Terminal Device	GPS Tracker	G500	Shenzhen CanTrack Technology Co. Ltd	9-Mar-22	
Terminal Device	GPS Tracker	G900	Shenzhen CanTrack Technology Co. Ltd	9-Mar-22	
Terminal Device	Zebra Printer	ZXP 3	Zebra Technologies Corporation	9-Mar-22	
Telecommunication Equipment	Apollo 480	CHPF-068	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	HPE Apollo 480 System, Storage Server	CMN507	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	66xx Router Series	66xx	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	HPE OfficeConnect 1620 Switch Series, JG912A, JG913A, JG914A	HNGZA-HA0017/18/19	Hewlett Packard Enterprise	10-Mar-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	BJNGA-BB0002,3,4	HPE FlexNetwork HSR6800 Router Series	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	HP/HPE SN6000B Switch	HSTNM-N035	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	Aruba 2620 24 Switch	RSVLC-1004	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	Aruba 2530 48G PoE+ Switch (J9772A), Aruba 2530 48 PoE+ Switch (J9778A)	RSVLC-1206	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	HPE Altonline 6900/6920/6940/6960 Switch Series	RSVLC-1411	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	Aruba 2930M 24G 1-slot Switch (JL319A); Aruba 2930M 48G 1-slot Switch (JL321A)	RSVLC-1601	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	ARUBA 2930F SWITCH SERIES	RSVLC-1702	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	HPE ProLiant DL160 Gen9	TPS-F016	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	ProLiant ML10 Gen9	TPS-I005	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	HPE ProLiant ML350 Gen10	TPS-I006	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	HPE ProLiant ML 150 Gen9	TPS-W007	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	HP ProLiant ML110 Gen9	TPS-W008	Hewlett Packard Enterprise	10-Mar-22	
Terminal Device	Cisco Aironet 1530 series Access Point	AIR-CAP1532x-H-K9	Cisco Systems, Inc.	10-Mar-22	
Telecommunication Equipment	Cisco 2800 Series Integrated Services Routers	CISCO28xxxx	Cisco Systems, Inc.	10-Mar-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Cisco Unified IP Phone 7945G	CP-7945G	Cisco Systems, Inc.	10-Mar-22	
Terminal Device	Cisco Unified IP Phone 7975G	CP-7975G	Cisco Systems, Inc.	10-Mar-22	
Telecommunication Equipment	Cisco Meraki MS210 Series Switches	MS210-xxx-HW	Cisco Systems, Inc.	10-Mar-22	
Telecommunication Equipment	3600 SI & 3100 EI Series Switches	BJNGA-AD0011, BJNGA-AD0009, BJNGA-AD0013, BJNGA-AD0014, BJNGA-AD0015 & BJNGA-AD0012	Hewlett Packard Enterprise	10-Mar-22	
Telecommunication Equipment	HPE 5800 & 5820 Switch Series	S5820X-28S, S5820X-xxC, S5820X-xxC-PWR & S5820X-32F	Hewlett Packard Enterprise	10-Mar-22	
Terminal Device	GSM WCDMA LTE Bluetooth/Wi-Fi Mobile Phone	SM-M205F/DS	Samsung Electronics	10-Mar-22	
Terminal Device	GSM WCDMA LTE Bluetooth/Wi-Fi Mobile Phone	SM-M105F/DS	Samsung Electronics	10-Mar-22	
Terminal Device	Lexmark Cs410dn Printer	28D0076	Huawei Technologies Co. Ltd	10-Mar-22	
Terminal Device	Smartphone	VOG-L29	Huawei Technologies Co. Ltd	11-Mar-22	
Terminal Device	MAR-LX1M smartphone	MAR-LX1M	Huawei Technologies Co. Ltd	11-Mar-22	
Terminal Device	ELE-L29 smartphone	ELE-L29	Huawei Technologies Co. Ltd	11-Mar-22	
Terminal Device	GPS Tracker	AY-GPS-G500	Shenzhen CanTrack Technology Co. Ltd	12-Mar-22	
Terminal Device	GPS Tracker	AY-GPS-900	Shenzhen CanTrack Technology Co. Ltd	12-Mar-22	
Telecommunication Equipment	Ethernet Switch	QFX10008	Juniper Networks, Inc.	16-Mar-22	
Terminal Device	GSM WCDMA LTE Bluetooth/Wi-Fi Mobile Phone	SM-M105G/DS	Samsung Electronics	16-Mar-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Rukus R510 Access Point	R510	Ruckus Wireless INC	16-Mar-22	
Terminal Device	Teleprotection Equipment	SWT 3000	Siemens	16-Mar-22	
Terminal Device	LTE/WCDMA/GSM mobile phone	Alcatel 5053D	TCL Communication Limited	18-Mar-22	
Terminal Device	LTE/WCDMA/GSM mobile phone	Alcatel 5053K	TCL Communication Limited	18-Mar-22	
Terminal Device	AXIS S2016 Network Video Recorder	S2016	Axis Communications AB	18-Mar-22	
Terminal Device	Axis P7216 Video Encoder	Axis P7216	Axis Communications AB	18-Mar-22	
Terminal Device	Huawei Smart Phone HONOR 10i	HRY-LX1T	Huawei Technologies Co. Ltd	18-Mar-22	
Telecommunication Equipment	**Digitat full outdoor point-to-point microwave radio with integrated antenna for commertial use**	**Integra - G - 23**	SAF Tehnika JSC	19-Mar-22	**This device shall only be used by a Licensee**
Telecommunication Equipment	**Digitat full outdoor point-to-point microwave radio with integrated antenna for commertial use**	**Integra - G - 15**	SAF Tehnika JSC	19-Mar-22	**This device shall only be used by a Licensee**
Terminal Device	**Microwave antenna**	**VHLP2-15-1WH/B**	SAF Tehnika JSC	19-Mar-22	**This device shall only be used by a Licensee**
Terminal Device	Corded Phone	3300MWD	Cetis, Inc.	23-Mar-22	
Terminal Device	Analog Telephone	3300TRM	Cetis, Inc.	23-Mar-22	
Terminal Device	Tablet Computer	A2123	Apple Inc.	23-Mar-22	
Terminal Device	Tablet Computer	A2124	Apple Inc.	23-Mar-22	
Terminal Device	Telematics Device	TVA20GNXXX	LG Electronics Inc.	23-Mar-22	
Terminal Device	GSM WCDMA LTE Bluetooth/Wi-Fi Mobile Phone	SM-A205F/DS	Samsung Electronics	23-Mar-22	
Telecommunication Equipment	Aruba 7200 Series Mobility Controller	ARCN7205	Hewlett Packard Enterprise Company	23-Mar-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Aruba 2530 24G PoE+ Switch	RSVLC-1207	Hewlett Packard Enterprise Company	23-Mar-22	
Telecommunication Equipment	Aruba 2530-8G-PoE+ Switch	RSVLC-1208	Hewlett Packard Enterprise Company	23-Mar-22	
Telecommunication Equipment	Aruba 2530 24G Switch	RSVLC-1210	Hewlett Packard Enterprise Company	23-Mar-22	
Terminal Device	Citrix Application Delivery Controller (ADC)	59XX	CITRIX SYSTEMS INC	23-Mar-22	
Terminal Device	GSM WCDMA LTE Bluetooth/Wi-Fi Mobile Phone	SM-A105F/DS	Samsung Electronics	23-Mar-22	
Terminal Device	Vodafone MachineLink 4G Lite	NWL-222	NetComm Wireless (UK) Limited	25-Mar-22	
Telecommunication Equipment	Services Gateway	SRX300	Juniper Networks, Inc.	25-Mar-22	
Telecommunication Equipment	Services Gateway	SRX320	Juniper Networks, Inc.	25-Mar-22	
Telecommunication Equipment	Services Gateway	SRX340	Juniper Networks, Inc.	25-Mar-22	
Telecommunication Equipment	Services Gateway	SRX345	Juniper Networks, Inc.	25-Mar-22	
Terminal Device	Printer	PR2 Plus MICR	Technost Sistemi	25-Mar-22	
Terminal Device	LTE/WCDMA/GSM mobile phone	Alcatel 5024D	TCL Communication Limited	25-Mar-22	
Terminal Device	INKJET Printer	Ax150i	DOMINO UK LTD	25-Mar-22	
Terminal Device	Samsung Tablet	SM-T385	Samsung Electronics LTD	27-Mar-22	
Terminal Device	Mobile Phone	LE9830 (R5v)	Lava International	31-Mar-22	
Terminal Device	Telematics Device	TVD20GNWNR	LG Electronics Inc.	31-Mar-22	
Terminal Device	Telematics Device	TVD20GNWBR	LG Electronics Inc.	31-Mar-22	
Terminal Device	Telematics Device	TVA20GNWNR	LG Electronics Inc.	31-Mar-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Cisco 5400 Series Enterprise Network Compute System	ENCS5412/K9	CISCO System	1-Apr-22	
Terminal Device	Mobile Phone	CPH1911	GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP.,LTD.	1-Apr-22	
Terminal Device	Mobile Phone	CPH1909	GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP.,LTD.	1-Apr-22	
Terminal Device	Mobile Phone	CPH1917	GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP.,LTD.	1-Apr-22	
Telecommunication Equipment	Security Products	ASA5508-K9	Cisco Systems, Inc.	6-Apr-22	
Telecommunication Equipment	**Wireless Controller**	**AIR-CT3504-CA-K9 - AIR-CT3504-K9**	Cisco Systems, Inc.	6-Apr-22	**Device is allowed under certain conditions**
Telecommunication Equipment	SyncServer	S600	Microsemi	6-Apr-22	
Terminal Device	GSM WCDMA LTE Bluetooth/Wi-Fi Portable Device	SM-T515	Samsung Electronics	6-Apr-22	
Terminal Device	GSM WCDMA LTE Bluetooth/Wi-Fi Portable Device	SM-T725	Samsung Electronics	6-Apr-22	
Terminal Device	Mobile Phone	M1903F2G	Xiaomi Communications Co. Ltd	6-Apr-22	
Terminal Device	Mobile Phone	M1902F1G	Xiaomi Communications Co. Ltd	6-Apr-22	
Terminal Device	Mobile Phone	M1810F6LG	Xiaomi Communications Co. Ltd	6-Apr-22	
Terminal Device	Mobile Phone	M1901F7G	Xiaomi Communications Co. Ltd	6-Apr-22	
Terminal Device	Mobile Phone	M1903C3GG	Xiaomi Communications Co. Ltd	6-Apr-22	
Terminal Device	Telematics	TTA20BNGBR	LG Electronics Inc.	6-Apr-22	
Terminal Device	Telematics	TTA20BNGNR	LG Electronics Inc.	6-Apr-22	
Terminal Device	Telematics	TTD20BNGBR	LG Electronics Inc.	6-Apr-22	
Terminal Device	Telematics	TTD20BNGNR	LG Electronics Inc.	6-Apr-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	**Radio 4443 B1B3**	**KRC 161 XXX/X**	Ericsson	6-Apr-22	**This device shall only be used by a Licensee**
Telecommunication Equipment	Video Switcher	ATEM Television Studio HD	Blackmagic Design Pty Ltd	8-Apr-22	
Telecommunication Equipment	Routing and Distribution	Smart Videohub 12x12	Blackmagic Design Pty Ltd	8-Apr-22	
Terminal Device	Apple TV	A1842	Apple Inc.	8-Apr-22	
Terminal Device	Apple TV	A1625	Apple Inc.	8-Apr-22	
Terminal Device	Touch Computer	TC57HO	Zabra Technologies Corporation	10-Apr-22	
Terminal Device	Multi-band GSM/WCDMA/LTE Phone with Bluetooth, WLAN	TA-1164	HMD Global Oy	10-Apr-22	
Telecommunication Equipment	HPE FlexFabric 5940 Switch Series_PL	BJNGA-AD0049	Hewlett Packard Enterprise	10-Apr-22	
Terminal Device	Unifi Cloud Key	UC-CK	Ubiquiti Networks	10-Apr-22	
Telecommunication Equipment	ARUBA 2930M SWITCH SERIES	RSVLC-1602	Hewlett Packard Enterprise	10-Apr-22	
Telecommunication Equipment	ARUBA 8400 SWITCH SERIES	RSVLC-1603	Hewlett Packard Enterprise	10-Apr-22	
Terminal Device	Mobile Phone	AMN-LX9	Huawei Technologies Co. Ltd	10-Apr-22	
Telecommunication Equipment	Outdoor Directional Hexa-band Antenna	ODI-2-065R17M18JJ02-GQ V1	Comba Telecom	14-Apr-22	
Telecommunication Equipment	Security Appliances	ASA5525-FPWR-K9	Cisco Systems,Inc	14-Apr-22	
Terminal Device	Tally DASCOM 2610 Printer	2610 Matrix Printer	DASCOM Tally	16-Apr-22	
Telecommunication Equipment	16 Port serial device server	Nport 5610-16	MOXA Inc	16-Apr-22	
Telecommunication Equipment	**NANO Station AC**	**NS - 5AC**	Ubiquiti Networks	16-Apr-22	**Device is allowed under certain conditions**
Terminal Device	Ascom Mycom 3, Cellular Wi-Fi	SH2-ACAA	Ascom (Sweden) AB	16-Apr-22	
Telecommunication Equipment	**Point to Point**	**PTP 550**	Cambium Networks	16-Apr-22	**Device is allowed under certain conditions**

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	GSM WCDMA LTE Bluetooth/Wi-Fi Mobile Phone	SM-A705FN/DS	Samsung Electronics	16-Apr-22	
Terminal Device	Telematics	TTA20ANEBR	LG Electronics Ins.	16-Apr-22	
Terminal Device	Telematics	TTA20ANENR	LG Electronics Ins.	16-Apr-22	
Terminal Device	Telematics	TTD20ANEBR	LG Electronics Ins.	16-Apr-22	
Terminal Device	Telematics	TTD20ANENR	LG Electronics Ins.	16-Apr-22	
Terminal Device	Telematics	TTA20BNEBR	LG Electronics Ins.	16-Apr-22	
Terminal Device	Telematics	TTA20BNENR	LG Electronics Ins.	16-Apr-22	
Terminal Device	Telematics	TTD20BNEBR	LG Electronics Ins.	16-Apr-22	
Terminal Device	Telematics	TTD20BNENR	LG Electronics Ins.	16-Apr-22	
Terminal Device	Cisco Aironet 2800 Series Access Point	AIR-AP2802x-E-K9	Cisco Systems Inc	16-Apr-22	
Telecommunication Equipment	**Broadband Digital Transmission System**	**LigoPTP 5-N RapidFire, LigoPTP 5-23 RapidFire**	LigoWave LLC.	21-Apr-22	**Device is allowed under certain conditions**
Terminal Device	Cisco Aironet 1570 Series Access Point	AIR-AP1572EAC-H-K9	Cisco Systems Inc	21-Apr-22	
Telecommunication Equipment	Cisco 4-Port channel T1/E1 High Speed WAN Interface Card	HWIC-4T1/E1	Cisco Systems Inc	21-Apr-22	
Telecommunication Equipment	**NaNO Station LOCO M**	**LOCO M2**	Ubiquiti Networks	21-Apr-22	**Device is allowed under certain conditions**
Terminal Device	**Unifi AP long Range Enterprise Wifi system**	**UAP-LR**	Ubiquiti Networks	21-Apr-22	**Device is allowed under certain conditions**
Terminal Device	QSC - Q - Syscore Flex Channel DSP - with Software	CORE 110F	QSC	21-Apr-22	
Terminal Device	Remote Engine Starter	Remoto TCU V3 (BBRES-ET-LC17)	TRADEZONE HK LIMITED	21-Apr-22	
Telecommunication Equipment	**Nanostation M5**	**NSM5**	Ubiquiti Networks	21-Apr-22	**Device is allowed under certain conditions**
Terminal Device	Cisco Aironet 1815i Access Point	AIR-AP1815i-I-K9	Cisco systems, Inc	24-Apr-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Cisco Webex Share	SPK-SHARE-K9	Cisco systems, Inc	24-Apr-22	
Telecommunication Equipment	Cisco Catalyst 9200 Series Switches	C9200xxxxx	Cisco systems, Inc	24-Apr-22	
Terminal Device	Printer Line Matrix Printer	A8C10-0253-O	PRINTRONIX	24-Apr-22	
Terminal Device	Ascom Mycom 3, Wi-Fi EU	SH2-ABAA	Ascom (Sweden AB	24-Apr-22	
Telecommunication Equipment	Outdoor Directional Hexa-band Antenna	ODI2-065R16MJJ-G	Comba Telecom	24-Apr-22	
Telecommunication Equipment	XG Firewall	XG125	Sophos	24-Apr-22	
Terminal Device	Mobile Phone	Galaxy A80 - SM-A805F	Samsung Electronics	28-Apr-22	
Terminal Device	Wireless Access Point for Ceiling Mount	AP230	Aerohive Networks	28-Apr-22	
Terminal Device	Touch Computer	TC25BJ	Zebra Technologies Corporation	29-Apr-22	
Telecommunication Equipment	UPS	UPS5000-E / UPS5000-S	Huawei Technologies Co. Ltd	4-May-22	
Telecommunication Equipment	Network Ethernet Switch	IE-2000-8TC-G-B	Cisco systems, Inc	4-May-22	
Telecommunication Equipment	CRAH	NetCol5000C-030H	Huawei Technologies Co. Ltd	4-May-22	
Telecommunication Equipment	LVP	Low Voltage Panel	Huawei Technologies Co. Ltd	4-May-22	
Telecommunication Equipment	Sonicwall TZ300 Firewall	TZ300	Sonicwall Inc	4-May-22	
Terminal Device	STK-L21	Huawei Y9 Prime - STK-L21	Huawei Technologies Co. Ltd	4-May-22	
Terminal Device	Product Link, Cellular/Satellite Radio Telematics Devices	PL243 4G Cellular Radio	Caterpillar Inc.	6-May-22	
Telecommunication Equipment	Barracuda Web Filter/Security Gateway	410	Barracuda Networks INC	6-May-22	
Terminal Device	Think System Blade Server	SN550	Lenovo	6-May-22	
Telecommunication Equipment	Meraki MX 250-HW	MX250-HW	Cisco Meraki	6-May-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	DMP 64 Audio Matrix	60-1054-01	Extron Electronics Middle East FZE	8-May-22	
Terminal Device	GPS Receiver Unit 03 01	NCD 901 56/1	Ericsson	8-May-22	
Terminal Device	Vodafone MachineLink 4G Lite	NWL-222	NetComm Wireless (UK) Limited	8-May-22	
Terminal Device	Multi Band Compenser	LTE-MBC-EU2	Molex CVS Dabendorf GmbH	12-May-22	
Telecommunication Equipment	Cisco ASA 5500-X Series Fire Power Services	ASA55xx-xxxx-xx	Cisco Systems Inc	12-May-22	
Telecommunication Equipment	Cisco Industrial Ethernet 4000 Series Switches	IE-4000-xxxx	Cisco Systems Inc	12-May-22	
Terminal Device	Product Link Cellular Radio Telematics Device	PL243 4G Cellular Radio	Caterpillar Inc.	14-May-22	
Telecommunication Equipment	Cisco SG350X-48MP	SG350x-48MP-K9-UK	Cisco Systems Inc	14-May-22	
Terminal Device	Huawei Smart Phone HONOR 8S	KSA-LX9	Huawei Technologies Co. Ltd	19-May-22	
Terminal Device	Huawei G610	G610	Huawei Technologies Co. Ltd	19-May-22	
Telecommunication Equipment	HPE FlexFabric 5945 Switch Series	BJNGA-AD0076	Hewlett Packard Enterprise	19-May-22	
Terminal Device	Portable Tablet Computer	Lenovo TB-X505L	Lenovo PC HK Limited	19-May-22	
Terminal Device	Car AVN	IGCJ1PHE	LG Electronics Inc.	19-May-22	
Terminal Device	Aruba Network Sensor	ASIN0100	Hewlett Packard Enterprise	19-May-22	
Terminal Device	MorphoTablet 2 Iris	MPH-MB001A	IDEMIA Identity & Security France	19-May-22	
Telecommunication Equipment	HPE FlexFabric 5710 Switch Series	BJNGA-AD0082	Hewlett Packard Enterprise	19-May-22	
Terminal Device	K155 Vantage Phone	K155	Avaya	19-May-22	
Terminal Device	Nokia 2.2 DS smartphone	Noka TA-1188	HMD Global Oy	19-May-22	
Terminal Device	LF6810 smartphone	LF6810	Lava International	22-May-22	
Terminal Device	LF9820 smartphone	LF9820	Lava International	22-May-22	
Terminal Device	LF9810 smartphone	LF9810	Lava International	22-May-22	
Telecommunication Equipment	Access Router	AR1200 Series	Huawei Technologies Co. Ltd	22-May-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Access Router	AR120 Series	Huawei Technologies Co. Ltd	22-May-22	
Telecommunication Equipment	Sonicwall NSA 3650 Secure Upgrade Plus	01-SSC-4079	Sonicwall	22-May-22	
Terminal Device	Mobile Phone	CPH 1919	Guandong Oppo Mobile Telecommunication Corp Ltd	22-May-22	
Terminal Device	Multi Function Printer	WF-M5799 (C642B)	Seiko Epson Corporation	22-May-22	
Terminal Device	Mobile Phone	CPH 1979	Guandong Oppo Mobile Telecommunication Corp Ltd	22-May-22	
Terminal Device	WEPRESENT WIPG-1000P SET EU	WIPG-1000P	Barco N. V Belgium	22-May-22	
Terminal Device	2-Port EtherNet I/O Adapter Module	1734-AENTR	Rockwell Automation, Inc	25-May-22	
Terminal Device	Thermal Receipt Printer	D600	X-Printer	26-May-22	
Telecommunication Equipment	Ethernet Switch	QFX5120-32C	Juniper Networks, Inc.	26-May-22	
Terminal Device	Multi Function Printer with WIFI and Fax	F175002	Canon Inc	26-May-22	
Terminal Device	Thermal Receipt Printer	C300H	X-Printer	26-May-22	
Terminal Device	Telematics device	LG TTA20GNEBR	LG Electronics Inc.	28-May-22	
Terminal Device	Telematics device	LG TTA20GNENR	LG Electronics Inc.	28-May-22	
Terminal Device	Telematics device	LG TTD20GNEBR	LG Electronics Inc.	28-May-22	
Terminal Device	Telematics device	LG TTD20GNENR	LG Electronics Inc.	28-May-22	
Telecommunication Equipment	**Base station to house radio unit**	**BFM 901 290/2**	Ericsson	29-May-22	**This device shall only be used by a Licensee**
Terminal Device	Trim Line SIP Phone	H229, H239, H249	Avaya	1-Jun-22	
Terminal Device	IP Phone Global	K155	Avaya	1-Jun-22	
Telecommunication Equipment	Cisco Meraki MX67-HW Security Appliance	MX67-HW	Cisco Systems Inc	1-Jun-22	
Telecommunication Equipment	Cisco Web Security Appliance WSA-S380-K9	WSA-S380-K9	Cisco Systems Inc	1-Jun-22	
Terminal Device	Car Telematics Device	TL3LNB-E	LG Electronics Inc.	1-Jun-22	
Terminal Device	Car Telematics Device	TL3TNB-E	LG Electronics Inc.	2-Jun-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Car Telematics Device	TL3HEB-E	LG Electronics Inc.	2-Jun-22	
Terminal Device	Cisco Aironet 1560 Series Access Point	AIR-AP1562I-H-K9	Cisco Systems Inc	12-Jun-22	
Telecommunication Equipment	HPE ProLiant DL20 Gen10Server	TPS-W016	Hewlett Packard Enterprise	12-Jun-22	
Terminal Device	Printer	SP3710DN	Ricoh	12-Jun-22	
Terminal Device	Printer	SP4510DN	Ricoh	12-Jun-22	
Terminal Device	POC Terminal	PNC 370	Hytera Communications Corp. Ltd	15-Jun-22	
Terminal Device	POC Terminal	PNC 550	Hytera Communications Corp. Ltd	15-Jun-22	
Telecommunication Equipment	Tenda Network Switches	S105 / S108 TEG 3224P	Shenzhen Tend Technology	15-Jun-22	
Terminal Device	Router	Huawei 5G CPE Pro - H112-370	Huawei Technologies Co. Ltd	15-Jun-22	
Telecommunication Equipment	Cisco Catalyst IE 3200 rugged Series Switch	IE-3000-SP25-E	Cisco Systems Inc	15-Jun-22	
Terminal Device	Point I/O Modules	1734-X	Rockwell Automation	15-Jun-22	
Terminal Device	Card Laminator	Prima451	Dai Nippon Printing Co. Ltd	15-Jun-22	
Terminal Device	Magic card duo ID card printer	Prima802	Dai Nippon Printing Co. Ltd	15-Jun-22	
Terminal Device	Tablet	Alcatel 3T 10 4G - 8088X	TCL Communcation Limited	17-Jun-22	
Terminal Device	Multifunction Printer with WIFI and Fax	F176202	Canon Inc	18-Jun-22	
Terminal Device	mobile phone	RAVOZ Z4	HK REXSO Communication TECH Co	18-Jun-22	
Terminal Device	CP100 TRUCKFONE	One Touch CP 100	HUI 2HOU TCL Mobile Comm Co. Ltd	23-Jun-22	
Terminal Device	mobile phone	M1903F10G-MI 9T	Xiaomi Communications Ltd	23-Jun-22	
Terminal Device	Mix3 5G	Mix 3 5G M1810E5GG	Bullitt Mobile Limited	23-Jun-22	
Terminal Device	Digital Signal Processor	Audio Flex CM	Biamp	23-Jun-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Polycom VVX 500 Series Phone	Polycom VVX 500 Business Media Phone	Polycom	23-Jun-22	
Terminal Device	Color Laser Multifunction Product	CX921	Lexmark	23-Jun-22	
Telecommunication Equipment	**Wireless Gigabit Ethernet Radio**	**FLEX 46-3000**	Bridge Wave	26-Jun-22	**Device is allowed under certain conditions**
Terminal Device	mobile phone	RAVOZ Z5	Coosea Group	26-Jun-22	
Terminal Device	mobile phone	RAVOZ Z8	Coosea Group	26-Jun-22	
Terminal Device	Tablet PC	SM-T295	Samsung Electronics Co., Ltd.	1-Jul-22	
Terminal Device	mobile phone	Galazy SM-107F/DS	Samsung Electronics Co., Ltd.	1-Jul-22	
Telecommunication Equipment	Cisco Security Appliance	ASA5506-K9	Cisco Systems Inc	1-Jul-22	
Telecommunication Equipment	Cisco Firepower Appliance	FP8350-K9	Cisco Systems Inc	1-Jul-22	
Terminal Device	Smart Phone	MRD-LX1F	Huawei Technologies Co. Ltd	1-Jul-22	
Terminal Device	Smart Phone	MAR-LX1A	Huawei Technologies Co. Ltd	1-Jul-22	
Terminal Device	Sophos APX 320	APX 320	Sophos Ltd	1-Jul-22	
Terminal Device	GSM & WCDMA & LTE Elevator VoIP call system	KONE4G	KONE CORPORATION	3-Jul-22	
Terminal Device	Elevator Monitoring System	KONE Connection 220	KONE CORPORATION	3-Jul-22	
Terminal Device	MOVETIME FAMILY WATCH 2	MT40X	TCL Communication Limited	8-Jul-22	
Terminal Device	mobile phone	Alcatel 5033F	TCL Communication Limited	8-Jul-22	
Terminal Device	mobile phone	Mate20 X 5G EVR-N29	Huawei Technologies Co. Ltd	8-Jul-22	
Terminal Device	LTE/UMTS/GSM Smartphone	5024F	TCL Communication Limited	8-Jul-22	
Terminal Device	Tablet	SM-T290	Samsung Electronics Co., Ltd.	8-Jul-22	
Terminal Device	Nokia 105 DS	TA-1174	HMD Global Oy	8-Jul-22	
Telecommunication Equipment	ITE Server	CS1811ORFIR	ZT Group Int'l Inc	9-Jul-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Automatic data processing machines	E42W	Dell Inc.	9-Jul-22	
Terminal Device	GSM WCDMA LTE Blutooth/Wi-Fi Mobile Phone	SM-A260F/DS	ASHTEL W.L.L	14-Jul-22	
Telecommunication Equipment	HPE Apollo 2000 Gen 10 System	TPS-W012	Hewlett Packard Enterprise	14-Jul-22	
Telecommunication Equipment	HPE ProLiant XL170r Gen 10	TPS-W013	Hewlett Packard Enterprise	14-Jul-22	
Telecommunication Equipment	HPE ProLiant XL190r Gen 10	TPS-W014	Hewlett Packard Enterprise	14-Jul-22	
Terminal Device	Receiver Assy, Navigation	PEAVN-10-LC20GC	Toyota Tusho Asia Pacific Pte.Ltd	14-Jul-22	
Telecommunication Equipment	Mobility Access Switch	ARCN0103	Hewlett Packard Enterprise Company	14-Jul-22	
Telecommunication Equipment	TGCS Toshiba TCxWave 6140	14C	Toshiba Global Commerce Solutions	14-Jul-22	
Telecommunication Equipment	Voice Over IP Gateway	VG310	Cisco Systems Inc.	17-Jul-22	
Terminal Device	Receiver Assy, Radio	PEDA1-10-LC20GC	Toyota Tusho Asia Pacific Pte.Ltd	17-Jul-22	
Terminal Device	LTE/UMTS/GSM Smartphone	5001U	TCL Communication Limited	17-Jul-22	
Terminal Device	UMTS/GSM Smartphone	5003U	TCL Communication Limited	17-Jul-22	
Terminal Device	Telematics Device	TLVHW3IU-E	LG Electronics Inc.	17-Jul-22	
Terminal Device	Redmi 7A	M1903C3EG	XIAOMI COMMUNICATIONS CO. LTD	21-Jul-22	
Terminal Device	Ethernet Switch	EX3400	Juniper Networks, Inc.	21-Jul-22	
Terminal Device	Compact Ethernet Switch	EX2300-C	Juniper Networks, Inc.	21-Jul-22	
Terminal Device	Ethernet Switch	EX2300	Juniper Networks, Inc.	21-Jul-22	
Terminal Device	Wireless data POS System	T5921	Shanghai Sunmi Technology Co., Ltd.	21-Jul-22	
Telecommunication Equipment	Signal Processing Device for Building-in, WB Spectralnet	AA-11760-00X	Kratos Defense & Security Solution Inc.	21-Jul-22	
Terminal Device	iPad Air	A2123	Apple Inc.	21-Jul-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Mobile Phone	vivo 1901 (vivo Y15)	vivo mobile communications Co. Ltd	21-Jul-22	
Terminal Device	Mobile Phone	vivo 1902 (vivo Y17)	vivo mobile communications Co. Ltd	21-Jul-22	
Terminal Device	Mobile Phone	vivo 1907 (vivo S1)	vivo mobile communications Co. Ltd	21-Jul-22	
Telecommunication Equipment	Cisco Meraki	MR45-HW	Cisco Systems Inc.	22-Jul-22	
Terminal Device	Mobile Phone	M1901F9E (Mi Play)	XIAOMI COMMUNICATIONS CO. LTD	22-Jul-22	
Telecommunication Equipment	Wirelss LAN Access Point	AP8050DN-S / V200	Huawei Technologies Co., Ltd.	22-Jul-22	
Terminal Device	Featurephone	Ex-Handy 10	Pepperl+Fuchs GmbH	23-Jul-22	
Terminal Device	DTP Transmitter/Receiver For HDMI	DTP HDMI 4K 230 Tx	Extron Electronics	23-Jul-22	
Terminal Device	Telematics Device	TLVHM3IU-E	LG Electronics Inc.	28-Jul-22	
Telecommunication Equipment	Analog Telephone Adapter	ATA191-K9	Cisco Systems Inc.	28-Jul-22	
Terminal Device	Telematics Device	TLAHW3IU-E	LG Electronics Inc.	28-Jul-22	
Telecommunication Equipment	Cisco SX80 codec speaker track 60 touch 10	CRS - Spker-track60	Cisco Systems Inc.	28-Jul-22	
Terminal Device	Sticker printer	PX4i / PX6i	Intermec	28-Jul-22	
Terminal Device	Cisco DX8-GPL	CP-DX80-K9	Cisco Systems Inc.	28-Jul-22	
Terminal Device	Personal Safety and wireless gas monitoring	G7C-EU	Blackline Saftey Corp	28-Jul-22	
Terminal Device	Office telephone communication	BE6M - M5-K9	Cisco Systems Inc.	28-Jul-22	
Terminal Device	printer	2590n+	Lexmark	28-Jul-22	
Terminal Device	Mono printer	B2338DW	Lexmark	28-Jul-22	
Terminal Device	Headunit with Bluetooth, WLAN and Receiver AM, FM,	NTG6N ENTRY/MID	Harman Becker Automotive Systems GmbH	3-Aug-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Headunit with Bluetooth, WLAN and Receiver AM, FM,	NTG6N HIGH	Harman Becker Automotive Systems GmbH	3-Aug-22	
Telecommunication Equipment	Cisco power supply	A900-RSP3C-400-W	Cisco Systems Inc.	4-Aug-22	
Telecommunication Equipment	Aironet 3802 Series Access Point	AIR-AP3802I-H-K9	Cisco Systems Inc.	4-Aug-22	
Terminal Device	Cisco Webex Room Kit	CS-KIT-K9 (TTC7-23 & TTC5-09)	Cisco Systems Inc.	4-Aug-22	
Terminal Device	Cisco Webex Room Kit Mini	CS-KIT-MINI	Cisco Systems Inc.	4-Aug-22	
Terminal Device	HP USB-C to Multi Dock Connection Hub	2UX26AA#ABB	HP	4-Aug-22	
Telecommunication Equipment	DataDefender	AA-11570-00x	Kratos	4-Aug-22	
Terminal Device	Nokia 105 SS mobile phone	TA-1203	Nokia	4-Aug-22	
Terminal Device	IP Link Pro Control Processor	IPL PRO S1, IPL PRO S3, IPL PRO S6, IPL PRO CR88, and IPL PRO IRS8	Extron Electronics	4-Aug-22	
Terminal Device	Wifi Access Point	cnPilot E600 outdoor	Cambium Network Limited	4-Aug-22	
Terminal Device	Wifi Access Point	cnPilot E410 indoor	Cambium Network Limited	4-Aug-22	
Telecommunication Equipment	Tipping Point 440T HW + support 1 Yr Firewall	AUTXA-1017	Trend Micro Incorporate	4-Aug-22	
Terminal Device	Nokia 110 DS mobile phone	TA-1192	Nokia	4-Aug-22	
Terminal Device	Mobile Phone	RAVOZ Z3	Coosea Group (HK) Company Limited	4-Aug-22	
Terminal Device	Mobile Phone	RAVOZ Z7	Coosea Group (HK) Company Limited	4-Aug-22	
Terminal Device	Portable Tablet Computer	Lenovo YT-X705X	Lenovo PC HK Limited	4-Aug-22	
Terminal Device	Explosion protected tablet	Tab-Ex 02 DZ1 WWAN	Pepperl+Fuchs GmbH	4-Aug-22	
Terminal Device	Ethernet Switch	QFX10016	Juniper Networks, Inc	13-Aug-22	
Terminal Device	Galaxy Note 10	SM-N970F/DS	Samsung Electronics	13-Aug-22	
Terminal Device	Galaxy Note 10+	SM-N975F/DS	Samsung Electronics	13-Aug-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Printer	Versalink C500DN	Xerox (UK)	13-Aug-22	
Telecommunication Equipment	HPE Apollo 4200 Gen9Server	HSTNS-2157	Hewlett Packard Enterprise	13-Aug-22	
Terminal Device	Trimble GNSS Receiver	R9S	Trimble Inc.	13-Aug-22	
Terminal Device	Nokia 7.2 DS	TA-1196	HMD Global Oy	17-Aug-22	
Terminal Device	Nokia 6.2 DS	TA-1198	HMD Global Oy	17-Aug-22	
Terminal Device	Nokia 2720 DS	TA-1170	HMD Global Oy	17-Aug-22	
Terminal Device	Nokia 800	TA-1189	HMD Global Oy	17-Aug-22	
Terminal Device	Galaxy Tab S6	SM-T865	Samsung Electronics	18-Aug-22	
Terminal Device	Smart Mobile Phone	Mi A3 (M1906F9SH)	XIAOMI COMMUNICATION CO. LTD	19-Aug-22	
Terminal Device	Portable Tablet Computer	Lenovo TB-7305I	Lenovo Pc HK Limited	19-Aug-22	
Telecommunication Equipment	Cisco Catalyst 6800ia Series Switches	C6800IA-xxxxx	Cisco Systems Inc	19-Aug-22	
Telecommunication Equipment	Ethernet Switch	ICX 7150-24	Ruckus Wirelss Inc.	19-Aug-22	
Telecommunication Equipment	SLC 500 Product Family	1747-XXX	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	CompactLogix Product Family	1768-XXX	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	CompactLogix™ I/0	1769-XXX	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	Managed Industrial Ethernet Switch Product Family	1783-IMSXXX, Stratix 5410 Series	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	Enhanced Unmanaged Industrial Ethernet Switch Product Family	Enhanced 1783-USXXX, Stratix 2000 Series	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	Managed Industrial Ethernet Switch Product Family	1783-HMSXXX Stratix 5400 Series	Rockwell Automation Inc.	25-Aug-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Entry Level Managed Industrial Ethernet Switch Product Family	1783-BMSXXX Stratix 5700	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	Configurable NAT Router	1783-NATR	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	Managed Industrial Ethernet Switch Product Family	1783-MXXX - 1783-RMXXX , Stratix 8000/8300 Series	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	E300 Electronic Motor Overload Relay	193-ESM, -EIO, -ECM, -EXP and -EOS Series , 592-ESM Series	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	PanelView Plus 6 Operator Interface Terminals	2711P and 2711PC Series	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	Industrial Communication Gateway	PLX31	Prosoft Technology	25-Aug-22	
Telecommunication Equipment	Slotserver	PS56-BAS-XXX	Prosoft Technology	25-Aug-22	
Telecommunication Equipment	Remote Access dial-in ethernet modem	9300-XXX	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	Entry Level Managed Industrial Ethernet Switch Product Family	1783-Stratix 6000 Series	Rockwell Automation Inc.	25-Aug-22	
Telecommunication Equipment	Multifunction Printer with WIFI and FAX	K10497	Canon Inc.	25-Aug-22	
Terminal Device	AC2200 Smart Whole-Home Wifi System	Deco M9 Plus	TP Link	25-Aug-22	
Telecommunication Equipment	Network Appliance	XG 210	Sophos Limited	25-Aug-22	
Telecommunication Equipment	Router and Power Supply	VG450-144FXS/K9	Cisco Systems Inc	25-Aug-22	
Terminal Device	GPS/UMTS/GSM/GPRS Tracker	AK7V-UG	Atrack Technology Inc.	26-Aug-22	
Terminal Device	GSM/HSPA/UMTS Tracker	AU7	Atrack Technology Inc.	26-Aug-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Stratix 8000 Ethernet Managed Switches	1783-SFPXXX	Rockwell Automation Inc.	28-Aug-22	
Telecommunication Equipment	communication linking device 1	1788-XXX	Rockwell Automation Inc.	28-Aug-22	
Terminal Device	Apple Watch	A1891	Apple Inc.	28-Aug-22	
Terminal Device	Apple Watch	A1889	Apple Inc.	28-Aug-22	
Terminal Device	Mobile Phone	ENERGY E241S	AVENIR TELECOM	28-Aug-22	
Terminal Device	Multi-band GSM/WCDMA/LTE Phone with Bluetooth, WLAN	SM-207F/DS	Samsung Electronics	28-Aug-22	
Terminal Device	Mobile Phone	VIVO 1904 (VIVP Y12)	Vivo Mobile Communications Co Ltd	28-Aug-22	
Terminal Device	LTE/UMTS/GSM mobile phone	5048I	TCL Communication Ltd	1-Sep-22	
Terminal Device	LTE/UMTS/GSM mobile phone	5048U	TCL Communication Ltd	1-Sep-22	
Telecommunication Equipment	FirePower	Cisco FirePOWER 7000 Series	Cisco Systems, Inc.	10-Sep-22	
Terminal Device	IP Phone	Avaya J100 EXP MOD 24B/JEM24	Avaya	10-Sep-22	
Telecommunication Equipment	Wireless Bridge	P300	Ruckus Wireless Inc	11-Sep-22	
Telecommunication Equipment	Media Gateway	Avaya G450 MP 160 Media Gateway	Avaya	11-Sep-22	
Telecommunication Equipment	Collaboration Unit	Avaya CU-360 Collaboration Unit	Avaya	11-Sep-22	
Telecommunication Equipment	Server	Avaya S8300 Server	Avaya	11-Sep-22	
Terminal Device	3G Tablet with Dual SIM	EX7SL4	Shenzhen Tian YuanHengTai Communication equipemtn Co., Ltd	11-Sep-22	
Terminal Device	EXCEED EX10S4	EX10S4	Shenzhen Tian YuanHengTai Communication equipemtn Co., Ltd	11-Sep-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	4G SmartPhone	XL	iBRITECH DMCC	11-Sep-22	
Terminal Device	SMART PHONE	XTOUCH X	Tecsync Technology Co Ltd.	11-Sep-22	
Terminal Device	Feature Phone	XSLIDER	XTOUCH Technologies FZE	11-Sep-22	
Telecommunication Equipment	TZ350 Firewall	APL28-0B4	SONICWALL	11-Sep-22	
Telecommunication Equipment	Router	FG-300E	Fortinet	11-Sep-22	
Telecommunication Equipment	Router	F5-BIG-LTM-3600	Fortinet	11-Sep-22	
Terminal Device	SMART PHONE	iBrit M4	iBRITECH DMCC	11-Sep-22	
Terminal Device	GPS Tracker	MVT380	Meitrack Group	15-Sep-22	
Terminal Device	Galaxy A30s	SM-A307FN/DS	Samsung Electronics	15-Sep-22	
Terminal Device	SMART PHONE	Xtouch A5	XTOUCH Technologies FZE	15-Sep-22	
Terminal Device	Feature Phone	Xtouch L4	XTOUCH Technologies FZE	15-Sep-22	
Terminal Device	SMART PHONE	Xtouch X10	XTOUCH Technologies FZE	15-Sep-22	
Terminal Device	2G Robot Phone	Xtouch CS4	XTOUCH Technologies FZE	15-Sep-22	
Terminal Device	2G Robot Phone	Xtouch Swimmer	XTOUCH Technologies FZE	15-Sep-22	
Terminal Device	iPhone 11 Pro	A2215	Apple Inc.	17-Sep-22	
Terminal Device	iPhone 11 Pro Max	A2218	Apple Inc.	17-Sep-22	
Terminal Device	iPhone 11	A2221	Apple Inc.	17-Sep-22	
Terminal Device	iPAd	A2198	Apple Inc.	17-Sep-22	
Terminal Device	Apple Watch Series 5	A2157	Apple Inc.	17-Sep-22	
Terminal Device	Apple Watch Series 5	A2156	Apple Inc.	17-Sep-22	
Telecommunication Equipment	Network Security Appliance	IRK39-0C9	Sonic Wall	18-Sep-22	
Terminal Device	GSM Quad Band Mobile Phone	2008D	TCL Communication Limited	18-Sep-22	
Terminal Device	Notebook	S410G3	Getac Technology Corporation	18-Sep-22	
Terminal Device	Mobile WiFi	Huawei E5577Es-932	Huawei Technologies Co., Ltd	18-Sep-22	
Telecommunication Equipment	**Radio 4418 B41**	**KRC161 xxx/x**	Ericsson	22-Sep-22	**This device shall only be used by a Licensee**
Terminal Device	LAN device with WLAN and SRD	MAP-2014 T	LANCOM Systems GmbH	24-Sep-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	BS Switch-300-R5	Brocade 300	NetApp, Inc.	25-Sep-22	
Terminal Device	Enterprise Digital Assistant	MC67NA	Zebra Technologies Corporation	25-Sep-22	
Telecommunication Equipment	Network Switch	SG110D-08-UK	Cisco Systems	25-Sep-22	
Telecommunication Equipment	NETWORKING SWITCH	CE0152PB	LENOVO	2-Oct-22	
Terminal Device	Galaxy M30s	SM-M307FN/DS	Samsung Electronics	2-Oct-22	
Telecommunication Equipment	AS7762-32X-HVDC Switch	AS7762	Edgecore	2-Oct-22	
Terminal Device	CN75 Mobile Computer	CN75e	Honeywell International Inc.	2-Oct-22	
Terminal Device	Galaxy M30s	SM-F900F	Samsung Electronics	7-Oct-22	
Telecommunication Equipment	Network Security Gateway	FML-200F	Fortinet	7-Oct-22	
Terminal Device	GPS Vehicle Tracking	FM3612	Teltonika	7-Oct-22	
Terminal Device	Mobile Phone	CPH1937	Oppo	7-Oct-22	
Terminal Device	Mobile Phone	CPH1907	Oppo	7-Oct-22	
Terminal Device	Mobile Phone	CPH1989	Oppo	7-Oct-22	
Terminal Device	Mobile Phone	CPH1933	Oppo	7-Oct-22	
Terminal Device	Mobile Phone	CPH1931	Oppo	7-Oct-22	
Terminal Device	Touch Computer	TC77HL	Zebra Technologies Corporation	8-Oct-22	
Terminal Device	Services Gateway	SRX4100	Juniper Networks, Inc	8-Oct-22	
Terminal Device	Services Gateway	SRX4200	Juniper Networks, Inc	8-Oct-22	
Terminal Device	Xiaomi REDMI 8	REDMI 8 - M1908C3IG	Xiaomi Communications Ltd.	15-Oct-22	
Terminal Device	Xiamoi REDMI NOTE 8 PRO	REDMI NOTE 8 PRO M1906G7G	Xiaomi Communications Ltd.	15-Oct-22	
Terminal Device	Xiamoi REDMI NOTE 8	REDMI NOTE 8 M1908C3JG	Xiaomi Communications Ltd.	15-Oct-22	
Terminal Device	Xiamoi REDMI NOTE 8A	REDMI 8A M1908C3KG	Xiaomi Communications Ltd.	15-Oct-22	
Terminal Device	Mobile WIFI	E5785-92c	Huawei Technologies Co., Ltd.	15-Oct-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Aruba 9004 Series Gateways	ARCN9004	Hewlett Packard Enterprise Company	15-Oct-22	
Terminal Device	Data Communicator for Construction Machine	KDTC830	Komatsu Ltd.,	15-Oct-22	
Terminal Device	Single-line Common Telephone	A110S	Cetis, Inc.	21-Oct-22	
Terminal Device	Single-line Common Telephone	A101	Cetis, Inc.	21-Oct-22	
Telecommunication Equipment	Radio Dot System	Dot 4479 B78A	Ericsson	21-Oct-22	
Telecommunication Equipment	**Radio Equipment for Radio Base Station**	**Radio 2217 B20**	Ericsson	21-Oct-22	**This device shall only be used by a Licensee**
Terminal Device	In-line Amplifier	PTX-ILA	Juniper Networks, Inc.,	22-Oct-22	
Terminal Device	Data Communicator	KDTG100	Komatsu Ltd.,	29-Oct-22	
Terminal Device	Smart Phone	STK-LX1	Huawei Technologies Co., Ltd.	30-Oct-22	
Terminal Device	Mobile Phone	L19041	Lenovo PC HK Limited	30-Oct-22	
Terminal Device	Mobile Phone	L18021	Lenovo PC HK Limited	30-Oct-22	
Terminal Device	DECT Telephone	Ac8110S	Cetis, Inc.	30-Oct-22	
Terminal Device	DECT Telephone	RD8110	Cetis, Inc.	30-Oct-22	
Terminal Device	Mobile Phone Lenovo K10 Plus	L39051	Lenovo PC HK Limited	30-Oct-22	
Telecommunication Equipment	Aruba 6300 Switch Series	RSVLC-1803	Hewlett Packard Enterprise Company	30-Oct-22	
Telecommunication Equipment	Aruba 6300 Switch Series	RSVLC-1804	Hewlett Packard Enterprise Company	30-Oct-22	
Telecommunication Equipment	Aruba 6300 Switch Series	RSVLC-1805	Hewlett Packard Enterprise Company	30-Oct-22	
Telecommunication Equipment	Aruba 6300M 24-port SFP+ and 4-port SFP56 Switch (JL658A)	RSVLC-1806	Hewlett Packard Enterprise Company	30-Oct-22	
Telecommunication Equipment	Aruba 6300 Switch Series	RSVLC-1807	Hewlett Packard Enterprise Company	30-Oct-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Aruba 6300 Switch Series	RSVLC-1808	Hewlett Packard Enterprise Company	30-Oct-22	
Telecommunication Equipment	Aruba 2930F 12G PoE+ 2G/2SFP+ Switch	RSVLC-1902	Hewlett Packard Enterprise Company	30-Oct-22	
Telecommunication Equipment	Sophos Next-Generation Firewall Appliance	XG 135	Sophos Limited	4-Nov-22	
Telecommunication Equipment	Sophos Next-Generation Firewall Appliance	XG 86	Sophos Limited	4-Nov-22	
Terminal Device	HUAWEI Smart Honor 8A Pro	JAT-L41	Huawei Technologies Co., Ltd.	4-Nov-22	
Telecommunication Equipment	Aruba 2930F 8G PoE+ 2SFP+ TAA Switch (JL692A)	RSVLC-1420	Hewlett Packard Enterprise Company	5-Nov-22	
Terminal Device	Smart Phone	STK-L21	Huawei Technologies Co., Ltd.	11-Nov-22	
Terminal Device	Home WiFi Access Point	SBR-AC1200P	ARRIS GROUP	11-Nov-22	
Terminal Device	IP Phone	CP-3905	Cisco	12-Nov-22	
Terminal Device	Mobile Phone	Vivo 1906 (VIVO Y11)	Vivo Mobile Communications Co, Ltd	12-Nov-22	
Telecommunication Equipment	Aruba 7000 Series mobility Controller	ARCN0104	Hewlett Packard Enterprise Company	13-Nov-22	
Terminal Device	Multi-band GSM/WCDMA/LTE Phone with Bluetooth, WLAN	SM-A015F/DS	Samsung Electronics Co., Ltd.	16-Nov-22	
Terminal Device	Base Station	BS332	MITEL	16-Nov-22	
Terminal Device	Mitel 5614 & 5613 DECT Phone	5613 & 5614	MITEL	16-Nov-22	
Terminal Device	Featurephone	Ex-Handy 10	Pepperl+Fuchs GmbH	16-Nov-22	
Terminal Device	Portable Computing Device	1876	Microsoft Corporation	16-Nov-22	
Terminal Device	Wireless Coverage	MR84-HW	Cisco Systems Inc	16-Nov-22	
Telecommunication Equipment	MX SERIES 5G UNIVERSAL ROUTING PLATFORMS	MX960	JUNIPER	16-Nov-22	
Terminal Device	Smart band 5	CRS-B19S	Huawei Technologies Co., Ltd.	16-Nov-22	
Terminal Device	Smart Phone	Smart-Ex 02	Pepperl+Fuchs GmbH	16-Nov-22	
Terminal Device	Nokia 2.3	TA-1206	HMD Global Oy	16-Nov-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	PCS IP Phone	PCS 542	Splicecom Ltd	16-Nov-22	
Telecommunication Equipment	Router	NCA-4010	Lanner	16-Nov-22	
Terminal Device	HD IP Conference Phone	CP920	Yealink (Xiamen) Network Tech Co. Ltd.	16-Nov-22	
Terminal Device	XEROX VERSALINK C7000DN	C7000V-DN	XEROX	16-Nov-22	
Terminal Device	Telematics	TLVHE4IU-E	LG Electronics Inc.	17-Nov-22	
Terminal Device	OBDII Dongle	CT-150-F Eu LTE	Aptiv Services US, LLC	18-Nov-22	
Terminal Device	Nokia 216 DS Mobile Phone	RM-1187	HMD Global Oy	18-Nov-22	
Terminal Device	Nokia 150 DS Mobile Phone	RM-1190	HMD Global Oy	18-Nov-22	
Terminal Device	DUAL STATION PRINTER	6145-2TN	TOSHIBA GLOBAL COMMERCE SOLUTIONS	18-Nov-22	
Terminal Device	Smart Phone Nokia C1 DS	TA-1165	HMD Global Oy	18-Nov-22	
Telecommunication Equipment	ARUBA CX 6400 SWITCH SERIES	RSVLC-1901	Hewlett Packard Enterprise Company	20-Nov-22	
Telecommunication Equipment	Sophos Next-Generation Firewall Applince	XG 106	Sophos	20-Nov-22	
Terminal Device	Mobile Phone	VIVO 1915 (VIVO Y19)	vivo Mobile Communications Co. Ltd	20-Nov-22	
Terminal Device	GSM Quad Band Mobile Phone	1067F	TCL Communication Limited	23-Nov-22	
Telecommunication Equipment	FORTIGATE Firewall	FG-201E	FORTINET	26-Nov-22	
Terminal Device	Digital Cordless Phone	KX-TG7841UE	Panasonic Corporation	26-Nov-22	
Terminal Device	PBX SYSTEM	KX - TES824	Panasonic	27-Nov-22	
Telecommunication Equipment	Ethernet Switch	QFX5220-128C	JUNIPER Networks, Inc.	30-Nov-22	
Telecommunication Equipment	Data Center Switch	DCS - 7060CX - 32S	Arista Networks, Inc.	1-Dec-22	
Terminal Device	Indoor Wireless Access Point	DAP-2610	D-Link	1-Dec-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Infotainment system	LICU	Art S.p.A.	3-Dec-22	
Terminal Device	VIVO 1920 (VIVO S1 Pro)	VIVO 1920 (VIVO S1 Pro)	vivo Mobile Communications Co. Ltd	4-Dec-22	
Terminal Device	Printer	FARGO HDP5000	HID	4-Dec-22	
Telecommunication Equipment	IP PBX	UCM6208	Grandstream	17-Dec-22	
Telecommunication Equipment	IP PBX	UCM6202	Grandstream	17-Dec-22	
Terminal Device	GRP2613 IP Phone	GRP2613	Grandstream	17-Dec-22	
Terminal Device	GXP1625 IP Phone	GXP1625	Grandstream	17-Dec-22	
Terminal Device	YAL-L21	YAL-L21	Huawei Technologies Co., Ltd.	17-Dec-22	
Terminal Device	Intrinsically Safe Tablet	Tab-Ex 02 DZ2 WWAN	ecom instruments GmbH	17-Dec-22	
Terminal Device	Confrence Phone	GAC2500	Grandstream Networks, Inc	17-Dec-22	
Terminal Device	Wireless Access Point (WiFi) MPIM for WW	SRX-MP-WLAN-WW	Juniper Networks, Inc.	17-Dec-22	
Telecommunication Equipment	THUNDR 1404S GI Firewall	THUNDR 1404S	A10 Networks, Inc	18-Dec-22	
Terminal Device	5007U	LTE/ECDMA/GSM mobile phone	TCL Communication Limited	18-Dec-22	
Terminal Device	5028D	LTE/ECDMA/GSM mobile phone	TCL Communication Limited	18-Dec-22	
Terminal Device	Lenovo L38012	Mobile Phone Lenovo K9 Note	Lenovo PC HK Limited	18-Dec-22	
Terminal Device	Galaxy A01	SM-A015F/DS	Samsung Electronics	22-Dec-22	
Terminal Device	Galaxy A51	SM-A515F/DSN	Samsung Electronics	22-Dec-22	
Telecommunication Equipment	CISCO 1905-xxx/K9	C1905 Serial Router, 2 GE, 1 EHWIC slot, 256U512DRAM, IP Base	Cisco systems Inc.	23-Dec-22	
Terminal Device	MI NOTE 10 (M1910F4)	MI NOTE 10 (M1910F4)	Xiaomi Smart Phone	24-Dec-22	
Terminal Device	MI NOTE 10 PRO (M1910F44S)	MI NOTE 10 PRO (M1910F44S)	Xiaomi Smart Phone	24-Dec-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Infotainment system with GPS, LTE, BT, v4.2, UMTS, GSM, Radio Module	LICU	ART S.p.A.	24-Dec-22	
Telecommunication Equipment	**RADIO COMMUNIC.EQUIP - RBS 6501 B3;EQUIPPED UNIT (AC INT ANT)**	**KRD901103/1**	**Ericsson**	24-Dec-22	**This device shall only be used by a Licensee**
Telecommunication Equipment	SOPHOS NEXT GENERATION FIREWALL APPLIANCE	XG210	SOPHOS LTD.	24-Dec-22	
Telecommunication Equipment	MATICA EDISECURE CARD PRINTER	EDISECURE MC660	MATICA TECHNOLOGIES	24-Dec-22	
Terminal Device	Laser Printer	HL-L5000D	Brother Industries, LTD	24-Dec-22	
Terminal Device	LIO-N29	LIO-N29 5G Smart Phone	Huawei Technologies Co., Ltd.	24-Dec-22	
Terminal Device	DIR-806A Wi-Fi Router	DIR-806A	D-LINK	24-Dec-22	
Terminal Device	GPON Terminal	Echolife HG8145V5	Huawei Technologies Co., Ltd.	24-Dec-22	
Telecommunication Equipment	ZEBRA-PRINTER	ZD620	ZEBRA TECHNOLOGIES CORPORATION	24-Dec-22	
Terminal Device	CPH1921	Reno 5G	OPPO Mobile Telecommunications Corp., Ltd.	26-Dec-22	
Telecommunication Equipment	FORTIGATE UTM	FG-101F	FORTINET	26-Dec-22	
Telecommunication Equipment	FORTGATE UTM	FG-1101E	FORTINET	26-Dec-22	
Terminal Device	CORDLESS PHONE	AT 4503	CC TECH ADVANCED PRODUCT LIMITED	26-Dec-22	
Terminal Device	CORDLESS PHONE	AT 4103	CC TECH ADVANCED PRODUCT LIMITED	26-Dec-22	
Terminal Device	B612-233	LTE CPE	Huawei Technologies Co., Ltd.	29-Dec-22	
Telecommunication Equipment	Teleprotection Equipment	Teleprotection Equipmet NSD570	ABB Swizerland	31-Dec-22	
Telecommunication Equipment	Cisco Nexus 3000 Series Switch	N3K-C3524P-10GX	Cisco System	31-Dec-22	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Cisco 1000 Series Firewall	FPR1140-NGFW-K9	Cisco System	31-Dec-22	
Terminal Device	MOTOROLA CORDLESS PHONE	C1001LB	SUNCORP TECHNOLOGIES LTD-CHINA	6-Jan-23	
Terminal Device	MOTOROLA CORDLESS PHONE	C401	SUNCORP TECHNOLOGIES LTD-CHINA	6-Jan-23	
Terminal Device	MOTOROLA CORDLESS PHONE	C402	SUNCORP TECHNOLOGIES LTD-CHINA	6-Jan-23	
Terminal Device	MOTOROLA CORDLESS PHONE	C4201	SUNCORP TECHNOLOGIES LTD-CHINA	6-Jan-23	
Terminal Device	MOTOROLA CORDED PHONE	CT202	SHENZHEN GUO WEI ELECTRONIS CO,-CHINA	6-Jan-23	
Telecommunication Equipment	Ethernet Fiber Multiplexer	FRM220-FOM 01-SR	CTC Union Technologies Co.,LTD.	6-Jan-23	
Terminal Device	Huawei Y6s	JAT-L29	HUAWEI TECHNOLOGIES Co., Ltd.	6-Jan-23	
Telecommunication Equipment	F5 Big IP system	F5 Big IP i5600	F5 Networks Inc,	10-Jan-23	
Telecommunication Equipment	Message Archiver	Barracuda Message Archiver	Barracuda Networks	10-Jan-23	
Terminal Device	Thermal Receipt Printer	7199-7001-9001	Toshiba TEC Singapore PTE LTD	10-Jan-23	
Terminal Device	C9115AXI Access Point	C9115AXI - H	Cisco System	10-Jan-23	
Telecommunication Equipment	Cisco C9800-40 Controller	C9800-40-K9	Cisco System	10-Jan-23	
Telecommunication Equipment	Siemens Canada Limited	RS900-24-D-ML-XX	RUGGEDCOM RS900	12-Jan-23	
Terminal Device	Car Infotainment System With GPS and Bluetooth	TSU	ART S.p.A.	14-Jan-23	
Terminal Device	GSM/UMTS/LTE Mobile phone	5002D	TCL Communication Limited	14-Jan-23	
Telecommunication Equipment	HP OfficeJet Pro 8730 All-in-One Printer	SNPRC-1602-02	HP INC.	14-Jan-23	
Telecommunication Equipment	Industrial Ethernet Switch	AS-IGS2011P	Optone Technology Co Ltd	19-Jan-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	**Radio 2238 B8 B20 B28B**	**KRC161797/1**	Ericsson	19-Jan-23	**This device shall only be used by a Licensee**
Terminal Device	Automative Infotainment system	MMXF Online	Alpine Electronics Manufacuring of Europe, Ltd	19-Jan-23	
Terminal Device	CN51	CN51	Honeywell International Inc.	21-Jan-23	
Telecommunication Equipment	MEDICAL DEVICE SERVER	EDSOR4P-01	Lantronix	21-Jan-23	
Telecommunication Equipment	SCALERS & SIGNAL PROCCESSORS	IN1606	EXTRON ELECTRONICS	21-Jan-23	
Telecommunication Equipment	IP LINK PRO CONTROL PROCCESSOR	IPCP PRO 555	EXTRON ELECTRONICS	21-Jan-23	
Terminal Device	Galaxy A71	SM-A715F/DS	Samsung electronics	26-Jan-23	
Terminal Device	Galaxy Note Lite	SM-N770F	Samsung electronics	26-Jan-23	
Terminal Device	Cisco Industrial Wireless IW3700 Series Access Point	IW3702-4E-UXK9	Cisco Systems, Inc.	26-Jan-23	
Terminal Device	Cisco Unified Phone 8945	CP-8945-xx-K9	Cisco Systems, Inc.	26-Jan-23	
Telecommunication Equipment	Industrial Ethernet Switch	AS-IES1011PS20	Optone Technology Co Ltd	26-Jan-23	
Telecommunication Equipment	Industrial Ethernet Switch	AS-M2200A	Optone Technology Co Ltd	26-Jan-23	
Terminal Device	Hybrid IP-PBX	KX-NS500	Panasonic Corporation	26-Jan-23	
Terminal Device	Proprietary Telephone for PBX	KX-T7716X	Panasonic Corporation	26-Jan-23	
Terminal Device	Proprietary Telephone for PBX	KX-T7705X	Panasonic Corporation	26-Jan-23	
Terminal Device	Huawei 5G CPE Pro	H112-372	HUAWEI TECHNOLOGIES Co., Ltd.	27-Jan-23	
Terminal Device	HUAWEI 5G Mobile WiFi Pro	E6878-370	HUAWEI TECHNOLOGIES Co., Ltd.	27-Jan-23	
Terminal Device	Cisco MERAKI MR42-HW	MR42-HW	Cisco	27-Jan-23	
Telecommunication Equipment	**Air Faber**	**AF-5XHD**	Ubiquiti Inc.	28-Jan-23	**Device is allowed under certain conditions**
Terminal Device	**#REF!**	**AF-5G30-S45**	Ubiquiti Inc.	28-Jan-23	**Device is allowed under certain conditions**

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	AC3800 Tri-Band Ho,e WiFI System	Huawei WA8011Y	HUAWEI TECHNOLOGIES Co., Ltd.	28-Jan-23	
Terminal Device	FARGO	DTC4500e	HID GLOBAL	28-Jan-23	
Terminal Device	FLET MANAGEMENT	FMU130	TELTONIKA	28-Jan-23	
Telecommunication Equipment	PON Port EPON OLT	BT-P6104H	Baitong Putain Technology Co.,Ltd.	28-Jan-23	
Terminal Device	EPON Router	BT-BCM6838E+	Baitong Putain Technology Co.,Ltd.	28-Jan-23	
Telecommunication Equipment	FORTINET FAP-223E	FAP-223E	FORTINET INC	29-Jan-23	
Terminal Device	Portable Tablet Computer	Lenovo TB-X606X	Lenovo PC HK Limited	29-Jan-23	
Telecommunication Equipment	Ethernet Switch	AL3600A15	Extreme Networks	29-Jan-23	
Terminal Device	1408 Telset	1408	Avaya	29-Jan-23	
Terminal Device	Galaxy S10 Lite	SM-G770F	Samsung electronics	29-Jan-23	
Telecommunication Equipment	HP LaserJet Pro M501n	HP LaserJet Pro M501n	HP INC.	1-Feb-23	
Telecommunication Equipment	Cisco Firepower 2120 Appliance	FPR2120-xxxx-K9	Cisco Systems, Inc.	1-Feb-23	
Terminal Device	Alcatel Smart Phone	5002F	TCL Communication Limited	4-Feb-23	
Terminal Device	ZEBRA PRINTER	QLN220	ZEBRA TECHNOLOGIES CORPO	4-Feb-23	
Telecommunication Equipment	Aruba 7200 Series Controller	ARCN0101	Hewlett Packared Enterprise	4-Feb-23	
Telecommunication Equipment	Aruba 7200 Series Mobility Controller	ARCN7280	Hewlett Packared Enterprise	4-Feb-23	
Telecommunication Equipment	Aruba 7000 Series Mobility Controler	ARCN7008	Hewlett Packared Enterprise	4-Feb-23	
Telecommunication Equipment	Aruba 7000 Series Cloud Services Controler	ARCN7024	Hewlett Packared Enterprise	4-Feb-23	
Telecommunication Equipment	Aruba 7000 Series Cloud Services Controler	ARCN7030	Hewlett Packared Enterprise	4-Feb-23	
Telecommunication Equipment	Cisco UCS C220 M5 Rack Server	UCS C220 M5	Cisco Systems, Inc.	4-Feb-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	ARUBA 9000 SERIES GATEWAYS	ARCN9012	Hewlett Packared Enterprise	4-Feb-23	
Telecommunication Equipment	HPE FlexFabric 5949 Switch Series	BJNGA-AD0075	Hewlett Packared Enterprise	4-Feb-23	
Telecommunication Equipment	Baseband6630	KDV127621/11	Ericsson	5-Feb-23	
Terminal Device	LTE/UMTS/GSM/ mobile phone	5029D	TCL Communication Limited	5-Feb-23	
Telecommunication Equipment	Smart Wireless Gateway	1420828384N1G1	Emerson Process Management	5-Feb-23	
Terminal Device	Huawei Y7p	ART-L29	HUAWEI TECHNOLOGIES Co., Ltd.	5-Feb-23	
Terminal Device	ISAFE MOBILE	IS910.2	i.safe MOBILE GmbH	5-Feb-23	
Terminal Device	Galaxy S20+	SM-G985F/DS	Samsung Electronics	11-Feb-23	
Terminal Device	Galaxy S20	SM-G980F/DS	Samsung Electronics	11-Feb-23	
Terminal Device	Galaxy S20 Ultra	SM-G988B/DS	Samsung Electronics	11-Feb-23	
Terminal Device	Galaxy Z Flip	SM-F700F/DS	Samsung Electronics	11-Feb-23	
Terminal Device	Galaxy S20+ 5G	SM-G986B/DS	Samsung Electronics	11-Feb-23	
Terminal Device	Dlink 4G mobile Router	DWR-932	D-Link CO.,	16-Feb-23	
Telecommunication Equipment	XTP FTHD 4K	XTP FI HD 4K	Extron Electronics	16-Feb-23	
Telecommunication Equipment	XTP 11 Cross Point 3200	Custom XTP II 3200 Cross Point	Extron Electronics	16-Feb-23	
Terminal Device	Dolphin CT60	CT60L1N	Honeywell International Inc.	16-Feb-23	
Telecommunication Equipment	checkpoint	SG-5400	checkpoint	16-Feb-23	
Terminal Device	Galaxy Tab Active Pro	SM-T545	Samsung Electronics	16-Feb-23	
Terminal Device	Low Profile E-band antenna for compact ODU	LPE 03-710S	Fabbrica Italiana Antenne	16-Feb-23	
Terminal Device	Aruba User Experience Insight Sensor, UX-G5C	ASIN0302	Hewlett Packard Enterprise Company	18-Feb-23	
Terminal Device	Aruba User Experience Insight Sensor, UX-G5E	ASIN0301	Hewlett Packard Enterprise Company	18-Feb-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Penta Beam Antenna	5UPX0805F6	Guangdong BroadRadio Communication Technologies .,Ltd	18-Feb-23	
Terminal Device	Terminal Payment Device	XCL_AT-150-17E	XAC Automation Corp	22-Feb-23	
Telecommunication Equipment	GEMINI COMMUNICATIONMATRIX	700-26-03	TRILOGY COMMUNICATION LTD	26-Feb-23	
Terminal Device	Galaxy Xcover Pro	SM-G715F	Samsung Electronics	1-Mar-23	
Terminal Device	Gai-Tronics	100001197	Hubbell Company	1-Mar-23	
Telecommunication Equipment	Avaya G430 Gateway	G430	Avaya	1-Mar-23	
Telecommunication Equipment	ASBCE -CAD-0230 for IPO	CAD-0230	Caswell	1-Mar-23	
Terminal Device	Telematics device for fleet management	TU600-5	Trackunit A/S	1-Mar-23	
Terminal Device	TPS450 (BIOSID)	TPS450	Telpo	1-Mar-23	
Telecommunication Equipment	Next Generation Firewall	CPAP-SG1550	checkpoint	1-Mar-23	
Terminal Device	Nokia 5310 DS	TA-1212	HMD Global Oy	5-Mar-23	
Terminal Device	Nokia C2 DS	TA-1204	HMD Global Oy	5-Mar-23	
Telecommunication Equipment	Switch	CNGE3FE8MS POE	Comnet	5-Mar-23	
Telecommunication Equipment	POE Extender	CLLFE1POE U	Comnet	5-Mar-23	
Terminal Device	JNY-LX1	JNY-LX1	Huawei Technologies Co., Ltd.	5-Mar-23	
Telecommunication Equipment	Sonicwall NSA 2650	NSA 2650	SonicWall	5-Mar-23	
Terminal Device	SMART PHONE	XTOUCH S40	XTOUCH TECHNOLOGIES FZE	12-Mar-23	
Terminal Device	CPH2015 Mobile Phone	A31	OPPO Mobile Telecomunications Corp., Ltd.	12-Mar-23	
Terminal Device	CPH2043 Mobile Phone	Reno 3	OPPO Mobile Telecomunications Corp., Ltd.	12-Mar-23	
Terminal Device	Galaxy M31	SM-M315F/DSN	Samsung Electronics	12-Mar-23	
Telecommunication Equipment	ARUBA 2920 SWITCH SERIES	RSVLC-1201A	Hewlett Packard Enterprise	12-Mar-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Service Gateway	SRX380	Juniper Networks, Inc.	12-Mar-23	
Telecommunication Equipment	ARUBA 2920 SWITCH SERIES	RSVLC-1201B	Hewlett Packard Enterprise	12-Mar-23	
Terminal Device	SOPHOS AP120	APX 120	SOPHOS LIMITED	12-Mar-23	
Terminal Device	Huawei P40 Pro	ELS-NX9	Huawei technologies co., ltd.	12-Mar-23	
Telecommunication Equipment	Lenovo ThinkSystem SR250 Server	Lenovo SR250	Lenovo	12-Mar-23	
Telecommunication Equipment	Lenovo ThinkSystem SR650 Server	Lenovo SR650	Lenovo	12-Mar-23	
Terminal Device	CPH2035 Mobile Phone	Reno 3 Pro	OPPO Mobile Telecomunications Corp., Ltd.	12-Mar-23	
Terminal Device	Huawei Mate Xs	TAH-N29m	Huawei technologies co., ltd.	12-Mar-23	
Terminal Device	Cisco Webex DX80	CP-DX80-K9=	Cisco Systems, Inc.	17-Mar-23	
Terminal Device	Cisco Unified IP Phone 6901	CP-6901-CL-K9=	Cisco Systems, Inc.	17-Mar-23	
Telecommunication Equipment	Cisco VG450 Analog Voice Gateway	VG450/K9	Cisco Systems, Inc.	17-Mar-23	
Telecommunication Equipment	Cisco Catalyst 9800-L Wireless Controller	C9800-L-F-CA-K9	Cisco Systems, Inc.	17-Mar-23	
Terminal Device	IP Propriteray Telephone for PBX	KX-NT553X	Panasonic Corporation	17-Mar-23	
Terminal Device	IP Propriteray Telephone for PBX	KX-NT551X	Panasonic Corporation	17-Mar-23	
Terminal Device	Hybrid IP-PBX	KX-HTS32UE	Panasonic Corporation	17-Mar-23	
Terminal Device	Mobile Thermal Printer	ZQ620	Zebra Technologies	17-Mar-23	
Terminal Device	GPON Terminal	Ecolife HG8245Q2	Huawei technologies co., ltd.	17-Mar-23	
Telecommunication Equipment	IRU 8846 8-port HC	KRC161754/2	ERICSON	17-Mar-23	
Terminal Device	LTE M.2 Module	T77W968C9	HON HAI PRECISION IND.CO., LTD	17-Mar-23	
Terminal Device	3G GPS tracker	M508	ROPE Innovation Co. LTD	18-Mar-23	
Terminal Device	3G GPS tracker antenna	M508	ROPE Innovation Co. LTD	18-Mar-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	IP PHONE	GXP1630	GRANDSTREAM	22-Mar-23	
Telecommunication Equipment	HPE ProLiant DL385 Gen10 Plus Server	HSTNS-2161	Hewlett Packard Enterprise	22-Mar-23	
Terminal Device	Apple iPad Pro	A2232	Apple Inc.	25-Mar-23	
Terminal Device	Apple iPad Pro	A2230	Apple Inc.	25-Mar-23	
Terminal Device	Multi Band Compenser	UMTS/GSM-MMC-AG-3	Molex	26-Mar-23	
Telecommunication Equipment	Cisco Catalyst 9600 Series Switches	C9600-xxxxx	Cisco Systems, Inc.	26-Mar-23	
Telecommunication Equipment	Cisco 250 Series Smart Switches	SG250xxxxx	Cisco Systems, Inc.	26-Mar-23	
Telecommunication Equipment	Cisco Firepower 1000 series	FPR1010-NGFW-K9	Cisco Systems, Inc.	26-Mar-23	
Telecommunication Equipment	AVAYA J159 IP Deskphone (Part # 700512394)	AVAYA J159 IP Deskphone	AVAYA	29-Mar-23	
Terminal Device	WIRELESS LAN ACCESS POINT	AP4D50DW-E/HUAWEI	Huawei technologies co., ltd.	29-Mar-23	
Terminal Device	Huawei Honor 9x Lite Smart Phone	JSN-L22	Huawei technologies co., ltd.	29-Mar-23	
Terminal Device	Huawei Honor 9x Pro Smart Phone	HLK-L42	Huawei technologies co., ltd.	29-Mar-23	
Terminal Device	Cisco Catalyst 9117 Access Point	C9117AX-H	Cisco Systems, Inc.	29-Mar-23	
Terminal Device	DECT and WiFi Smart Handset	SH2-ADAA	Ascom Sweden AB	29-Mar-23	
Telecommunication Equipment	HUAWEI 2700-9TP-SI-AC	HUAWEI SWITCH	Huawei technologies co., ltd.	30-Mar-23	
Terminal Device	Aruba IAP-305 Access Point	APIN0305	Hewlett Packard Enterprise	30-Mar-23	
Terminal Device	Thermal Label Printer	ZT510	Zebra Technologies	1-Apr-23	
Terminal Device	12-port Antenna	800372991	ERICSON	5-Apr-23	
Terminal Device	Vehicle Telematics Control Unit	FB5-TCU-ROW	Ford Motor Company	5-Apr-23	
Telecommunication Equipment	FORTIGATE/FORTIWIFI 80E SERIES UTM	FG-8xx	FORTINET	5-Apr-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	FORTIGATE/FORTIWIFI 60E SERIES UTM	FG-6xx	FORTINET	5-Apr-23	
Terminal Device	Nokia 5.3 DS	TA-1234	HMD Global Oy	7-Apr-23	
Telecommunication Equipment	HPE G2 0x1x4 USB KVM Console Switch	CS1304	ATEN INTERNATIONAL CO.,LTD.	7-Apr-23	
Telecommunication Equipment	HPE G2 0x1x8 USB KVM Console Switch	CS1308	ATEN INTERNATIONAL CO.,LTD.	7-Apr-23	
Telecommunication Equipment	HPE G2 0x1x16 USB KVM Console Switch	CS1316	ATEN INTERNATIONAL CO.,LTD.	7-Apr-23	
Telecommunication Equipment	MOXA	IKS-6728A-8PoE Series	Moxa Technologies Co., Ltd.	8-Apr-23	
Terminal Device	Multi Band Compenser	LTE-MBC-EU2-JLR	Molex CVS Dabendrof GmbH	8-Apr-23	
Terminal Device	CPH2083	A12	OPPO Mobile Telecommunications Corp., Ltd.	8-Apr-23	
Terminal Device	CPH 2059	A92	OPPO Mobile Telecommunications Corp., Ltd.	12-Apr-23	
Terminal Device	CPH2061	A52	OPPO Mobile Telecommunications Corp., Ltd.	12-Apr-23	
Terminal Device	Redmi Note 9S / M2003J6A1G	Redmi Note 9S / M2003J6A1G	Xiaomi Communications Ltd	13-Apr-23	
Terminal Device	Low Profile - Deep dish type	FIA 03-710SW	Fabbrica Italiana Antenne	13-Apr-23	
Terminal Device	Galaxy M11	SM-A315F/DS	Samsung Electronics	14-Apr-23	
Terminal Device	Galaxy M12	SM-M115F/DS	Samsung Electronics	14-Apr-23	
Telecommunication Equipment	Router & Power Supply	ISR4451-X-V/k9	Cisco Systems Inc.	14-Apr-23	
Terminal Device	Galaxy Tab Active Pro	SM-P615	Samsung Electronics	14-Apr-23	
Telecommunication Equipment	AXL F BK ETH BU	3688459	PHOENIX CONTACT GmbH	15-Apr-23	
Terminal Device	LTE/UMTS/GSM/ mobile phone	5030U	TCL Communication Limited	19-Apr-23	
Terminal Device	iPhone SE	A2296	Apple Inc.	20-Apr-23	
Terminal Device	Mobile Phone (Lenovo K11)	XT2055-3	Motorola Mobility, LLC	21-Apr-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Aruba 303 Series AP	Aruba AP-303 (JZ320A)	Aruba Networks	21-Apr-23	
Terminal Device	JKM-LX1	JKM-LX1	Huawei Technologies Co., Ltd	22-Apr-23	
Terminal Device	Mobile Phone (Lenovo A7)	Lenovo L19111	Lenovo PC HK Limited	23-Apr-23	
Terminal Device	DRA-LX9	DRA-LX9	Huawei Technologies Co., Ltd	26-Apr-23	
Telecommunication Equipment	Managed Ethernet Switch	CNGE11FX3TX8MSPOE	Comnet	26-Apr-23	
Terminal Device	GSM Dual band Mobile phone	2011U	TCL Communication Limited	26-Apr-23	
Terminal Device	Laser Multifunctional Equipment	F162002	Canon Inc.	30-Apr-23	
Terminal Device	Laser Multifuctional Equipment	F162004	Canon Inc.	30-Apr-23	
Terminal Device	Nokia 150 DS	TA-1235	HMD Global Oy	30-Apr-23	
Terminal Device	Networking Equipment	SD-WAN 110-LTE-WiFi	CITRIX SYSTEMS, INC	4-May-23	
Telecommunication Equipment	CE0152PB Swith	7Z350022ww	China	5-May-23	
Terminal Device	Telematics Control Unit	PLG641V2 (EU)	Caterpillar Inc.	7-May-23	
Telecommunication Equipment	Router	C921-4P, C931 -4P	Cisco	7-May-23	
Terminal Device	Basestation Omni-directional single Ant	51012541	MITEL	7-May-23	
Terminal Device	Air Fiber X Antenna	AF-5G34-S45	Ubiquiti Inc.	7-May-23	
Telecommunication Equipment	Security Appliance	PSA3000	Pulse Secure LLC	11-May-23	
Telecommunication Equipment	Security Appliance	PSA5000	Pulse Secure LLC	11-May-23	
Terminal Device	Handheld Wirelss Terminal	T8900	shanghai Sunmi Technology Co. Ltd	12-May-23	
Terminal Device	Datalogger	WeMOTA/ECHO	WeiB Elktronik und Software GmbH	12-May-23	
Telecommunication Equipment	Microwave radio	Integra-E 70-80 CHz	SAF	13-May-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	FaxKit	SL-FAX2501	HP Inc.	17-May-23	
Terminal Device	FaxKit	SL-FAX1001	HP Inc.	17-May-23	
Terminal Device	HTC 5G Hub	HTC Cororation	HTC Corporation	20-May-23	
Terminal Device	SMART PHONE	Z2 LITE	IBRITECH DMCC	21-May-23	
Terminal Device	SMART PHONE	Z2 LITE	IBRITECH DMCC	21-May-23	
Terminal Device	VIVO 1820 (VIVO Y91C)	VIVO 1820 (VIVO Y91C)	vivo Mobile Communications Co. Ltd	21-May-23	
Terminal Device	VIVO 1933 (VIVO V19)	VIVO 1933 (VIVO V19)	vivo Mobile Communications Co. Ltd	21-May-23	
Terminal Device	VIVO 1938 (VIVO Y30)	VIVO 1938 (VIVO Y30)	vivo Mobile Communications Co. Ltd	21-May-23	
Terminal Device	SMART PHONE	5061K	TCL Communication Limited	27-May-23	
Terminal Device	SMART PHONE	5061U	TCL Communication Limited	27-May-23	
Terminal Device	SOPHOS ACCESS POINT	APX120	SOPHOS	27-May-23	
Terminal Device	Galaxy A11	SM-A155F/DS	Samsung Electronics	31-May-23	
Terminal Device	MED-LX9	MED-LX9	HUAWEI TECHNOLOGIES Co, Ltd.	31-May-23	
Terminal Device	AQM-LX1	AQM-LX1	HUAWEI TECHNOLOGIES Co, Ltd.	31-May-23	
Terminal Device	Tracking device	ATB31EA	MARBELLI EUROPE S.P.A.	31-May-23	
Terminal Device	Tracking device	ATB31IA	MARBELLI EUROPE S.P.A.	31-May-23	
Terminal Device	FaxKit	CLX-FAX160	HP Inc.	1-Jun-23	
Telecommunication Equipment	Universal Metro Router	ACX710	Juniper Networks, Inc.	1-Jun-23	
Telecommunication Equipment	Switch Series	RSVLC-1904	HP Inc.	1-Jun-23	
Telecommunication Equipment	Switch Series	RSVLC-1905	HP Inc.	1-Jun-23	
Telecommunication Equipment	Switch Series	RSVLC-1906	HP Inc.	1-Jun-23	
Telecommunication Equipment	Switch Series	RSVLC-1907	HP Inc.	1-Jun-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Switch Series	RSVLC-1908	HP Inc.	1-Jun-23	
Terminal Device	Wireless LAN access Point/Huawei	5760-10	HUAWEI TECHNOLOGIES Co, Ltd.	3-Jun-23	
Terminal Device	Wireless LAN access Point/Huawei	5760-51/V200	HUAWEI TECHNOLOGIES Co, Ltd.	3-Jun-23	
Terminal Device	BAH3-L09	BAH3-L09	HUAWEI TECHNOLOGIES Co., Ltd.	3-Jun-23	
Terminal Device	Galaxy A21s	SM-A217F/DS	Samsun Electonics	7-Jun-23	
Terminal Device	Terminal	xCL_AT-150-R	XAC Automation Corp.	7-Jun-23	
Terminal Device	KOB2-L09	KOB2-L09	HUAWEI TECHNOLOGIES Co., Ltd.	8-Jun-23	
Telecommunication Equipment	SONICWALL NSA3600	NSA3600-IRK2G-OA1	SoNICWALL INC.	8-Jun-23	
Telecommunication Equipment	RORTIGATE 30 E	FG-30E	FORTINET, INC.	8-Jun-23	
Terminal Device	Tablet	9013T	TCL Communication Limited	9-Jun-23	
Terminal Device	Touch Computer	TC26BK	Zebra Technologies Corporation	10-Jun-23	
Terminal Device	Wirelss LAN access Point / Huawei	AP8050DN V200	HUAWEI TECHNOLOGIES Co., Ltd.	10-Jun-23	
Terminal Device	Wirelss LAN access Point / Huawei	Air engine 8760-X1-PRO/V200	HUAWEI TECHNOLOGIES Co., Ltd.	10-Jun-23	
Terminal Device	Wirelss LAN access Point / Huawei	AP6050DN Huawei	HUAWEI TECHNOLOGIES Co., Ltd.	10-Jun-23	
Terminal Device	REDMI NOTE 9 PRO (M2003J6B2G)	REDMI NOTE 9 PRO (M2003J6B2G)	Xiaomi communications Ltd	10-Jun-23	
Terminal Device	BrainV2	ATD300E	Mobilogix Inc.	10-Jun-23	
Telecommunication Equipment	Switch Series	SN3700	HPE Inc.	14-Jun-23	
Terminal Device	RMX2001 Mobile Phone	Realme 6	Realme Chongqing Mobile Telecommunications Crop., Ltd.	15-Jun-23	
Terminal Device	RMX2020 Mobile Phone	Realme C3	Realme Chongqing Mobile Telecommunications Crop., Ltd.	15-Jun-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	RMX2061 Mobile Phone	Realme 6 Pro	Realme Chongqing Mobile Telecommunications Crop., Ltd.	15-Jun-23	
Terminal Device	RMX2040 Mobile Phone	Realme 6i	Realme Chongqing Mobile Telecommunications Crop., Ltd.	15-Jun-23	
Terminal Device	MOBILE PHONE	Z6 LITE	COOSEA GROUP(hk) COMPANY LIMITED	16-Jun-23	
Terminal Device	MOBILE PHONE	Z5 LITE	COOSEA GROUP(hk) COMPANY LIMITED	16-Jun-23	
Terminal Device	MOBILE PHONE	Z3 PRO	COOSEA GROUP(hk) COMPANY LIMITED	16-Jun-23	
Terminal Device	MOBILE PHONE	Z5 PRO	COOSEA GROUP(hk) COMPANY LIMITED	16-Jun-23	
Terminal Device	GPS DEVICE	FMB 130	TELTONIKA	16-Jun-23	
Terminal Device	MRX-AL09	MRX-AL09	HUAWEI TECHNOLOGIES Co., Ltd.	21-Jun-23	
Telecommunication Equipment	Ubiquiti	USG-PRO-4	Ubiquiti	23-Jun-23	
Terminal Device	Smart Phone	5030E	TCL Communication Limited	23-Jun-23	
Terminal Device	Mobile Phone	T782H	TCL Communication Limited	23-Jun-23	
Terminal Device	HDP 5000 PRINTER	HDP 5000	HID CORPORATION LTD	24-Jun-23	
Terminal Device	ELS-N39	MED-LX9	HUAWEI TECHNOLOGIES Co., Ltd.	24-Jun-23	
Terminal Device	JEF-NX9	JEF-NX9	HUAWEI TECHNOLOGIES Co., Ltd.	24-Jun-23	
Terminal Device	HP Fax Card	VCVRA-1710	HP Inc.	29-Jun-23	
Terminal Device	Mi Note 10 Lite - M2002F4LG	Mi Note 10 Lite - M2002F4LG	Xiaomi communications Ltd	29-Jun-23	
Terminal Device	POCO F2 Pro - M2004J11G	POCO F2 Pro - M2004J11G	Xiaomi communications Ltd	29-Jun-23	
Terminal Device	Redmi 9A - M2006C3LG	Redmi 9A - M2006C3LG	Xiaomi communications Ltd	29-Jun-23	
Terminal Device	Mi 10 Lite 5G - M2002J9G	Mi 10 Lite 5G - M2002J9G	Xiaomi communications Ltd	29-Jun-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Redmi Note 9 - M2003J15SS	Redmi Note 9 - M2003J15SS	Xiaomi communications Ltd	29-Jun-23	
Terminal Device	Redmi 9 - M2004J19G	Redmi 9 - M2004J19G	Xiaomi communications Ltd	29-Jun-23	
Terminal Device	VDSL CPE	ZXHN H168N	ZTE Corporation	5-Jul-2023	
Terminal Device	E6878-870	E6878-870	Huawei Technologies Co., Ltd.	5-Jul-2023	
Terminal Device	Electonic Control Unit	TGW2.1 4G+WIFI W	ACTIA AUTOMOTIVE	6-Jul-2023	
Terminal Device	Ethernet Switch	QFX5110-32Q	Juniper Networks, Inc.	6-Jul-2023	
Telecommunication Equipment	Multi-Service Access Module	SmartAX MA5616/HUAWEI	Huawei Technologies Co., Ltd.	8-Jul-2023	
Terminal Device	Home Gateway	HG630 V2	Huawei Technologies Co., Ltd.	8-Jul-2023	
Antenna	Antenna	BY-GSM-01 and BY-3G-05	Jiaxing Beyondoor Electronics Co., Ltd.	8-Jul-2023	
Telecommunication Equipment	HPE MSA 2060 2U 24d SFF Drv Enclosure	HSTNM-S015	HPE	11-Jul-2023	
Telecommunication Equipment	HPE MSA 2060 2U 12d LFF Drv Enclosure	HSTNM-S016	HPE	11-Jul-2023	
Telecommunication Equipment	Mellanox IB HDR 40P Managed Switch	QM8700	HPE	11-Jul-2023	
Telecommunication Equipment	Mellanox IB HDR 40P Switch	QM8790	HPE	11-Jul-2023	
Terminal Device	KONE CONNECTION 210	KONE CONNECTION 210	KONE CORPORATION	11-Jul-2023	
Terminal Device	Galaxy M21	SM-M215F/DSN	Samsung Electronics	14-Jul-2023	
Terminal Device	Galaxy A01 Core	SM-A013G/DS	Samsung Electronics	14-Jul-2023	
Terminal Device	Telematics	TL21BNU1	LG Electronics Inc.	14-Jul-23	
Terminal Device	Telematics	TL21BNU2	LG Electronics Inc.	14-Jul-23	
Terminal Device	Mobile Phone	T766U	TCL Communication LTd.	19-Jul-2023	
Terminal Device	Wirelss - N Multifunction VPN Router	RV130W	CISCO	19-Jul-2023	
Terminal Device	5G WWAN Module	T99W175	HON LIN Technology Co., Ltd	20-Jul-2023	
Telecommunication Equipment	901-1205-UK00 ZONE DIRECTOR	901-1205-UK00	RUCKUS WIRELESS	21-Jul-2023	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	901-R720-WW00 Access Point	901-R720-WW00	RUCKUS WIRELESS	21-Jul-2023	
Terminal Device	Wireless N Router	TL-WE940N	TP-Link Technogies Co., Ltd	22-Jul-2023	
Terminal Device	VEHICLE GPS TRACKER	GV20	Shenzhen Concox Information Technology Co., Ltd	22-Jul-2023	
Telecommunication Equipment	HPE Apollo 2000 Gen 10 Plus	TPS-F036	HPE	26-Jul-2023	
Telecommunication Equipment	HPE ProLiant XL225n Gen10 Plus	TPS-I012	HPE	26-Jul-2023	
Telecommunication Equipment	1G/100 ETHERNET SWITCHES-S3900 SERIES	S3900-24t4s	FIBERSTORE CO., LIMITED	28-Jul-2023	
Telecommunication Equipment	S4148F-ON	S4148F-ON	Dell INC	28-Jul-2023	
Telecommunication Equipment	Z9100-ON	Z9100-ON	Dell INC	28-Jul-2023	
Terminal Device	TABLET PC	TAG-DC	QPS Electronics Co., Ltd	5-Aug-2023	
Terminal Device	Beetel M71	M71	Beetel	5-Aug-2023	
Terminal Device	Cisco IP DECT Phone 6825	Cisco IP DECT Phone 6825	CISCO	5-Aug-2023	
Terminal Device	GALAXY NOTE 20 5G/4G	SM-N981B/DS SM/980F/DS	Samsung Electronics	5-Aug-2023	
Terminal Device	GALAXY NOTE 20 ULTRA 4G/5G	SM-N985F/DS SM/N986B	Samsung Electronics	5-Aug-2023	
Terminal Device	QPS Electronics Co., Ltd	TAG-DC	TABLET PC	5-Aug-23	
Terminal Device	Tablet PC	TAG-TAB 11	QPS Electonices Co., Ltd	9-Aug-23	
Terminal Device	Nokia C3 DS	TA-1292	HMD Global Oy	9-Aug-23	
Terminal Device	IoT Gateway	N03G	Dell Inc.	10-Aug-23	
Terminal Device	Portable Tablet Computer	Lenovo TB-X306X	Lenovo PC HK Limited	10-Aug-23	
Terminal Device	Galaxy Tab S7	SM-T875	Samsung Electronics	10-Aug-23	
Terminal Device	CDY-NX9B	CDY-NX9B	Huawei Technologies Co., Ltd.	10-Aug-23	
Terminal Device	Digital cordelss phone	KX-TGD510UE, KX-TGD512UE & KX-TGD520UE	Panasonic Corporation	11-Aug-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Mobile Communication device to track and monitor industrial heavy Equipment	PT8-GL4	ORBCOMM Inc.	11-Aug-23	
Terminal Device	TABLET	MAX 7	IBRITECH DMCC	11-Aug-23	
Terminal Device	Mobile Cellular Phone	XT2073	Motorola Mobility, LLC	15-Aug-23	
Antenna	PT7 Cell/GNSS Antenna	1001262326	ORBCOMM Inc.	15-Aug-23	
Terminal Device	ClickShare CSE-200	R9861521EU	Barco NV Belgium	18-Aug-23	
Terminal Device	Windows Version WWAN-Rugged Tablet PC	RT10W-L10	Honeywell International Inc.,	22-Aug-23	
Telecommunication Equipment	**KRD 901 119/11**	**AIR 6449 B42**	ERICSSON	23-Aug-23	**This device shall only be used by a Licensee**
Terminal Device	EchoLife HG8245W5	EchoLife HG8245W5	Huawei Technologies Co., Ltd.	23-Aug-23	
Terminal Device	Tablet PC	9032X	TCL Communication Limited	23-Aug-23	
Terminal Device	Mobile Phone Lenovo K11	XT2053	Motorola Mobility, LLC	23-Aug-23	
Telecommunication Equipment	**KRC 161 787/1**	**Radio 4499 B1 B3 C**	ERICSSON	24-Aug-23	**This device shall only be used by a Licensee**
Terminal Device	LTE/UMTS/GSM Smartphone	50301	TCL Communication Limited	1-Sep-23	
Terminal Device	Industrail Hotspot	RLX2-IHNF-X	Prosoft Technology	2-Sep-23	
Terminal Device	HP MFP Analog Single Fax Accessory 800	BOISB-1814-00	HP Inc.	2-Sep-23	
Terminal Device	FRL-L22	FRL-L22	HUAWEI TECHNOLOGIES Co., Ltd.	5-Sep-23	
Telecommunication Equipment	Internet Router	JNP10008	Juniper Networks, Inc.	6-Sep-23	
Telecommunication Equipment	Internet Router	PTX10008	Juniper Networks, Inc.	6-Sep-23	
Telecommunication Equipment	Internet Router	MX10008	Juniper Networks, Inc.	6-Sep-23	
Terminal Device	ZTE Blade 10 Smart	ZTE 2050	ZTE Corporation	6-Sep-23	
Terminal Device	ZTE Corporation	ZTE Blade A5 2020	ZTE Blade A5 2020	7-Sep-23	
Terminal Device	Android version WWAN - Rugged Tablet PC	RT10AL1N	Honeywell International Inc.,	7-Sep-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	CPH2095	A73	OPPO Mobile Telecommunications Corp., Ltd	7-Sep-23	
Terminal Device	**Enstation5-AC Outdoor Wireless Access point**	**Enstation 5 -ACV2**	Engenius Networks Singapore	7-Sep-23	**Device is allowed under certain conditions**
Terminal Device	CPH2109	Reno4 Pro	OPPO Mobile Telecommunications Corp., Ltd	7-Sep-23	
Terminal Device	CPH2121	A93	OPPO Mobile Telecommunications Corp., Ltd	7-Sep-23	
Terminal Device	CPH2171	A53	OPPO Mobile Telecommunications Corp., Ltd	7-Sep-23	
Terminal Device	SMART PHONE	S20	XTOUCH TECHNOLOGIES FZE	7-Sep-23	
Telecommunication Equipment	Ipe 40ax V2	Ipe 40ax V2	Infovista Ipanema Technologies	9-Sep-23	
Antenna	Antenna	AN0727-6706BSM	Wistron NeWeb Corporation	9-Sep-23	
Terminal Device	CPH2113	Reno4	OPPO Mobile Telecommunications Corp., Ltd	12-Sep-23	
Terminal Device	Galaxy M51	SM-M515F/DSN	Samsung Electronics	13-Sep-23	
Terminal Device	Alcatel 1SE Elite Edition	4087U	TCL Communication Limited	15-Sep-23	
Terminal Device	REDMI 9C	REDMI 9C (M2006C3MG)	XIAOMI COmmuNICATIONS CO. LTD	21-Sep-23	
Telecommunication Equipment	HP 2910-24G-PoE+ al Switch	RSVLC-0705	HPE	21-Sep-23	
Terminal Device	Galaxy M31s	SM-M317F/DSN	Samsung Electronics	21-Sep-23	
Telecommunication Equipment	E80	E80	Clavister	21-Sep-23	
Terminal Device	Ipad	A2429	Apple, Inc	21-Sep-23	
Terminal Device	Apple Watch	A2375	Apple, Inc	21-Sep-23	
Terminal Device	Apple Watch	A2376	Apple, Inc	21-Sep-23	
Terminal Device	Mobile Cellular Phone (Lenovo k12 note)	XT2083	Motrola Mobility, LLC	22-Sep-23	
Telecommunication Equipment	HPE Edgeline El300 Converged Edge System	HSTNS-2162	HPE	22-Sep-23	
Terminal Device	Telematics Device	PL542V2	Caterpillar Inc.	22-Sep-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Aruba 6200F Switch Series	RSVLC-1910	HPE	22-Sep-23	
Terminal Device	V2005 (VIVO X50)	V2005 (VIVO X50)	vivo Mobile Communications Co. Ltd	22-Sep-23	
Terminal Device	Apple Watch	A2355	Apple, Inc	22-Sep-23	
Terminal Device	Apple Watch	A2356	Apple, Inc	22-Sep-23	
Telecommunication Equipment	Aruba 6200F Switch Series	RSVLC-1911	HPE	23-Sep-23	
Telecommunication Equipment	Aruba 6200F Switch Series	RSVLC-1912	HPE	23-Sep-23	
Telecommunication Equipment	Aruba 6200F Switch Series	RSVLC-1913	HPE	23-Sep-23	
Terminal Device	V2006 (VIVO X50 Pro)	V2006 (VIVO X50 Pro)	vivo Mobile Communications Co. Ltd	23-Sep-23	
Terminal Device	V2015 (VIVO 2015Y1s)	V2015 (VIVO 2015Y1s)	vivo Mobile Communications Co. Ltd	23-Sep-23	
Terminal Device	V02022 (VIVO 20 SE)	V02022 (VIVO 20 SE)	vivo Mobile Communications Co. Ltd	23-Sep-23	
Terminal Device	V2027 (VIVO Y20)	V2027 (VIVO Y20)	vivo Mobile Communications Co. Ltd	23-Sep-23	
Terminal Device	Nokia 215 4G DS	TA-1284	HMD Global Oy	26-Sep-23	
Terminal Device	Nokia 225 4G DS	TA-1279	HMD Global Oy	26-Sep-23	
Telecommunication Equipment	CG-S/ IP-ROUTER PLUS-IP.V2	CG-S/ IP-ROUTER PLUS-IP.V2	EATEN	26-Sep-23	
Terminal Device	PPA-LX2	PPA-LX2	HUAWEI TECHNOLOGIES Co., Ltd.	26-Sep-23	
Terminal Device	Galaxy S20 FE 5G/4G	SM-G781B/DS	Samsung Electronics	26-Sep-23	
Telecommunication Equipment	Cisco ASR 920 Series	ASR-920-4SZ-A	Cisco	30-Sep-23	
Telecommunication Equipment	MediaPack MP-118	MP-118/8FXS/3AC	AudioCodes Ltd.	30-Sep-23	
Terminal Device	Polycom SoundStation IP5000	Polycom SoundStation IP5000	Polycom (Netherlands) B.V.	30-Sep-23	
Terminal Device	Galaxy A42 5G	SM-A426B/DS	Samsung Electronics	30-Sep-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	Harmony Enhanced 15	T562RL15B01Sx.xx; T562RH15B01Sx.xx;	Dragonwave-X	4-Oct-23	
Telecommunication Equipment	Harmony Enhanced 38	T562RL38B01Sx.xx; T562RH38B01Sx.xx;	Dragonwave-X	4-Oct-23	
Antenna	Antenna 15GHz	VHLP1-15	Commscope	4-Oct-23	
Antenna	Antenna 38GHz	VHLP1-38_B	Commscope	4-Oct-23	
Telecommunication Equipment	Avia™ 12x8 Digital Signal Processor w/dante™, USB Audio AEC, & Audio Conference Interface	6506920	Crestron	5-Oct-2023	
Terminal Device	Snom D765	D765	Snom Technology GmbH	5-Oct-2023	
Terminal Device	Nokia 3.4 DS	TA-1288	HMD Global Oy	5-Oct-2023	
Telecommunication Equipment	HPE Integrity Server	RSVLA-RC01	HPE	5-Oct-2023	
Telecommunication Equipment	HPE M-series SN2700M Switch	SN2700	HPE	5-Oct-2023	
Terminal Device	Nokia 2.4 DS	TA-1270	HMD Global Oy	5-Oct-2023	
Terminal Device	N5368x	N5368x	HUAWEI TECHNOLOGIES Co., Ltd	5-Oct-2023	
Terminal Device	Portable Computing Device	1961	Microsoft Corporation	5-Oct-23	
Terminal Device	iPad	A2072	Apple, Inc.	10-Oct-2023	
Terminal Device	CPH2127	A53	OPPO Mobile Telecommunications Corp., Ltd.	11-Oct-2023	
Terminal Device	H122-373	H122-373	HUAWEI TECHNOLOGIES Co., Ltd	11-Oct-2023	
Terminal Device	Galaxy Tab A7	SM-T505	Samsung Electronics	12-Oct-2023	
Terminal Device	CPH2089	Reno4 Pro 5G	OPPO Mobile Telecommunications Corp., Ltd.	14-Oct-2023	
Telecommunication Equipment	Barracuda CloudGen Firewall	BNGiF180a	Barracuda Networks	14-Oct-2023	
Terminal Device	Wireless Hotspot Modem	M2000C	Inseego Corporation	17-Oct-2023	
Terminal Device	iPhone	A2399	Aplle, Inc.	18-Oct-2023	
Terminal Device	iPhone	A2403	Aplle, Inc.	18-Oct-2023	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	iPhone	A2407	Aplle, Inc.	18-Oct-2023	
Terminal Device	iPhone	A2411	Aplle, Inc.	18-Oct-2023	
Terminal Device	REALME 7 PRO	RMX2170	Realme Chongqing Mobile Telecommunication Corp., Ltd	19-Oct-2023	
Terminal Device	REALME 7	RMX2151	Realme Chongqing Mobile Telecommunication Corp., Ltd	19-Oct-2023	
Terminal Device	vivo 2025 (vivo V20)	vivo 2025 (vivo V20)	vivo Mobile communications Co. Ltd	19-Oct-2023	
Terminal Device	V2026 (vivo Y12s)	V2026 (vivo Y12s)	vivo Mobile communications Co. Ltd	19-Oct-2023	
Terminal Device	vivo 2029 (vivo Y20S)	vivo 2029 (vivo Y20S)	vivo Mobile communications Co. Ltd	19-Oct-2023	
Terminal Device	Tablet	8094X	TCL Communication Limited	24-Oct-2023	
Terminal Device	NOH-NX9	NOH-NX9	HUAWEI TECHNOLOGIES Co., Ltd	31-Oct-2023	
Terminal Device	M2007 J20CG (POCO X3 NFC)	M2007 J20CG (POCO X3 NFC)	Xiaomi Smart Phone	2-Nov-23	
Telecommunication Equipment	**airFiber5XHD**	**AF-5XHD**	Ubiquiti Inc.	7-Nov-23	**Device is allowed under certain conditions**
Antenna	**airFiber X Antenna**	**AF-5G30-S45**	Ubiquiti Inc.	7-Nov-23	**Device is allowed under certain conditions**
Terminal Device	SM-A102U1	Samsung Galaxy A10e	Samsung Electronics Co. Ltd	7-Nov-23	
Antenna	Omnidirectional In-building Ultra-Thin Antenna	510-144	Interconnect Solutions Ltd	10-Nov-23	
Telecommunication Equipment	Internet Router	JNP10003	Juniper Networks, Inc.	14-Nov-2023	
Telecommunication Equipment	Internet Router	JNP10006	Juniper Networks, Inc.	14-Nov-2023	
Telecommunication Equipment	MX150 3D Universal Edge Router	MX150	Juniper Networks, Inc.	14-Nov-2023	
Terminal Device	Multifunction Printer with WiFi and Fax	K10527	Canon Inc.,	16-Nov-2023	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Multifunction Printer with WiFi and Fax	K10528	Canon Inc.,	16-Nov-2023	
Terminal Device	6300 DS	TA-1287	HMD Global Oy	16-Nov-2023	
Terminal Device	Nokia 8000 DS	TA-1311	HMD Global Oy	16-Nov-2023	
Terminal Device	CPH2185	A15	OPPO Mobile Telecommunication Corp., Ltd	16-Nov-2023	
Terminal Device	CPH2095	A73	OPPO Mobile Telecommunication Corp., Ltd	18-Nov-2023	
Telecommunication Equipment	Aruba 9004 Branch Gateway with LTE	ARCN9004LTE	HPE	18-Nov-2023	
Terminal Device	Galaxy Tab A02s	SM-A025F/DS	Samsung Electronics	22-Nov-2023	
Telecommunication Equipment	**Radio 2279 22B8 22B20**	**KRC 161 864/1**	Ericsson	23-Nov-2023	**This device shall only be used by a Licensee**
Telecommunication Equipment	Palo Alto Networks Firewall	PA-820	Palo Alto Networks	23-Nov-2023	
Telecommunication Equipment	**Baseband 6630**	**KDU1370015/11**	Ericsson	24-Nov-2023	**This device shall only be used by a Licensee**
Telecommunication Equipment	**KRC 161 777/1**	**Radio 4480 44B1 44B3 C**	Ericsson	24-Nov-2023	**This device shall only be used by a Licensee**
Antenna	Aruba 90xx-LTE Spare Indoor Antenna	Aruba 90xx-LTE Spare Indoor Antenna	HPE	24-Nov-2023	
Terminal Device	AGR-L09	AGR-L09	Huawei Technologies Co., Ltd	29-Nov-2023	
Terminal Device	AGS3-L09	AGS3-L09	Huawei Technologies Co., Ltd	29-Nov-2023	
Antenna	**12-Port Antenna 2LB/4HB 1.5m**	**800482001**	Ericsson	29-Nov-2023	**This device shall only be used by a Licensee**
Telecommunication Equipment	Prosafe Plus 8-Port gigabit Switch	GS108E-300INS	NETGEAR Inc.	29-Nov-2023	
Telecommunication Equipment	Prosafe Netgear 24P POE+managed Switch	GS724TP-200EUS	NETGEAR Inc.	29-Nov-2023	
Terminal Device	Mobile Phone (Lenovo k12)	XT2095-4	Motorola Mobility LLC	2-Dec-23	
Terminal Device	Galaxy A12	SM-A125G/DSN	Samsung Electronics	5-Dec-23	
Telecommunication Equipment	CISCO ISR 1100 4Port DSC ANNEX A/M and GE WAN ROUTER	CISCO C1117-4P	CISCO SYSTEMS INC	7-Dec-23	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	LTE Module	L850-GL	Fibocom Wireless Inc.	7-Dec-23	
Telecommunication Equipment	ARUBA INSTANT ON 1930 24G 4SFP/SFP+ SWITCH	JL682A	HEWLETT PACKARD ENTERPRISE	9-Dec-23	
Telecommunication Equipment	Network Security Device	N51L	Forcepoint LLC	9-Dec-23	
Terminal Device	Nokia 5.4 DS	TA-1337	HMD Global Oy	12-Dec-23	
Terminal Device	Nokia 5.4 DS	TA-1325	HMD Global Oy	12-Dec-23	
Terminal Device	Phone PlugIn system with GSM/UMTS/LTE	PPIS LTE II, BE A528	Harman Becker Automotive System GmbH	21-Dec-23	
Terminal Device	Fleet Management and Tracking Device	LMU2630MB	CalAmp Wireless Networks	21-Dec-23	
Terminal Device	HP4105	JAWWY-TV-2.0	Skyworth Digital	21-Dec-23	
Terminal Device	Mobile Phone	V2035	VIVO	26-Dec-23	
Terminal Device	Galaxy M12	SM-M127F/DS	Samsung Electronics	26-Dec-23	
Terminal Device	HTC 5G hub	2Q6U310	HTC	26-Dec-23	
Terminal Device	**Access Station**	**SBS-T3-868**	Sigfox	27-Dec-23	**This device shall only be used by a Licensee**
Antenna	Collinear array	RO8605NF	PulseLarsen Antennas	27-Dec-23	
Terminal Device	M2007J22G-REDMI NOTE 9T	M2007J22G-REDMI NOTE 9T	Xiaomi Communications Ltd	28-Dec-23	
Terminal Device	M2010J19SG-REDMI 9T	M2010J19SG-REDMI 9T	Xiaomi Communications Ltd	28-Dec-23	
Terminal Device	M2010J19CG-POCO M3	M2010J19CG-POCO M3	Xiaomi Communications Ltd	28-Dec-23	
Terminal Device	M2007J3SY-Mi 10T	M2007J3SY-Mi 10T	Xiaomi Communications Ltd	28-Dec-23	
Terminal Device	SM-G991B/DS	Galaxy S21 5G	Samsung Electronics	30-Dec-23	
Terminal Device	SM-G996B/DS	Galaxy S21+5G	Samsung Electronics	30-Dec-23	
Terminal Device	SM-G998B/DS	Galaxy S21 Ultra 5G	Samsung Electronics	30-Dec-23	
Telecommunication Equipment	Forcepoint VK 10000 appliance	VK 10000 appliance	Dell EMC	6-Jan-24	
Terminal Device	Lexmark PSTN Internal Network Adapter	LEX-M14-002	Lexmark International, Inc.	11-Jan-24	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Automatic Data Processing Machines	E42W	Dell Inc.	12-Jan-24	
Terminal Device	Automatic Data Processing Machines	E42W	Dell Inc.	12-Jan-24	
Telecommunication Equipment	Internet Router	MX10003	Juniper Networks, Inc.	12-Jan-24	
Terminal Device	Dolphin CT60 Mobile Computer	CT60L1N	Honeywell International Inc.	13-Jan-24	
Antenna	ANTENNA BASE_ANT VT FULL FEAT.23311779	920 447-011	Hirschmann (TE Connectivity)	13-Jan-24	
Telecommunication Equipment	3D Universal Edge Router	MX204	Juniper Networks, Inc.	13-Jan-24	
Telecommunication Equipment	3D Universal Edge Router	JNP204	Juniper Networks, Inc.	13-Jan-24	
Telecommunication Equipment	UniFi Security Gateway	USG	Ubiquiti Networks	16-Jan-24	
Terminal Device	Mobile Cellular Phone (moto g 5G)	XT2113-3	Motorola Mobility, LLC	16-Jan-24	
Antenna	**E-band 2ft (60cm) Antenna**	**FIA 06-710SW**	Fabbrica Italiana Antenna	17-Jan-24	**This device shall only be used by a Licensee**
Telecommunication Equipment	Cisco Catalyst 2960 Series Switches	WS-C2960xxxx	Cisco Systems, Inc.	18-Jan-24	
Terminal Device	Cisco IP Phone 8851	CP-8851-K9	Cisco Systems, Inc.	18-Jan-24	
Terminal Device	Cisco IP Phone 8811	CP-8811-K9	Cisco Systems, Inc.	18-Jan-24	
Telecommunication Equipment	**UAP AC IW**	**UAP AC IW**	Ubiquiti Networks	18-Jan-24	**Device is allowed under certain conditions**
Telecommunication Equipment	**UniFi Cloud Key Gen2**	**UCK-G2-PLUS**	Ubiquiti Networks	18-Jan-24	**Device is allowed under certain conditions**
Terminal Device	LTE Module	L830-EB	Fibocom Wireless Inc.	19-Jan-24	
Terminal Device	DIR-822	DIR-822	D-Link	19-Jan-24	
Terminal Device	Smart Phone	TAG-Phone	Shenzhen TENSEN Industrial Co	23-Jan-24	
Telecommunication Equipment	Sonicwall TZ570	APL62-OF7	Sonicwall Inc.	23-Jan-24	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Galaxy A32 5G	SM-A326B/DS	Samsung Electronics	26-Jan-24	
Terminal Device	Galaxy A32	SM-A325F/DS	Samsung Electronics	30-Jan-24	
Terminal Device	Galaxy A02	SM-A022F/DS	Samsung Electronics	30-Jan-24	
Telecommunication Equipment	Comnet	CNGE28FX4TX24MSPOE2	Comnet Communicaton Network	30-Jan-24	
Telecommunication Equipment	Fortinet	FG-1100E	Fortinet	30-Jan-24	
Terminal Device	LTE-A Cat 12 M.2 M.2 Module	EM120R-GL	Quectel Wireless Solutions Co., Ltd	30-Jan-24	
Terminal Device	LTE-A Cat 16 M.2 Module	EM160R-GL	Quectel Wireless Solutions Co., Ltd	30-Jan-24	
Telecommunication Equipment	**UniFi AC Mesh AP**	**UAP AC M**	Ubiquiti Networks	31-Jan-24	**This device shall only be used by a Licensee**
Terminal Device	Tablet PC	TAC-TAB 111	QPS Electronics Co. Ltd.	31-Jan-24	
Terminal Device	CAT-S31	S31	Bullit Mobile Limited	1-Feb-24	
Terminal Device	CAT-S60	S60	Bullit Mobile Limited	1-Feb-24	
Terminal Device	Routers	BiPAC 4520NZ R2	Billion Electric Co. Ltd.	1-Feb-24	
Telecommunication Equipment	ARUBA CX 8360 SWITCH SERIES	RSVLC-1801	HPE	1-Feb-24	
Telecommunication Equipment	**mPico Repeater**	**MP5232**	Comba Telecom	3-Feb-24	**This device shall only be used by a Licensee**
Antenna	**Yagi Antenna**	**PM-AS-OLP-065V11NMJ-ND**	Comba Telecom	3-Feb-24	**This device shall only be used by a Licensee**
Terminal Device	Routers	BiPAC M100	Billion Electric Co. Ltd.	3-Feb-24	
Terminal Device	TCL10 TABMAX	9295G	TCL Communication Limited	7-Feb-24	
Telecommunication Equipment	Service Gateway	SRX4600	Juniper Networks, Inc.	7-Feb-24	
Telecommunication Equipment	ARUBA CX 6100 SWITCH SERIES	RSVLC-1810	HPE	9-Feb-24	
Telecommunication Equipment	ARUBA CX 6100 SWITCH SERIES	RSVLC-1811	HPE	9-Feb-24	
Telecommunication Equipment	ARUBA CX 6100 SWITCH SERIES	RSVLC-1813	HPE	9-Feb-24	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	ARUBA CX 6100 SWITCH SERIES	RSVLC-1814	HPE	9-Feb-24	
Telecommunication Equipment	ARUBA CX 6100 SWITCH SERIES	RSVLC-1812	HPE	10-Feb-24	
Terminal Device	Alcatel 1S	6025D	TCL Communication Limited	13-Feb-24	
Terminal Device	TCL 20 5G	T781	TCL Communication Limited	13-Feb-24	
Terminal Device	Mobile Phone	CPH2179	GUANGDONG OPPO MOBILE TELECOMMUNICATION CORP. LTD	14-Feb-24	
Telecommunication Equipment	Switch Series	RSVLC-1904	Hewlett Packard Enterprise Company	16-Feb-24	
Telecommunication Equipment	Switch Series	RSVLC-1905	Hewlett Packard Enterprise Company	16-Feb-24	
Telecommunication Equipment	Switch Series	RSVLC-1906	Hewlett Packard Enterprise Company	16-Feb-24	
Telecommunication Equipment	Switch Series	RSVLC-1907	Hewlett Packard Enterprise Company	16-Feb-24	
Telecommunication Equipment	Switch Series	RSVLC-1908	Hewlett Packard Enterprise Company	16-Feb-24	
Terminal Device	Galaxy M62	SM-M625F/DS	Samsung Electronics	20-Feb-24	
Terminal Device	Galaxy A72	SM-A725F/DS	Samsung Electronics	20-Feb-24	
Terminal Device	Galaxy A52 4G	SM-A525F/DS	Samsung Electronics	20-Feb-24	
Terminal Device	Galaxy A52 5G	SM-A526 B	Samsung Electronics	20-Feb-24	
Terminal Device	Portable Tablet Computer	Lenovo TB-7306X	Lenovo PC HK Limited	20-Feb-24	
Terminal Device	VL-MWD272CX	Main Station	Panasonic Corporation	21-Feb-2024	
Terminal Device	VL-WD613CX	Wireless Monitor	Panasonic Corporation	21-Feb-2024	
Terminal Device	VL-SWD272CX	Wireless Video Intercom System	Panasonic Corporation	21-Feb-2024	
Terminal Device	VL-FKD2CX	DECT Repeater	Panasonic Corporation	21-Feb-2024	
Telecommunication Equipment	DMP 128	60-1211-01	Extron Electronics Middle East FZE	21-Feb-24	
Terminal Device	Unified Media Server	UMS-00	Aspect Software Inc,	22-Feb-24	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Cisco Aironet 3700 Series Access Point	AIR-CAP3702I-H-K9	Cisco System, Inc	24-Feb-24	**Device is allowed under certain conditions**
Terminal Device	Cisco Catalyst 3850 Series Switches	WS-C3850	Cisco System, Inc	24-Feb-24	
Terminal Device	Cisco Meraki MS220 Series Switches	MS220-xxx-HW	Cisco System, Inc	24-Feb-24	
Terminal Device	Cusci Catalyst 3750-X Series Switches	WS-C3750X-xxxx	Cisco System, Inc	24-Feb-24	
Terminal Device	Cisco 500 Series Stackable Managed Switches	SG500XXXXX	Cisco System, Inc	24-Feb-24	
Terminal Device	Cisco Multimode VDSL2 and ADSL2/2+ High speed WAN Interface Card	EHWIC-VA-DSL-A	Cisco System, Inc	27-Feb-24	
Terminal Device	Cisco 4000 Series Integrated Services Router	ISR4321xxxx	Cisco System, Inc	27-Feb-24	
Terminal Device	Cisco Meraki MS225 Series Switch	MS225-xxx-HW	Cisco System, Inc	27-Feb-24	
Terminal Device	Cisco Meraki MX84 Security Appliance	MX84-HW	Cisco System, Inc	27-Feb-24	
Terminal Device	Cisco Meraki Ms350 Series Switches	MS350-xxx-HW	Cisco System, Inc	27-Feb-24	
Terminal Device	Cisco Meraki MS250 Series Switches	MS250-xxx-HW	Cisco System, Inc	27-Feb-24	
Terminal Device	Mobile Phone	CPH2203	GUANGDONG OPPO MOBILE TELECOMMUNICATION CORP. LTD	1-Mar-24	
Telecommunication Equipment	HPE J2000 Flash Enclosure	BSP-14	Hewlett Packard Enterprise Company	1-Mar-24	
Telecommunication Equipment	HPE Apollo 6500 Gen10 Plus System	HSTNS-5300	Hewlett Packard Enterprise Company	1-Mar-24	
Telecommunication Equipment	Switch Series	SN4600C	Hewlett Packard Enterprise Company	1-Mar-24	
Terminal Device	HP Smart Tank 790/7600 series	SNPRC-2102-05	HP Inc.	1-Mar-24	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Terminal Device	Nokia 1.4	TA-1322	HMD Global Oy	2-Mar-2024	
Telecommunication Equipment	HPE ProLiant DL360 Gen10 Plus Server	TPS-I010	Hewlett Packard Enterprise Company	2-Mar-24	
Telecommunication Equipment	HPE ProLiant DL380 Gen10 Plus Server	TPS-I011	Hewlett Packard Enterprise Company	2-Mar-24	
Telecommunication Equipment	HPE ProLiant DL325 Gen10 Plus Server	TPS-I015	Hewlett Packard Enterprise Company	2-Mar-24	
Telecommunication Equipment	HPE ProLiant DL365 Gen10 Plus Server	TPS-I016	Hewlett Packard Enterprise Company	2-Mar-24	
Telecommunication Equipment	Aruba 8325 switch series	RSVLC-1809	Hewlett Packard Enterprise Company	2-Mar-24	
Telecommunication Equipment	Multi-Service Access Module/HUAWEI	SmartAX EA5801-GP08	Huawei Technologies co., LTd	2-Mar-24	**Device is allowed under certain conditions**
Terminal Device	MOBILE PHONE	CPH2207	GUANGDONG OPPO MOBILE TELECOMMUNICATION CORP.LMTD	6-Mar-24	
Terminal Device	Security Appliance	NA-SN710	STROMSHIELD	6-Mar-24	
Terminal Device	TCL 20 SE	T671F	TCL Communication Limited	7-Mar-24	
Terminal Device	TCL 20 SE	T671H	TCL Communication Limited	7-Mar-24	
Telecommunication Equipment	Ethernet Switch	EX9251	Juniper Networks, Inc.	7-Mar-24	
Terminal Device	Redmi Note 10 (M2101K7AG	Redmi Note 10 (M2101K7AG	Xiaomi Communications Ltd	8-Mar-24	
Terminal Device	MI NOTE 10 PRO (M1910F4S)	MI NOTE 10 PRO (M1910F4S)	Xiaomi Communications Ltd	8-Mar-24	
Terminal Device	MI 11 (M2011K2G)	MI 11 (M2011K2G)	Xiaomi Communications Ltd	8-Mar-24	
Terminal Device	TCL 20Y	6156D	TCL Communication Limited	9-Mar-24	
Terminal Device	HP Analog Fax Accessory 700	BOISB-0703-01	HP Inc	10-Mar-24	
Terminal Device	BlueMark ID Printer	Phoenix	Phoenix Contact GmbH & Co. KG	10-Mar-24	
Terminal Device	Mobile Phone	CPH2211	GUANGDONG OPPO MOBILE TELECOMMUNICATION CORP.LMTD	13-Mar-24	

List of Type Approved Telecom Equipment by Telecommunication Regulatory Authority

Telecommunication Equipment	XG 230 - FIREWALL	XG 230	SOPHOS LTD	16-Mar-24	
Telecommunication Equipment	XG 310 - FIREWALL	XG 310	SOPHOS LTD	16-Mar-24	
Telecommunication Equipment	HPE ProLiant ML30 Gen10 Server	TPS-W018	Hewlett Packard Enterprise Company	20-Mar-24	
Telecommunication Equipment	CICSO - C240 -M5S	CICSO - C240 -M5S	Cisco	20-Mar-24	

Cabling of premises for telecommunications

Lead-in cabling and building entry facilities for homes

IT'S HOW WE CONNECT

Author's name	Sub-business unit	Issue number
	Access Technology Planning	1

Business unit	Issue date	Telstra ID
Telstra Operations	26 August 2013	017153a02

Summary

This document provides summary guidance to developers, builders, electricians, telecommunications cabling providers and consumers about the installation of telecommunications lead-in cabling including the cable entry arrangements at the building. For detailed information, refer to Telstra Document No. 017153a00, *Cabling of premises for telecommunications — A complete guide to home cabling*.

This document is optimised for reading on a tablet or portable computer to take advantage of hyperlinks, document search functions and on-screen magnification of photographs and drawings.

CONTENTS

1 PURPOSE

The purpose of this document is to provide essential guidance for the installation of telecommunications lead-in cabling and cable entry arrangements at the building ("building entry facilities") for the connection of broadband and telephone services that may be supplied by any of the following technologies:

- copper twisted pair cable — for telephone and ADSL (Asymmetric Digital Subscriber Line) services
- HFC (Hybrid Fibre-Coax) — otherwise known as "Cable" (for Cable internet and Cable pay TV)
- FTTP (Fibre To The Premises) — for telephone, broadband and, in some cases, TV services.

The guidance provided by this document is intended to ensure that the cabling is compatible with the **National Broadband Network (NBN)** to which all homes are expected to be connected eventually.

For essential guidance on internal cabling for the home, refer to Document No. 017153a01, *Cabling of premises for telecommunications — Essential information for home cabling*.

The Telstra documents may be downloaded from the "Builders" menu of the Telstra Smart Community® website (http://www.telstra.com.au/smart-community/builders/).

2 SCOPE

This document applies to any building constructed for use as a home. It applies to detached buildings (single dwellings) as well as semi-detached buildings (town houses, villas, etc.). While the document generally describes cabling for new buildings, it may also be applied to building renovations where the lead-in cabling is to be upgraded or replaced.

3 INTRODUCTION

3.1 Broadband services and the National Broadband Network

"Broadband" is the general term used to describe services that operate at higher frequencies or digital bit rates than are necessary to transmit the human voice (e.g. for high-speed access to the internet).

The National Broadband Network (NBN) is a telecommunications network that is being constructed by NBN Co Limited, a company established by the Commonwealth Government to provide access to high-speed broadband services by all Australian residents by the year 2021. In densely populated ("urban") areas, services will mainly be supplied using Fibre-To-The-Premises (FTTP) technology, whereas in sparsely populated ("rural") areas, services will be supplied using fixed wireless or satellite technology.

For more information, refer to Document No. 017153a00, *Cabling of premises for telecommunications — A complete guide to home cabling*.

3.2 What is lead-in cabling?

Lead-in cabling is the cabling from the last distribution point in a carrier's telecommunications network to the "network boundary", e.g. a Network Termination Device (NTD) in a customer's premises.

Lead-in cabling will normally be installed underground unless aerial cabling distribution is already being used in the street and/or the ground conditions or circumstances preclude underground installation. Telecommunications carriers decide whether to install their lead-in cabling underground or aerial based on technical, safety, economic and any applicable environmental or regulatory factors.

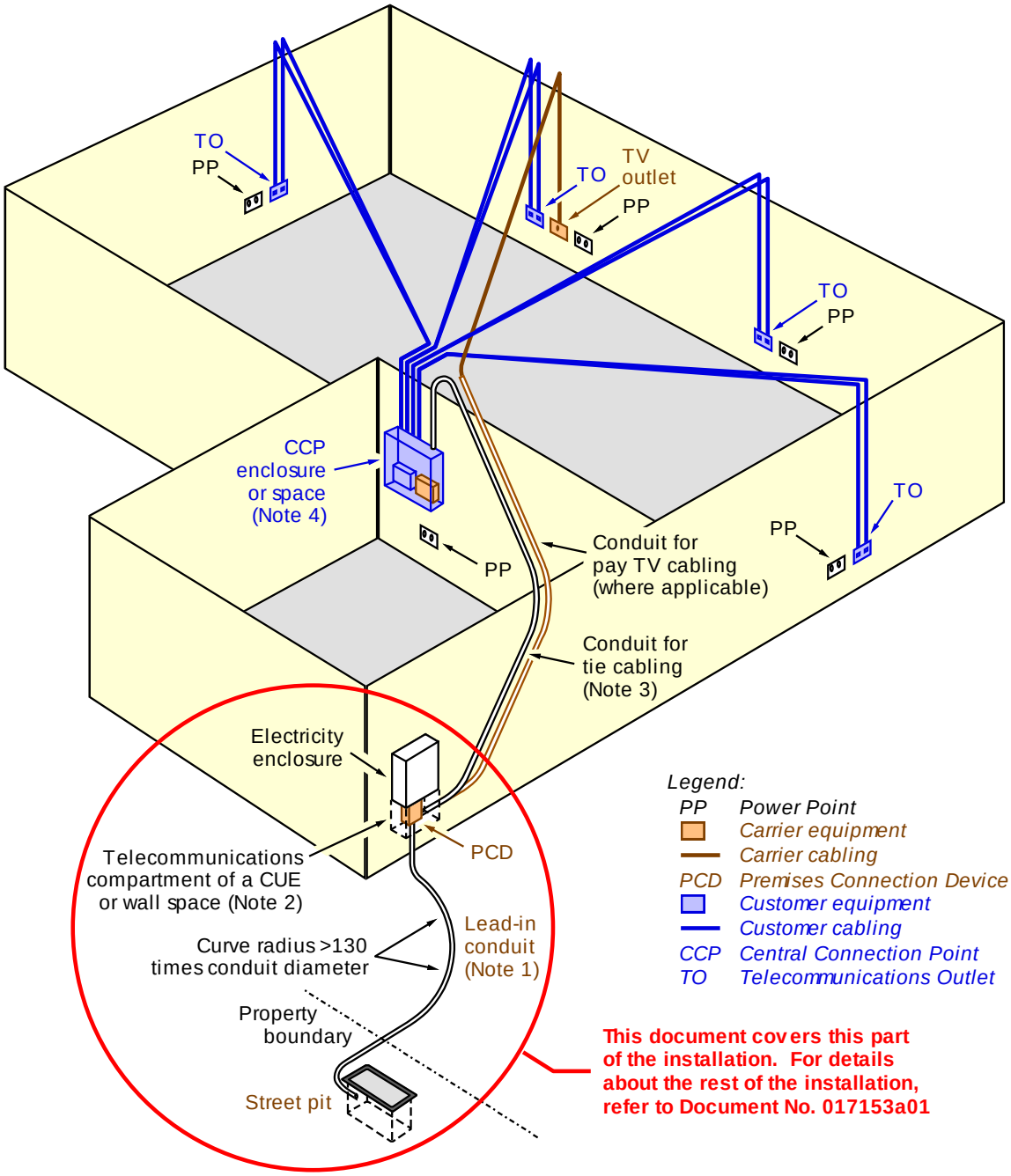
Underground cabling is used in virtually all new property developments.

3.3 Home cabling elements

A pictorial summary of the elements that make up a typical, modern home cabling installation is provided in Figure 1. The part of the installation covered by this document (017153a02) is circled.

® Registered trade mark of Telstra Corporation Limited

Figure 1 Home cabling elements



Notes:

1. The lead-in conduit is used for pulling in twisted pair, coaxial, or optical fibre lead-in cabling, as applicable.
2. The use of a Combined Utilities Enclosure (CUE) is recommended. A CUE will house any style of PCD and avoids the need to work out conduit positioning for the PCD. Refer to 6.2 for details.
3. A cabling pathway (conduit) is required between the PCD and the CCP for installation of "tie cabling" between the PCD and the CCP **after** building completion. The conduit is used for pulling in twisted pair, coaxial, power supply or optical fibre cabling, as applicable. A second conduit may be required for coaxial cabling for cable TV (where available). The length of tie cabling between the PCD and the CCP should not exceed **25 m** unless it is certain that an **indoor** FTTP NTD will be installed, in which case the length should not exceed **40 m**.
4. The CCP enclosure may be sized to house some or all of the powered electronic devices required to operate some services (e.g. NTD, modem or gateway). Alternatively, the devices may be located outside the CCP enclosure or in a separate enclosure.

4 UNDERGROUND LEAD-IN CABLING

If it is known that **aerial** lead-in cabling will be used, skip to section 5 on page 30.

4.1 General

Where underground lead-in cabling is to be installed, the builder, home owner or customer is required to arrange and pay for suitable trenching for the lead-in cabling between the carrier's cabling entry point at the boundary of the premises ("property entry point") and the cabling entry point at the building ("building entry point"). "Trenching" means clearing of land along the cabling route, digging of the trench and reinstating the land after the cabling is installed. Refer to 4.4.5 on page 18 for details.

The builder, owner or customer may also be required to supply and install the lead-in conduit (see 4.2.5).

In **urban areas**, lead-in cabling is installed in conduit irrespective of the distance between the property boundary and the building. Where the total length of the conduit **will exceed 50 m**, **intermediate pits** are required at no more than **50 m intervals** to provide access points for pulling cables (see Figure 4).

In **rural areas**, Telstra installs its lead-in cable directly in the ground without conduit except for about the last 3 m to the building where conduit is used for additional cable protection.

Note: It is unlikely that FTTP will be installed in rural areas in the foreseeable future. In rural areas, NBN services are likely to be supplied by fixed wireless or satellite. Nevertheless, copper lead-in cabling may be required for the supply of a telephone service and, if available, an ADSL service may also be supplied via this cable.

4.2 Conduit requirements

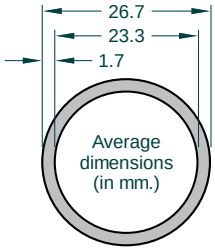
4.2.1 Conduit material and size

For an individual home, the lead-in conduit must be **rigid UPVC** with an **inside diameter** (**ID**) of **23 mm**. Flexible or corrugated conduit must **not** be used for underground lead-in cabling. The cross-sectional dimensions of the conduit are illustrated in Figure 2.

Notes:

1. This conduit size is referred to by Telstra as "20 mm" conduit (its nominal inside diameter) or "P20" ("Plastic 20 mm").
2. Any conduit manufactured to Australian Standard AS/NZS 2053 (e.g. marked as "20 mm", "25 mm" or "32 mm" and including "2053" in the markings) is physically incompatible with Telstra and NBN Co networks and is **not** suitable for lead-in cabling. Polyethylene conduit or pipe is also **not** suitable for lead-in cabling.

Figure 2
Conduit dimensions



4.2.2 Conduit colour and markings

Lead-in conduit and bends must be coloured **white**. Conduit of any other colour is **not** acceptable. For **Telstra** lead-in cabling, the conduit and bends may be marked "Telstra", "NBN" or "Communications". Any of these markings are acceptable to Telstra as long as the conduit ID is 23 mm.

Note: Alternative conduit markings may not be acceptable to NBN Co for NBN lead-in cabling.

4.2.3 Bends and curves

No more than **two underground 90° bends** with a minimum inner bend radius of **300 mm** are permitted between access points. Composite bends may be used at the building footings as shown in Figure 37 on page 43. A **third 90° bend** with a minimum inner bend radius of **100 mm** is permitted **above ground** at the cable access point **at the building** (e.g. in the wall cavity). Only **prefabricated bends** may be used. Conduits must **not** be bent on site (e.g. by application of heat).

Curvature of glued lengths of conduit **is allowable** without affecting the number of bends that may be used as long as the **curvature radius** is no less than **130 times the nominal inside diameter of the conduit** (in practical terms, this means curving the conduit without distorting the cross-sectional roundness of the conduit). Refer to Figure 4.

Where it would be necessary to use more than two underground 90° bends (e.g. to effect a sharp change of direction in the middle of the conduit run), an intermediate access pit must be used as a cable pulling point. Refer to Figure 5.

4.2.4 Conduit installation

Conduit and bend joints must be glued with solvent cement.

The conduit markings should face upwards when the conduit is laid in the trench so as to be visible if the conduit is exposed by digging after its initial installation.

A pull-cord or cable must be threaded through the lengths of conduit during assembly for later installation of the lead-in cable by the carrier. Each end of the conduit must be plugged to prevent the ingress of silt or debris into the conduit.

4.2.5 Who provides the conduit?

In new developments that are in NBN Co's "long-term fibre footprint", the lead-in conduit and any necessary pits are to be supplied and installed by the builder, owner or customer to NBN Co's specifications. In the absence of any NBN Co specifications for lead-in conduit, the lead-in conduit requirements described in this document may be used as a guide.

Where the lead-in cabling is to be connected to the Telstra network to supply a Telstra service, the supply and installation the lead-in conduit and any necessary pits in a customer-supplied trench are included in the Telstra connection charge for the service. However, the builder or owner may opt to supply and install the lead-in conduit for expediency, in which case it must be installed in accordance with Telstra's requirements as described in this document.

4.2.6 Conduit integrity

To be "FTTP ready", the lead-in conduit and bends must be capable of passing an optical fibre cable that has a pre-terminated connector protected by stiff plastic tubing and covered by a polypropylene hauling sock. This assembly has a total diameter of up to 18 mm for a length of about 800 mm and is semi-rigid. The protective tubing and hauling sock protect the optical fibre and optical connector while the cable is being pulled through the lead-in conduit and ensure that no pulling force is exerted on the connector. The sock will not pull through small-radius conduit bends due to its large diameter and relative stiffness.

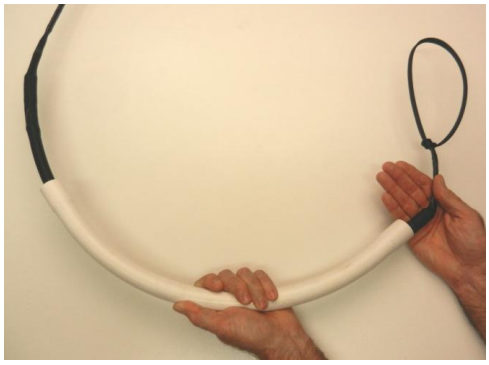
Figure 3 shows an optical fibre cable assembly threaded through 300 mm and 100 mm radius bends.

Note: Optical fibre cables with factory-fitted connectors may be preferred by some carriers to simplify installation and reduce installation costs by avoiding the need for expensive field splicing equipment and skilled operators. The main disadvantages of using cable with factory-fitted connectors are:

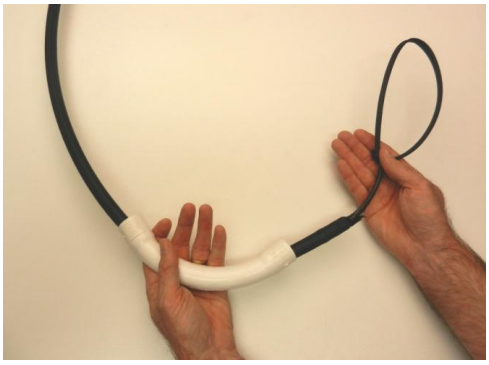
- The integrity of the conduit used to pull in the cable is very important.
- The cables are supplied in predetermined lengths, so slack cable needs to be stored somewhere (e.g. in the pit, PCD or a building cavity).

Figure 3 Pre-terminated optical fibre lead-in cable threaded through 23 mm ID conduit bends

(a) 300 mm radius bend (for use underground)



(b) 100 mm radius bend (for use in the wall cavity)

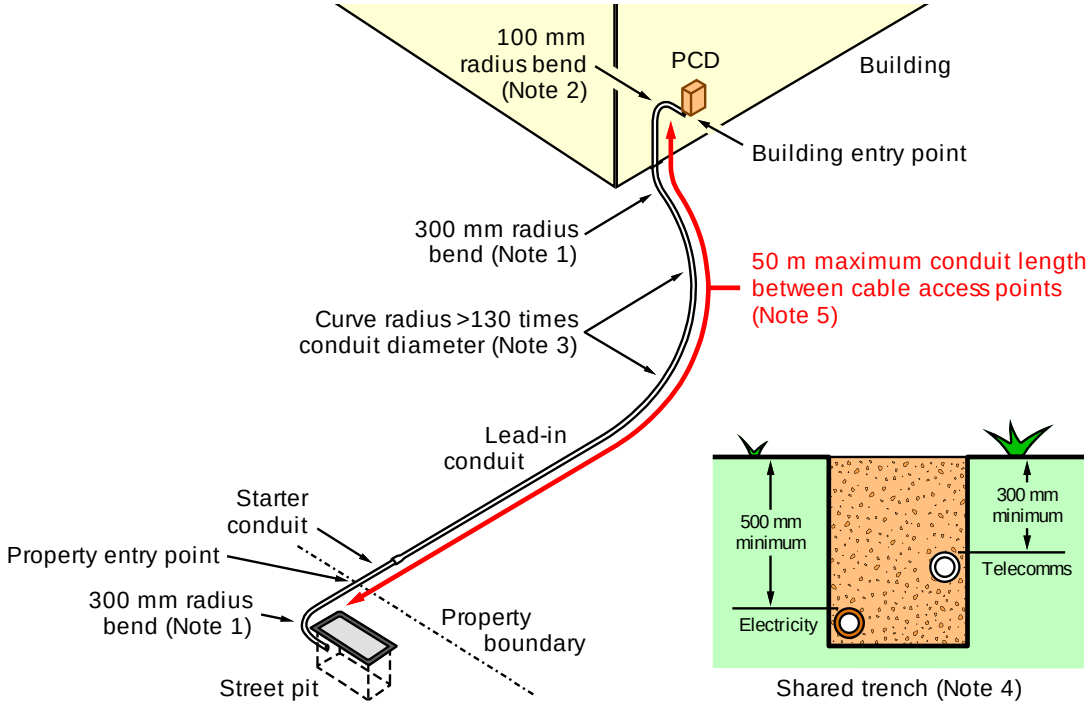


Notes:

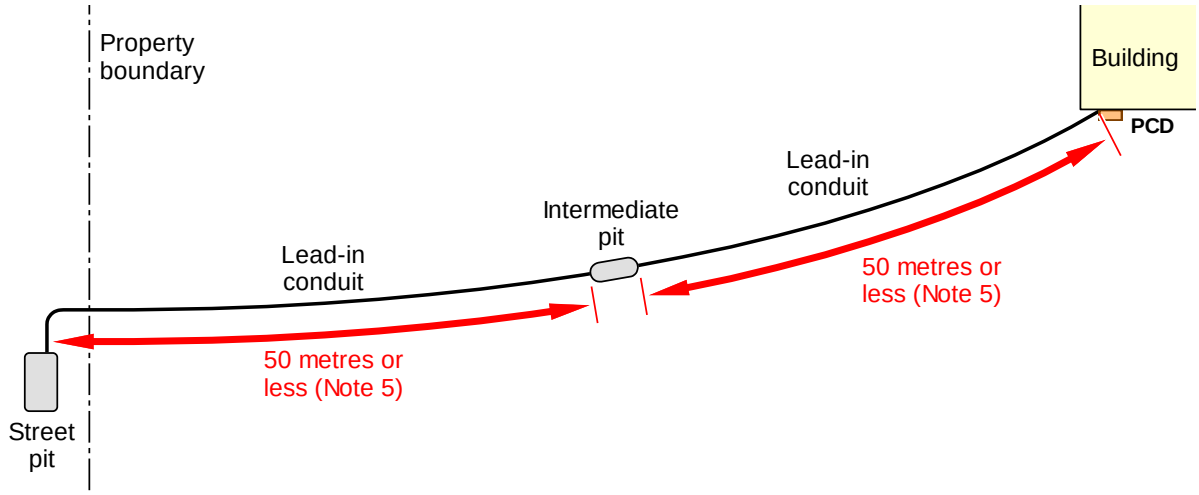
1. 300 mm radius bends are used at pits and vertically at the building footings.
2. A 100 mm radius bend is only permissible in the wall cavity of the building.
3. It can be seen from the above pictures that the cable hauling sock is a tight fit in the conduit, so clear, undamaged conduit and large radius bends are essential.

Figure 4 Lead-in conduit length, curvature and bend limitations

(a) Standard urban lot



(b) Large urban lot (or street pit distant from the premises)



Notes:

1. Underground bends must have a minimum inner bend radius of 300 mm. Composite bends may be used at the building footings as shown in Figure 37 on page 43.
2. A prefabricated bend with a minimum inner bend radius of 100 mm is allowable in the wall cavity of the building.
3. The conduit may be curved to a minimum radius of 130 times the nominal inside diameter of the conduit (i.e. 2600 mm in the case of 23 mm ID conduit which has a nominal inside diameter of 20 mm). In practical terms, this means curving the conduit without distorting the cross-sectional roundness of the conduit.
4. A shared trench with the electricity mains is recommended. No separation is required between the orange electricity conduit and the white telecommunications conduit but the white conduit should be laid above (on top of) the orange conduit where possible. Refer to 4.5.8 on page 23 for details.
5. If the total length of conduit between access points will exceed 50 m, one or more intermediate pits must be installed at intervals not exceeding 50 m.

Figure 5 Right and wrong use of intermediate pits

(a) Intermediate pit for pulling cables

(b) Intermediate pit for change of conduit direction

Notes:

1. A size 2 ("P2") pit may be used as an intermediate pit for lead-in conduit to a single dwelling. The minimum internal dimensions (in mm) of a size 2 pit are 490 L x 125 W x 500 D. These pits are usually round-ended as shown above.
2. The conduit should be glued to a bush that is installed flush with the inside wall of the pit except in highly reactive soils where the conduit may be extended no more than 50 mm inside the pit. The bush or conduit must be a tight fit through the pit wall to minimise the entry of silt into the pit.
3. The bottom edge of the conduit must enter the pit no less than 50 mm above the inside surface of the bottom of the pit (this is to reduce the risk of silt or debris entering and clogging the conduit over time).
4. Where more than one conduit enters the same end of the pit (e.g. for branching of conduits as shown in Figure 12 on page 16), the conduits must be separated at the pit by at least 25 mm.

4.2.7 Use of lead-in conduits/pits/cables

Lead-in **conduit** must **not** be used for customer cabling (e.g. for private cabling to another building in the premises). Customer cabling must be installed in separate conduit but may share the lead-in trench. Separate conduit must be provided for the installation of customer cabling between buildings.

Lead-in **pits** should not be used for customer cabling unless this is unavoidable (e.g. due to limited space for locating pits), in which case only lead-in pits supplied and installed by the builder, owner or customer may be shared with customer cabling. In such cases, the customer cabling must be clearly labelled in the pit. Lead-in pits installed by the carrier (i.e. with the carrier's markings) must **not** be used for customer cabling.

4.3 Property entry point

4.3.1 Description

The property entry point is the point where the carrier's lead-in cabling will enter the private land in which the building is located, including

- any land occupied in common with, or shared with, multiple occupants (e.g. land controlled by a body corporate); and
- any private easement or right of way (e.g. a driveway).

The carrier determines the location of the property entry point based on the location of the nearest suitable lead-in cable connection point. Where radio technology is used to supply a service to the premises, the property entry point is the base of the radio shelter or antenna structure from which the cabling runs to the building.

4.3.2 Urban residential areas

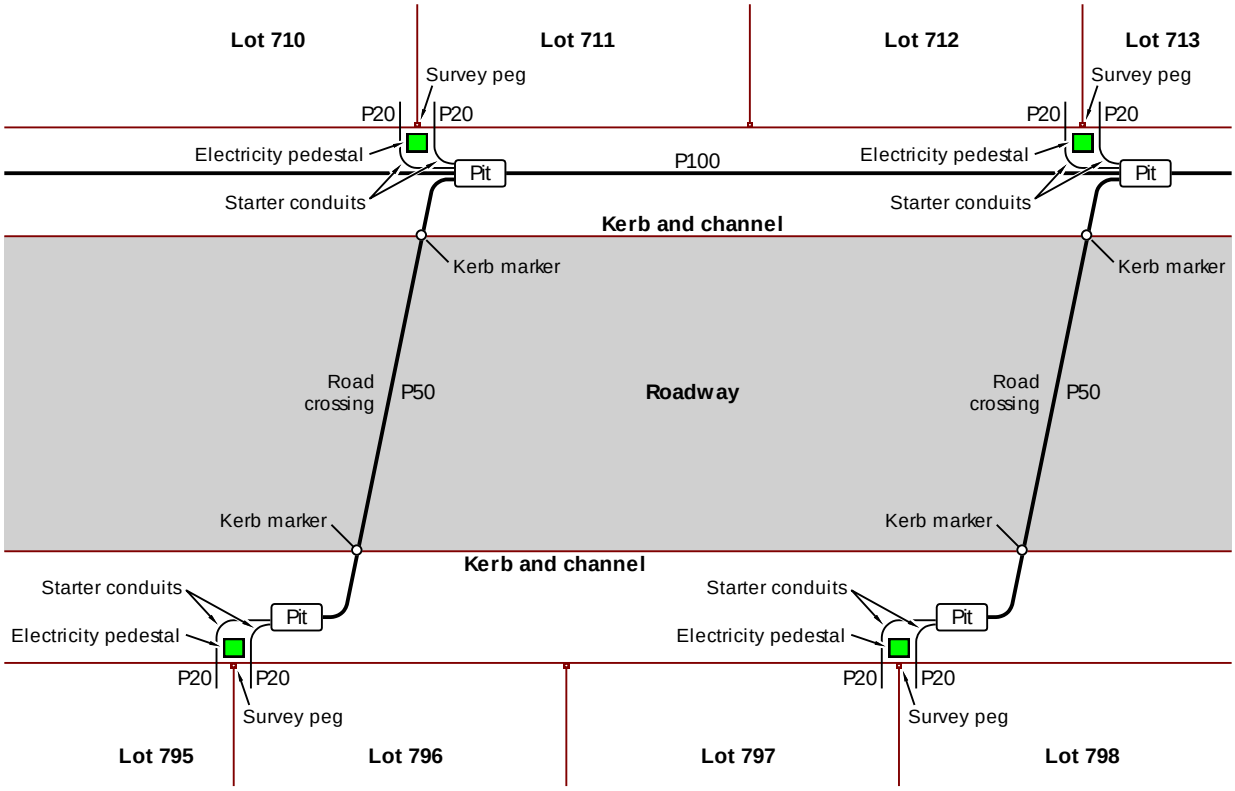
In urban residential areas, underground lead-in cabling is typically fed from a pit or pole in the street or a public easement adjacent to (usually at the rear of) the property. In some cases, the property entry point location will be evident from the location of the telecommunications pits and may be confirmed by digging at the property boundary to locate the "starter conduit". In other cases, the location of the property entry point may not be obvious and the relevant carrier may need to be consulted.

Typical street cable distribution arrangements for new urban residential estates are illustrated in Figure 6 and Figure 7. Figure 8 shows typical "starter conduit" locations.

4.3.3 Commercial/Industrial and rural areas

The cable distribution arrangements for homes located in commercial/industrial areas and rural communities may differ from the arrangements shown in Figure 6 and Figure 7, and are not specifically covered by this document. You should seek advice from the relevant carrier as to the location of the property entry point in such cases. For Telstra contact details, see 4.4.6.

Figure 6 Typical telecommunications street distribution cabling for new urban residential estates using single-sided distribution with pits on both sides of the street



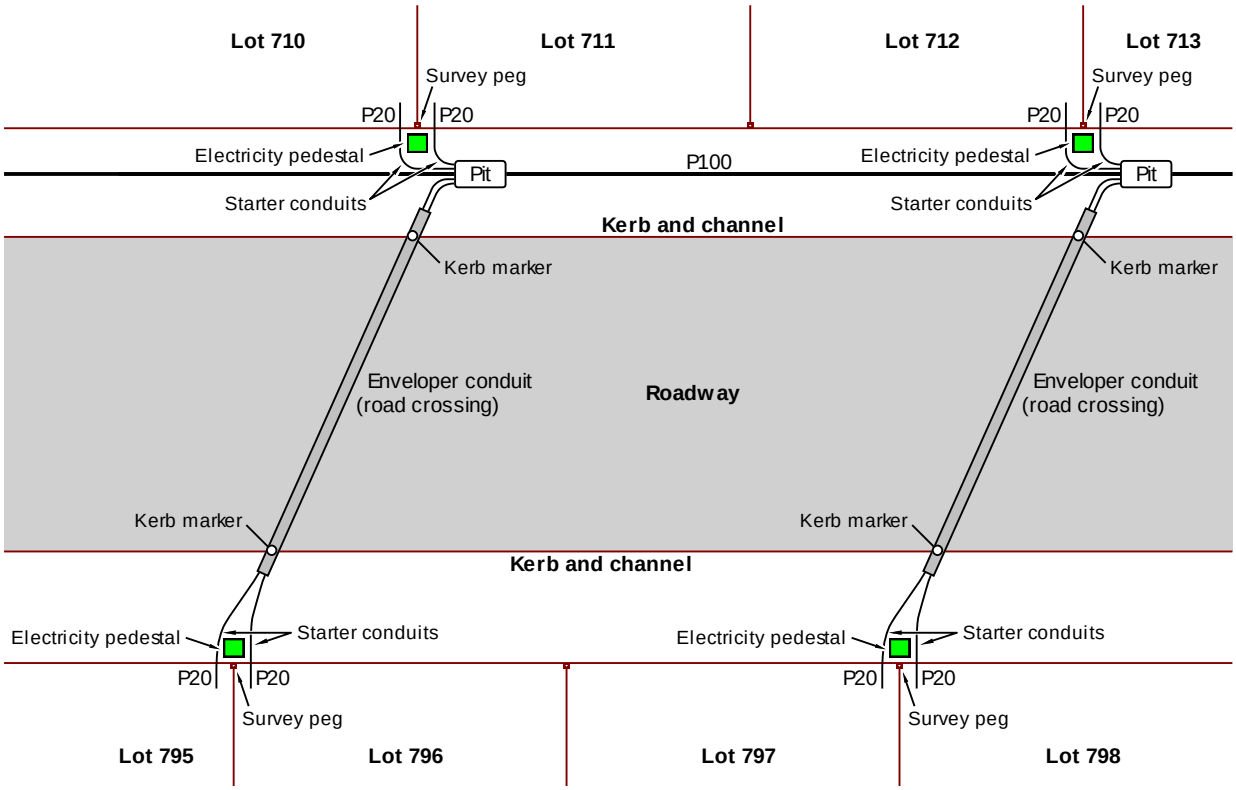
LEGEND:

P20	Plastic 20 mm (nominal inside diameter) conduit
P50	Plastic 50 mm (nominal inside diameter) conduit
P100	Plastic 100 mm (nominal inside diameter) conduit

Notes:

1. The lead-in cable may be coiled up in the nearest pit ready to pull through the lead-in conduit to the building. The cable is only to be pulled in by the carrier's installer. Other persons are **not** authorised to open the pit or to pull in the lead-in cable.
2. The starter conduits should extend at least to the property boundary and may extend one to two metres into the property (see Figure 8).

Figure 7 Typical telecommunications street distribution cabling for new urban residential estates using single-sided distribution with pits on one side of the street only

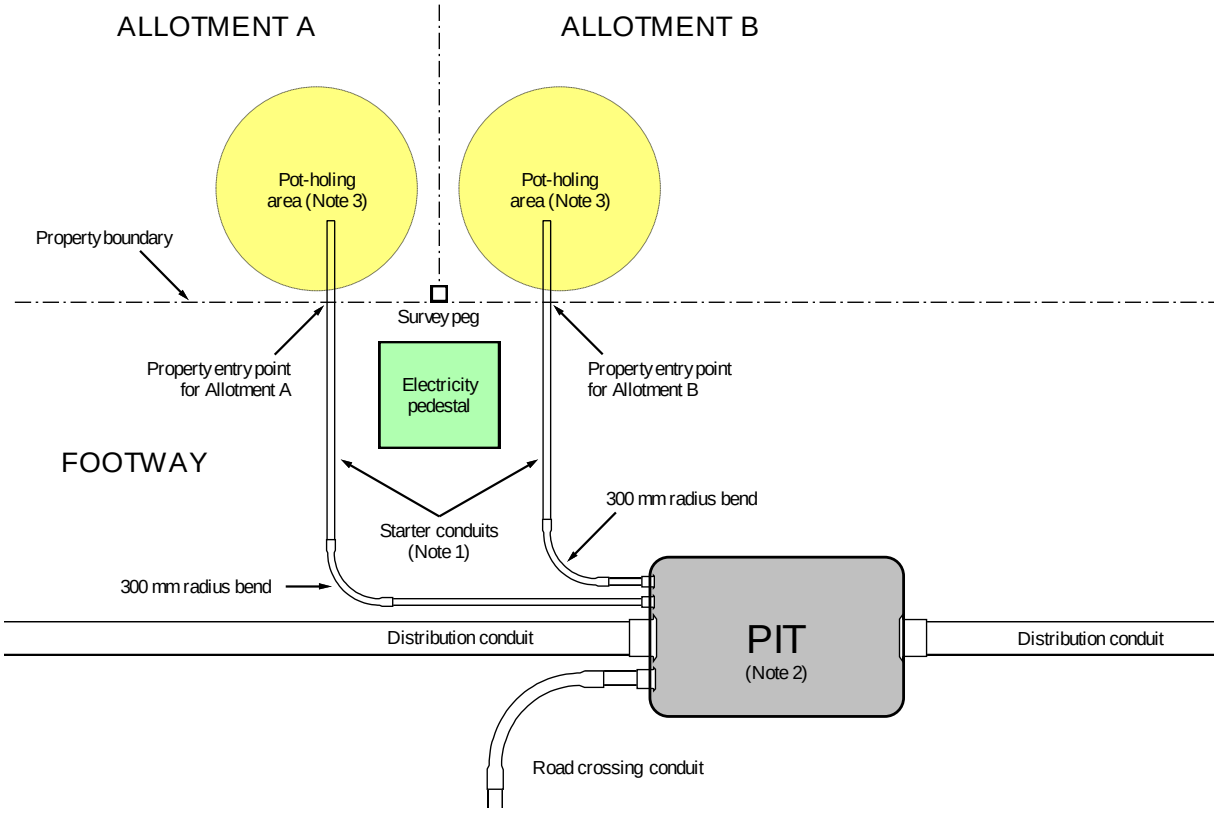


LEGEND: P20 Plastic 20 mm (nominal inside diameter) conduit
P100 Plastic 100 mm (nominal inside diameter) conduit

Notes:

1. The lead-in cable may be coiled up in the nearest pit ready to pull through the lead-in conduit to the building. The cable is only to be pulled in by the carrier's installer. Other persons are **not** authorised to open the pit or to pull in the lead-in cable.
2. The starter conduits should extend at least to the property boundary and may extend one to two metres into the property (see Figure 8).

Figure 8 Typical starter conduit arrangements (urban residential)



Notes:

1. In new urban residential estates, starter conduits will usually be provided as shown and be installed at least to the property boundary but they may extend one to two metres into the property. The minimum depth of cover for these conduits is normally 300 mm — or 450 mm if the conduit runs parallel with the property boundary for some distance before it enters the property.
2. Where pits are only installed on one side of the street (see Figure 7), the starter conduits on the non-pit side of the street should straddle the electricity pedestal as indicated in Figure 7.
3. "Pot-holing" (e.g. careful hand digging with a wooden-handle shovel) may be necessary to confirm the location of the starter conduit. With new building construction, the starter conduit may be exposed when the trench is being dug for the electricity mains.

4.4 Lead-in cabling route

4.4.1 Copper lead-in cabling

By default, any lead-in cabling that is not being provided in a designated FTTP estate is deemed to be copper cabling. With copper lead-in cabling, separation from electrical power hazards and the ability to provide effective lightning surge suppression are primary considerations in determining the lead-in cabling route. For a typical urban home, the lead-in cabling should take the shortest practicable path between the starter conduit and the **side of the building where the electricity enclosure is located**.

Complications may arise where:

- there is more than one building in the premises;
- the electricity enclosure is located at a detached building or structure; or
- power is fed to the premises from a nearby HV transformer (rural premises).

The flow chart in Figure 14 may be used to determine the appropriate lead-in cabling route for copper lead-in cabling.

4.4.2 Optical fibre lead-in cabling (FTTP)

Any lead-in to be provided in a designated FTTP estate is deemed to be an optical fibre lead-in. If there is any doubt, the lead-in must be treated as a copper lead-in.

With optical fibre lead-in cabling, there is less concern about electrical power hazards and there is no need to consider lightning surge suppression requirements. Nevertheless, an external FTTP NTD requires connection to the building electrical earthing system (although the length of the earthing conductor is not important, as is the case with lightning surge suppression). For a typical urban home, the lead-in cabling may take the shortest practicable path between the starter conduit and the building entry point which should preferably be near the electricity enclosure for the reasons given in 4.4.3.

Conduit integrity is very important with optical fibre lead-in cabling.

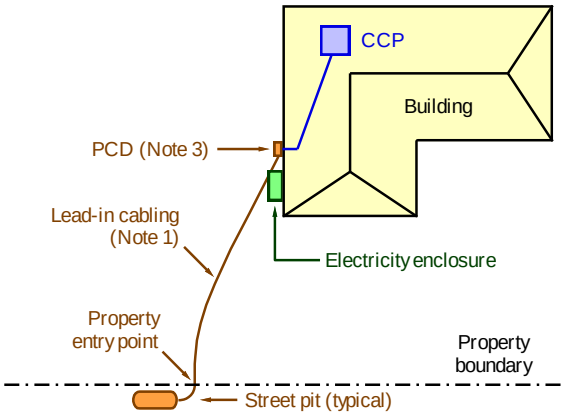
4.4.3 Single dwelling

For a single residential dwelling, the building entry point should be located near the electricity enclosure (meter panel or switchboard) to ensure that the carrier has future ready access to the PCD, to facilitate earthing of the PCD to the building electrical earthing system where necessary and to keep away from any gas cylinders that may be installed at the building. Accordingly, the lead-in cabling should run from the starter conduit at the property entry point to the electricity enclosure location — even if this means trenching across the front of the building. Refer to Figure 9.

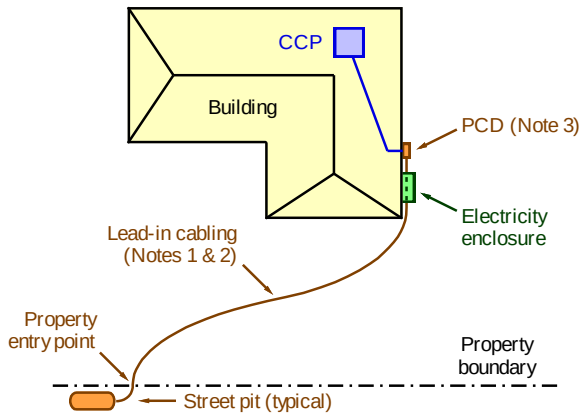
Where trenching across the front of the building is not possible (e.g. due to difficult terrain, extensive landscaping, retaining wall, paved driveway, swimming pool, etc.), the lead-in cabling may take the most direct path to the building. In such cases, care must be taken to avoid gas cylinders (see 6.3.3.1) which are normally located away from the electricity enclosure. Also, if the premises is in a defined lightning risk situation and is connected to a copper network, there may be a need to install "lead-in extension" cabling for the purpose of providing effective lightning surge suppression (see Figure 10).

Figure 9 Typical path of the lead-in cabling to a single dwelling

(a) Electricity enclosure on the same side of the building as the property entry point



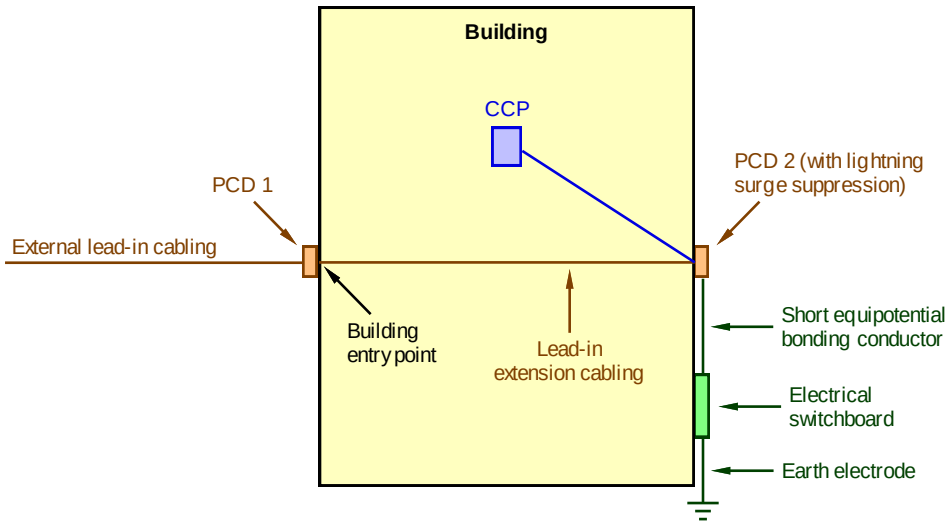
(b) Electricity enclosure on the opposite side of the building to the property entry point



Notes:

1. The cabling path must be such that there are no bends in the conduit between the starter conduit and the building footings unless these are made via an intermediate pit (see 4.2.3). Sweeping curves that will allow the glued lengths of conduit to be laid in the trench without significant stress are permitted, as indicated in example (b) above.
2. Where trenching across the front of the building is not possible (e.g. due to difficult terrain, extensive landscaping, etc.), the lead-in cabling may take the most direct path to the building. In such cases, care must be taken to avoid gas cylinders (see 6.3.3.1 on page 40) which are normally located away from the electricity enclosure. Also, if the premises is in a defined lightning risk situation and is connected to a copper network, there may be a need to install "lead-in extension" cabling for the purpose of providing effective lightning surge suppression (see Figure 10).
3. The carrier's PCD will be mounted on the wall below or beside the electricity enclosure where practicable.

Figure 10 Lead-in extension cabling for lightning surge suppression (copper lead-ins)



Notes:

1. Where copper lead-in cabling runs to the opposite side of the building to the electrical switchboard and lightning surge suppression is required, the installation of "lead-in extension cabling" will be necessary to achieve a short equipotential bonding conductor between the electrical earthing system and the lightning surge suppressors. The total length of the bonding/earthing conductor between the earthing bar in the electrical switchboard and the lightning protector should preferably be less than 1.5 m but in any case must not exceed 10 m.
2. Where lead-in extension cabling is required, such cabling must either be installed on the external perimeter of the building or the conductors of the cable used must be at least double the cross-sectional area of the external lead-in cabling conductors to minimise the risk of fire under surge conditions. Lead-in extension cabling is installed by the carrier.
3. More information about lead-in extension cabling is provided in Telstra Specification 012882, *Alteration of Telstra Facilities in Homes and Small Businesses — Information for Cabling Providers*.

4.4.4 Multiple buildings

If there is only one building in the premises and the property is a typical urban lot, skip to 4.4.5 (page 18).

4.4.4.1 General

Where the premises will contain two or more buildings (e.g. the main building and an "outbuilding") and the buildings will require separate telecommunications services, separate lead-in cabling and/or separate PCDs may be required for each building. Whether or not separate lead-in cables will be required may depend on the lead-in cabling technology used, i.e. whether the cable is copper or optical fibre. Refer to 4.4.4.2 and 4.4.4.3.

4.4.4.2 Copper twisted pair lead-in cabling

With copper lead-in cabling, it is essential that the lead-in cabling runs to the building or structure where the electrical switchboard is located to ensure that effective lightning surge suppression can be provided if required.

Where the electricity enclosure is installed at a separate detached building or structure (e.g. a fence, pole or garage), the lead-in cabling may need to be run via the building or structure at which the electricity enclosure is located, as shown in Figure 11 and Figure 13 (a). However, care must be taken to avoid any pole carrying a power transformer as shown in Figure 13 (b). In some cases, it may be possible or desirable to run separate lead-in cabling directly to an outbuilding, as shown in Figure 12.

The appropriate lead-in cabling method may be determined using the flow chart in Figure 14 — but the relevant carrier should be contacted for advice in such cases prior to digging the trench for the cabling.

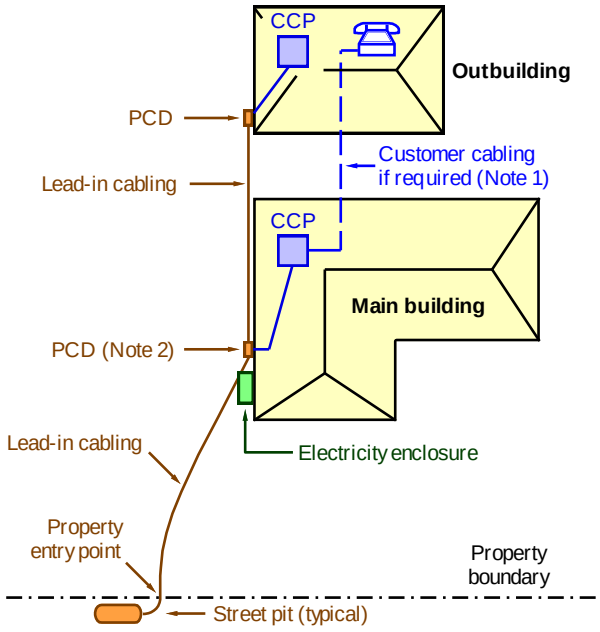
4.4.4.3 Optical fibre lead-in cabling (FTTP)

With optical (FTTP) networks, the lead-in cabling may run directly to the building no matter where the electrical switchboard is located but, for technical and safety reasons, the FTTP NTD must be installed at the same building where the telecommunications service is to be used by the occupant. However, while the FTTP NTD cannot be located at a detached building or structure such as a separate garage or a fence, a separate PCD (i.e. a splice box) may be located at a detached building to provide an intermediate connection point, e.g. for branching of a separate optical fibre cable running to a separate building. Refer to Figure 11 for examples.

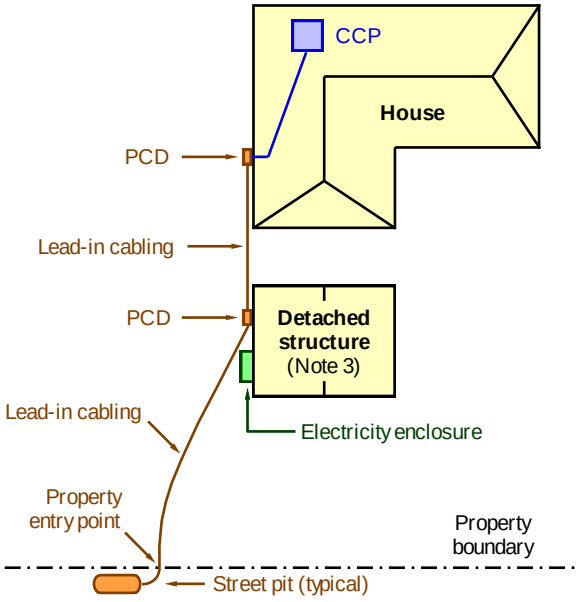
In some cases, it will be more expedient to run separate lead-in cabling to the separate buildings in accordance with Figure 12.

Figure 11 Typical path of the lead-in cabling to an outbuilding or to the main building where the electricity enclosure is located at a detached building or structure

(a) Lead-in cabling path for the supply of a separate telecommunications service to the outbuilding



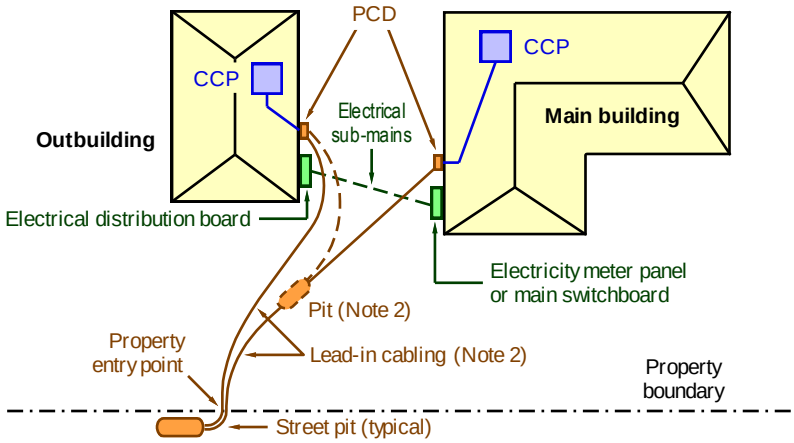
(b) Lead-in cabling path where the electricity enclosure is located at a detached building or structure



Notes:

1. Any customer cabling required between the main building and the outbuilding, e.g. for additional access points (telecommunications outlets) as shown in arrangement (a), must be separate and distinct from the lead-in cabling, i.e. it must use separate cable and conduit to the lead-in cable and conduit.
2. The PCD at the main building may be used as a branching point for the lead-in cabling to the outbuilding. Unrestricted access to this PCD must be guaranteed; otherwise the arrangement shown in Figure 12 must be used.
3. The detached structure at which the electricity enclosure is located may be a garage, shed, pole or fence. Arrangement (b) may apply for copper lead-in cabling where this is required in accordance with the flow chart in Figure 14. For optical fibre lead-in cabling, arrangement (b) would normally only apply where the lead-in cabling needs to be installed in two sections due to site conditions (e.g. retaining walls) or because a separate telecommunications service is required in each building.
4. The lead-in cabling must **not** be run near any pole that carries a SWER (Single Wire Earth Return) transformer, e.g. rural properties. Refer to Figure 13 (b).

Figure 12 Lead-in cabling directly to an outbuilding

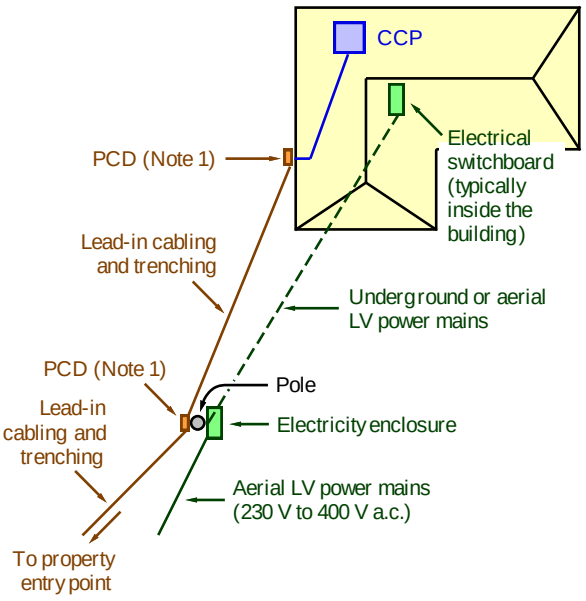


Notes:

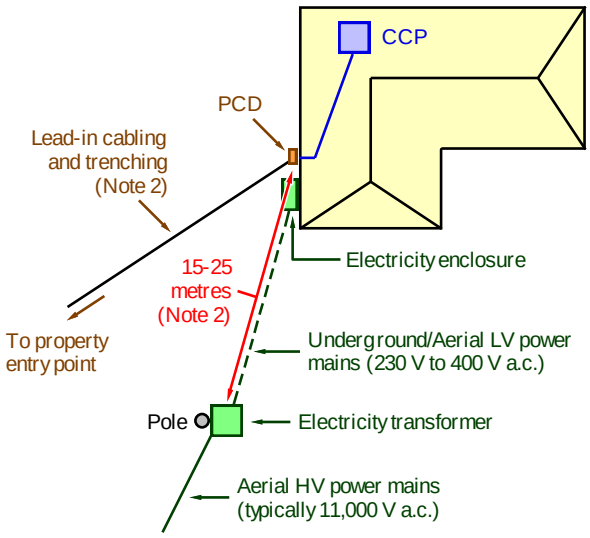
1. In some cases, the lead-in cabling may need to be provided via the main building for technical reasons. Refer to Figure 11 and, for copper lead-in cabling, the flow chart in Figure 14 to determine whether it may be appropriate to provide lead-in cabling via the main building rather than directly to the outbuilding.
2. Some lead-in trenching and conduit may be common, using a pit where the lead-in cables branch off.
3. Any customer cabling required between the buildings, e.g. for intercommunication between the buildings, must be separate to the lead-in cabling, i.e. using separate cable and conduit to the lead-in cable and conduit.

Figure 13 Typical path of the lead-in cabling where the power mains are fed from an electricity enclosure or a transformer located on a pole (acreage or rural properties)

(a) Low voltage (230 V to 400 V a.c.) power mains connected via an electricity enclosure on a pole



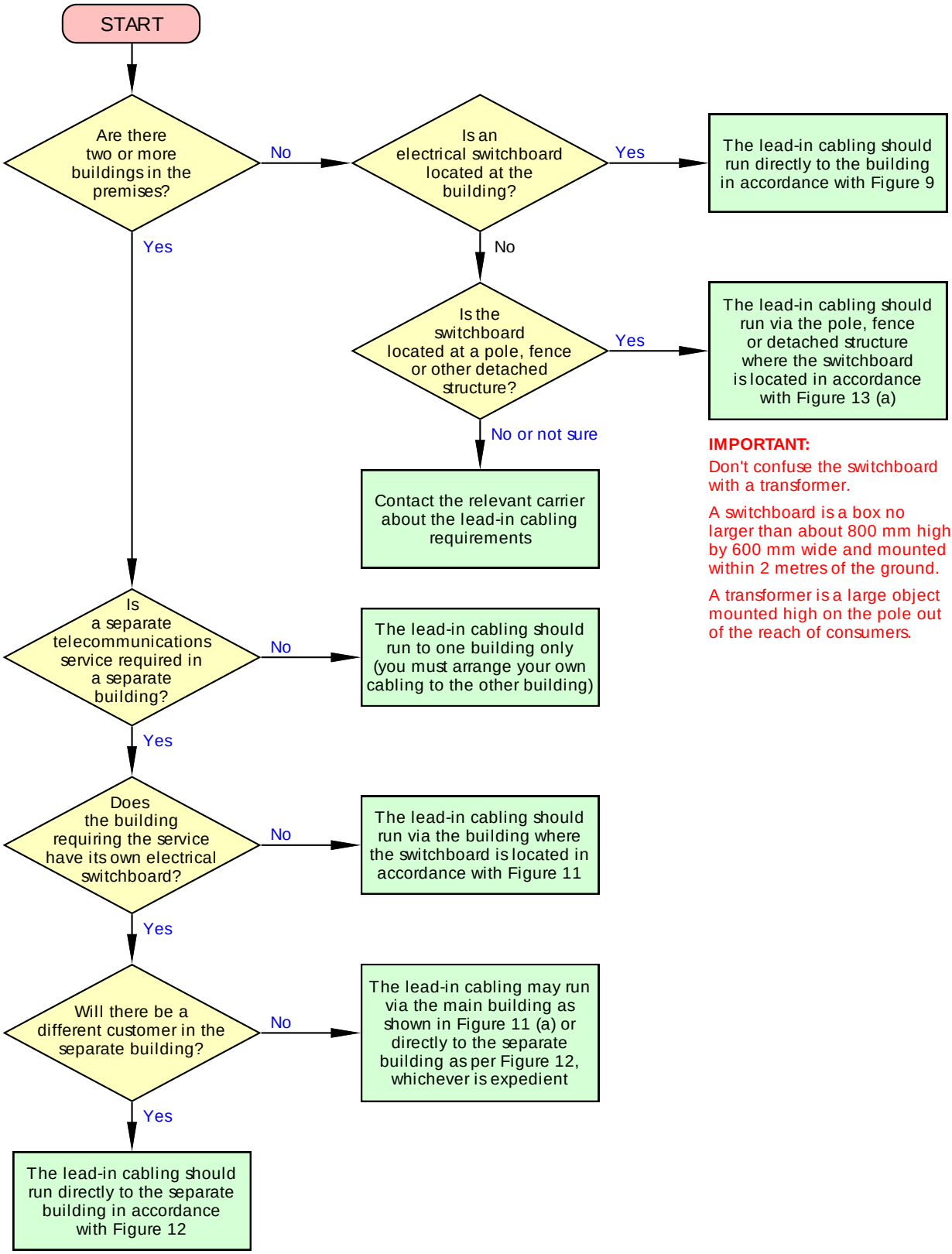
(b) High voltage (e.g. 11,000 V a.c.) power mains connected to a transformer on a pole



Notes:

1. In case (a), if copper lead-in cabling is to be installed, the carrier may need to install PCDs at both the pole and the building for lightning surge suppression purposes. In such cases, the PCD at the building should also be located on the external wall as close as possible to the electrical switchboard for effective earthing of lightning protectors.
2. In case (b), the carrier's PCD should be kept at least 25 m away from any pole carrying a SWER (Single Wire Earth Return) transformer or at least 15 m away from any other electricity transformer.

Figure 14 Determining the appropriate lead-in cabling route to a particular building (copper lead-in cabling)



Note: For optical fibre lead-in cables (e.g. Telstra or NBN Co FTTP estates), there is no need to use this flow chart. The lead-in cabling may run directly to the building where the service is required per Figure 9 or Figure 12.

4.4.5 Rural areas

In rural areas, NBN services are likely to be supplied using satellite or fixed wireless technologies. Where Telstra installs copper cabling to supply a standard telephone service, ADSL may be available.

In rural areas, Telstra normally buries the lead-in cable directly in the ground without conduit and marks the route at regular intervals with signs and marker posts. With directly buried cable there is no limitation on the number of bends in the cabling. However, the cable route should be as direct as possible between cable route markers to enable subsequent location of the cable for repairs and to reduce the risk of accidental damage to the cable during any digging or cultivation activities.

Where practicable the path of the lead-in cabling should follow established geographical features such as private roadways, tracks, right-of-ways, fence boundaries, etc. to minimise the risk of disturbance. Traversing of cultivated land or grazing paddocks should be avoided if possible. Where the cable runs beside a fence or property boundary, it must be spaced at least 1 m from the fence line (see also 4.5.6 regarding proximity to power poles).

For long cable runs in rural areas, Telstra may opt to plough its lead-in cable directly into the ground instead of requiring the provision of an open trench. Nevertheless, even if the lead-in cable is to be ploughed in, the last section of lead-in cable to the building should be installed in conduit, so an open trench will be required for at least the last 3 m of lead-in cabling to the building. Advice should be sought from Telstra as to lead-in trenching and conduit requirements in rural areas.

4.4.6 Contacting Telstra about Telstra lead-in cabling

4.4.6.1 New lead-in cabling

Where it is necessary to contact Telstra for trenching advice for the installation of **new** lead-in cabling, please call the appropriate number listed below and follow the procedure listed.

Home 13 2200

Business 13 2000

- To the automated voice greeting, respond "**connections**", then "**fixed line phone**", and then your **telephone number** or "**I don't have one**", as applicable.
- Inform the Telstra consultant that you are calling about pre-provisioning of your premises.
- State the address to which the enquiry is related and, if requested, your name and contact number.
- Discuss your requirements with the Telstra consultant who will tell you the name and contact number of the Telstra contractor for your area.
- Call the Telstra contractor who will assist you with your enquiry.
- The Telstra consultant or the Telstra contractor may provide you with a reference number for any follow-up enquiries.

4.4.6.2 Existing lead-in cabling

If the lead-in trenching is for relocation of **existing** lead-in cabling (e.g. due to building renovations or land redevelopment), please call the following number:

Home or Business 1800 810 443

You will receive a brief automated voice greeting and then you will be switched through to the Telstra Network Integrity Team with which you may discuss your requirements.

You may be given a reference number for any follow-up enquiries.

4.5 Lead-in trench

4.5.1 Safety

4.5.1.1 General

For new buildings, all service cables, conduits and pipes are usually exposed at the time of installation of the lead-in cabling, minimising the hazards for the installer and the risk of damage to other services. Ideally, the lead-in cabling should be installed in the trench being dug for the electricity mains (see 4.5.8).

For established premises, the location of other underground services may be unknown. Accordingly, the trench should be dug by an experienced person who is familiar with underground service arrangements and who is suitably accredited or licensed where required by the relevant authority. Careless excavation work may result in personal injury (e.g. through contact with live underground power cables) or costly damage to underground conduits, pipes and cables. Service providers (including Telstra) may seek to recover their entire repair and associated costs in the event that any damage is caused to their assets.

4.5.1.2 Locating existing underground services

In order to avoid personal injury or damage to property, existing underground services should be located and identified by an experienced, suitably accredited or licensed person.

Methods for locating underground services include:

- Before any earth breaking activity is contemplated, contact the Dial Before You Dig (DBYD) "free call service", by telephoning 1100 or by visiting the DBYD website at http://www.1100.com.au for information about any underground services that may be in the vicinity (note that while plans supplied by DBYD may contain information about underground services on public or adjoining land, you are not required to dig the trench outside the boundary of your premises, e.g. in public footways, roadways or in neighbouring premises).
- Review any property documentation (e.g. building plans, electrical specifications, plumbing plan).
- Visually inspect the site noting the location of conduits, pipes or cables emerging from the ground at buildings, sheds, swimming pools, fountains, electric barbecues, garden lights, external power outlets, etc.
- Visually inspect the footway and verge for the location of any power, water, gas, sanitation, stormwater, drainage or telecommunications facilities (e.g. pedestals, pits, poles, meters, kerb markers, drains, conduits/pipes, cables).
- Ascertain the likely path of underground services using the above indicators.
- Verify the location of services using a cable locator or similar equipment, if available (note that existing services may not have been installed in a straight line).
- Verify the presence or absence of underground services at appropriate points along the chosen trenching route by careful hand digging (see below).

Where there is evidence of underground services along the chosen trench route but their position cannot be verified with reasonable accuracy, look for a more suitable route or excavate by careful hand digging where uncertainty exists.

Apply the following precautions when digging the trench:

- Allow for at least 1 m separation from any suspected underground service.
- Except where otherwise required by this document, e.g. if a PCD is to be installed on a pole as shown in Figure 13 (a), keep at least one 1 m away from any pole (to avoid disturbance of the pole footings and to allow for future replacement of the pole without disturbing the lead-in cabling that will be installed in the trench).
- When hand digging, use non-conductive tools (e.g. with wooden handles) and wear insulating (rubber) boots.
- Do not dig the trench any deeper than the recommended depth (see Table 1).

4.5.1.3 Service identification

As a guide only, the types of underground services that may be encountered on private property, and their typical characteristics, are as follows:

- Electrical power — power cables may be installed in orange conduit or covered by orange marker tape or cover strip. However, they may be incorrectly installed in galvanised iron pipe or grey conduit marked "ELECTRICAL" without an orange covering, so take care if you come across any such pipes or conduits.
- Garden lighting — cables for garden lighting operating directly from mains power (230 V a.c.) may be installed in the same way as electrical power cables described above. Cables for garden lighting that operate from a transformer (e.g. 12 V a.c.) are deemed to be non-hazardous and may be buried directly in the ground.
- Piped fuel gas — modern gas lines usually consist of yellow or yellow-ochre pipe (or a black pipe with a yellow stripe) or are covered by a yellowish marker tape, but earlier installations may have used copper or steel pipe.
- Water — potable water is usually supplied in copper, galvanised iron, black polyethylene or white plastic pipe.
- Grey water (recycled water) — pipes used for recycled water are likely to be black polyethylene (preferably with a violet stripe), white plastic or violet plastic pipe.
- Sanitation (sewerage/waste water) — modern sanitation pipes are generally white or light grey plastic, but earlier installations may have used earthenware (e.g. fired clay), concrete or asbestos cement pipes.
- Stormwater — modern stormwater pipes are generally light coloured plastic (e.g. white, grey, pink, blue) but earlier installations may have used earthenware (e.g. fired clay), concrete or asbestos cement pipes.
- Drainage (surface water or seepage drain) — pipes used for drainage of surface or seepage water are usually white plastic or black polyethylene with slots or holes cut in them, but earlier installations may have used earthenware or concrete pipes without seals, rubble (gravel) pits covered with sheeting and soil or a combination of these.

If you damage any underground service, do not attempt to fix it yourself. Get an expert to repair it.

4.5.2 Trench depth

The trench depth requirements are different for urban and rural areas. You may need to contact the relevant carrier for advice as to whether the carrier deems the area to be urban or rural.

To the extent that the terrain will reasonably allow, the conduit (or cable in rural areas where the cable is directly buried) must be installed in a uniform trench of the depth specified in Table 1 for the applicable conditions. The depth specified in Table 1 includes allowance for the depth of the conduit or cable itself.

In urban areas, if the length of the lead-in conduit will exceed 50 m, pits must be installed at intervals of no more than 50 m.

In rural areas where the cable is normally buried directly in the ground without conduit, pits will usually only be necessary for long cable runs to joint cables (in some areas, aboveground jointing posts may be used for this purpose instead of pits). The carrier (usually Telstra) will install any necessary cable jointing pits or posts as required.

Table 1 Trench depth required (Note 1)

		Urban area	Rural area (cable directly buried without conduit)	
		For 23 mm ID conduit	Soil & non-continuous rock (Note 2)	Continuous rock (Note 3)
Non-trafficable area, driveway or private footway (Note 4)	Minimum	350 mm	500 mm (where deep cultivation ploughing is not likely)	250 mm
	Maximum	550 mm	650 mm	650 mm
	Recommended (Note 5)	400 mm	550 mm	300 mm
Private roadway (Note 4)	Minimum	500 mm under the lowest point	500 mm under the lowest point (usually the gutter or kerb)	

Notes:

1. If it is not possible to provide the required depth due to ground conditions, seek advice from the carrier.
2. "Soil" means sand, gravel, clay, loam or silt. "Non-continuous rock" means stones and boulders ("floaters") set in soil.
3. "Continuous rock" means rock in continuous strata or prevailing on a massive scale. It can only be removed by blasting and ripping or by using a rock breaker or a rock saw.
4. Private footways and roadways are typically found in town-house/villa complexes, retirement villages, caravan parks, etc. Such complexes do not generally have clearly defined footways.
5. The recommended depth allows for fluctuations in ground conditions and for the use of bedding material, if required, to ensure that the minimum depth of cover above the conduit or cable is achieved.

4.5.3 Trench width

For 23 mm ID conduit or directly buried rural cables, the width of the trench should be no less than 100 mm and should follow the contour of the conduit/cable path as closely as possible (see 4.2.3 on page 6).

4.5.4 Bedding and backfill material

The installed conduit must be supported firmly and evenly on all sides using bedding sand or the excavated material as long as the material does not contain any metal, concrete, rocks or similarly hard material exceeding 50 mm in cross-section. The bedding and backfill material must be free of any timber or other fibrous material that may decompose or attract termites.

4.5.5 Retaining walls and embankments

Where there is, or will be, a retaining wall or embankment in the path of the lead-in cabling:

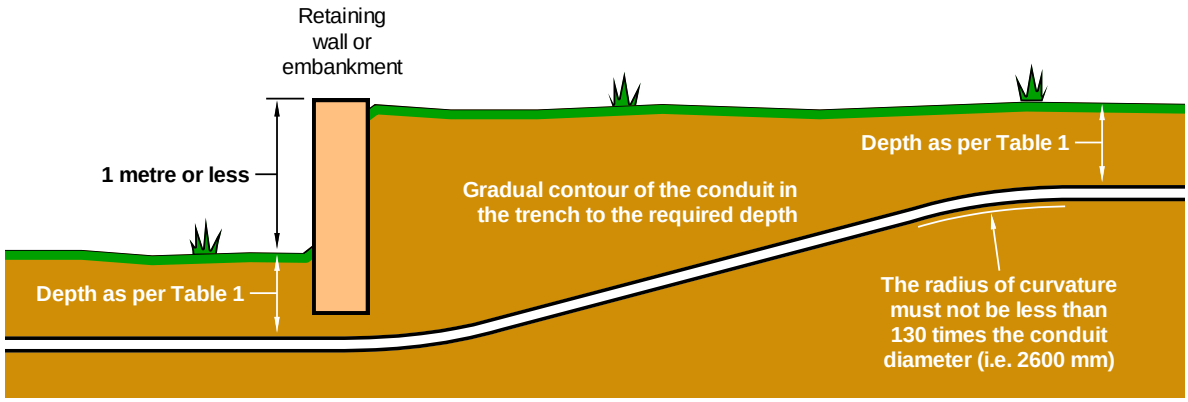
(a) If the vertical height of the retaining wall or embankment does not exceed 1 m, the trenching/ conduit may continue under the wall or embankment at a gradual incline to resume the appropriate depth set out in Table 1 on the high side of the wall/embankment (see Figure 15). Alternatively, the technique described in (b) may be applied.

(b) If the vertical height of the retaining wall or embankment exceeds 1 m, the trenching/conduit must end at the foot of the retaining wall or embankment and recommence at the high side of the wall/embankment at the depth set out in Table 1 (see Figure 16).

(c) If the wall or embankment is at a gradual incline to the horizontal, the trenching/conduit should follow the incline as close as practicable to the appropriate depth set out in Table 1 (see Figure 17).

Note: If one side of the wall or embankment is on public property (such as a footway) or a neighbouring property, the trenching/conduit on that side of the wall/embankment is the carrier's responsibility.

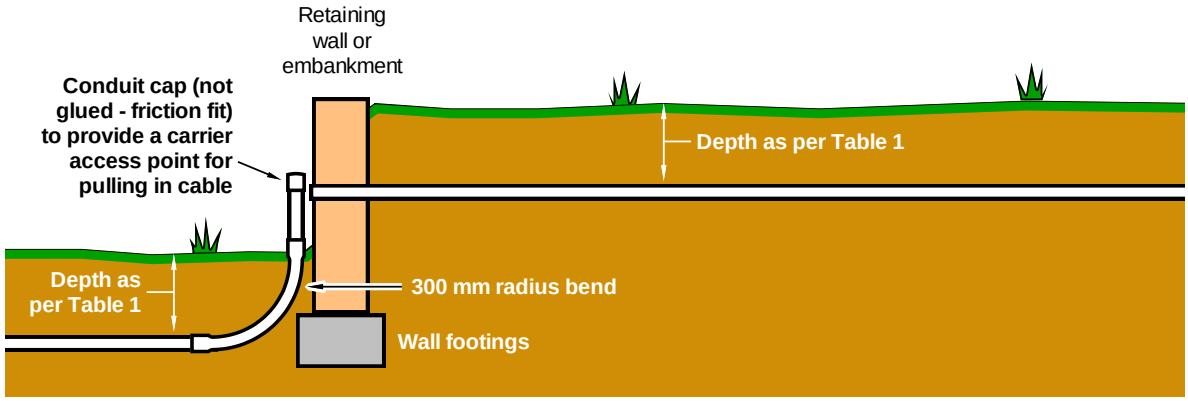
Figure 15 Lead-in conduit arrangement where a retaining wall or embankment does not exceed a vertical height of 1 m



Notes:

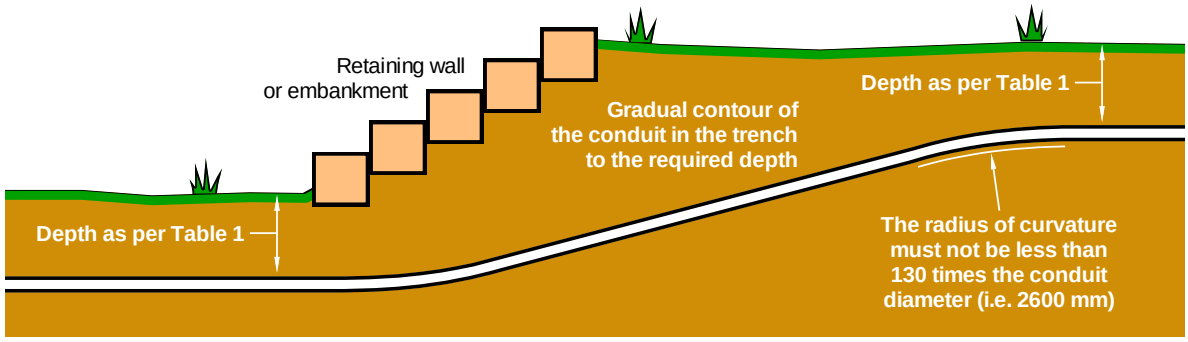
1. The technique may be applied either before or after the retaining wall is installed or an embankment is created.
2. For an existing retaining wall or embankment, the technique shown in Figure 16 may be applied.

Figure 16 Lead-in conduit arrangement where a retaining wall or embankment exceeds a vertical height of 1 m



Note: The carrier may install a metal cover strip over the conduit on the surface of the retaining wall as a mower guard.

Figure 17 Lead-in conduit arrangement for a gradually sloping retaining wall or embankment



Note: The trenching should follow the contour of the finished ground level within the curvature (flexing) constraints of the conduit.

4.5.6 Proximity to power poles

Lead-in trenching should be kept at least 1 m away from any power poles (including poles used for lighting) to allow for future replacement of the pole without disturbing the lead-in cabling — except in cases where the electricity enclosure is installed on the pole and it is necessary to run the lead-in cabling via a PCD on the pole supporting the electricity enclosure. Refer to Figure 13 (a) and Figure 14.

4.5.7 Trenching outside the premises

Your premises includes common property (e.g. controlled by a body corporate) or a private easement or right of way (e.g. for a driveway). You must obtain permission from the body corporate or owner of the easement or right of way before trenching through it.

Do not dig the trench outside the boundary of your premises, e.g. in a public footway, roadway or in neighbouring premises. Trenching outside your premises is subject to land access code requirements and is the carrier's responsibility.

4.5.8 Shared trench arrangements

For new building construction, lead-in cabling may be installed in a shared trench with another service (preferably the electricity mains) to reduce costs and minimise the width of the service corridor through the property. Trench sharing arrangements are illustrated in Figure 18 to Figure 20. Where the trench is shared with more than one other service, their respective separations must be maintained. Local authority requirements, or the requirements of the other utility, may preclude a shared trench with some services.

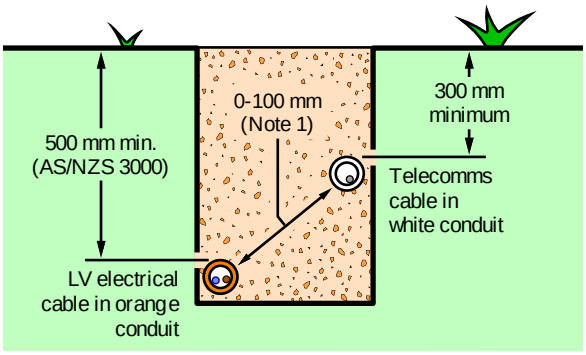
For **Telstra** lead-in cabling, no separation is required from the conduits or cables of another **telecommunications** service unless:

- separation is required by the owner of the other telecommunications service; or
- the other telecommunications service is a conduit or cable of **another carrier**, in which case a minimum radial clearance of **100 mm** is required in accordance with ACIF Industry Code C524, *External Telecommunication Cable Networks*.

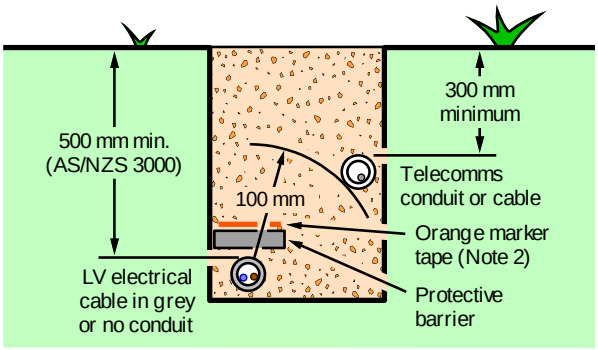
Note: NBN Co may require other telecommunications conduits to be separated from their lead-in conduits.

Figure 18 Shared trench with LV (low voltage) electricity (e.g. normal domestic single-phase or three-phase power mains)

(a) Electrical cable in orange conduit



(b) Electrical cable physically protected by means other than orange conduit

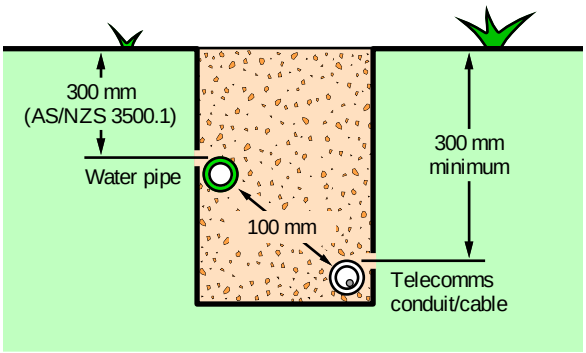


Notes:

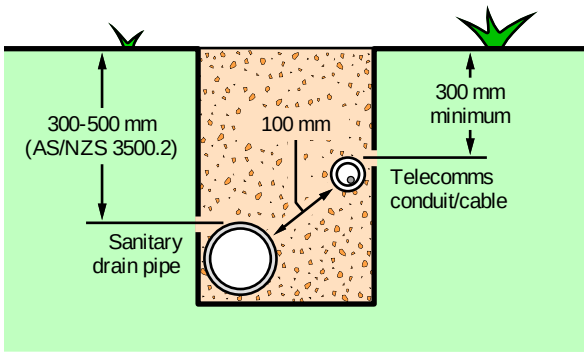
1. No separation is required if the lead-in cable is installed in white conduit and the electrical cable is installed in orange conduit. At least 100 mm separation is required if the electrical cable is installed in orange conduit and the lead-in cable is directly buried without conduit (e.g. rural areas). The telecommunications conduit or cable should be installed above the electrical conduit.
2. Orange marker tape is required where the protective barrier is not orange in colour. The lead-in conduit must be installed above the electrical cable/conduit and separated from it by a minimum distance of 100 mm whether or not the lead-in cable is buried in conduit.
3. Lead-in cabling must **not** share a trench with unprotected electrical cable (e.g. not in orange conduit or not covered by concrete, approved bricks etc.) or electrical cable that is not identified by orange conduit, orange cover strip or orange marker tape. In such cases the lead-in cable must be installed in a separate trench.
4. In some rural areas, Telstra installs a guard wire above the cable to provide additional protection against lightning ground strikes. However, this does not affect the trench depth requirements or the separation distances required from other services.
5. Lead-in cabling must **not** be installed in a shared trench with HV (high voltage) electricity cabling (i.e. cable carrying a voltage exceeding 1000 V a.c.).

Figure 19 Shared trench with water and sanitary pipes

(a) Water service pipe



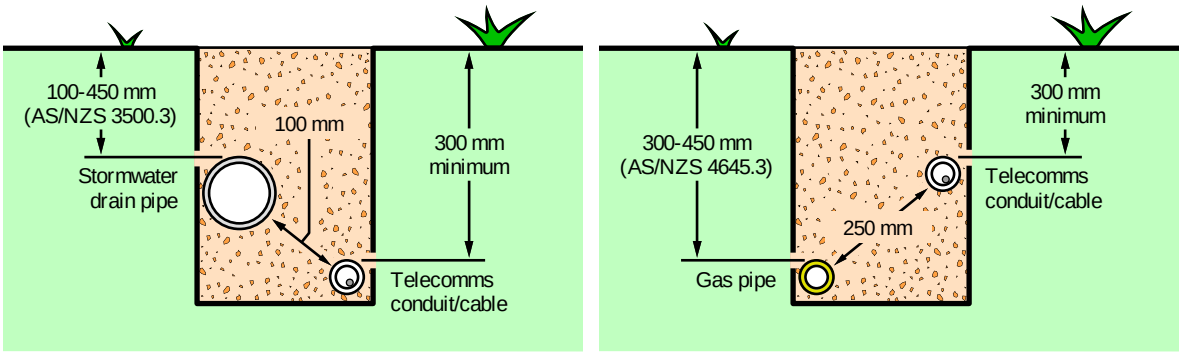
(b) Sanitary plumbing/drainage pipe



Note: The depths shown for water pipe and sanitary plumbing/drainage pipe are provided for guidance. The depths stated are the minimum specified in the relevant standards for burial of the pipe on private property. The required minimum depth may vary according to exposure of the location to vehicular traffic or the type of pipe used.

Figure 20 Shared trench with stormwater and gas pipes

(a) Stormwater drainage pipe **(b) Gas service pipe**



Notes:

1. The lead-in conduit/cable must **not** be installed above the stormwater drainage pipe (this is a requirement of AS/NZS 3500.3).
2. The depths shown for stormwater pipe and gas pipe are provided for guidance. The depths stated are the minimum specified in the relevant standards for burial of the pipe on private property. The required minimum depth may vary according to exposure of the location to vehicular traffic, the type of pipe used or, in the case of gas pipe, the service pressure.

4.5.9 Exclusive (separate) trench

Where it is not possible to use a shared trench with another service, the lead-in cabling must be installed in an exclusive (separate) trench.

For parallel runs with services other than electrical cables, the minimum separation from these services must be in accordance with 4.5.8. For parallel runs with electrical cables, the minimum separation between the lead-in cable or conduit and the electrical cable/conduit must be in accordance with Table 2 and Figure 21.

Where the Telstra conduit crosses the path of another service, the crossover must comply with 4.5.10.

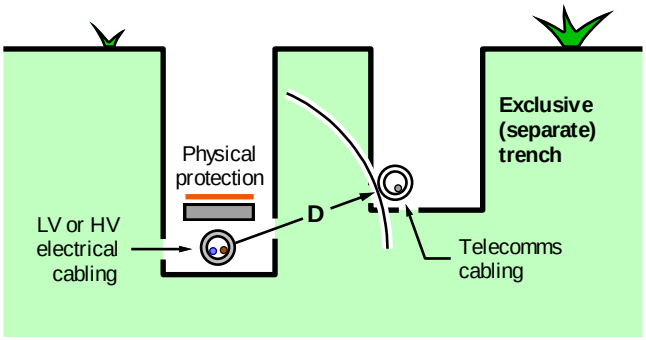
Table 2 Separation from electricity — exclusive trench

	LV (Note 1)		**HV** (Note 2)	
	With protective covering (Note 3)	**Without protective covering** (Note 4)	**With protective covering** (Note 3)	**Without protective covering** (Note 4)
Minimum separation distance "D" (see Figure 21)	100 mm	300 mm	300 mm	450 mm

Notes:

1. LV (Low Voltage) is typically used for electricity mains supply to single dwellings (i.e. 230 V a.c. single-phase power or 400 V a.c. three-phase power).
2. HV (High Voltage) is typically used for electricity mains supply to large multi-residential or large commercial premises (e.g. 11,000 V a.c. power to an HV transformer).
3. For an exclusive trench, try to keep at least 300 mm away from LV and 450 mm from HV whether or not the electricity has a protective covering. Where there is any doubt as to whether the electricity is, or will be, physically protected in accordance with AS/NZS 3000, a minimum separation distance of 300 mm from LV or 450 mm from HV must be maintained.
4. Installation of underground electrical cable in customer premises without a protective covering is not allowable under the electrical wiring rules (AS/NZS 3000). However, there may be cases where AS/NZS 3000 doesn't apply or unprotected cable is incorrectly installed.

Figure 21 Separation from electrical conduit or cable — exclusive trench



Note: The trench must be located such that distance "D" (refer to Table 2) is maintained between the electrical conduit or cable and the lead-in conduit/cable. This distance may be measured radially in any direction from the electrical conduit/cable.

4.5.10 Crossovers with other services

Where the lead-in cabling crosses another service, separation from the other service at the crossover must be in accordance with Table 3.

Table 3 Separation at crossovers with other services within customer premises

Other service	Lead-in separation requirements
LV electrical cable with a protective covering	The lead-in cabling must be separated from the electrical cable by at least 100 mm at the crossover, and should cross **above** the electrical cable (see Figure 22). The lead-in cabling may only cross under the electrical cable if a concrete protective covering is installed above the electrical cable at the crossover in accordance with Figure 25.
LV electrical cable **without** a protective covering (Note 1)	The lead-in cabling must cross at least 300 mm **above** the electrical cable (see Figure 23) unless a protective covering of concrete is provided over the electrical cable 600 mm each side of the crossing as shown in Figure 24, in which case a 100 mm separation is allowable. If it is necessary for the lead-in cabling to cross under the electrical cable: • it should only be installed by boring; • a concrete protective covering must be installed above the electrical cable at the crossover in accordance with Figure 25; and • a minimum separation distance of 300 mm must be maintained from the electrical cable at the crossover.
HV electrical cable with a protective covering	The lead-in cabling must be separated from the electrical cable by at least 300 mm at the crossover, and should cross **above** the electrical cable (see Figure 22). The lead-in cabling may only cross under the electrical cable if a concrete protective covering is installed above the electrical cable at the crossover in accordance with Figure 25.
HV electrical cable **without** a protective covering (Note 1)	The lead-in cabling must cross at least 450 mm **above** the electrical cable (see Figure 23) unless a protective covering of concrete is provided over the electrical cable 600 mm each side of the crossing as shown in Figure 24, in which case a 300 mm separation is allowable. If it is necessary for the lead-in cabling to cross under the electrical cable: • it should only be installed by boring; • a concrete protective covering must be installed above the electrical cable at the crossover in accordance with Figure 25; and • a minimum separation distance of 300 mm must be maintained from the electrical cable at the crossover.
Water service pipe	The lead-in cabling must cross at least 100 mm **below** the water pipe at an angle not less than 45° and should be covered by white marker tape complying with AS/NZS 2648.1 laid 150 mm above the lead-in cabling for at least 1 m either side of the crossing (Note 2).
Sanitary plumbing/ drainage pipe	The lead-in cabling must cross at least 100 mm **above** the pipe at an angle not less than 45° and should be covered by white marker tape complying with AS/NZS 2648.1 laid 150 mm above the lead-in cabling for at least 1 m either side of the crossing (Note 2).
Stormwater drainage pipe	The lead-in cabling must cross at least 100 mm **below** the pipe at an angle not less than 45° and should be covered by white marker tape complying with AS/NZS 2648.1 laid 150 mm above the lead-in cabling for at least 1 m either side of the crossing (Note 2).
Gas service pipe	The lead-in cabling must cross at least 100 mm **above** the pipe at an angle not less than 45° and should be covered by white marker tape complying with AS/NZS 2648.1 laid 150 mm above the lead-in cabling for at least 1 m either side of the crossing (Note 2).
Telecommunications	The lead-in cabling must cross at least 100 mm **above or below** (whichever is expedient) the other telecommunications conduit or cable and should be covered by white marker tape complying with AS/NZS 2648.1 laid 150 mm above the lead-in cabling for at least 1 m either side of the crossing (Note 2).

Notes:

1. Installation of underground electrical cable in customer premises without a protective covering is not allowable under the electrical wiring rules (AS/NZS 3000). However, there may be cases where AS/NZS 3000 doesn't apply or unprotected cable is incorrectly installed.
2. Marker tape that complies with Australian Standard AS/NZS 2648.1, *Underground marking tape Part 1: Non-detectable tape*, is required to be at least 75 mm wide (preferably 100 mm or 150 mm wide) with black block lettering at least 25 mm high. The text should contain "COMMUNICATION" or "TELECOMMUNICATION" to identify the service. The text must be repeated at intervals of 1 m or less.

Figure 22 Crossing *above* electrical cable with a protective covering that complies with AS/NZS 3000 requirements

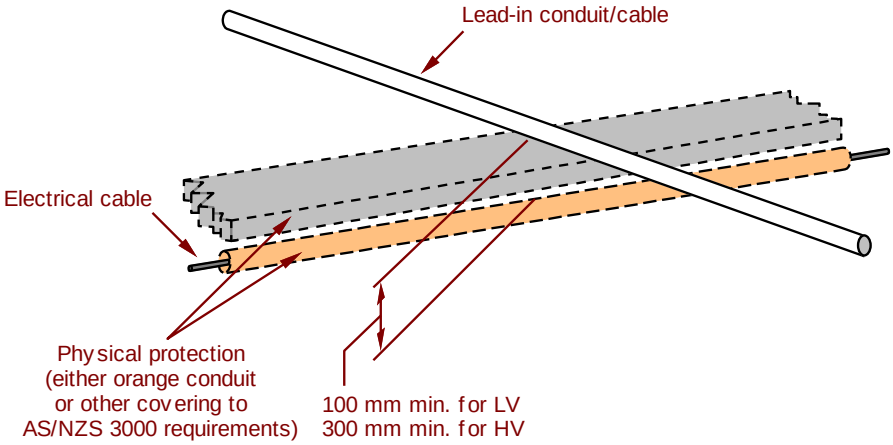
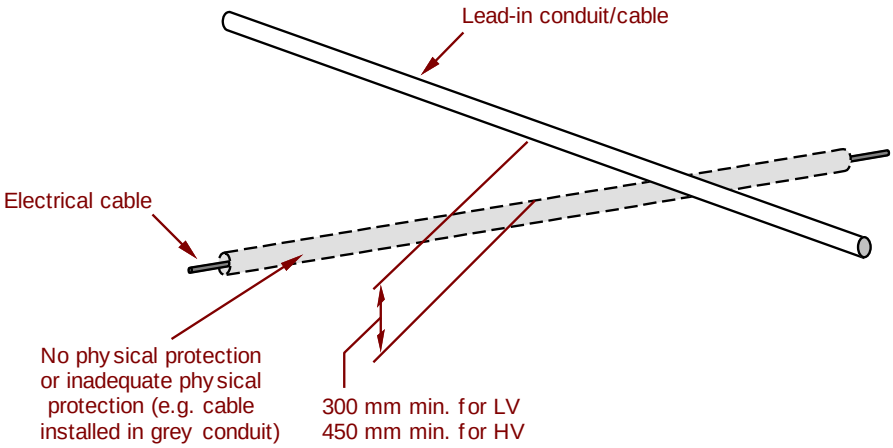
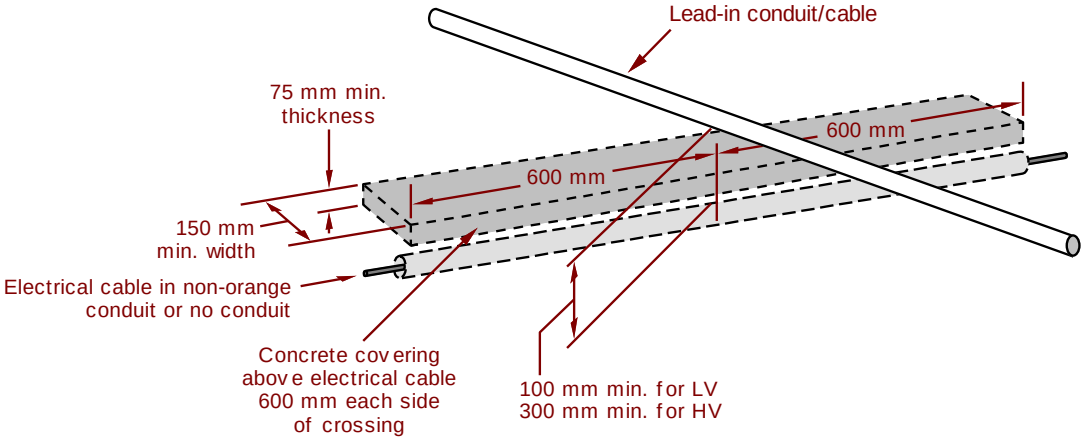


Figure 23 Crossing *above* electrical cable with NO protective covering



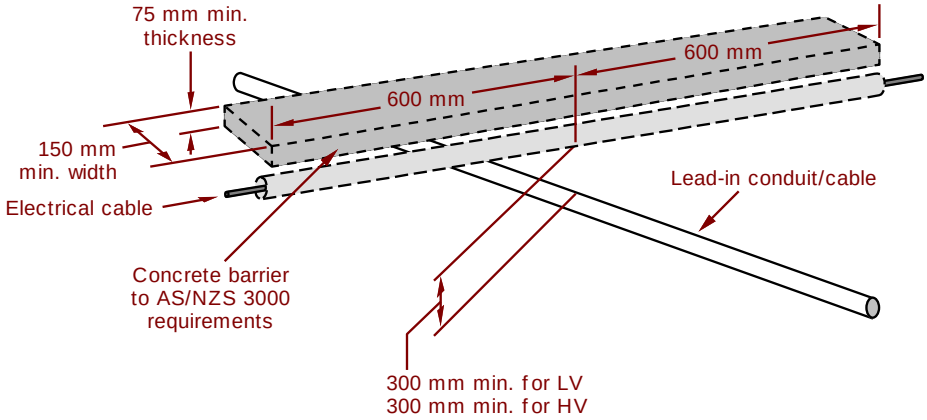
Note: Installation of underground electrical cable in customer premises without a protective covering is not allowable under the electrical wiring rules (AS/NZS 3000). However, there may be cases where AS/NZS 3000 doesn't apply or unprotected cable is incorrectly installed.

Figure 24 Crossing *above* electrical cable with a concrete protective covering that complies with AS/NZS 3000 requirements installed at the crossing



Note: The concrete covering is to protect against accidental contact with the electrical cable if excavating along the path of the lead-in cabling subsequent to its initial installation.

Figure 25 Crossing *under* electrical cable



Notes:

1. Lead-in cabling should only be installed under electrical cable during boring. If a concrete protective covering to AS/NZS 3000 requirements has not been provided above the electrical cable, a concrete strip at least 150 mm wide and 75 mm thick must be provided 600 mm each side of the crossing.
2. The concrete covering is to protect against accidental contact with the electrical cable if excavating along the path of the lead-in cabling subsequent to its initial installation.

4.6 Lead-in cable

The carrier will supply, install and connect the lead-in cable. The customer's cabler must **not** pull the lead-in cable through the conduit or connect it to the PCD.

Note: Lead-in cabling must **not** be used for customer cabling purposes. Customer cabling must be separate and distinct from lead-in cabling.

5 AERIAL LEAD-IN CABLING

To skip the aerial lead-in cabling information, go to section 6 (premises connection devices) on page 35.

5.1 General

Where aerial lead-in cabling is to be installed for connection to the Telstra network to supply a Telstra service, the customer is required to pay the cost of erection, by Telstra, of any Telstra poles that are required within the confines of the customer's premises, including clearing of land along the cabling route, digging of the pole holes and reinstatement of the land after the poles are installed (such poles are normally only required with acreage or rural properties). The supply of the poles and the cable, and the installation of the cable on the poles, is included in the basic telephone new service connection charge.

Telstra will not permit the customer or a third party (e.g. a contractor of the customer's choosing) to install the Telstra poles but the customer may reduce Telstra's pole installation charges by arranging clearing of the land, digging the holes and backfilling them under Telstra direction and supervision.

5.2 Lead-in cabling route

The route of the lead-in cabling will be determined by Telstra in accordance with the principles set out in 4.4.1 to 4.4.4 (pages 12 to 16). This information may be used to determine the likely PCD location.

5.3 Private poles and trees

For safety reasons, Telstra will not use trees or customer-owned poles to support new aerial Telstra lead-in cabling. This includes any poles installed by the customer to support the power mains.

5.4 Power utility poles

Telstra may agree to use poles owned by a power utility (subject to the agreement of the power utility) because they are regularly inspected and properly maintained by the power utility. However, the use of such poles is at Telstra's discretion.

5.5 Inspection and maintenance of poles

Telstra regularly inspects Telstra-owned poles and replaces any defective poles at Telstra's cost.

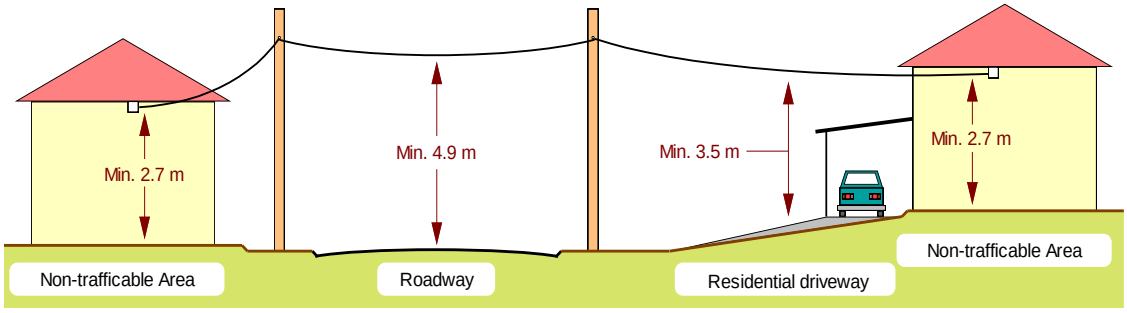
5.6 Clearance of aerial lines from the ground

The minimum ground clearances required for aerial lead-in cabling in residential areas are as follows (see Figure 26):

- over any private land not traversable by road vehicles 2.7 m
- over any residential driveway 3.5 m
- over any commercial/industrial driveway or private roadway 4.9 m.

Note: This information is provided for guidance only in determining whether a raiser pole may be required at the building (see Figure 29 and Figure 30). The lead-in cable will be installed by the relevant carrier.

Figure 26 Minimum ground clearances for residential aerial lead-in cabling



Note: At least 5.5 m clearance (or as specified by the relevant transport authority) is normally required above any part of a freeway, primary arterial or collector road or highway.

5.7 Clearance from other services

5.7.1 At poles and in-span

The minimum separation distances required from low voltage (230 V AC single-phase or 400 V AC three-phase) power mains, associated fittings and terminations on poles or in-span are set out in 5.8 (h).

5.7.2 At the building

Sufficient separation must be provided at the building between the lead-in cable attachment point and any insulated low voltage power service lead such that **600 mm** can be maintained between the power cables and fittings and the **body of a person working on the lead-in cabling**. This means that if the telecommunications worker cannot safely access the lead-in cable or attachment on the side of the cable or attachment furthest from the power cables and fittings, a separation of at least 1200 mm will be required between the power cables and fittings and the lead-in cables and fittings at the building.

5.8 Use of Telstra poles for power mains

While Telstra will not use any poles installed by the customer to support the LV power mains, Telstra will allow Telstra-owned lead-in poles to be used to support the customer's low voltage (LV) power mains (i.e. 230 V AC single-phase or 400 V AC three-phase) under the following conditions:

(a) Only poles erected at the customer's cost (as described in 5.1) may be used, i.e. poles installed in accordance with the standard terms and conditions for the supply of a Telstra telephone service as set out in Telstra's "Our Customer Terms" available online at www.telstra.com.au/customer-terms/ (the poles are supplied at Telstra's cost but are erected at the customer's cost).

(b) Telstra must be notified of this requirement **prior** to the commencement of pole installation.

(c) The customer must pay any additional cost incurred to meet this requirement (e.g. any extra pole height required to accommodate the power mains).

(d) The customer must arrange and pay for the installation and maintenance of the power mains on the Telstra poles, including transfer of the power mains to any poles subsequently replaced by Telstra.

(e) Only Telstra poles located within the boundaries of the customer's premises may be used. Telstra poles located outside the customer's real property boundary must **not** be used to support the customer's power mains.

(f) High voltage power lines (exceeding 1000 V AC) must **not** be installed on the Telstra poles.

(g) The power mains must be installed **above** the aerial Telstra cable at a height that, taking into account the required separation distances described in (h), would enable the following minimum ground clearances to be maintained for the Telstra aerial cabling (see 5.6):

(i)	Over any private land not traversable by road vehicles	2.7 m
(ii)	Over any residential driveway	3.5 m
(iii)	Over any commercial/industrial driveway or private roadway	4.9 m

(h) The power mains, associated fittings and terminations must be separated from the aerial Telstra cabling, associated fittings and terminations by the following minimum distances:

(i)	Insulated power mains	At the pole	600 mm
		In span	600 mm
(ii)	Uninsulated power mains	At the pole	1200 mm
		In span	600 mm
(iii)	Light fitting, stay fitting or power conduit	At the pole	50 mm

5.9 Use of Telstra poles for customer cabling

Telstra will allow Telstra-owned lead-in poles to be used to support customer cabling under the following conditions:

(a) Only poles erected at the customer's cost (as described in 5.1) may be used, i.e. poles installed in accordance with the standard terms and conditions for the supply of a Telstra telephone service as set out in Telstra's "Our Customer Terms" available online at www.telstra.com.au/customer-terms/ (the poles are supplied at Telstra's cost but are erected at the customer's cost).

(b) Only Telstra poles located within the boundaries of the customer's premises may be used. Telstra poles located outside the customer's property boundary must **not** be used for customer cabling.

(c) The poles must be of sufficient height and the Telstra lead-in cable must be installed on the poles at sufficient height to allow installation of the customer cabling in accordance with (d), (e), (f) and (g).

(d) The customer cabling must be installed below the aerial Telstra cabling.

(e) The customer cable and associated pole fittings must be separated from the Telstra cable and associated pole fittings by at least 300 mm at the pole.

(f) The customer cable must be separated in-span from the Telstra cable by at least 300 mm.

(g) The customer cabling must be installed in accordance with the relevant requirements of the ACMA wiring rules including minimum ground clearances (currently the same as described in 5.6).

(h) The customer cable must not be installed within any Telstra underground conduit or pit or within any Telstra conduit installed on the pole.

5.10 Aerial cable attachment at the building

The cable attachment point should be as close as possible to the building electricity enclosure to facilitate location of the PCD in accordance with section 6. The location and height of the point of attachment to the building or other structure must allow a route from the pole to the building that:

- does not cross any adjacent property;
- is unobstructed by existing trees or foliage; and
- is capable of maintaining the specified ground clearances and separation from power cables described in 5.6 and 5.7.

Note: The location of the cable attachment point must also take into account any planned structural additions to the premises, future tree growth or prospective planting of any trees along the proposed cable path.

The cable attachment point at the building must be within reach of a standard one-person extension ladder that is able to be safely erected and secured at the site. The attachment must be made at the perimeter of the building (e.g. fascia, bargeboard or external wall) and not at any point on the roof.

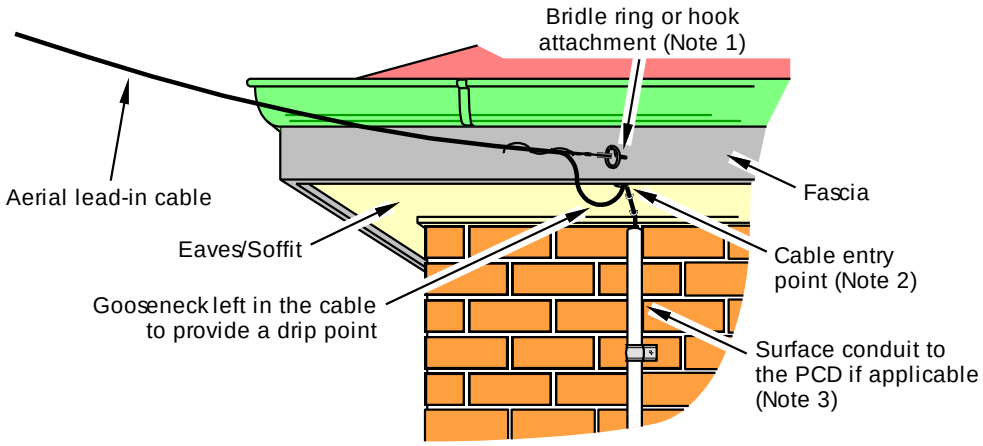
The preferred means of attachment of aerial lead-in cable to the building is to a solid timber fascia or bargeboard or a metal fascia/bargeboard backed by structural timber. The structural member into which the attachment is made must be of sufficient strength to withstand a tension of 2000 Newtons (approximately 200 kgf).

The proposed point of cable attachment with the required structural integrity should be marked on the building plan or the building itself by the builder. Up to three cables of the following description (in any combination) may be attached to the same attachment point:

- 2-pair lead-in cable with integral bearer (ALIC — Aerial Lead-In Cable)
- RG6 or RG11 coaxial "messenger" cable (i.e. with integral bearer)
- single-core optical fibre cable with integral strengthener(s).

The various means of attaching aerial telecommunications cables to buildings are illustrated in Figure 27 to Figure 30.

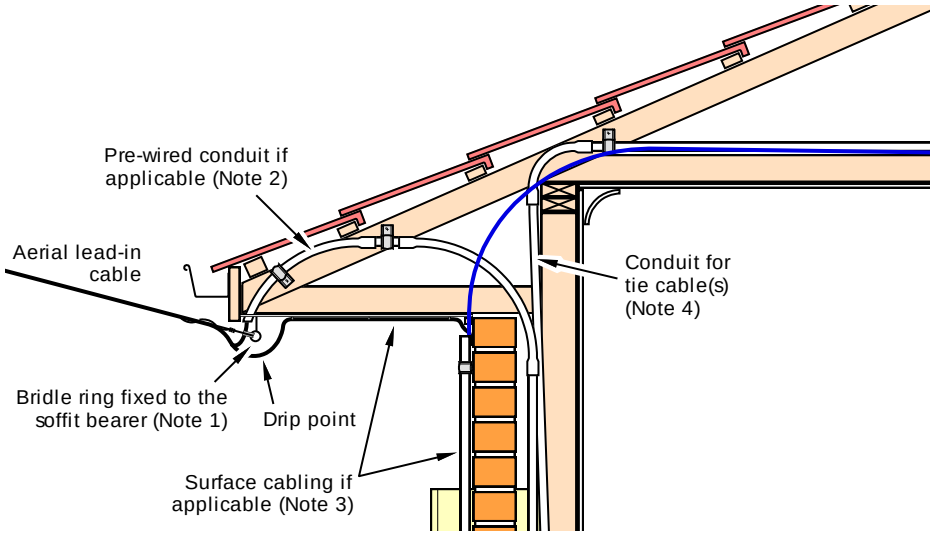
Figure 27 Attachment of aerial cable to the fascia



Notes:

1. This is the preferred means of attachment to the building if the fascia has sufficient structural integrity and the aerial cable will have sufficient ground clearance.
2. If the building has been prepared in accordance with 7.4.4 (page 52) or 7.5.4 (page 58), the lead-in cable may be pulled through the concealed conduit to the CUE or PCD.
3. For an established building, the lead-in cable will usually be extended to the PCD via conduit fixed to the external surface of the building.

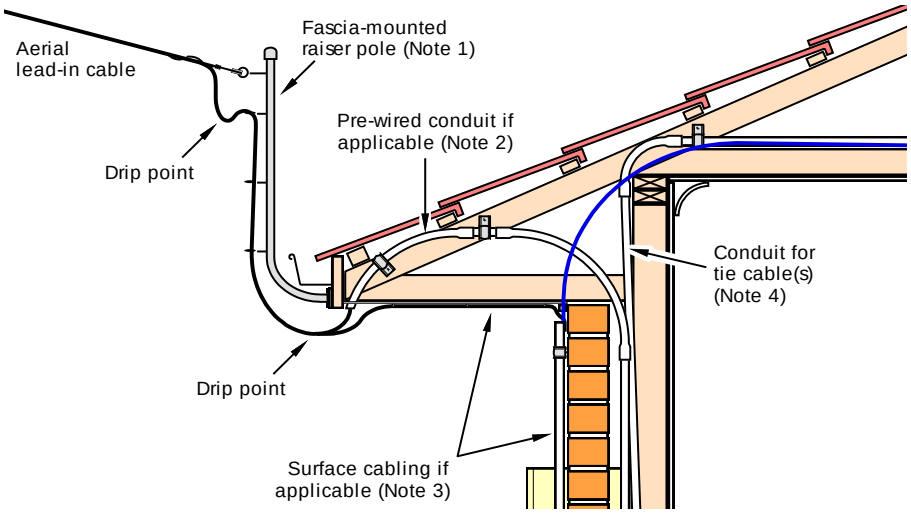
Figure 28 Attachment of aerial cable to the soffit bearer



Notes:

1. This method of attachment may be used if the fascia has insufficient strength to support the aerial cable attachment — as long as the cable will not rub against the fascia or gutter and there will be sufficient ground clearance if this method is used.
2. If the building has been prepared in accordance with 7.4.4 (page 52) or 7.5.4 (page 58), the lead-in cable may be pulled through the concealed conduit to the CUE or PCD.
3. For an established building, the lead-in cable will usually be extended to the PCD via conduit fixed to the external surface of the building.
4. If the building has been prepared in accordance with 7.4.4 or 7.5.4, the tie cable(s) may be pulled through the concealed conduit to the CCP. Otherwise, the tie cable(s) may need to be run via surface-run conduit.

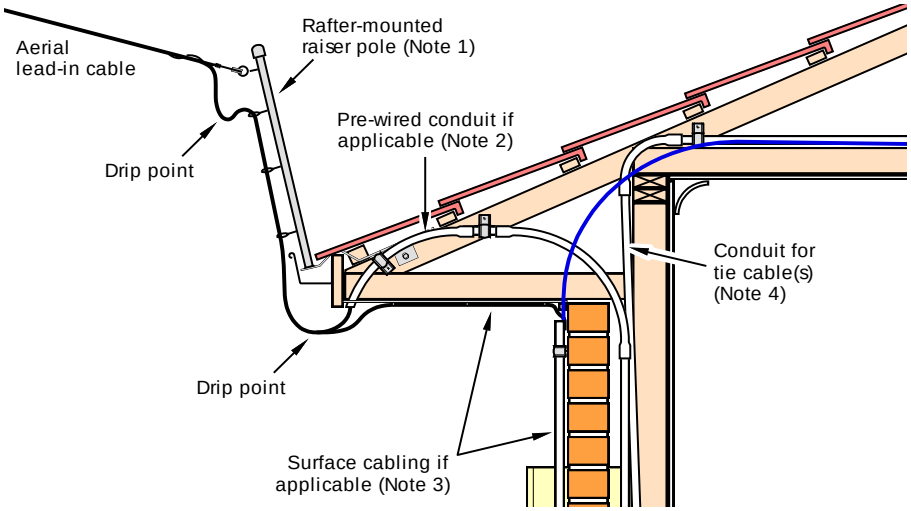
Figure 29 Attachment of aerial cable to a raiser pole attached to the fascia



Notes:

1. A raiser pole must be used where insufficient ground clearance can be obtained by attaching the aerial cable directly to the fascia. The raiser pole may be attached to the fascia as shown above if it has sufficient structural integrity to support the pole. The length of the raiser pole will not exceed 1200 mm and is installed by the carrier.
2. If the building has been prepared in accordance with 7.4.4 (page 52) or 7.5.4 (page 58), the lead-in cable may be pulled through the concealed conduit to the CUE or PCD.
3. For an established building, the lead-in cable will usually be extended to the PCD via conduit fixed to the external surface of the building.
4. If the building has been prepared in accordance with 7.4.4 or 7.5.4, the tie cable(s) may be pulled through the concealed conduit to the CCP. Otherwise, the tie cable(s) may need to be run via surface-run conduit.

Figure 30 Attachment of aerial cable to a raiser pole attached to the rafter/truss



Notes:

1. A raiser pole must be used where insufficient ground clearance can be obtained by attaching the aerial cable directly to the fascia. Where the fascia does not have sufficient structural integrity to support the pole, the pole must be attached to the roof rafter or truss as shown above. The length of the raiser pole will not exceed 1200 mm and is installed by the carrier.
2. If the building has been prepared in accordance with 7.4.4 (page 52) or 7.5.4 (page 58), the lead-in cable may be pulled through the concealed conduit to the CUE or PCD.
3. For an established building, the lead-in cable will usually be extended to the PCD via conduit fixed to the external surface of the building.
4. If the building has been prepared in accordance with 7.4.4 or 7.5.4, the tie cable(s) may be pulled through the concealed conduit to the CCP. Otherwise, the tie cable(s) may need to be run via surface-run conduit.

6 PREMISES CONNECTION DEVICE (PCD)

6.1 Description

The premises connection device (PCD) facilitates the transition from outdoor (underground or aerial) cabling to indoor cabling. No matter what wireline telecommunications network technology is used to supply the telecommunications services, the lead-in cabling will be connected to a PCD at the external wall of the building and will be interconnected to the indoor termination equipment via one or more indoor "tie" cable(s). The PCD may or may not be the network boundary and may vary in form and function depending on the telecommunications network technology used.

Typical PCDs are shown in Figure 31 and Figure 32.

Figure 31 Typical PCDs that are not the network boundary

Telstra FTTP (optical fibre) splice box

This box is 260 H x 250 W x 72 D

NBN Co FTTP (optical fibre) splice box

This box is 210 H x 175 W x 75 D

Standard Telstra HFC (coaxial) isolation box

This box is 215 H x 136 W x 63 D

Larger Telstra HFC (coaxial) isolation box

This box is 250 H x 270 W x 85 D

Notes:

1. The above devices are shown in relative size. These devices are not NTDs and do not require an earth. They are installed by the carrier.
2. The larger Telstra isolation box may be used for housing an RF amplifier (e.g. for more than 3 coaxial outlets).
3. At least 150 mm of clear space is generally required on all sides of all PCDs for cabling and access purposes. This clearance distance may be reduced for a PCD housed in a combined utilities enclosure (see 6.2) or between two PCDs located on the same wall (refer to 7.5.6.3 on page 64 for an example).

Figure 32 Typical network boundary PCDs (NTDs)

Telstra ADSL NTD for twisted pair lead-in cable

This NTD is 260 H x 250 W x 72 D

Telstra FTTP NTD for optical fibre lead-in cable

This NTD is 345 H x 305 W x 110 D

Notes:

1. The above NTDs are shown in relative size. They require a hard-wired communications earth (see section 9).
2. The NTD on the left may be installed by the builder's or customer's registered cabler. Refer to Telstra Document No. 012688, *Telstra Network Termination Device — Information for Cabling Providers*.
3. The NTD on the right is installed by Telstra. Telstra will cease using these NTDs for new installations in late 2013 and will use indoor NTDs instead. Refer to Document No. 017153a00 for more information.
4. At least 150 mm of clear space is generally required on all sides of the NTD for cabling and access purposes. This clearance distance may be reduced for an NTD housed in a combined utilities enclosure (see 6.2) or between the NTD and another PCD located on the same wall (refer to 7.5.6.3 on page 64 for an example).

6.2 External combined utilities enclosure (CUE)

6.2.1 Description

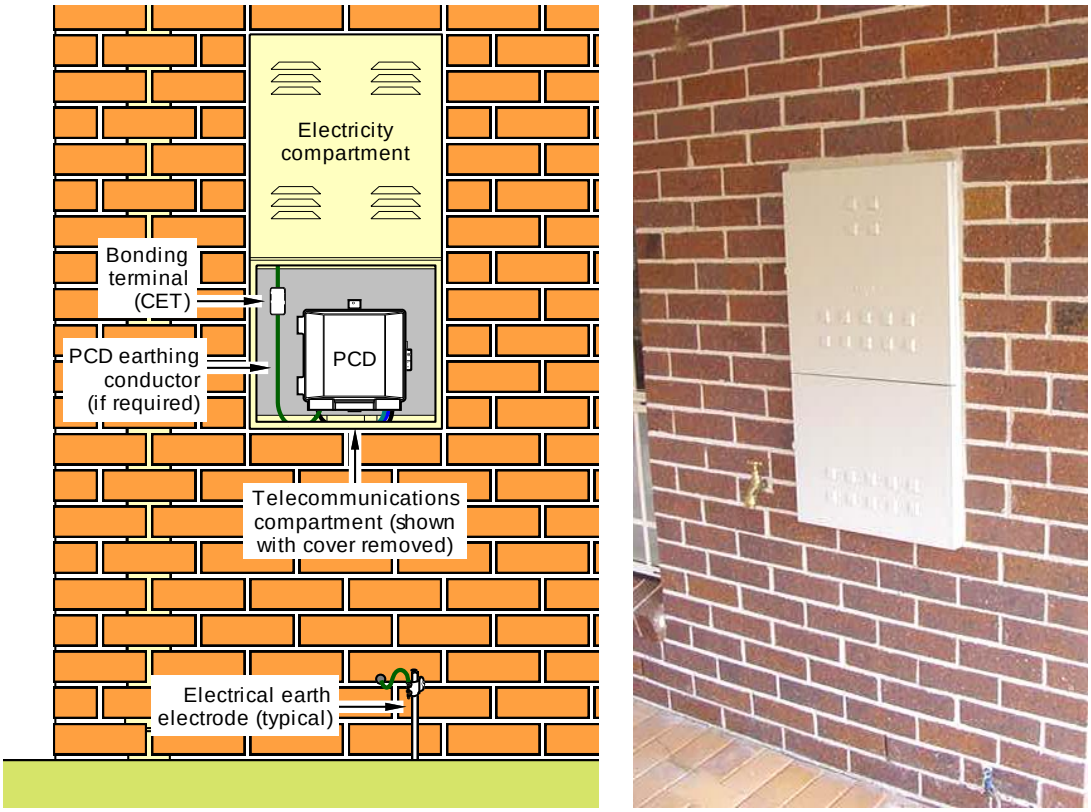
With new homes, it is preferable for the builder or electrician to provide a Combined Utilities Enclosure (CUE) for termination of the building entry conduit and housing of the PCD. Refer to Figure 33.

The CUE allows the cabling and equipment for various utilities such as electricity, telecommunications and, optionally, gas or water, to be housed in a single, compartmentalised enclosure. A CUE:

- improves the overall appearance of the building;
- simplifies the conduit and cabling arrangements, especially where the telecommunications network technology is unknown or is likely to change;
- provides convenient storage space for slack telecommunications cables (i.e. within the CUE);
- avoids problems with mounting PCDs on low-density cladding materials such as polystyrene;
- provides additional protection for the PCD and associated cables from the weather, hosing or impact from garden tools, balls, toys, etc.;
- facilitates effective earthing of the PCD, where required;
- improves accessibility by service personnel; and
- assists in implementing standardised installation practices.

The CUE must be installed by the electrician as part of the electrical installation.

Figure 33 Combined electricity and telecommunications enclosure (installed by the electrician)



Note: The equipotential bonding conductor for the CET (Communications Earth Terminal) must be installed by the electrician. The CET may be installed by either the electrician or the telecommunications installer. See section 9 for details.

6.2.2 CUE requirements

Telstra's requirements for CUEs are set out in Telstra Specification 010062, *Combined Utilities Enclosures* (Issue 4). The essential Telstra requirements for CUEs are as follows:

(a) The minimum internal dimensions of the space in which the PCD is to be housed must be 480W x 415H x 140D (in mm). The depth ("D") is measured between the face of the backboard described in (c) and the inside surface of the door.

(b) The telecommunications compartment door aperture must be at least 375W x 375H (in mm).

(c) A backboard of insulating material (e.g. timber) that is at least 400 mm wide and 18 mm thick must be provided for mounting of the PCD and must extend at least 350 mm below the horizontal plane of the top edge of the door aperture.

(d) A sturdy metal plate must be provided over any electrical conduits or cables that run behind the telecommunications backboard described in (c). A minimum clearance of 20 mm must be provided between the metal plate and the rear of the backboard for the passage of cables.

(e) Suitable cable entry facilities or knock-outs must be provided and must be accessible within the telecommunications compartment.

B&R Enclosures (http://www.brenclosures.com.au/nbn-enclosure.htm) manufactures a range of CUEs complying with Telstra Specification 010062, and these are available through electrical suppliers. Suitable enclosures are as follows:

State	Model No.	Description	Height (mm)	Width (mm)	Depth (mm)
NSW	CSN0401	Houses electrical meters & comms	934	482	255
	CSN042201	Houses electrical meters, switchboard & comms	1105	482	255
NT	CSQ0401	Houses electrical meters & comms	934	482	255
	CSQ042201	Houses electrical meters, switchboard & comms	1106	482	255
QLD	CSQ0401	Houses electrical meters & comms	934	482	255
	CSQ042201	Houses electrical meters, switchboard & comms	1106	482	255
TAS	CST022102	Houses electrical meters, switchboard & comms	1105	482	255
VIC	CSV022102	Houses electrical meters, switchboard & comms	1105	482	255

Where a CUE has been provided and meets the carrier's requirements, the PCD will be mounted inside the CUE as illustrated in Figure 33.

6.3 Where an external combined utilities enclosure (CUE) is not provided

6.3.1 General

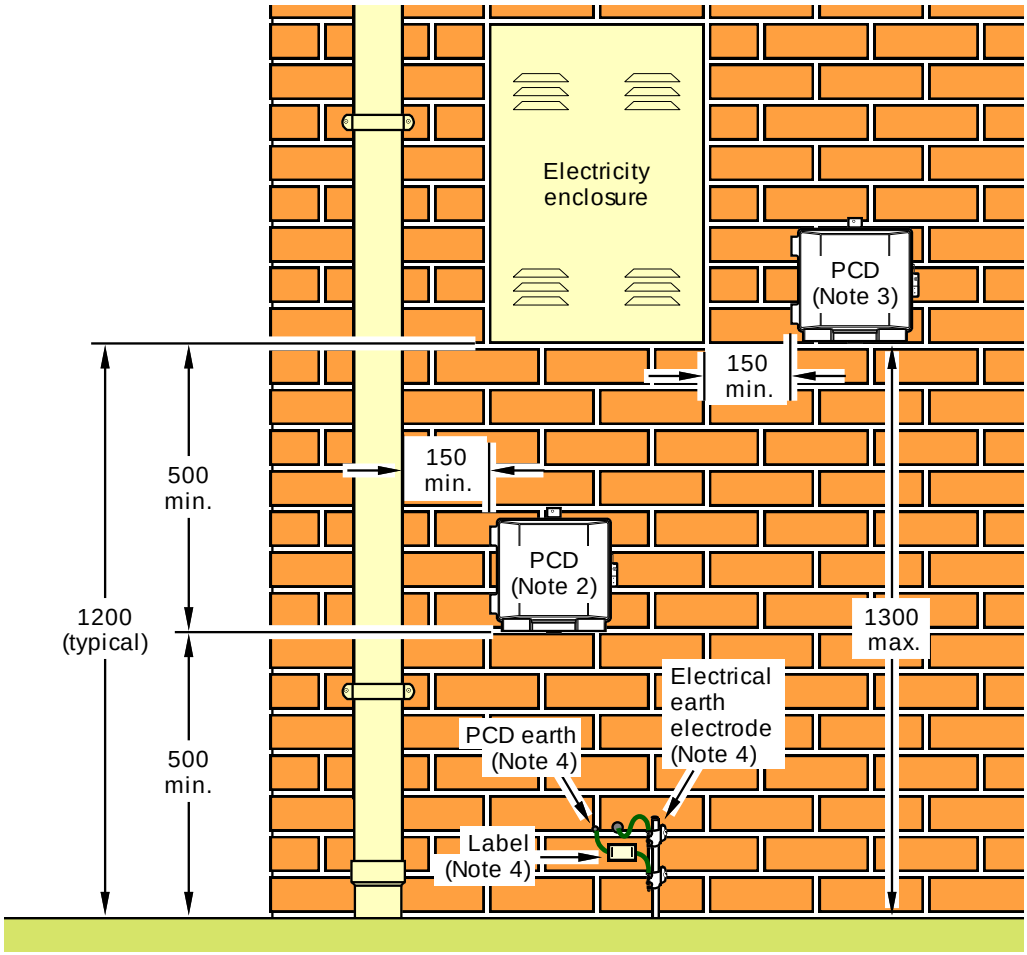
Where a CUE has not been provided, the PCD must be installed independently on the external wall.

The PCD must be installed:

- at a minimum height of 500 mm and a maximum height of 1300 mm from finished ground level, measured to the bottom of the lowest part of the PCD;
- at a minimum distance of 150 mm from the electricity enclosure or any other building fixture, measured to any part of the PCD with the cover closed; and
- outside any gas exclusion zone described in 6.3.3.1 (page 40).

These requirements are summarised in Figure 34.

Figure 34 PCD installation for new buildings where a CUE is not provided



Notes:

1. All measurements are in mm.
2. In areas that do not have a reticulated gas service (including homes where cylinder gas will be used), the preferred location for the PCD for new buildings under construction is below the electricity enclosure at a height of 500 mm to 600 mm above finished ground level. Locating the PCD below the electricity enclosure minimises the risk of obstruction by such things as downpipes, windows, doors, adjoining fences/gates and gas cylinders.
3. In areas that have a reticulated gas service, the gas meter is usually installed in the space below the electricity enclosure, in which case the preferred location for the PCD is at least 150 mm to the left or right of the electricity enclosure and at the same height as the electricity enclosure (usually about 1200 mm from finished ground level). In pre-wiring situations, if the PCD is to be located beside the electricity enclosure it will be necessary to ascertain the location of downpipes, doors, windows, adjoining fences, etc. from the building plan to determine which side of the electricity enclosure to install the PCD and the building entry conduits.
4. If the PCD requires an earth connection (refer to Figure 32), this should be made directly to the electrical earth electrode if it is accessible; otherwise, a suitable bonding conductor must be provided by the electrician from the main earthing bar of the electrical switchboard in accordance with section 9.
5. Where more than one PCD is installed (e.g. one for twisted pair lead-in cable and one for coaxial lead-in cable), they should be positioned at least 50 mm apart (measured between the nearest part of each PCD with the cover closed) even if the same lead-in conduit will be used to pull in the separate lead-in cables (see Figure 53 on page 65 for an example).

6.3.2 Low-density wall cladding (e.g. polystyrene)

If low-density cladding such as polystyrene is to be used, suitable backing board must be provided by the builder behind the cladding at the PCD location to support the PCD. In such cases, the intended position for the PCD should be marked on the building plan or the actual building by the builder.

6.3.3 PCD positioning

6.3.3.1 Separation from gas facilities

The PCD must be positioned:

- at least 500 mm above or 1000 mm to the side of any gas meter or associated fitting in accordance with Figure 35
- outside the conical exclusion zone around any gas cylinder as shown in Figure 36.

Lead-in conduit/cabling and tie conduit/cabling running to/from the PCD must be separated from any gas pipe, meter, cylinder or associated fitting by a minimum distance of 150 mm (see 8.2.2.2 on page 70).

Figure 35 Exclusion zone for gas meters

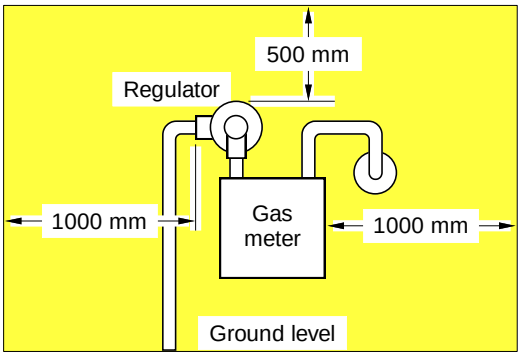
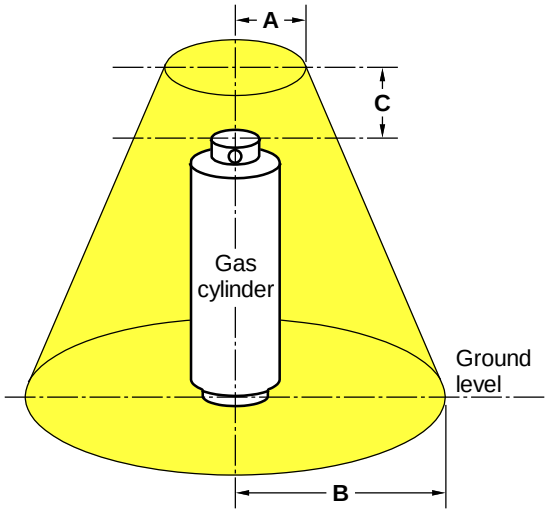


Figure 36 Exclusion zone for gas cylinders



	Exchange cylinder	In-situ fill cylinder
A	500 mm	1500 mm
B	1500 mm	3500 mm
C	500 mm	500 mm

6.3.3.2 Separation from water services

The PCD must be positioned at least **300 mm** in any direction from a **water meter** or **water tap**.

Lead-in conduit/cabling and tie conduit/cabling running to/from the PCD should be separated from any water pipe, water meter or associated fitting by a minimum distance of 50 mm (see 8.2.2.2 on page 70).

6.3.3.3 New buildings

6.3.3.3.1 Areas with reticulated gas

In areas that have a reticulated gas service, the gas meter is usually installed in the space below the electricity enclosure (meter panel or switchboard). In such areas, the preferred location for the PCD is at least 150 mm to the **left or right of the electricity enclosure** and at the **same height as the electricity enclosure** (usually about 1200 mm from finished ground level). In pre-wiring situations, if the PCD is to be located beside the electricity enclosure it will be necessary to ascertain the location of downpipes, doors, windows, adjoining fences, etc. from the building plan to determine which side of the electricity enclosure to install the PCD and the building entry conduits.

6.3.3.3.2 Areas without reticulated gas

In areas that do not have a reticulated gas service (including a home where cylinder gas will be used), the preferred PCD location for new buildings under construction is **below the electricity enclosure** at a height of 500 mm to 600 mm above finished ground level. Locating the PCD below the electricity enclosure reduces the risk of obstruction by downpipes, windows, doors, adjoining fences/gates, gas cylinders, etc.

6.3.3.3.3 PCD location away from the electricity enclosure

Where the electricity enclosure is on the opposite side of the building to the side where the property entry point is located and the underground or aerial lead-in cable cannot be run across to this side of the building (e.g. due to difficult terrain, extensive landscaping, retaining wall, paved driveway, swimming pool, trees, etc.), the PCD may be located at the side of the building nearest to the property entry point as long as the builder, electrician or customer provides a suitable earthing conductor at the PCD location if an earth is required (see Figure 32 and section 9). In such cases, care must be taken to avoid gas cylinders (see 6.3.3.1) which are normally located away from the electricity enclosure. Also, if the premises is in a defined lightning risk situation and will be connected to a copper network, there may be a need to install a PCD on each side of the building joined by "lead-in extension" cabling (see Figure 10).

For optical (FTTP) networks, the PCD may be located on the opposite side of the building to the electricity enclosure if this is expedient — as long as the builder, electrician or customer provides a suitable earthing conductor at the PCD location if an earth is required and care is taken to avoid gas cylinders. Refer to Figure 32 and section 9 for details.

Note: Even though optical fibre is not electrically conductive, optical PCDs must be separated from gas facilities in accordance with 6.3.3.1 in case fusion splicing of fibres needs to be carried out at the PCD.

6.3.3.4 Established buildings

For established buildings (e.g. building reconstruction or renovation), it will normally be necessary for the PCD to be located beside (not below) the electricity enclosure or, in some cases, near the existing building entry point which may not be near the electricity enclosure. In all cases, the PCD must be installed within the height limitations shown in Figure 34 and must be separated from gas and water services in accordance with 6.3.3.1 and 6.3.3.2.

A suitable earthing/bonding conductor must be provided for connection to the PCD, if required (refer to Figure 32 and section 9).

7 BUILDING ENTRY CONDUITS

7.1 Description

Building entry conduits are the conduits that provide for the penetration of the telecommunications cables into the building. The conduits must allow cables to be pulled through them while preventing the entry of water or vapour into the building or the covert entry of termites.

For some types of building construction (e.g. brick veneer), conduits may be partially concealed inside the wall cavity; otherwise they may be fastened to the surface of the external wall. Each method has its advantages and disadvantages. Concealed conduits produce a neater result — as long as the conduits are positioned correctly.

The integrity of the building entry conduits is very important to ensure that cables can be pulled through them without stress or damage.

In particular, the conduits and bends must be capable of allowing an optical fibre cable with a factory-fitted connector within a protective boot or hauling sock to pass through them (see 4.2.6 on page 7). Pre-formed bends **must** be used — conduit must **not** be bent on site whether or not this is done by the application of heat or using a bending tool.

The use of some form of Premises Connection Device (PCD) on the external wall of the home is an essential part of the building entry facilities.

The PCD:

- provides a transition from outdoor type cable to indoor type cable;
- supports mitigation against the entry of water and termites to the building via the lead-in conduit;
- facilitates future repair or replacement of the telecommunications lead-in cabling or tie cabling; and
- provides an external access point for testing of cables or services at the building.

If it is not possible to use an external PCD for some reason, the relevant carrier must be consulted.

Under no circumstances should underground lead-in conduit terminate inside the building unless a "drainage pit" is used at the external wall of the building to reduce the risk of entry of water and termites to the building via the conduit. Refer to 7.6 (page 68).

7.2 Lead-in entry conduit

7.2.1 Conduit type

For homes, **white**, **rigid** (UPVC) plastic conduit and fittings with an **inside diameter (ID) of 23 mm** that complies with 4.2.1 and 4.2.2 is used for installation of the lead-in cable(s) between the property entry point and the PCD. No more than the equivalent of **two 90° bends** is permissible **at the building**, comprising:

- one **300 mm radius** bend (or equivalent where composite bends are used over the footings) in the **underground** portion; and
- one **100 mm radius** bend in the **aboveground** portion (e.g. within the wall cavity).

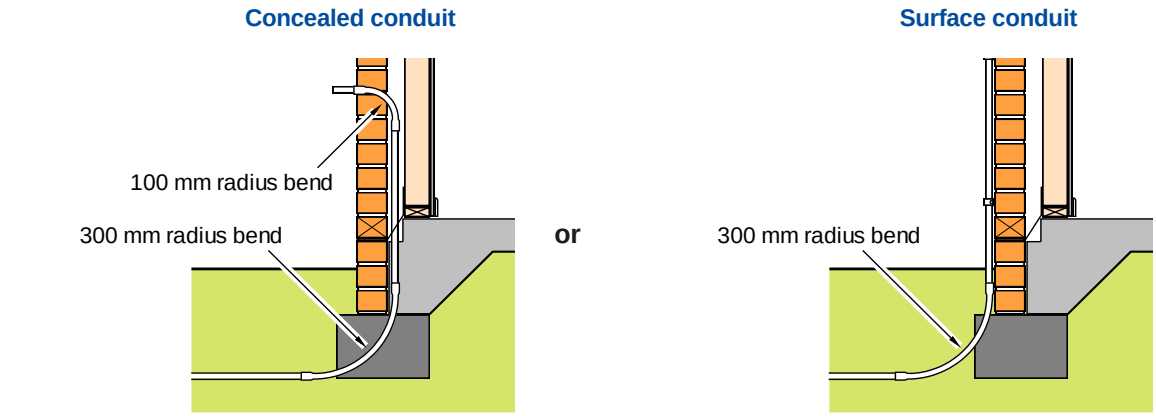
Refer to Figure 37.

Note: Another 300 mm radius bend may be used at the street pit, making a total of three bends (the maximum permissible) between cable access points (see Figure 4).

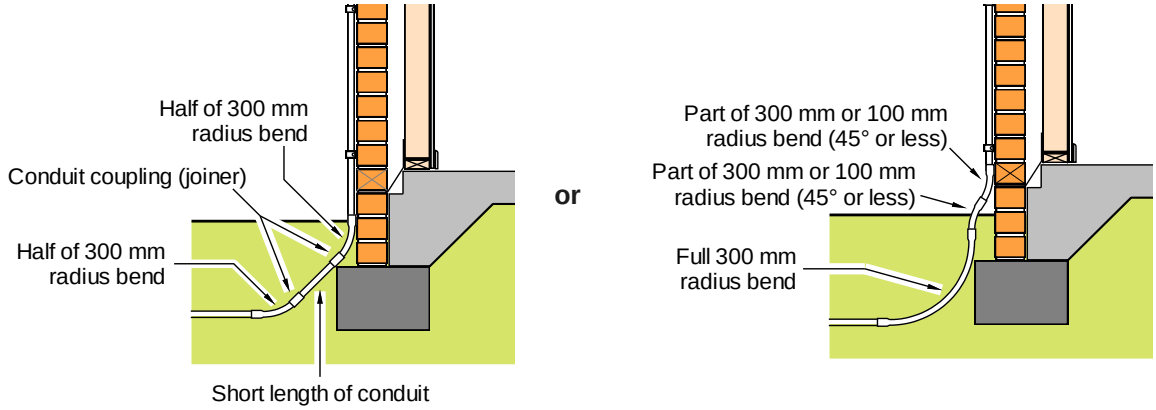
Flexible conduit with a minimum outside diameter (OD) of 25 mm may be used on the **external wall** to protect the cable between the point where the rigid conduit terminates on the external wall and the PCD, as long as the flexible conduit can be separated from the rigid conduit for future access. **This is for information only** — the **carrier** will install any flexible lead-in conduit that is required on the external wall.

Figure 37 Lead-in conduit and bends at the building

(a) Conduit installed in the building footings



(b) Conduit installed over the building footings



Notes:

1. No more than the equivalent of two 90° bends, comprising one **300 mm radius** bend **underground** and one **100 mm radius** bend **aboveground**, are permissible at the building. Another 300 mm radius bend may be used at the street pit, making a total of three bends (the maximum permissible) between cable access points (see Figure 4).
2. Only **pre-formed bends** may be used. Conduit must **not** be bent on site (e.g. by application of heat or using a bending tool). Flexible/corrugated conduit must not be used for this purpose.

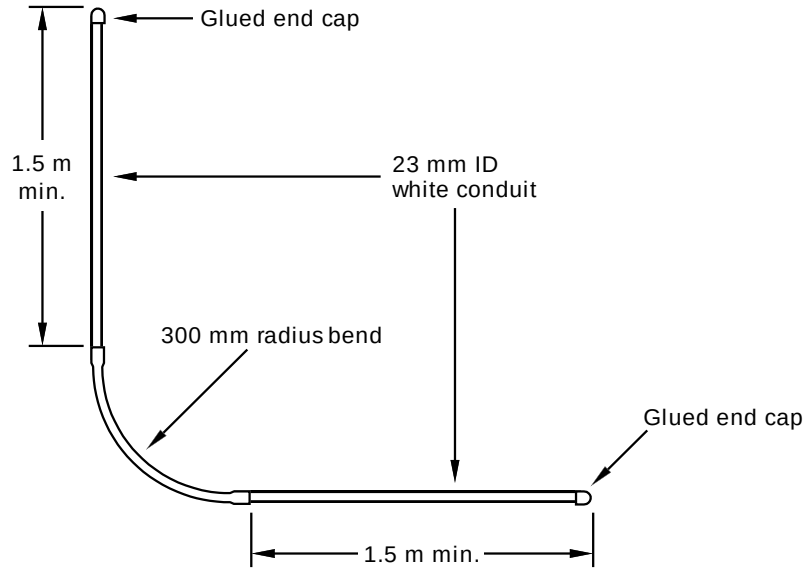
7.2.2 Lead-in conduit positioning in the building foundations

Conduit for underground lead-in cabling should be installed in the building footings before the concrete is poured. A conduit/bend assembly should be located in the building footings in accordance with Figure 38. Otherwise, the conduit will need to be installed over the footings later, but it may protrude from the wall as shown in Figure 37 (b).

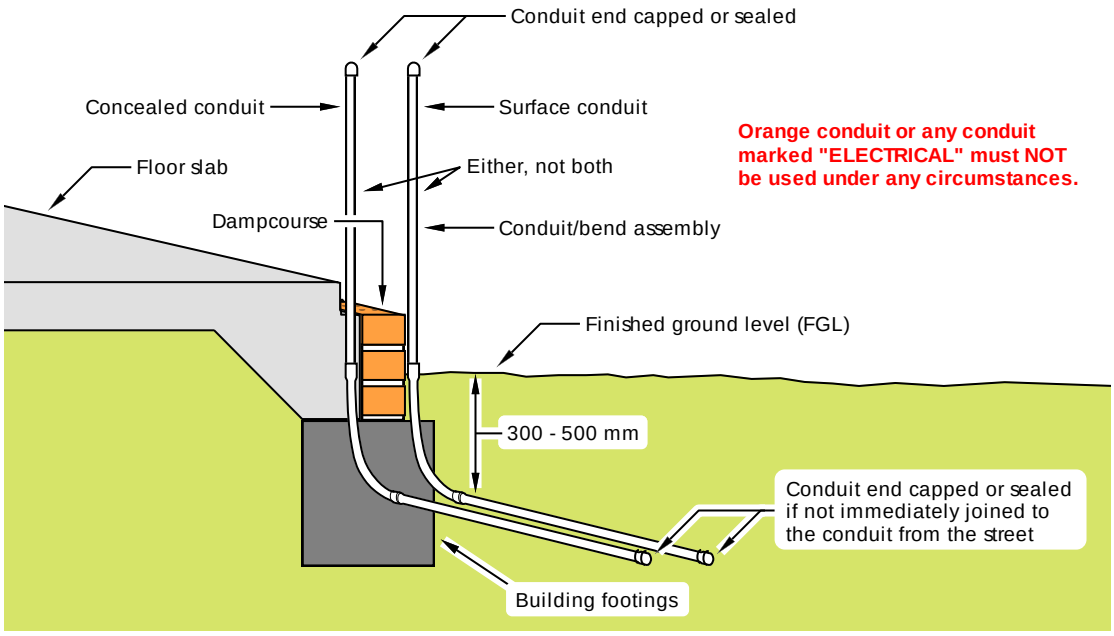
Any conduit installed in the building footings must comply with 7.2.1. Suitable lengths of conduit must be glued to the bend using solvent conduit cement. Conduit of any other size (whether it has a larger or smaller diameter) will not be useable by the carrier.

Figure 38 Lead-in building entry conduit installation

(a) Conduit and bend assembly (Note 1)



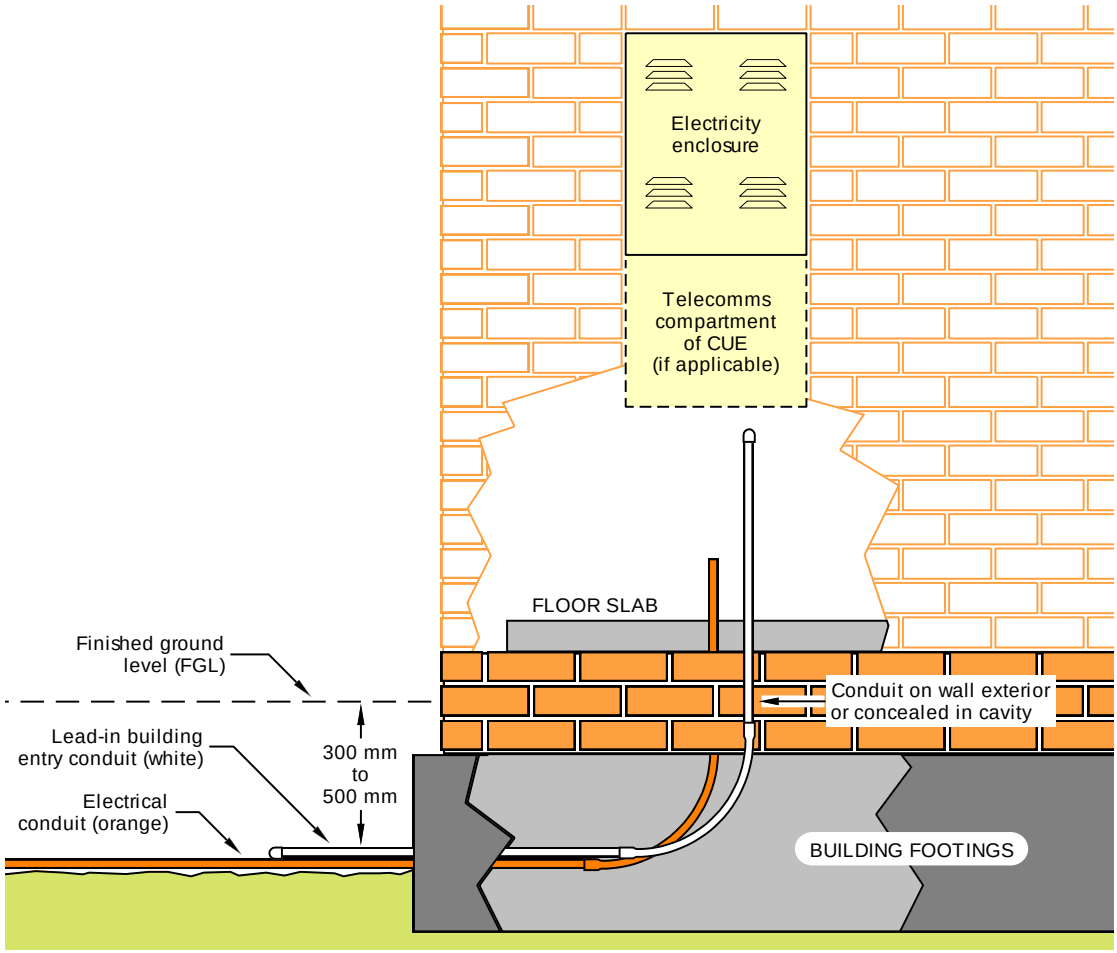
(b) Positioning of the lead-in conduit/bend assembly in the building footings



Notes:

1. The conduit/bend assembly must be made from suitable lengths of **white, 23 mm ID, UPVC conduit** complying with 7.2.1 glued to a **300 mm radius** bend using solvent conduit cement. For Telstra lead-in cabling, the conduits and bends may be marked “Telstra” or “NBN”. Conduits or bends of the same inside diameter but marked “Communications” may also be used — however, any conduit or bend marked as “20 mm” or “25 mm” and including “2053” in the markings (i.e. manufactured to Australian Standard AS/NZS 2053) is physically incompatible with Telstra and NBN Co networks and is **not suitable** for lead-in building entry conduit.
2. The end of the conduit/bend assembly should be capped to:
   - prevent the entry of debris or silt into the conduit during building construction; and
   - as a safeguard in case it is never used to ensure that it does not provide a corridor for the entry of water or termites into the wall cavity (the cap should be glued to any conduit laid in a trench or positioned in the wall cavity — to be cut away later when jointing the lead-in conduit or the bend in the wall cavity).

Figure 39 Building entry conduit positioning relative to the electricity enclosure



Notes:

1. The conduit may enter the building footings from any direction as long as it is pointed in the general direction of the carrier's property entry point (if it is not already joined to the lead-in conduit from the property entry point).
2. Where a CUE is not, or will not be, provided, the vertical section of the lead-in conduit must be correctly positioned in relation to the intended PCD location, as the use of flexible conduit or more than one bend within the wall cavity is not permitted for the lead-in cabling.

7.2.3 Termite barriers

Virtually all buildings in mainland Australia require a termite barrier to be installed around the perimeter of the building or on isolated piers, posts or stumps used to support the building or such things as verandas and staircases. The purpose of the barrier is to impede termite entry to the building and to ensure that any shelter tubes constructed by termites over the barrier are visible.

Common termite barriers consist of exposed slab edge, stainless steel mesh, metal capping, graded stone or chemically treated soil. Whatever method is used, the lead-in conduit will bridge or breach the termite barrier where the conduit enters the building. Termites can build a shelter tube around some barriers but they are then in the open where they can be detected more readily during regular inspections by a competent person. Bridging or breaching of these termite barriers by such things as conduits and cables may defeat the protection measures taken.

For new building construction, it is important that any underground lead-in conduit be installed at the building footings before the termite barrier is installed so that the conduit is treated appropriately by the termite barrier installer.

For established buildings, any new underground lead-in conduit installed will either bridge or breach the existing termite barrier. Where the conduit penetrates the termite barrier (e.g. graded stone, chemically treated soil), the barrier must be reinstated at the penetration point by a qualified termite barrier installer. Where the conduit bridges the termite barrier (e.g. exposed slab edge, stainless steel mesh or metal capping), the conduit must be installed in a way that does not impede clear visual inspection of the termite barrier where it is bridged (e.g. it must not be fixed into a corner against two adjoining walls or against another conduit or pipe). Additionally, the conduit must not cover any weepholes.

7.3 Conduit for tie cabling

7.3.1 Description

Tie cabling is the cabling between the PCD and the CCP. It may consist of customer cabling, multi-core DC power cabling, extension of the carrier's lead-in cabling, or a combination of these. For details, refer to Document No. 017153a01, *Cabling of premises for telecommunications — Essential information for home cabling*.

At least one **white**, **rigid** (UPVC) plastic conduit with a minimum **inside diameter (ID)** of **23 mm** should be provided between the PCD and the CCP or, if this is not possible, between the PCD and a suitable access point for pulling in the tie cable(s), as shown in Figure 40 and Figure 41. The requirements for the tie cabling conduits are set out in 7.3.2.

Note: Where the PCD is likely to be an outdoor FTTP NTD or if two PCDs will be installed, the provision of a **second conduit** may be required **for coaxial cabling** (see Figure 1).

The conduit for the tie cabling will:

- provide a pathway between the PCD and the CCP for the installation of the tie cabling either before or after building completion and for replacement of the cabling at some future time to accommodate any change in telecommunications network technology;
- protect the cabling from damage during construction activities;
- help to ensure that the cabling is not dislocated or entombed in the wall cavity during construction;
- ensure that any required cable separation requirements of the telecommunications and electrical wiring rules are met;
- where a CUE is not used, correctly position the cabling at the PCD location; and
- protect the cabling from possible rodent damage after construction (optical fibre cables in particular may be susceptible to damage by rodents due to the absence of an electric field around the cable).

7.3.2 Conduit requirements

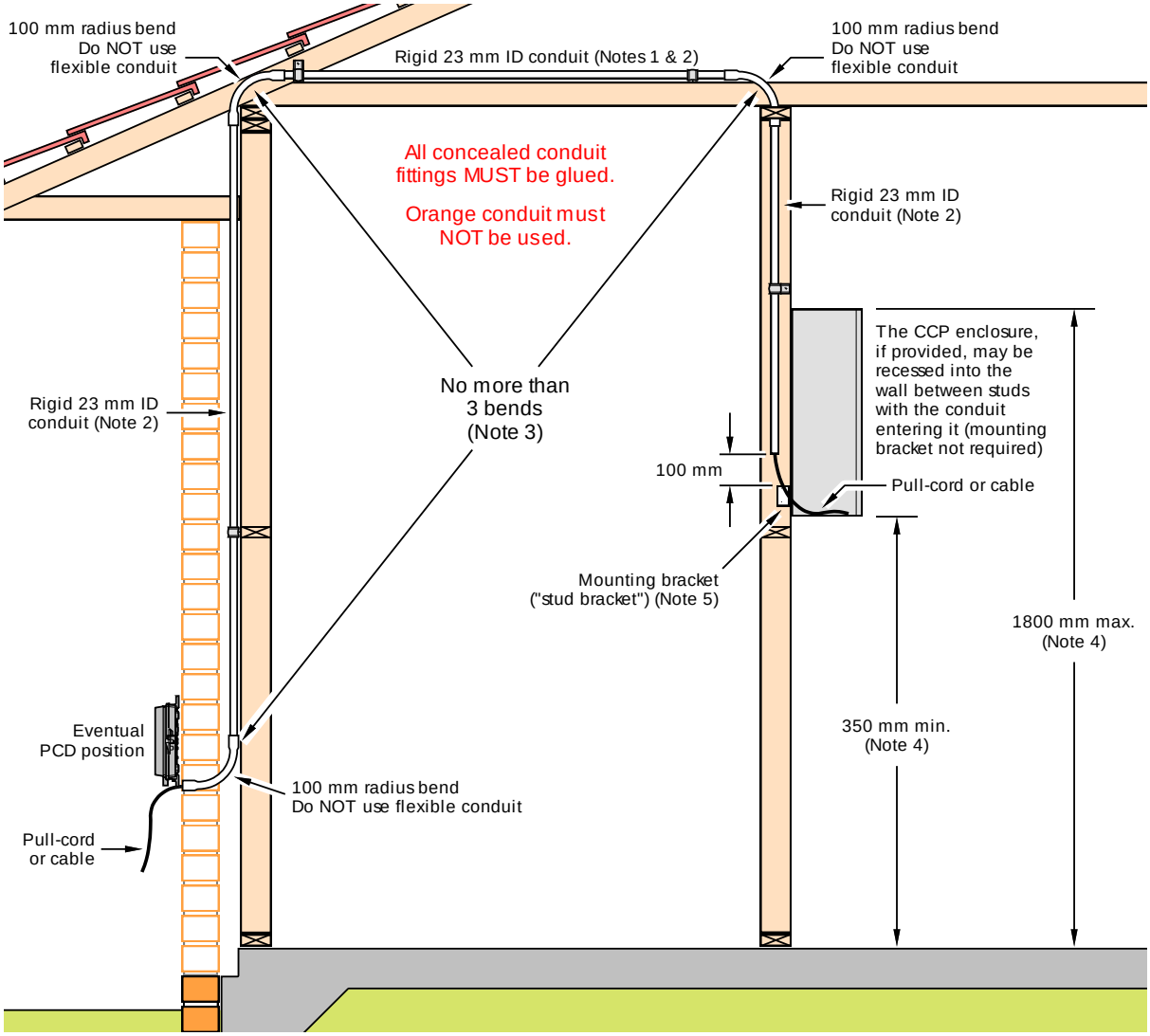
The conduit for the tie cabling is to comply with the following:

- **White, rigid (UPVC) plastic conduit** with a minimum **inside diameter (ID)** of **23 mm** must be used (e.g. Telstra or NBN "20 mm" conduit or 32 mm UPVC "Communications" conduit to AS/NZS 2053).
  Note: 32 mm (outside diameter) conduit won't fit in some external wall cavities (e.g. within double-brick walls or between bracing ply and brick veneer). Check with the builder or bricklayer before using 32 mm conduit.
- There must be **no more than 3 x 90° bends** between cable pulling points.
- Each bend must have an **inner bend radius of 100 mm or greater**.
- A 3 mm polypropylene, braided cord (or equivalent) must be threaded through the conduit and bends to be used as a **pull-cord** for the tie cable(s).
- All conduit and fittings **must be glued** to prevent them coming apart.
- The conduit must be **restrained along its length** to prevent movement while pulling cable in.
- Orange conduit, flexible conduit or any conduit marked "ELECTRICAL" **must not be used**.

7.3.3 Conduit installation

The conduit should be installed through the roof space (or through the floor space of the upper floor of a two-storey home). Arrange the conduit markings to be visible to any person working in the roof space after building completion. The conduit may be installed in the concrete slab but this carries a high risk of error in positioning the conduit at the internal wall (i.e. at the CCP) and the conduit being waterlogged due to rain during construction which may lead to premature failure of the internal tie cable(s).

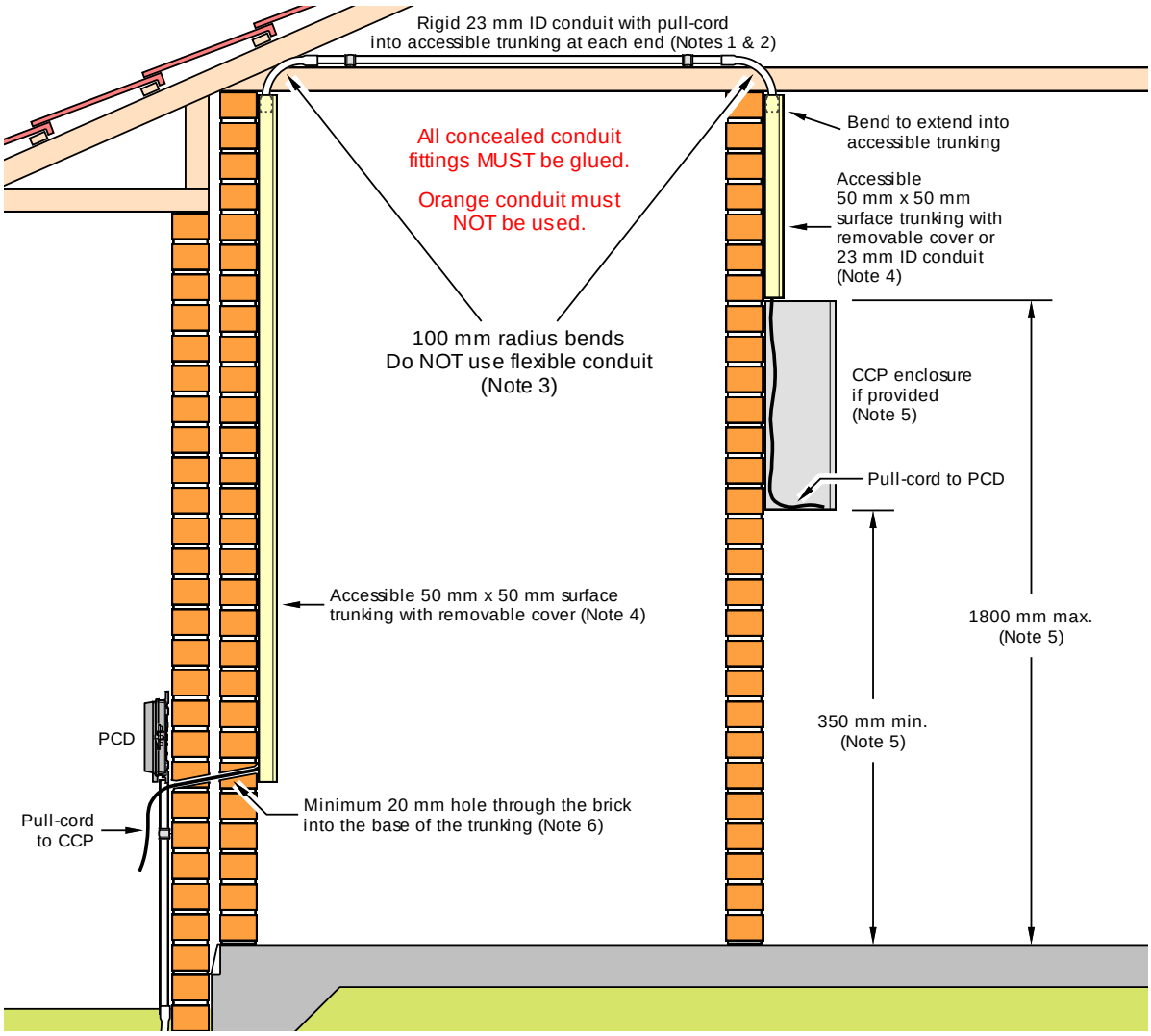
Figure 40 Typical conduit installation for tie cabling in cavity walls



Notes:

1. For a two-storey home, the conduit may pass between or through the bearers of the upper floor (subject to compliance with building codes) or through the roof space of the upper storey as long as the total length of cabling between the PCD and the CCP will not exceed **25 m** unless it is certain that an **indoor** FTTP NTD will be installed, in which case the length should not exceed **40 m**. The CCP may be located in the lower or upper floor, whichever is convenient. Where solid masonry or double-brick building construction is used, it may be necessary to chase the conduit into the walls unless surface-mounted conduit or trunking is acceptable to the customer (see Figure 41).
2. Use rigid conduit with a minimum inside diameter (ID) of 23 mm (e.g. Telstra or NBN “20 mm” UPVC conduit). Do **not** use orange conduit, flexible conduit or any conduit marked “ELECTRICAL”. Extra conduit(s) may be required for any coaxial cables (see Figure 1).
3. Use no more than 3 x 90° bends between cable pulling points. The inner bend radius of each bend must be 100 mm or greater. The conduit must be restrained along its length to prevent movement while pulling cable in.
4. Normally the CCP enclosure would be installed between wall studs above the nogging (about 1200 mm above the floor). If the CCP enclosure will be lower or higher, the bottom of the enclosure should be no less than 350 mm from the floor and the top of the enclosure should be no more than 1800 mm above the floor. Whether the powered electronic devices are to be located inside or outside the enclosure, they should be installed within the range of 350 mm to 1800 mm from the floor (i.e. no part of any device should be outside that range).
5. Where a CCP enclosure is not installed between the wall studs, install a mounting bracket 100 mm below the end of the conduit as a place marker for the tie cable.

Figure 41 Typical conduit/trunking installation for tie cabling on solid masonry or double-brick walls



Notes:

1. For a two-storey home, the conduit may pass between or through the bearers of the upper floor (subject to compliance with building codes) or through the roof space of the upper storey as long as the total length of cabling between the PCD and the CCP will not exceed **25 m** unless it is certain that an **indoor** FTTP NTD will be installed, in which case the length should not exceed **40 m**. The CCP may be located in the lower or upper floor, whichever is convenient.
2. Use rigid conduit with a minimum inside diameter (ID) of 23 mm (e.g. Telstra or NBN "20 mm" UPVC conduit). Do **not** use orange conduit, flexible conduit or any conduit marked "ELECTRICAL". Extra conduit(s) may be required for any coaxial cables (see Figure 1).
3. Use no more than 3 x 90° bends between cable pulling points. The inner bend radius of each bend must be 100 mm or greater. The conduit must be restrained along its length to prevent movement while pulling cable in.
4. The trunking must be accessible for removal of the cover and insertion of the cable(s). The conduit and pull-cord must extend into an accessible part of the trunking. Conduit may be chased into the wall or run on the surface of the wall in preference to using surface-mounted trunking, as long as the conduit complies with 7.3.2.
5. The bottom of the CCP enclosure should be no less than 350 mm from the floor and the top of the CCP enclosure should be no more than 1800 mm above the floor. Whether the powered electronic devices are to be located inside or outside the enclosure, they should be installed within the range of 350 mm to 1800 mm from the floor (i.e. no part of any device should be outside that range).
6. A hole must be drilled through the external wall from the bottom of the PCD into the trunking at a slight upward angle. The hole must be at least 20 mm diameter to pass an optical fibre cable fitted with a connector. Extra hole(s) may be required for any coaxial cable(s) (see Figure 1).

7.4 Building entry conduit arrangements where a CUE is used

If a combined utilities enclosure (CUE) is not being used, skip to 7.5 on page 55.

7.4.1 General

Underground lead-in cabling is used in virtually all new developments. Aerial lead-in cabling may be used in established areas or in new developments where the ground conditions preclude underground cabling construction.

Rigid conduit must be used all the way to the telecommunications compartment of the CUE. **All conduit joints and fittings must be glued.** Flexible conduit should not be used within building cavities due to the difficulty of pulling cables through flexible conduit.

7.4.2 Tie cabling

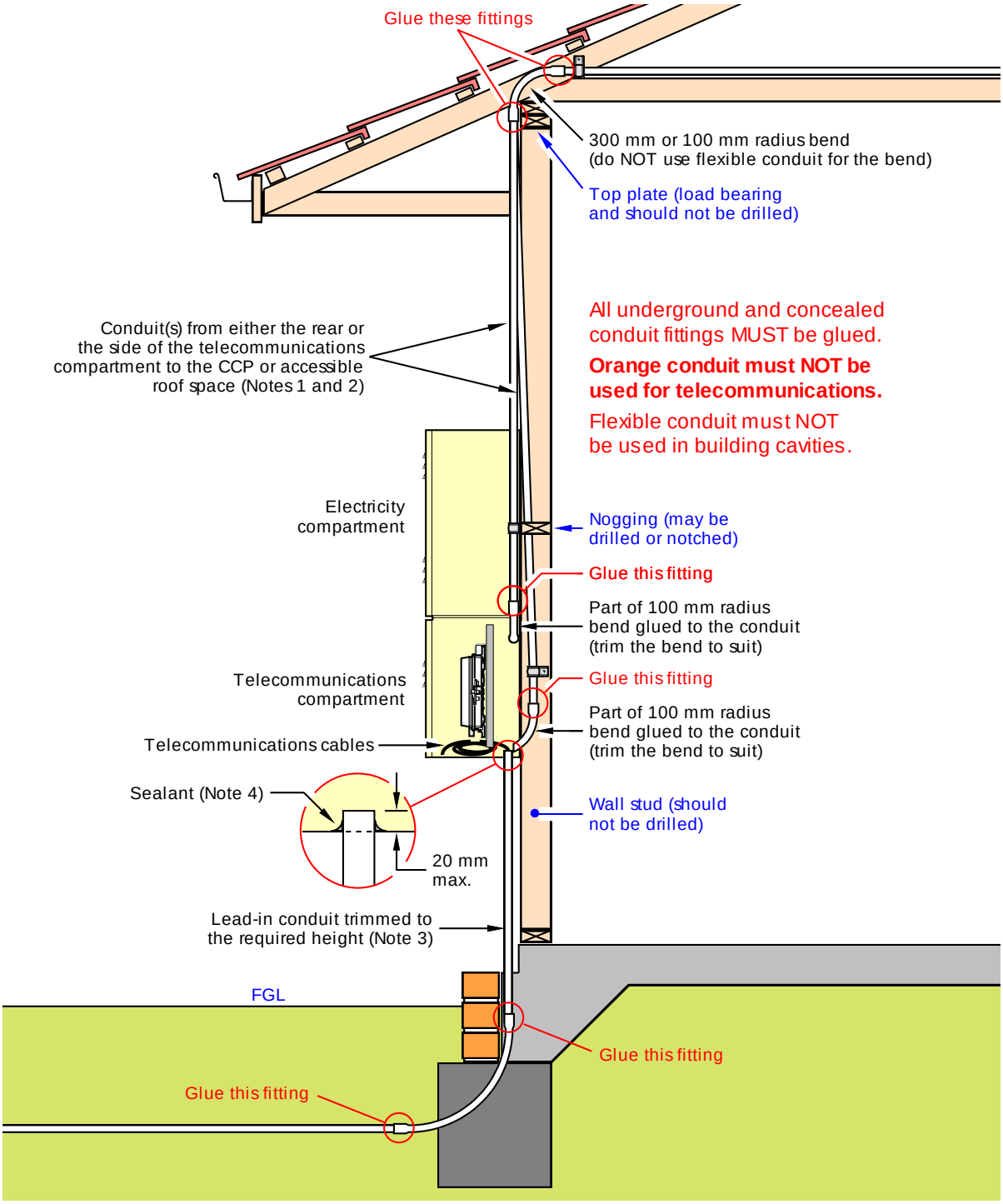
Conduit(s) for the tie cabling will terminate in the CUE as shown in Figure 42 to Figure 45. Refer to 7.3 for more information about conduits for tie cabling.

7.4.3 Underground lead-in cabling

Underground lead-in conduit will terminate within the CUE, which should be designed to allow any water emitting from the end of the conduit to drain to the bottom, front edge of the door opening. To ensure that such water does not drain back into the wall cavity, the outer surface of the conduit should be sealed where it penetrates the CUE (e.g. using an ant-resistant, flexible sealant). The end of the conduit should terminate no more than 20 mm above the penetration to the CUE to ensure that it is visible for inspection under the backboard for termite activity.

Figure 42 and Figure 43 show typical conduit arrangements for cavity wall (e.g. brick veneer and timber or metal framed) buildings. For buildings of solid masonry or double-brick construction, refer to Figure 41 for typical tie cabling conduit arrangements.

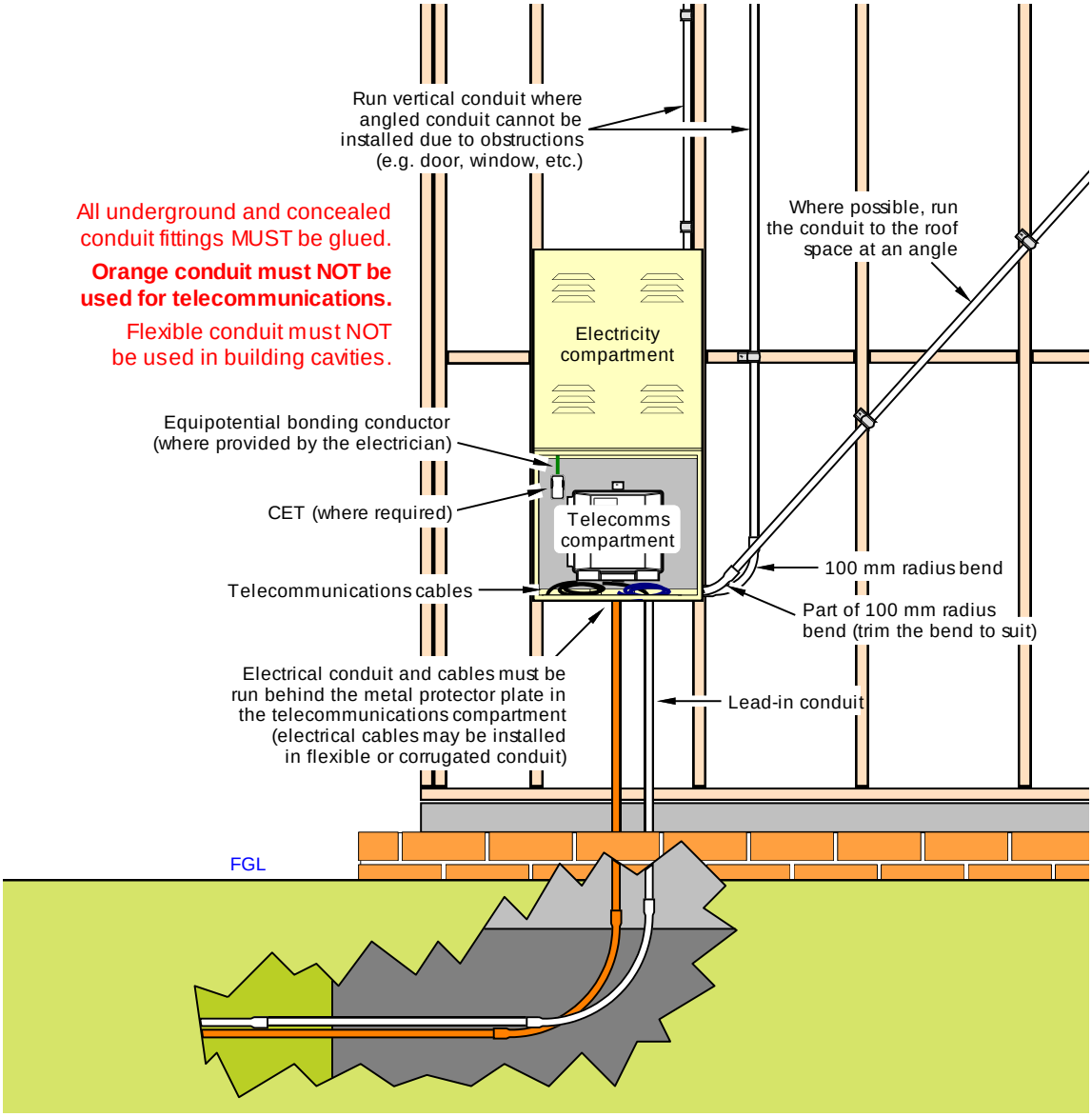
Figure 42 Conduit arrangements for a CUE installation on a cavity wall — side view



Notes:

1. Run the conduit for the tie cabling to either the side or the rear of the telecommunications compartment, as appropriate. Where the conduit runs behind the enclosure, run it between the studs, not on the front of the studs. Ensure that the telecommunications cables are separated from the power cables in accordance with 8.2.2.1.
2. Secure the conduit to the wall studs and/or noggings with conduit saddles or half-saddles. Glue all conduit and bend joints so that the fittings will not come apart when cables are being pulled through them.
3. The lead-in conduit must not be drilled under any circumstances, as this may allow the covert entry of water or termites to the wall cavity via the underground lead-in conduit.
4. The lead-in conduit should be sealed where it enters the CUE to prevent any water emitting from the conduit from draining into the wall cavity.

Figure 43 Conduit arrangements for a CUE installation on a cavity wall — front view



Notes:

1. If possible, run the conduit to the roof space at an angle so that:
   - the conduit bend at the top will fit comfortably between the top plate and the roof battens; and
   - the cabling will be clear of the power cables running from the electricity compartment in the roof space.

   Alternatively, the conduit may run directly to the CCP if it is to be located on the internal side of the same wall on which the CUE is located.
2. Where it is not possible to run the conduit at an angle, run it vertically beside the enclosure or between the wall studs behind it. Ensure that the telecommunications cables are separated from the power cables in accordance with 8.2.2.1.

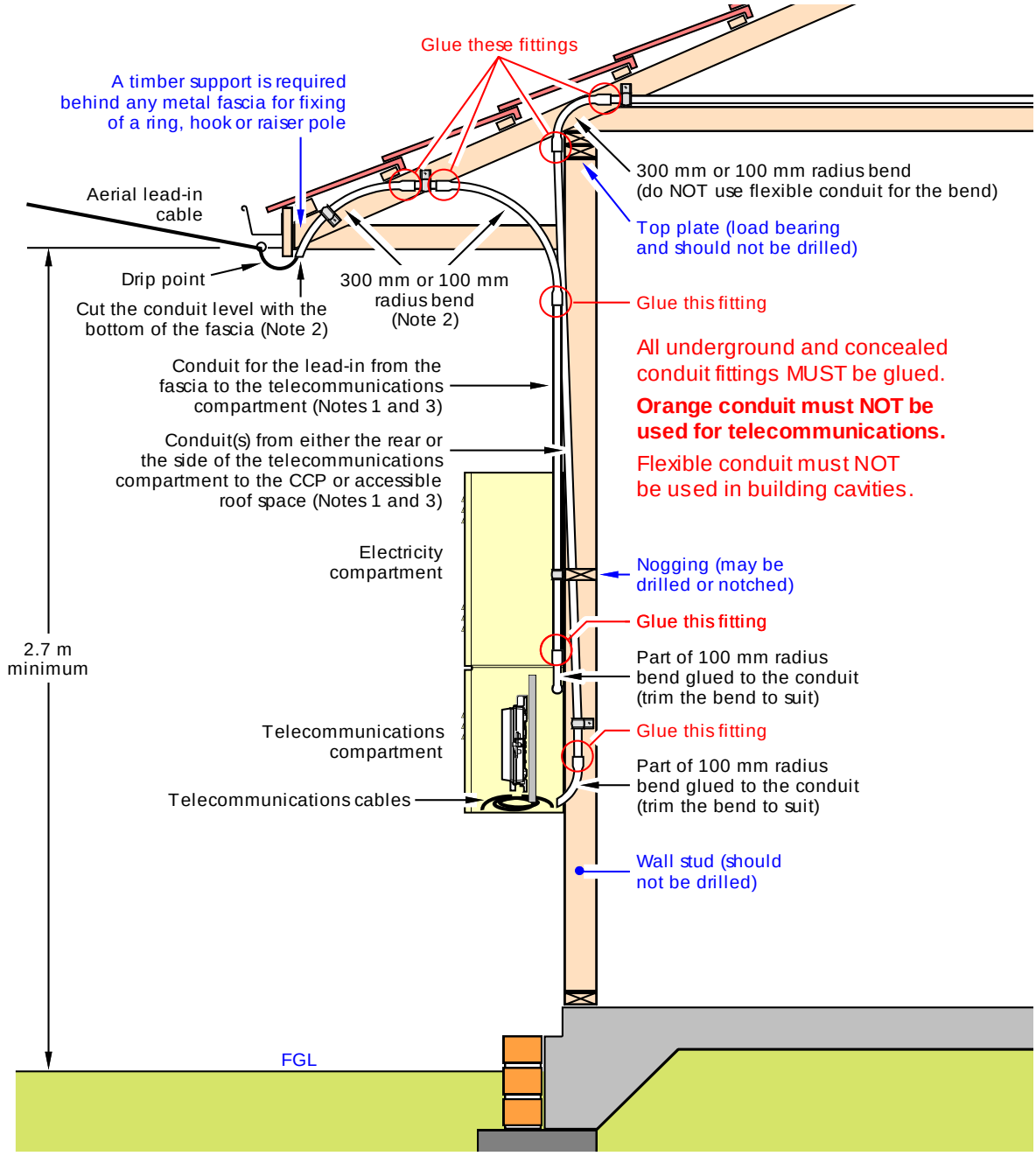
7.4.4 Aerial lead-in cabling

Aerial lead-in cabling is normally only used in established suburbs or in rural areas where the nature of the terrain precludes underground cabling.

Aerial lead-in conduit will terminate within the CUE, which should be designed to allow any rainwater that gets into the conduit at the fascia to drain to the bottom, front edge of the CUE door opening. With aerial lead-in cabling, there is no need to worry about inspection of the end of the conduit for termite activity.

Figure 44 and Figure 45 illustrate typical conduit arrangements for cavity wall (e.g. brick veneer and timber/metal framed) buildings. For buildings of solid masonry or double-brick construction, refer to Figure 41 for typical tie cabling conduit arrangements.

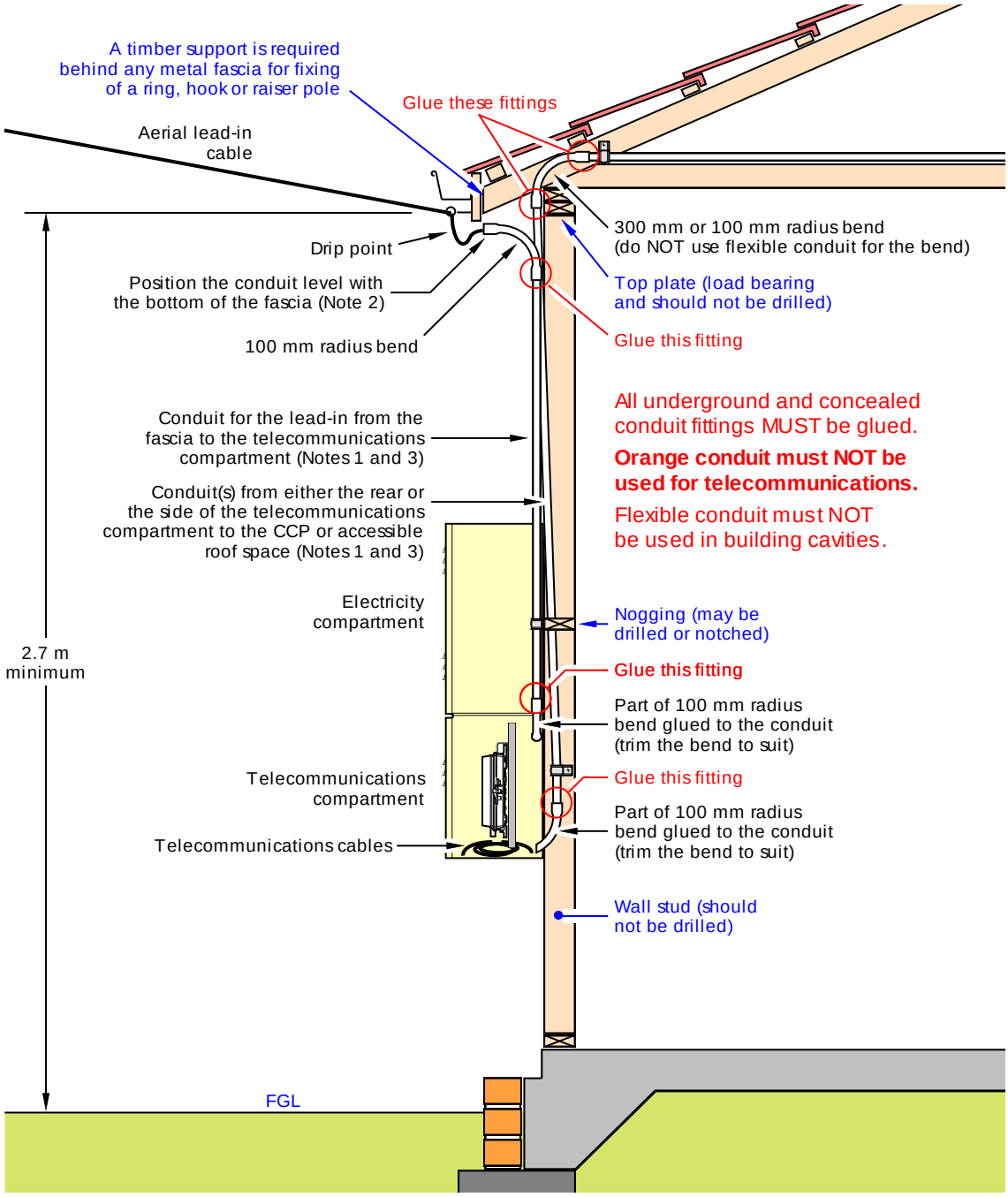
Figure 44 Conduit arrangements for a CUE installation on a cavity wall — building with 450 mm to 600 mm eaves



Notes:

1. Run the conduits for the lead-in cabling and tie cabling to either the side or the rear of the telecommunications compartment, as appropriate. Where the conduits run behind the enclosure, run them between the studs, not on the front of the studs. Ensure that the telecommunications cables are separated from the power cables in accordance with 8.2.2.1.
2. Fix the bends firmly to the eaves truss as shown such that the conduit is hard up against the inside of the fascia. 100 mm radius bends may be used where 300 mm radius bends won't fit. Cut the conduit flush with the bottom of the fascia. All bends must be glued to the conduit.
3. Secure the conduits to the wall studs and/or noggings with conduit saddles or half-saddles. Glue all conduit and bend joints so that the fittings will not come apart when cables are being pulled through them.

Figure 45 Conduit arrangements for a CUE installation on a cavity wall — building with narrow or no eaves



Notes:

1. Run the conduits for the lead-in cabling and tie cabling to either the side or the rear of the telecommunications compartment, as appropriate. Where the conduits run behind the enclosure, run them between the studs, not on the front of the studs. Ensure that the telecommunications cables are separated from the power cables in accordance with 8.2.2.1.
2. Fix the top bend as shown such that the top of the conduit is level with the bottom of the fascia. Cut the conduit flush with the inside face of the fascia. All bends must be glued to the conduit.
3. Secure the conduits to the wall studs and/or noggings with conduit saddles or half-saddles. Glue all conduit and bend joints so that the fittings will not come apart when cables are being pulled through them.

7.5 Building entry conduit arrangements where a CUE is *not* used

If a combined utilities enclosure (CUE) is being used, go back to 7.4 on page 49.

7.5.1 General

Underground lead-in cabling is used in virtually all new developments. Aerial lead-in cabling may be used in established areas or in new developments where the ground conditions preclude underground cabling construction.

Rigid conduit must be used all the way to the external wall of the building. **All rigid conduit joints and fittings must be glued.** Flexible conduit should not be used within building cavities due to the difficulty of pulling cables through flexible conduit. However, if necessary flexible conduit with a minimum outside diameter (OD) of 25 mm may be used on the **external surface** of the building as long as it can be separated from the rigid conduit for future access for pulling in cables (this is for information only — the carrier will install any flexible lead-in conduit that is required on the external wall).

7.5.2 Tie cabling

Conduit(s) for the tie cabling will terminate below the PCD as shown in Figure 46 to Figure 49. See 7.5.5 for details about positioning of the conduits at the PCD location. Refer to 7.3 for more information about conduits for tie cabling.

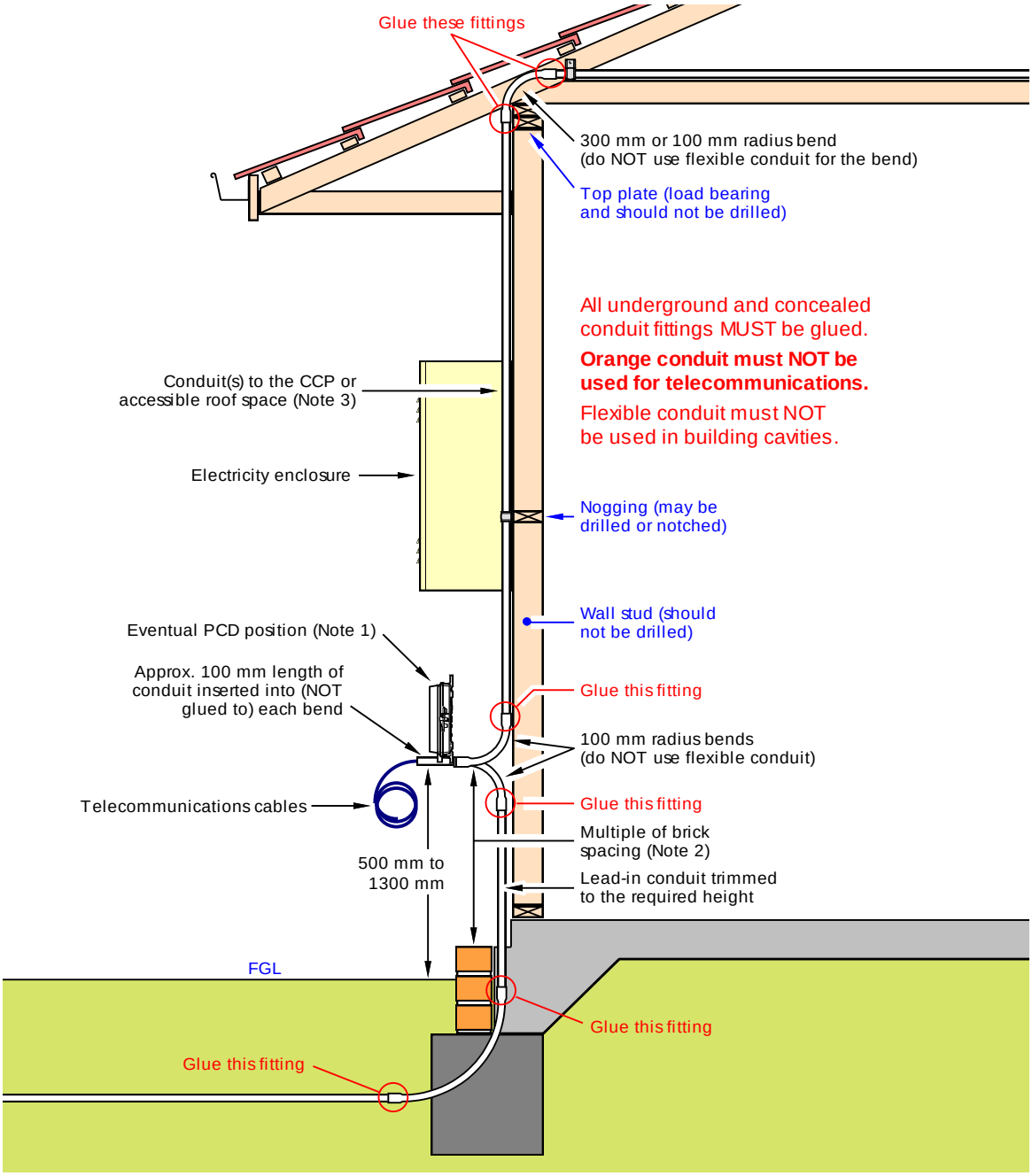
7.5.3 Underground lead-in cabling

Underground lead-in conduit must terminate at the external wall of the building to allow any water or vapour emitting from the end of the conduit to drain harmlessly outside the building and to ensure that the conduit opening is visible to enable inspection for termite activity.

For new buildings under construction, the PCD should be located either under or beside the electricity enclosure in accordance with 6.3.1 (page 38). Where it is not possible to locate the PCD near the electricity enclosure, refer to 6.3.3.3.3 (page 41).

Figure 46 and Figure 47 illustrate typical conduit arrangements for cavity wall (e.g. brick veneer and timber/metal-framed) buildings. For buildings of solid masonry or double-brick construction, refer to Figure 41 (page 48) for typical tie cabling conduit arrangements.

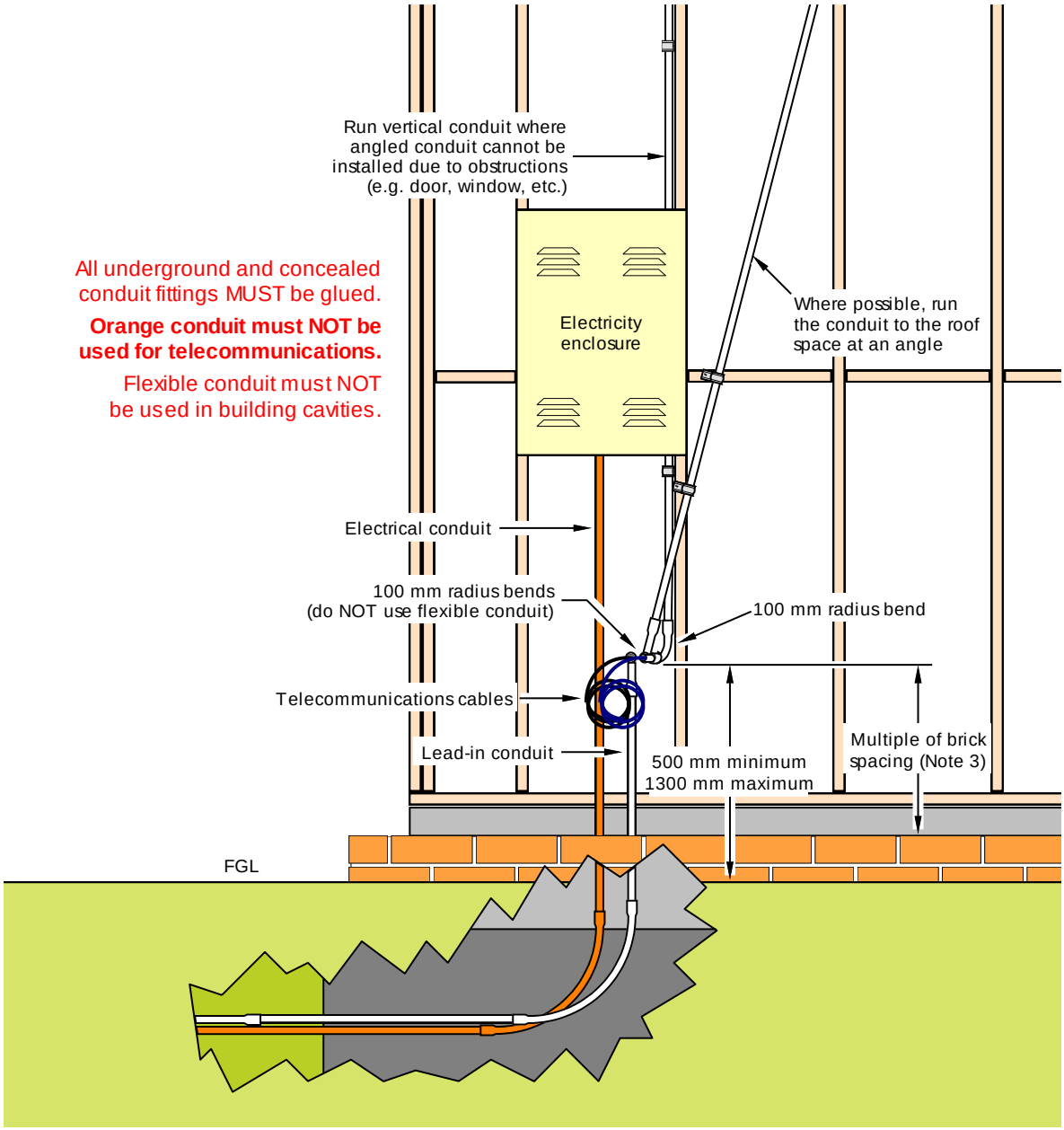
Figure 46 Conduit arrangements for a non-CUE installation on a cavity wall underground lead-in cabling — side view



Notes:

1. For new buildings under construction in an area that does not have a reticulated gas service (including homes where cylinder gas will be used), the PCD should be located below the electricity enclosure, as indicated above, to avoid obstruction by such things as downpipes, windows, doors, adjoining fences/gates and gas cylinders. Otherwise, the PCD should be located beside the electricity enclosure.
2. Fix the horizontal section of each bend a multiple of the brick spacing above the brick base. For standard 230 x 110 x 76 clay bricks, this will be a multiple of 86 mm, e.g. 7 bricks x 86 mm = 602 mm. In areas that have a reticulated gas service, locate the conduits to either side of, and level with the bottom of, the electricity enclosure (see Figure 34 on page 39 and 6.3.3.3.1 on page 40).
3. Where the conduit runs behind the electricity enclosure, run it between the studs, not on the front of the studs. Ensure that the telecommunications cables are separated from the power cables in accordance with 8.2.2.1. Secure the conduit to the wall studs and/or noggings with conduit saddles or half-saddles. Glue all conduit and bend joints so that the fittings will not come apart when cables are being pulled through them.

Figure 47 Conduit arrangements for a non-CUE installation on a cavity wall underground lead-in cabling — front view



Notes:

1. If possible, run the conduit to the roof space at an angle so that:
   - the conduit bend at the top will fit comfortably between the top plate and the roof battens; and
   - the cabling will be clear of the power cables running from the electricity enclosure in the roof space.

   Alternatively, the conduit may run directly to the CCP if it is to be located on the internal side of the same wall on which the PCD is located.
2. Where it is not possible to run the conduit at an angle, run it vertically beside or behind the electricity enclosure. Where the conduit runs behind the enclosure, run it between the studs, not on the front of the studs. Ensure that the telecommunications cables are separated from the power cables in accordance with 8.2.2.1.
3. Fix the horizontal section of each bend a multiple of the brick spacing above the brick base. For standard 230 x 110 x 76 clay bricks, this will be a multiple of 86 mm, e.g. 7 bricks x 86 mm = 602 mm. In areas that have a reticulated gas service, locate the conduits to either side of, and level with the bottom of, the electricity enclosure (see Figure 34 on page 39 and 6.3.3.3.1 on page 40).

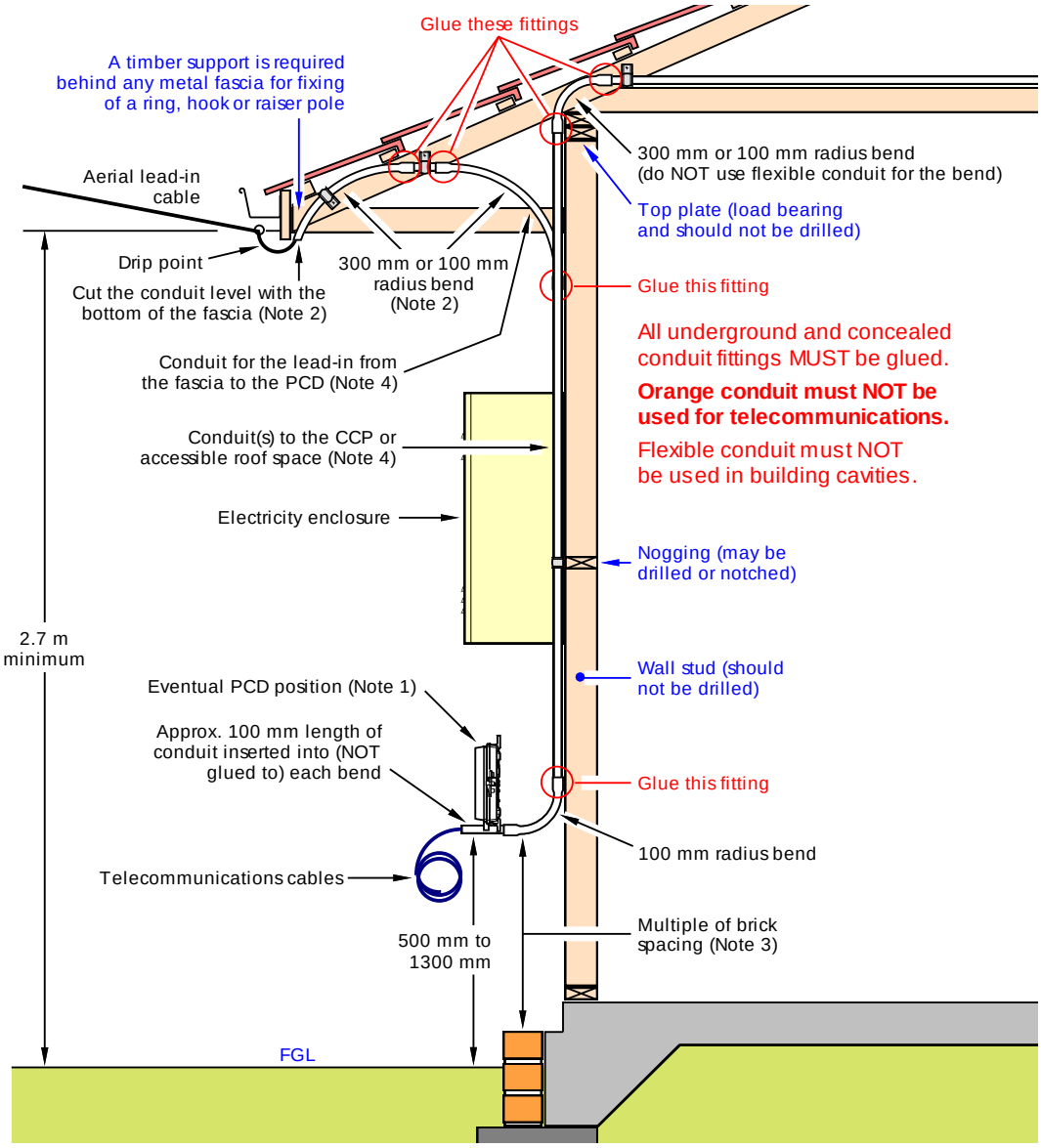
7.5.4 Aerial lead-in cabling

Aerial lead-in cabling is normally only used in established suburbs or in rural areas where the nature of the terrain precludes underground cabling.

For new buildings under construction in an area where aerial lead-in cabling is used, the PCD must be located either under or adjacent to the electricity enclosure so as to provide access to the PCD without the use of a ladder and to support the possible connection of underground lead-in cabling at some future time. Where it is not possible to locate the PCD near the electricity enclosure, it may be located below the point where the aerial cable attaches to the building as long as it is installed within the height limits described in Figure 34. Refer to 6.3.3.3.3 on page 41 for other requirements and precautions.

Figure 48 and Figure 49 illustrate typical conduit arrangements for cavity wall (e.g. brick veneer and timber/metal-framed) buildings. For buildings of solid masonry or double-brick construction, refer to Figure 41 (page 48) for typical tie cabling conduit arrangements.

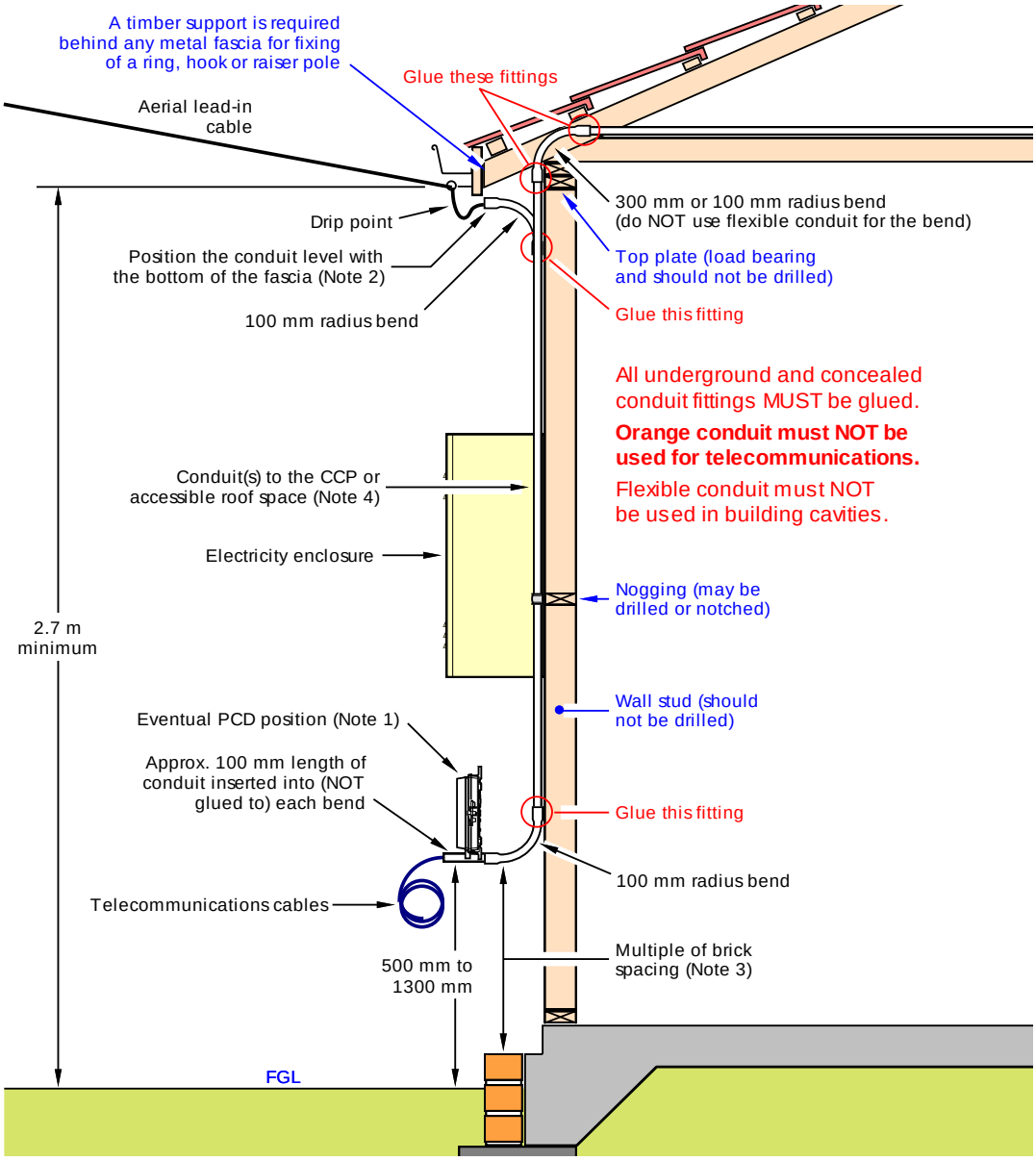
Figure 48 Conduit arrangements for a non-CUE installation on a cavity wall aerial lead-in cabling — building with 450 mm to 600 mm eaves



Notes:

1. For new buildings under construction in an area that does not have a reticulated gas service (including homes where cylinder gas will be used), the PCD should be located below the electricity enclosure, as indicated above, for safe and easy access, to avoid obstruction by such things as downpipes, windows, doors, adjoining fences and gas cylinders, and to facilitate future underground lead-in cabling. Otherwise, the PCD should be located beside the electricity enclosure.
2. Fix the bends firmly to the eaves truss as shown such that the conduit is hard up against the inside of the fascia. 100 mm radius bends may be used where 300 mm radius bends won't fit. Cut the conduit flush with the bottom of the fascia. All bends must be glued to the conduit.
3. Fix the horizontal section of each bend a multiple of the brick spacing above the brick base. For standard 230 x 110 x 76 clay bricks, this will be a multiple of 86 mm, e.g. 7 bricks x 86 mm = 602 mm. In areas that have a reticulated gas service, locate the conduits to either side of, and level with the bottom of, the electricity enclosure (see Figure 34 on page 39 and 6.3.3.3.1 on page 40).
4. Where the conduits run behind the electricity enclosure, run them between the studs, not on the front of the studs. Ensure that the telecommunications cables are separated from the power cables in accordance with 8.2.2.1. Secure the conduits to the wall studs and/or noggings with conduit saddles or half-saddles. Glue all conduit and bend joints so that the fittings will not come apart when cables are being pulled through them.

Figure 49 Conduit arrangements for a non-CUE installation on a cavity wall aerial lead-in cabling — building with narrow or no eaves



Notes:

1. For new buildings under construction in an area that does not have a reticulated gas service (including homes where cylinder gas will be used), the PCD should be located below the electricity enclosure, as indicated above, for safe and easy access, to avoid obstruction by such things as downpipes, windows, doors, adjoining fences and gas cylinders, and to facilitate future underground lead-in cabling. Otherwise, the PCD should be located beside the electricity enclosure.
2. Fix the top bend as shown such that the top of the conduit is level with the bottom of the fascia. Cut the conduit flush with the inside face of the fascia. All bends must be glued to the conduit.
3. Fix the horizontal section of each bend a multiple of the brick spacing above the brick base. For standard 230 x 110 x 76 clay bricks, this will be a multiple of 86 mm, e.g. 7 bricks x 86 mm = 602 mm. In areas that have a reticulated gas service, locate the conduits to either side of, and level with the bottom of, the electricity enclosure (see Figure 34 on page 39 and 6.3.3.3.1 on page 40).
4. Where the conduits run behind the electricity enclosure, run them between the studs, not on the front of the studs. Ensure that the telecommunications cables are separated from the power cables in accordance with 8.2.2.1. Secure the conduits to the wall studs and/or noggings with conduit saddles or half-saddles. Glue all conduit and bend joints so that the fittings will not come apart when cables are being pulled through them.

7.5.5 Conduit positioning at the PCD location

Cables should enter the bottom of the PCD to ensure that water or vapour will not enter the device via the cable entry hole. Therefore, the conduit ends must be positioned at the bottom of the PCD. All Telstra PCDs are designed to allow cables to pass behind them. Any cables coming down the surface of the wall from above the PCD may pass behind a Telstra PCD and then loop up into the cable entry port to form a drip point.

The NBN Co PCD pictured in Figure 31 is not designed to allow cables to pass behind it but it has a cable entry port at the top of the PCD, which may be used by NBN Co installers for cable entry.

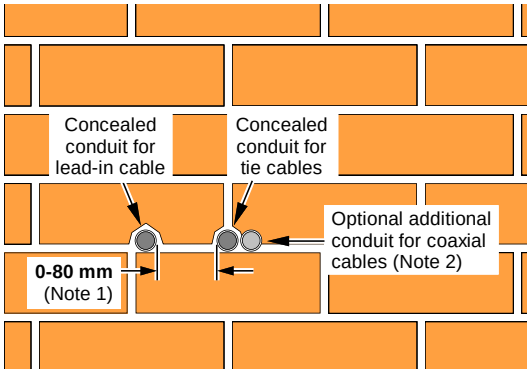
However, cables must **not** enter the top, side or rear of a **Telstra PCD** under any circumstances.

Refer to Figure 50 for correct conduit positioning on a cavity wall for **all** PCD types.

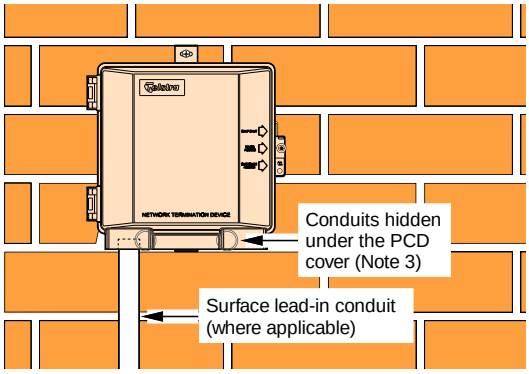
More detailed information is provided in 7.5.6 for various types of **Telstra** PCDs.

Figure 50 Conduit position for all PCDs on cavity walls where a CUE is not used

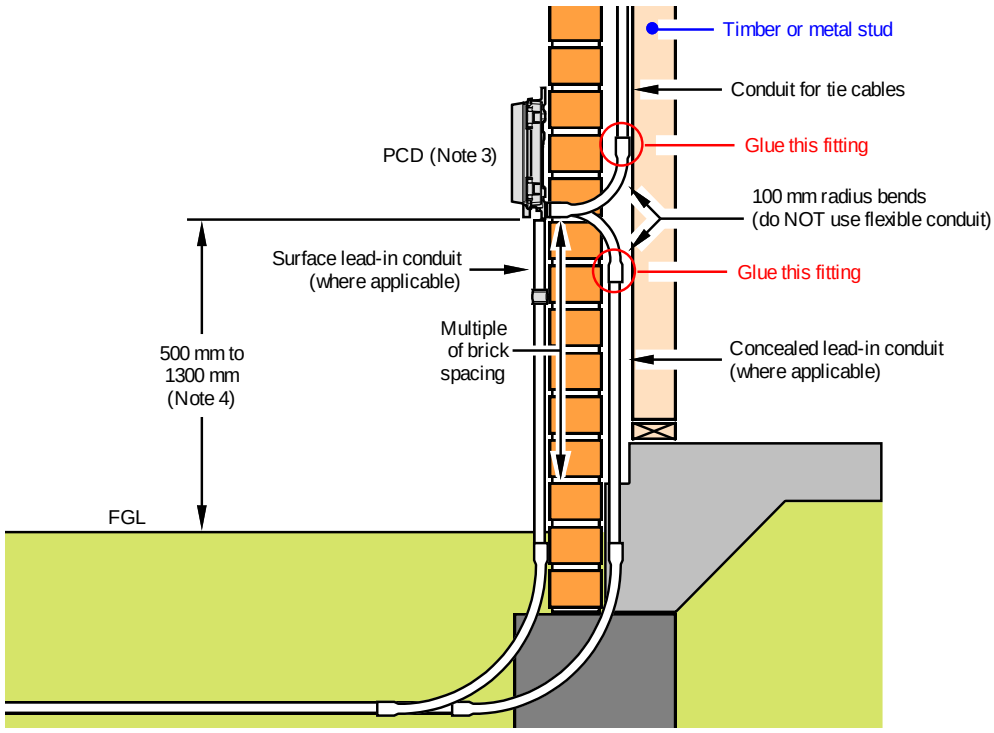
(a) Conduit spacing



(b) Front view of an installed Telstra PCD



(c) Side view of the completed PCD installation



Notes:

1. Optimal conduit positioning varies according to the type of PCD to be installed. Spacing the conduits between 0 mm and 80 mm will ensure compatibility with all PCDs.
2. The provision of a second conduit for the tie cabling is required where:
   - the PCD is likely to be an outdoor FTTP NTD as shown in Figure 32 on page 36 (in which case both conduits should be side by side as depicted in (a) above); or
   - a second PCD is to be installed, e.g. HFC isolation box for Cable internet or pay TV as shown in Figure 31 on page 35 (in which case the conduits should be spaced at least 180 mm apart — see 7.5.6.3 and Figure 53).
3. Telstra PCDs have a skirt on the cover to:
   - protect the cables from direct exposure to sunlight;
   - hide the ends of the conduits from general view while allowing water and vapour to escape from the lead-in conduit outside the PCD; and
   - enable the lead-in conduit opening to be readily inspected for termite activity by a pest inspector.
4. For pre-wiring in areas that do not have reticulated gas (including homes where cylinder gas will be used), locating the PCD below the electricity enclosure will minimise the risk of obstruction by such things as downpipes, fences, gas cylinders, etc. In such cases, positioning the conduits between 500 mm and 600 mm above finished ground level (FGL) will ensure there is sufficient clearance from the electricity enclosure while providing reasonable PCD height for access (see Figure 34 on page 39 and 6.3.3 on page 40).

7.5.6 PCD positioning over the conduits

7.5.6.1 General

Separate PCDs must be provided for twisted pair, coaxial and optical fibre lead-in cables. Where more than one PCD is required (e.g. one for a twisted pair lead-in cable and one for a coaxial lead-in cable), the PCDs should be separated by a minimum distance of 50 mm measured between the closest parts of each PCD with the cover closed. The same lead-in conduit may be used to pull in the separate lead-in cables, so at least one of the lead-in cables will be exposed before it enters the PCD (refer to 7.5.6.3 for an example).

A minimum clearance of 10 mm (20 mm preferred) must be maintained between the end of any underground conduit and the PCD cable entry to ensure that any water or vapour coming out of the conduit can escape externally and to enable any termite activity to be visible to a pest inspector. No minimum clearance is required for the end of any conduit provided for aerial cabling or indoor cabling.

7.5.6.2 ADSL NTD

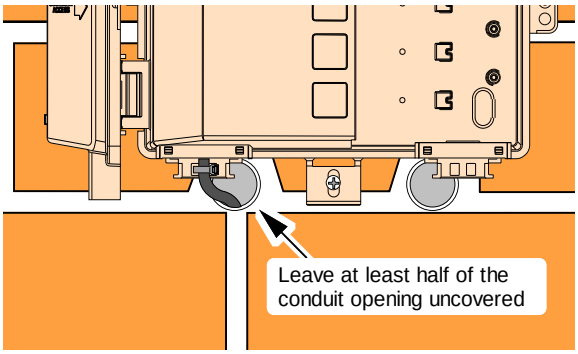
The Telstra NTD used for connection of twisted pair lead-in cables is coloured beige (light brown) and has a "Telco" (Telstra) side and a "customer" (cabler) side. The cable entry ports are spaced at 140 mm centres. Lead-in cable and the earthing conductor must enter the left-hand cable entry port and customer cables must enter the right-hand cable entry port. These cable entry arrangements cannot be reversed. However, flexibility is provided by the ability to pass cables behind and underneath the NTD without being exposed (see Figure 52).

Optimal positioning of the NTD over conduits spaced at 80 mm is shown in Figure 51. Typical positioning of the NTD over conduits located side-by-side is shown in Figure 52.

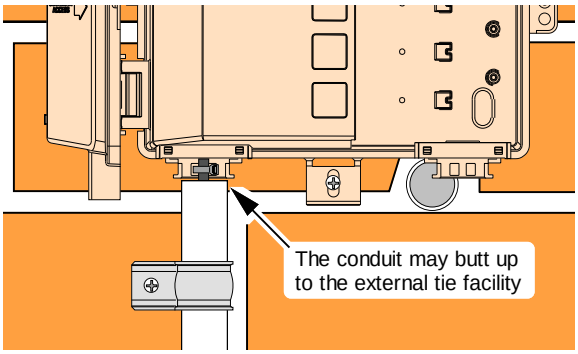
The NTD is normally supplied and installed by Telstra at no charge for the connection of a generic cabling system if the NTD is requested before the time of installation. Alternatively, a registered cabler may supply and install one, if expedient, in accordance with Telstra Specification 012688, *Telstra Network Termination Device — Information for Cabling Providers*.

Figure 51 Optimal Telstra ADSL NTD positioning over conduits spaced at 80 mm

(a) Concealed lead-in conduit (Note 1)



(b) Surface lead-in conduit (Note 2)



Notes:

1. **The end of any concealed lead-in conduit must not be covered by the base of the NTD** to ensure that any water or vapour coming out of the conduit can escape externally and to enable any termite activity to be visible to a pest inspector.
2. **Surface lead-in conduit must terminate 10 mm to 20 mm short of the cable entry hole.** In the case of the ADSL NTD, this will be achieved if the lead-in conduit butts up to the external cable tie facility.

Figure 52 Running cable behind or below the Telstra NTD to the cable entry port (conduits spaced less than 80 mm apart)

Cables running behind the NTD	Cables running below the NTD	Cables hidden by the cover
		

Note: If the lead-in and customer conduits are adjacent to each other, either the lead-in cable or the tie cables may be run behind or below the NTD to the appropriate cable entry port, as in the examples shown above. Either way, the skirt on the NTD cover will hide the cables from general view and protect them from exposure to sunlight. Cables running down the wall to the top of the NTD may run behind the NTD to the bottom of the NTD and then loop up into the cable entry to form a drip point.

7.5.6.3 HFC isolation box

Where HFC is available and is to be installed at the premises, a separate HFC isolation box is required for connection of the coaxial cabling. The standard Telstra isolation box is coloured grey and has three closely spaced cable entry ports, each of which may be used for either the outdoor or indoor coaxial cable entry. An earthing conductor is not required for this box.

A larger isolation box may be used in some circumstances (e.g. to house an RF amplifier), in which case the underground or aerial coaxial lead-in cable normally enters the left-hand cable entry port and each indoor coaxial cable usually enters one of the right-hand cable entry ports.

The isolation box will usually be provided in addition to another PCD, so typical positioning in relation to a separate PCD and the conduits is shown in Figure 53.

The isolation box is supplied and installed by Telstra (for cable internet) or FOXTEL (for pay TV), as applicable, as part of the HFC service. A registered cabler is not authorised to install the isolation box but may install the indoor coaxial cable (tie cable) to Telstra or FOXTEL specifications. Separate conduits are required for the coaxial cables running between the isolation box and the CCP (for cable internet) and between the isolation box and the wall plate at the entertainment point (for FOXTEL).

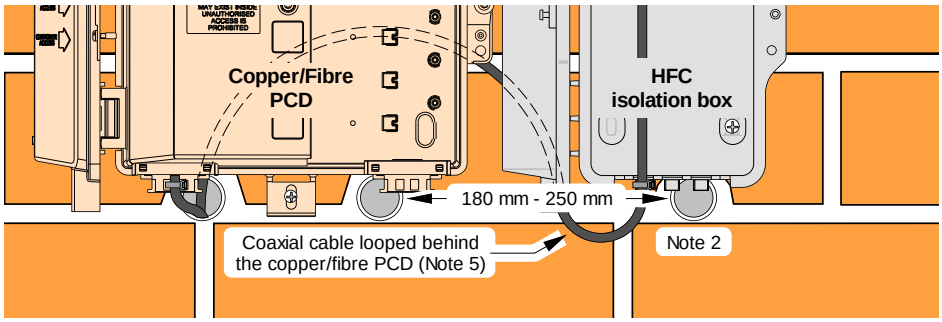
Notes:

1. Telstra coaxial cabling specifications are provided in Document No. 017153a00, *Cabling of premises for telecommunications — A complete guide to home cabling*.
2. It is not necessary to extend the conduit beyond accessible roof space for the FOXTEL cable(s) going to the entertainment point(s) because this would preclude branching of multiple cables to multiple points and, in any case, this cabling should never need upgrading. However, if a cable is damaged during or after building construction, the FOXTEL repairer is not obliged to conceal the replacement cable.

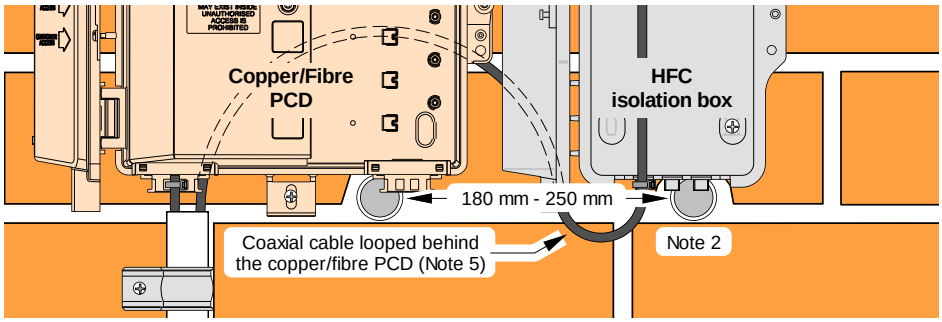
The box should be spaced at least 50 mm away from any other PCD and the conduits spaced 180 mm to 250 mm apart in accordance with Figure 53.

Figure 53 Optimal Telstra HFC isolation box spacing from the building entry conduits

(a) Concealed lead-in conduit



(b) Surface lead-in conduit



Notes:

1. The HFC isolation box should be spaced about 50 mm to the left or right of the other PCD, which means the conduits for the twisted pair and coaxial tie cables should be spaced between 180 mm and 250 mm apart, as shown above.
2. Separate tie cabling conduits will be required for the broadband internet cable and any pay TV (FOXTEL) cable because they will have different destinations (i.e. the internet cable goes to the CCP and the pay TV cable goes directly to the entertainment point).
3. **The end of any concealed lead-in conduit must not be covered by the base of the PCD** to ensure that any water or vapour coming out of the conduit can escape externally and to enable any termite activity to be visible to a pest inspector.
4. **Surface lead-in conduit must terminate 10 mm to 20 mm short of the cable entry hole.**
5. All Telstra PCDs have mounting feet that allow cables to pass behind the PCD.

7.5.6.4 Outdoor FTTP NTD

The outdoor Telstra FTTP NTD is coloured grey and has a "Telco" (Telstra) side and a "customer" (cabler) side. The cable entry ports are spaced at 180 mm centres. The lead-in cable must enter the left-hand cable entry port and customer cables must enter the right-hand cable entry port. These cable entry arrangements cannot be reversed. The earthing conductor should enter the left-hand cable entry port but may enter the right-hand cable entry port if necessary. There is a separate cable entry port for the PSU cable.

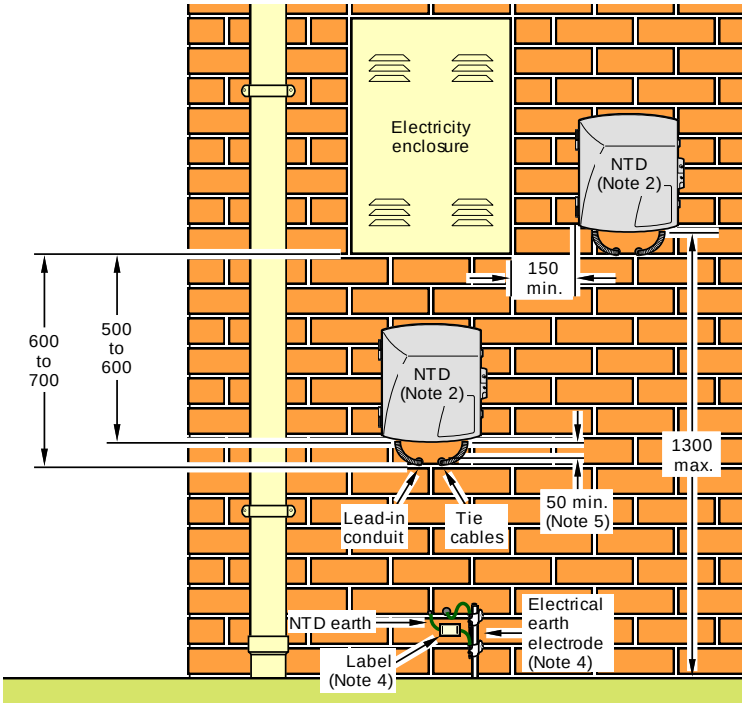
If RF TV (free-to-air TV or pay TV) is to be supplied from the NTD, two 23 mm ID conduits to Telstra or NBN Co. specification will be required between the NTD and the CCP.

The NTD must be positioned 50 mm to 100 mm above the conduits to accommodate the minimum bend radius for the optical fibre lead-in cable, in which case flexible conduit must be used (by the NTD installer) between the rigid conduits and the cable entry ports. The NTD positioning within the height limits described in 6.3.1 (page 38) is shown in Figure 54. Optimal positioning of the NTD over conduits spaced at 80 mm is shown in Figure 55.

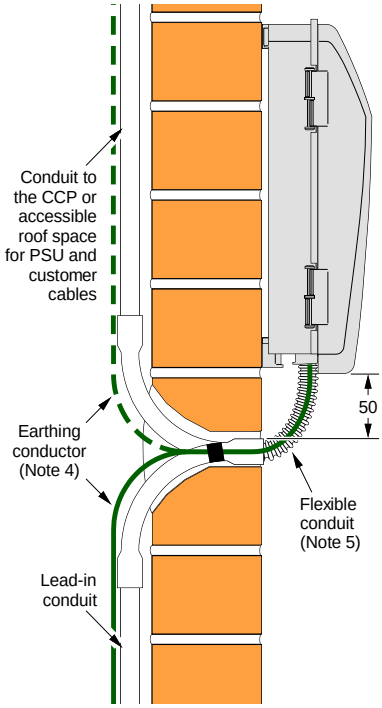
The NTD is supplied and installed by Telstra as part of the FTTP service and is normally installed at the time of service activation.

Figure 54 Outdoor Telstra FTTP NTD installation where a CUE is not used

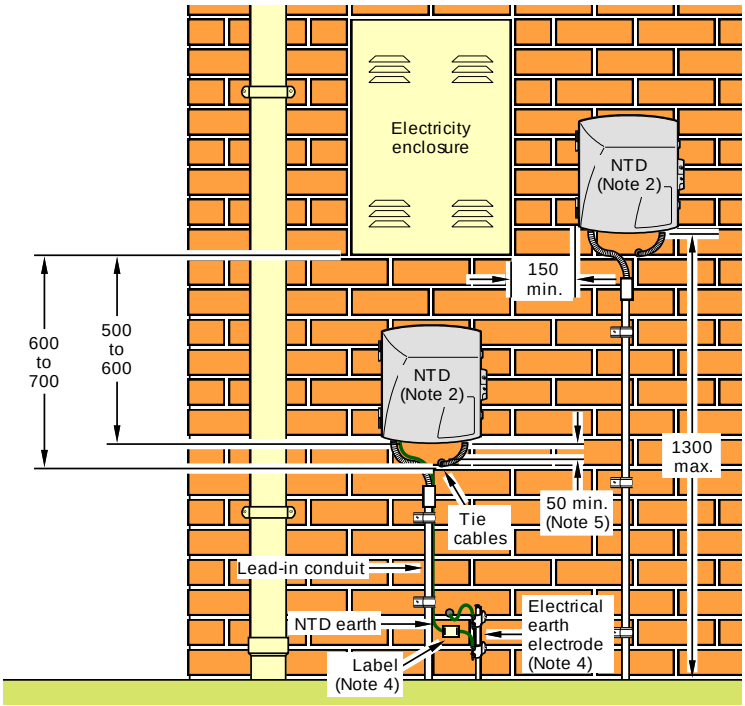
Front view (concealed lead-in conduit)



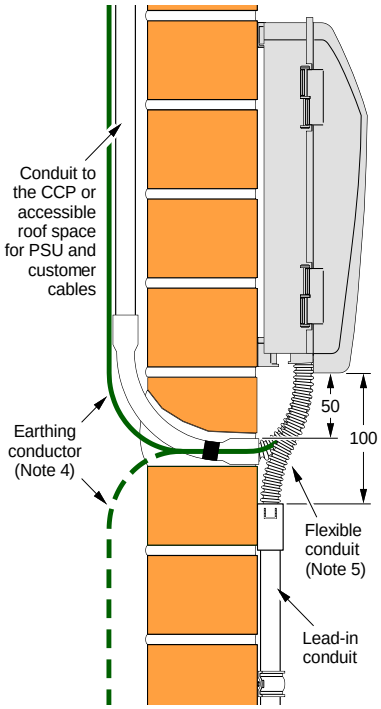
Side view (concealed conduit)



Front view (surface lead-in conduit)



Side view (surface conduit)

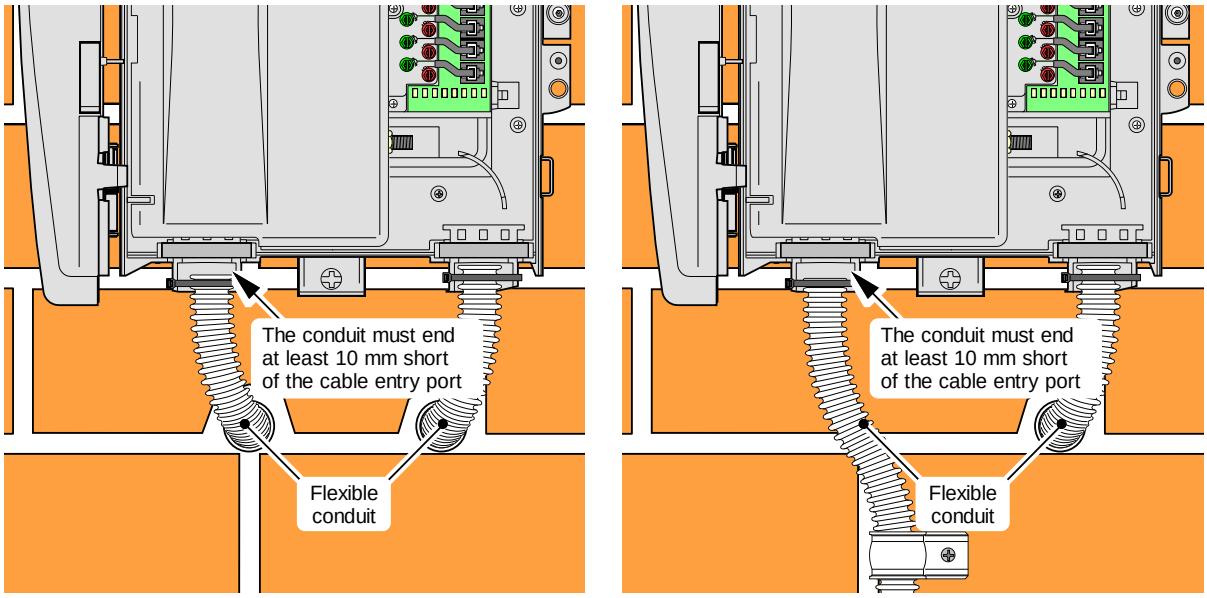


Notes:

1. All measurements are in mm.
2. For general PCD (NTD) location requirements, refer to 6.3.1 on page 38.
3. For conduit positioning in the building footings, refer to 7.2.2 on page 43.
4. For NTD earthing requirements, refer to section 9 (page 72).
5. Spacing of 50 mm to 100 mm is required between the end of the lead-in conduit and the NTD to meet optical fibre lead-in cable bend requirements. Telstra will use flexible conduit to make the final conduit connection to the NTD.

Figure 55 Optimal outdoor Telstra FTTP NTD positioning over conduits spaced at 80 mm

(a) Concealed lead-in conduit **(b) Surface lead-in conduit**



Notes:

1. Flexible conduits are used by the NTD installer to join the rigid conduits to the NTD to protect the cables. The flexible conduit for the underground lead-in cable must terminate at least 10 mm short of the cable entry grommet to ensure that any water or vapour coming out of the conduit can escape externally and to enable any termite activity to be visible to a pest inspector.
2. The flexible conduit for the tie cables may butt up to the cable entry grommet.
3. If the conduits are spaced less than 80 mm apart, the NTD will be positioned over the conduits, by the Telstra installer, so as to ensure that the minimum optical fibre cable bend radius is maintained.

7.5.6.5 FTTP PCD

7.5.6.5.1 General

Where an indoor FTTP NTD is to be provided, an outdoor PCD (optical fibre splice box) will be installed on the external wall to connect the underground or aerial optical fibre lead-in cable to the indoor optical fibre lead-in cable.

7.5.6.5.2 Telstra PCD

The Telstra FTTP PCD (for an indoor NTD) is coloured grey and uses similar casing to the ADSL NTD described in 7.5.6.2 on page 63 but it only has a single access cover. The requirements for positioning the PCD above the conduits are essentially the same as described in 7.5.6.2. However:

- The PCD may need to be positioned 50 mm to 100 mm above the conduits to accommodate the minimum bend radius for the optical fibre cables, in which case flexible conduit must be used (by the PCD installer) between the rigid conduits and the cable entry ports.
- Either cable entry port may be used for either the underground/aerial optical fibre lead-in cable or the indoor optical fibre lead-in cable — or both cables may enter the same (either) cable entry port.

An earthing conductor is not required for this PCD.

The PCD is supplied and installed by Telstra as part of the FTTP service and is normally installed at the time of service activation.

7.5.6.5.3 NBN Co PCD

The NBN Co PCD pictured in Figure 31 on page 35 (for an indoor NTD) is coloured light grey and has a single cover. It does not have a cover skirt to hide the cables entering the bottom of the PCD, so it is assumed that underground lead-in cable entering the PCD will be unprotected to ensure compliance with 7.5.6.1 (page 63). It is also assumed that the tie cable entering the PCD will be unprotected because the PCD has no facility for securing flexible conduit to the PCD (unless it enters the left-hand cable entry port, in which case the underground/aerial lead-in cable must enter one of the other cable entry ports).

Cables cannot pass behind the NBN Co PCD, so cables running down the surface of the wall from above the PCD will either enter the cable entry port at the top of the PCD or run beside the PCD and loop up into a bottom cable entry port.

At the time of writing, NBN Co's practices for installation and connection of the PCD were unclear. The installation of a CUE as described in 6.2 on page 36 would resolve the uncertainty and is recommended for new homes.

7.5.7 PCD fastenings

Impact fasteners should **not** be used to affix the PCD to the wall because these may be too difficult to remove later. The PCD needs to be easily removable to allow future removal and replacement of the PCD for repair or upgrade.

Note: This is for general information only — the Telstra ADSL NTD is the only PCD that may be installed by anyone other than the carrier.

7.6 Drainage pit

7.6.1 Description

A drainage pit is usually only installed in commercial premises or multi-storey apartment buildings where external PCDs are not used. It is mainly used when the lands falls to the building from the property entry point but can also be used to provide a cable/conduit access point immediately before the conduit enters the building. For single dwellings, a drainage pit may be required if the PCD cannot be installed on the external wall and the lead-in conduit cannot terminate at the external wall (e.g. due to extensive glazing). In such cases, the main purpose of the pit is to provide an external access point for sealing the conduit against the entry of water or termites immediately before the conduit enters the building.

Note: While it is possible to seal the conduit at the pit in the street, if the lead-in conduit is damaged in the ground between the pit and the building, there will be a risk of water and termite entry at the point of damage. The risk is minimised if the pit is located adjacent to the building.

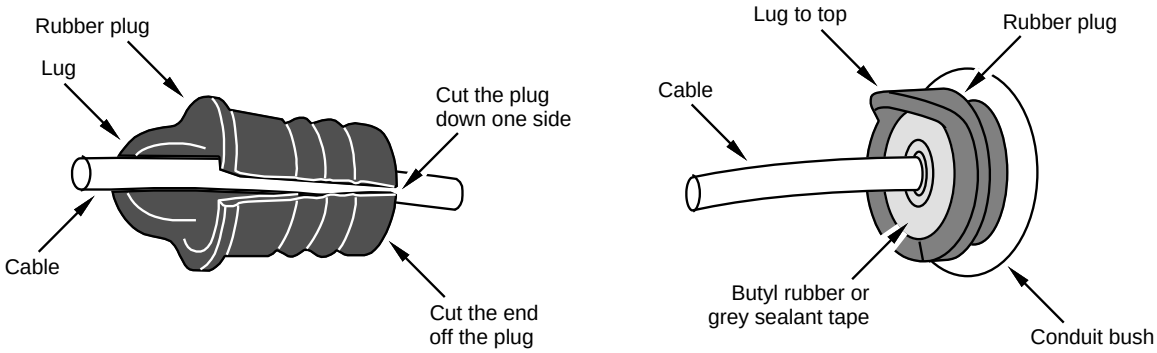
7.6.2 Plugging/Sealing of conduits

For 23 mm ID conduit that runs to a building or that runs downhill into a customer's property, a rubber plug (see Figure 56) is normally used by the carrier to plug the conduit in the pit to minimise water and insect entry to the premises via the conduit.

Figure 56 Typical rubber plug for 23 mm ID conduit

When the lead-in cable is installed in the conduit, the plug must be modified (by the carrier) as shown in Figure 57. If the underground conduit terminates inside a building as shown in Figure 58, the cavity of the plug must be filled with butyl rubber putty or grey sealant tape so as to make the seal watertight and to prevent the entry of insects (especially termites) to the building via the conduit.

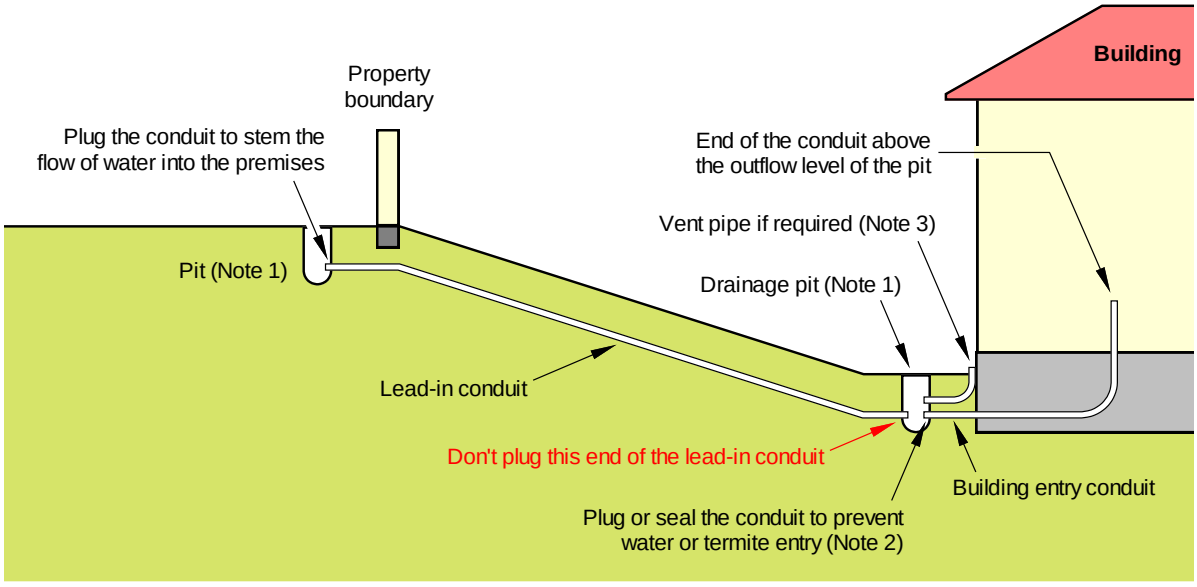
Figure 57 Modification of the rubber plug in the pit for installed cable



Notes:

1. When cable is installed in the conduit, the rubber plug is modified and wrapped around the cable as shown above left and pushed into the end of the conduit as shown above right. If the underground conduit terminates inside a building as shown in Figure 58, the cavity of the plug must be filled with butyl rubber putty or grey sealant tape so as to make the seal watertight and to prevent the entry of insects (especially termites) to the building via the conduit.
2. **This is provided for information only.** Any plugs in the pits must be fitted by the relevant carrier.

Figure 58 Use of a drainage pit



Notes:

1. Conduits must enter the end of the pit (see Figure 5 on page 9).
2. The "network" end of the lead-in and building entry conduits must be plugged or sealed in each pit using a rubber plug (see Figure 56) which must be modified (by the carrier) in accordance with Figure 57 when the lead-in cable is installed.
3. The drainage pit must be drained (or vented using a vent pipe as shown), and would normally sit below the level of the floor of the building. Any drainage or vent pipe must be at least the same size as the lead-in conduit.
4. A drainage pit is not normally required where the lead-in conduit terminates at the external wall of the building (e.g. to connect a PCD). In such cases, any water that trickles down the lead-in conduit should escape harmlessly outside the building and the end of the conduit is also visible for inspection for termite activity.

8 SEPARATION FROM OTHER SERVICES

8.1 General

All cables should be installed thoughtfully and with care to avoid damage during construction of the building and to ensure maximum performance of the completed installation. Compliance with Australian Standard AS/CA S009, *Installation requirements for customer cabling (Wiring rules)*, is the minimum requirement for customer cabling.

8.2 Electricity and gas

8.2.1 Underground conduits/pipes

The telecommunications lead-in cabling must be separated from other underground services in accordance with 4.5.8 to 4.5.10 (pages 23 to 29).

8.2.2 Conduits/Pipes/Cables in/on buildings

8.2.2.1 Separation from Low Voltage (LV) power cables

LV power cables are those cables used to supply 230 V AC single-phase power or 400 V AC three-phase power to appliances and power outlets within a building.

Separation from LV power cables is necessary for safety purposes. The main concern is simultaneous damage to the cable insulation of both wiring systems due to, for example:

- penetration by foreign objects such as nails and screws; or
- crushing or abrasion (e.g. building movement, trampling, impact, pulling one cable over another).

Telecommunications cables on or in the building must be permanently separated from LV power cables for safety purposes by:

- a minimum distance of 50 mm; or
- a barrier of durable insulating material or metal (e.g. enclosure of the cable in conduit); or
- a timber or metal stud, nogging, joist, beam, rafter or roof truss of any thickness.

No spatial separation is required between electrical and telecommunications conduits (for safety purposes) on or within a building.

A telecommunications cable and an LV power cable must not pass through the same bore hole within 50 mm of any securing face of building framework whether or not there is a barrier between the cables. In other cases, telecommunications cable may pass through the same hole (e.g. through wall/ceiling linings or floorboards) as LV power cable if either the telecommunications cable or the LV cable is installed in insulating or metal conduit or suitably designed trunking or ducting that provides a durable barrier between the telecommunications cable and the power cable.

Note: Drills, nails or screws driven into the building framework could penetrate cables passing through bore holes even if the cables are installed in conduit. However, such damage is unlikely for cables passing through wall/ceiling linings (e.g. plasterboard) or floorboards.

A minimum access clearance of 150 mm is required between any telecommunications enclosure (such as a PCD) and any electricity enclosure such as an electricity meter panel or switchboard.

Note: This is an access clearance, not a safety clearance.

8.2.2.2 Separation from services other than power

Telecommunications cables on or in the building must be separated from other non-telecommunications services (such as plumbing) so as not to impede access to, or repair of, the other service. Telecommunications cables must not be fastened to plumbing pipes or the conduits of other services.

Note: A minimum clearance of 50 mm is recommended by Australian Standard AS/CA S009, *Installation requirements for customer cabling (Wiring rules)*, where the telecommunications cabling runs alongside the other service cables, conduits or pipes.

Where the other service is deemed to be hazardous (e.g. a gas pipe or heating oil pipe), the telecommunications cable must be separated from the other service by a minimum distance of 150 mm whether or not the cable is installed in conduit.

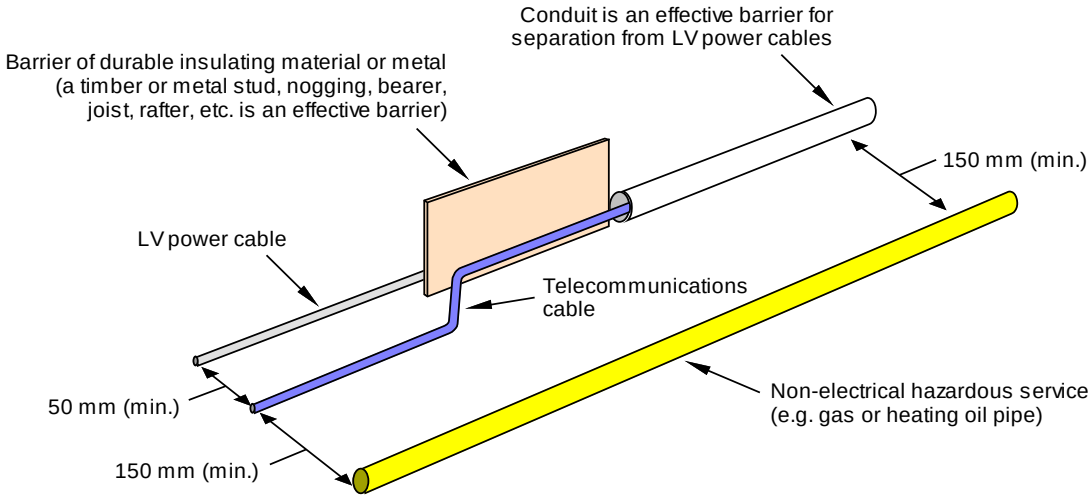
Notes:

1. This separation requirement reduces the risk of damage to the telecommunications cabling or the other service during installation or repair activities, which may cause personal injury or damage to property.
2. See also 6.3.3.1 (page 40) for the requirements for separation of PCDs from gas meters and gas cylinders.

No separation is required between cables of different communications cabling systems, e.g. telephone, data, TV (coaxial), audio (A/V, HDMI or speaker wires).

No separation is required between telecommunications cables and earthing conductors (whether these are associated with telecommunications or electricity) except for lightning down-conductors (see 8.3.2).

Figure 59 Summary of safety separation requirements from LV power cables and non-electrical hazardous services for concealed cabling and outdoor surface cabling



8.3 Other building fixtures

8.3.1 General

Telecommunications conduits emerging from underground should not be installed in a way that may conceal termite activity, e.g. in the corners of external walls or against other conduits or pipes. Refer to 7.2.3 (page 45).

8.3.2 Lightning down-conductors

Lightning down-conductors are earthing conductors installed between a lightning rod or strip located on the roof of the building and an earthing electrode or earthing mat at the base of the building. These are rarely installed on single dwellings but may be installed on multi-storey apartment buildings. Lightning down-conductors are designed to carry thousands of volts and amperes of lightning voltage and current in the event of a lightning strike. It is important to keep metallic cables well away from such conductors to avoid "side-flashing" which may cause fire or injury.

Telecommunications conduits, cables and connection devices must be separated from lightning down-conductors by a minimum distance of **9 m** unless this is impractical, in which case the cabling must be separated from any lightning down-conductor in accordance with the requirements of Australian Standard AS/NZS 1768, *Lightning protection*.

Notes:

1. A separation distance less than 9 m will usually require assessment by a suitably qualified electrical engineer.
2. An earthing conductor for a domestic TV antenna or satellite dish is not a lightning down-conductor.

9 EARTHING

9.1 When is earthing required?

Where the outdoor PCD is an FTTP NTD or an ADSL NTD, an earthing conductor will be required at the PCD location. In the case of an FTTP NTD, the earth is required for electrical safety purposes whereas, for the ADSL NTD, the earth is for lightning surge suppression purposes.

9.2 Equipotential bonding

Where earthing is required, the earth should be derived from the electrical earthing system. This is an important safety requirement to ensure that there is no earth differential at or in the building. Earthing should **not** be achieved by driving a separate earth electrode unless that electrode is also bonded (connected) to the electrical earth electrode.

Telecommunications earthing is obtained from the electrical earthing system by means of "**equipotential bonding**", i.e. by "bonding" (connecting) the two earthing systems together to ensure that they are at "equal potential". The equipotential bonding must be done at the **electrical switchboard** — either inside the switchboard itself by connection to the main earthing bar or main earthing conductor, or outside the switchboard by connection to the main earthing conductor or to the electrical earth electrode. Refer to Figure 4 of Australian Standard AS/CA S009:2013, *Installation requirements for customer cabling (Wiring rules)*. The three allowable methods of equipotential bonding are illustrated in Figure 60.

It is important that there is a **demarcation point** between the electrical earthing system and the telecommunications earthing system so that:

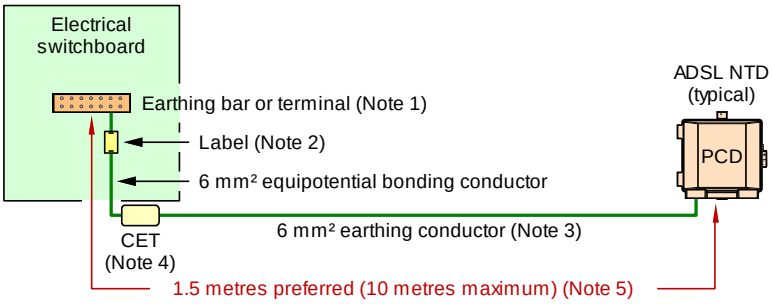
- the telecommunications earth can be isolated from the electrical earth at a single, readily accessible point by either a telecommunications worker or an electrical worker; and
- earthing of telecommunications equipment can be legally performed by a telecommunications worker who is not also a licensed electrical worker.

This demarcation point will be either a **Communications Earth Terminal (CET)** located outside the electrical switchboard or a distinct, removable **connection device on the electrical earth electrode**.

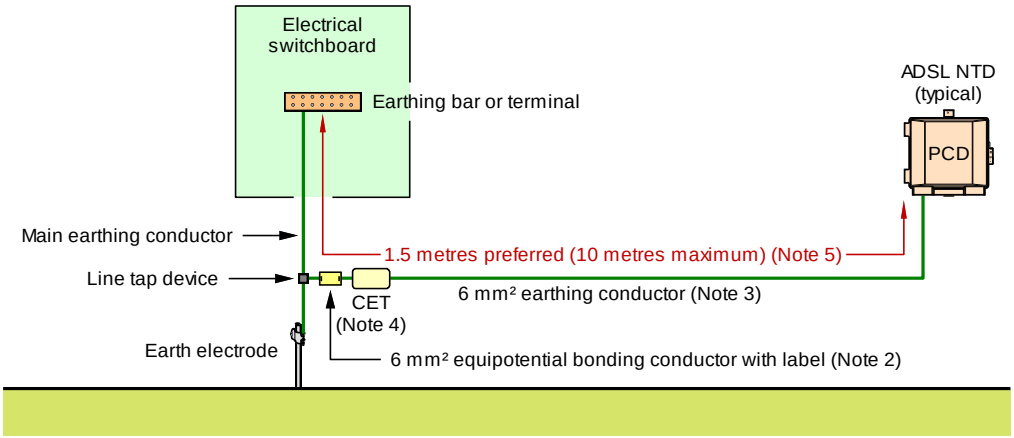
An earthing conductor for telecommunications equipment should not be connected (hard wired) directly to the electrical earthing system even if this is not precluded by the electrical wiring rules (AS/NZS 3000). Furthermore, while telecommunications equipment may use the earth from a power outlet via the power plug and power cord as part of the equipment design, a telecommunications earth should **never** be hard wired from the earthing conductor at the rear of a power outlet.

Figure 60 Equipotential bonding methods

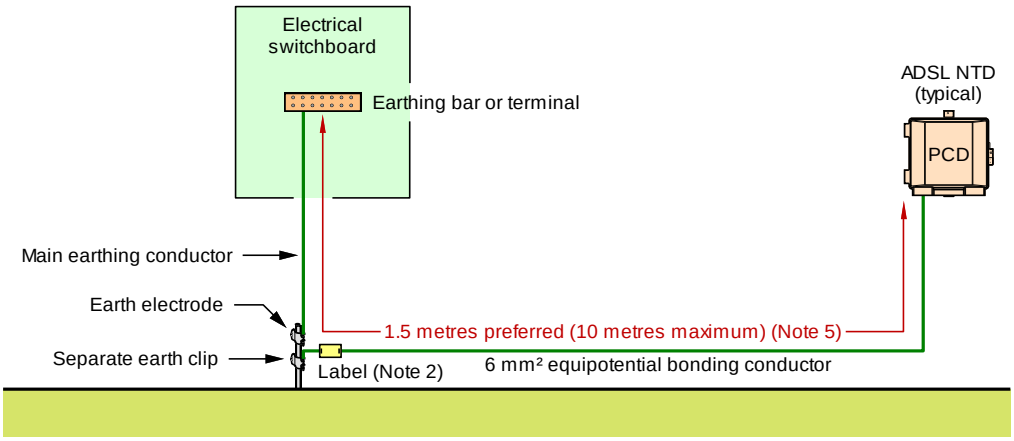
(a) Equipotential bonding to the earthing bar or terminal of the electrical switchboard (Method 1)



(b) Equipotential bonding to the main earthing conductor outside the electrical switchboard (Method 2)



(c) Equipotential bonding to the electrical earth electrode (Method 3)



Notes:

1. Only a licensed electrical worker may access the internals of an electrical switchboard.
2. The equipotential bonding conductor must be labelled “Telecommunications Bonding Conductor” or “Communications Bonding Conductor” at the switchboard end and also at the other end if the other end is not within sight of the switchboard.
3. While a 2.5 mm² earthing conductor is acceptable between the CET and an outdoor FTTP NTD, a 6 mm² conductor is recommended between the CET and the PCD in all cases to ensure compatibility with all PCDs.
4. The CET should be located in the telecommunications compartment of the CUE in accordance with Figure 33 (page 37) or, if a CUE is not provided, the CET may be located in any readily accessible location external to the electrical switchboard — preferably immediately below the switchboard per Figure F3 of AS/NZS 3000:2007.
5. The total length of bonding/earthing conductor between the earthing bar/terminal in the electrical switchboard and the PCD should preferably be less than 1.5 m but, in any case, should not exceed a length of 10 m.

9.3 Installation of earthing conductors

9.3.1 General

A Communications Earth System (CES) conductor may be provided at the CCP for possible earthing of cable screens/shields.

A CET is required if equipotential bonding methods 1 or 2 are used (see Figure 60). The CET should be located within the telecommunications compartment of the CUE (where used) or under the electrical switchboard (see Note 4 to Figure 60). Where bonding method 3 is used, the equipotential bonding conductor may be connected to an earthing terminal located at the CCP. There is no reason why two equipotential bonding conductors cannot be installed for separate purposes, e.g. bonding method 3 for earthing of the outdoor PCD and bonding method 1 or 2 for earthing, via a CET located below the electrical switchboard, to a separate earthing terminal located at the CCP — as long as the indoor earthing terminal and the PCD earth are not interconnected to create an "earth loop" (see the next paragraph). However, it is recommended that a single equipotential bonding connection be made to the electrical earthing system to avoid confusion.

All earthing conductors should be cabled in a "tree" or "star" wiring configuration from the CET or other common earthing point. Care should be taken to avoid intentionally or accidentally earthing the same metallic component at two separate points (such as both ends of a screened cable), which may create "earth loop" currents that could generate noise in the cabling system.

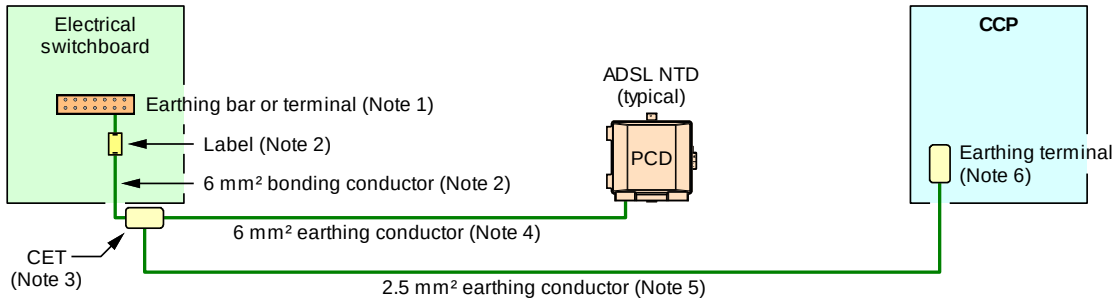
9.3.2 Earthing conductor size and colour

The equipotential bonding conductor must be at least 6 mm² in cross-sectional area (7/1.04 mm) with green/yellow insulation. Any earthing conductor required for end-user lightning surge suppression purposes (such as to an ADSL NTD) must also be 6 mm² with green/yellow insulation. In all other cases, a minimum 2.5 mm² (7/0.67 mm) green/yellow earthing conductor is required, which must be cabled from the CET or other earthing terminal.

Earthing and bonding conductors do not need to be installed in conduit within building cavities.

The recommended earthing conductor arrangement for a generic cabling system is shown in Figure 61.

Figure 61 Recommend earthing conductor cabling for generic home cabling



Notes:

1. Only a licensed electrical worker may access the internals of an electrical switchboard.
2. The equipotential bonding conductor between the earthing bar or terminal of the electrical switchboard and the CET must be at least 6 mm² (7/1.04 mm) copper conductor with green/yellow insulation and labelled "Telecommunications Bonding Conductor" or "Communications Bonding Conductor" in accordance with the requirements of Clause 20.11 of AS/CA S009:2013 and Clause 5.6.2.7 of AS/NZS 3000:2007.
3. The CET should be located in the telecommunications compartment of the CUE in accordance with Figure 33 (page 37) or, if a CUE is not provided, the CET should be located immediately below the electrical switchboard in accordance with Figure F3 of AS/NZS 3000:2007.
4. The earthing conductor between the CET and the PCD should be at least 6 mm² (7/1.04 mm) copper conductor with green/yellow insulation. There is no need to label this conductor. The total length of bonding/earthing conductor between the earthing bar/terminal in the electrical switchboard and the PCD should preferably be less than 1.5 m but, in any case, should not exceed a length of 10 m (see Figure 60).
5. The earthing conductor between the CET and the earthing terminal at the CCP must be at least 2.5 mm² (7/0.67 mm) copper conductor with green/yellow insulation. There is no need to label this conductor. The length of this conductor must not exceed 135 m to ensure that it does not exceed the maximum specified CES resistance of 1 ohm.
6. An earthing terminal may be provided at the CCP for possible earthing of cable screens/shields (refer to 9.3.1). If end-users can access the earthing terminal, it is a requirement of AS/CA S009 for the terminal to have an insulated cover to prevent end-user access to the terminations. All telecommunications earthing connections (e.g. to cable screens/shields) should be made at the CCP.

10 ABBREVIATIONS

For a full list of abbreviations and definitions, refer to Document No. 017153a00.

Acronym	Full expression
AC	Alternating Current
ACIF	Australian Communications Industry Forum (now CA)
ACMA	Australian Communications and Media Authority (formerly AUSTEL and ACA)
ADSL	Asymmetric Digital Subscriber Line
AS/CA	Australian Standard/ Communications Alliance
AS/NZS	Australian Standard/New Zealand Standard
A/V	Audio-Visual
CCP	Central Connection Point (or Cross-Connection Point)
CES	Communications Earth System
CET	Communications Earth Terminal
CUE	Combined Utilities Enclosure
D	Deep
DC	Direct Current
FGL	Finished Ground Level
FTTP	Fibre To The Premises
HDMI	High-Definition Multimedia Interface
HFC	Hybrid Fibre-Coax (“Cable”)
HV	High Voltage
ID	Inside Diameter
kgf	kilogram-force
L	Long
LV	Low Voltage
m	metre(s)
NBN	National Broadband Network

Acronym	Full expression
NTD	Network Termination Device
OD	Outside Diameter
PCD	Premises Connection Device
PP	Power Point
PSU	Power Supply Unit
RF	Radio Frequency
SWER	Single Wire Earth Return
TO	Telecommunications Outlet
TV	Television
UPVC	Unplasticised Polyvinyl Chloride
V	Volt(s)
W	Wide

11 ASSOCIATED DOCUMENTS

Document number	Title
017153a00	Cabling of premises for telecommunications — A complete guide to home cabling
017153a01	Cabling of premises for telecommunications — Essential information for home cabling

12 DOCUMENT CONTROL SHEET

Issue number	Issue date	Details on the change
1	26/08/2013	Approved version for publication

(/)

Termination Tools

D814™ Series Impact Tools

Learn More > (/datacom-cabling/installation-tools/D814-Series-Impact-Tools)

D914™ Series Impact Punchdown Tools

Learn More > (/datacom-cabling/installation-tools/D914-Series-Impact-Tools)

Punchdown Tool Blades

Learn More > (/datacom-cabling/installation-tools/Punchdown-Tool-Blades)

JackRapid™ Punchdown Tool

Learn More > (/datacom-cabling/installation-tools/JackRapid-Punchdown-Tool)

(/)

Pro-Tool™ Kits

Learn More > (/datacom-cabling/installation-tools/Pro-Tool-Kits)

D-Snips™ Heavy Duty Wire Strippers

Learn More > (/datacom-cabling/installation-tools/D-Snips)

Need-L-Lock Crimping Pliers

Learn More > (/datacom-cabling/installation-tools/Need-L-Lock-Crimping-Pliers)

Electrician's Snips

Learn More > (/datacom-cabling/installation-tools/Electricians-Snips)

Modular Crimper

Learn More > (/datacom-cabling/installation-tools/Modular-Crimper)

Can Wrenches

Learn More > (/datacom-cabling/installation-tools/Can-Wrenches)

Wire and Cable Strippers

Learn More > (/datacom-cabling/installation-tools/Cable-Strippers)

(/)

Cable Splicing Knife

Learn More > (/datacom-cabling/installation-tools/Cable-Splicing-Knife)

Probe Pic

Learn More > (/datacom-cabling/installation-tools/Probe-Pic)

Modular Adapters

Learn More > (/datacom-cabling/installation-tools/Modular-Adapters)

Voltage Detector

Learn More > (/datacom-cabling/installation-tools/Voltage-Detector)

ABOUT (/ABOUT-US)

(https://twitter.com/FlukeNetDCI) (http://www.facebook.com/flukenetworks)
(/) (http://www.youtube.com/flukenetworksvideo)

Integrity and Compliance Program (https://www.fortive.com/integrity-compliance)
Privacy Policy (/about/privacy) Terms of Use (/about/terms-of-use) Sitemap (/sitemap)

Fiber Optic Components
Just for Fiber Optic Communication Networks

Three Types of Cable Connectors Used in Cabling Installation Techniques

Posted on **August 12, 2013**

There are three types cable connectors in a basic cabling installation techniques: twisted-pair connectors,coaxial cable connectors and fiber-optic connectors. Generally cable connectors have a male component and a female component, except in the case of hermaphroditic connectors such as the IBM data connector. Usually jacks and plugs are symmetrically shaped, but sometimes they are keyed. This means that they have a unique, asymmetric shape or some system of pins, tabs, and slots that ensure that the plug can be inserted only one way in the jack.

Twisted-Pair Cable Connectors

Many people in the cabling business use twisted-pair connectors more than any other type of connector. The connectors include the modular RJ types of jacks and plugs and the hermaphroditic connector employed by IBM that is used with shielded twisted-pair cabling. Twisted-Pair Cable Connectors are used with patch panels, punchdown blocks, and wall plates. Twisted-Pair Cable connector is called an IDC, or insulation displacement connector.

Most unshielded twisted-pair (UTP) and screened twisted-pair (ScTP) cable installations use patch panels and, consequently, 110-style termination blocks. The 110-Block contains rows of specially designed slots in which the cables are terminated using a punch-down tool. When terminating 66-blocks, 110-blocks, and often, wall plates, both UTP and ScTP connectors use IDC technology to establish contact with the copper conductors. You don’t strip the wire insulation off the conductor as you would with a screw-down connection. Instead, you force the conductor either between facing blades or onto points that pierce the plastic insulation and make contact with the conductor.

Both UTP and ScTP cables use modular jacks and plugs. For decades, modular jacks have been commonplace in the home for telephone wiring. Modular connectors come in four-, six-, and eight-position configurations. The number of positions defines the width of the connector. However, often only some of the positions have metal contacts installed. Make sure that the connectors you purchase are properly populated with contacts for your application.

Common Modular-Jack Designations and Their Configuration

Coaxial Cable Connectors

Unless you have operated a 10Base-2 or 10Base-5 Ethernet network, you are probably familiar only with the coaxial connectors you have in your home for use with televisions and video equipment. Actually, a number of different types of coaxial connectors exist.

The coax connectors used with video equipment are referred to as F-series connectors.The F-connector consists of a ferrule that fits over the outer jacket of the cable and is crimped in place. The center conductor is allowed to project from the connector and forms the business end of the plug. A threaded collar on the plug screws down on the jack, forming a solid connection. F-connectors are used primarily in residential installations for RG-58, RG-59, and RG-6 coaxial cables to provide CATV, security-camera, and other video services.

F-Series Coaxial Connectors

F-connectors are commonly available in one-piece and two-piece designs. In the two-piece design, the ferrule that fits over the cable jacket is a separate sleeve that you slide on before you insert the collar portion on the cable. Experience has shown us that the single-piece design is superior. Fewer parts usually means less fumbling, and the final crimped connection is both more aesthetically pleasing and more durable. However, the usability and aesthetics are largely a function of the design and brand of the two-piece product. Some two-piece designs are very well received by the CATV industry.

N-Series Coaxial Connectors

The N-connector is very similar to the F-connector but has the addition of a pin that fits over the center conductor; The pin is suitable for insertion in
the jack and must be used if the center conductor is stranded instead of solid. The assembly is attached to the cable by crimping it in place. A screw-on collar ensures a reliable connection with the jack. The N-type connector is used with RG-8, RJ-11U, and thicknet cables for data and video backbone applications.

The BNC Connector

When coaxial cable distributes data in commercial environments, the BNC connector is often used. BNC stands for Bayonet Neill-Concelman, which describes both the method of securing the connection and its inventors. Many other expansions of this acronym exist, including British Naval Connector, Bayonet Nut Coupling, Bayonet Navy Connector, and so forth. Used with RG-6, RG-58A/U thinnet, RG-59, and RG-62 coax, the BNC utilizes a center pin, as in the N-connector, to accommodate the stranded center conductors usually found in data coax.

The BNC connector comes as a crimp-on or a design that screws onto the coax jacket. As with the F-connector, the screw-on type is not considered reliable and should not be used. The rigid pin that goes over the center conductor may require crimping or soldering in place. The rest of the connector assembly is applied much like an F-connector, using a crimping die made specifically for a BNC connector.

Fiber-Optic Cable Connectors

Fiber-optic connections use different terminology than copper based connectors. The male end of the connection in a fiber-optic system is termed the connector, in contrast to the plug in a copperbased system. The female end of the connection is termed the receptacle or adapter, in contrast to the jack in a copper-based system.

To transmit data up to 10Gbps, two fibers are typically required: one to send and the other to receive. For 40Gbps and 100Gbps over multimode, as many as 24 fibers will be required. Fiber optic connectors fall into one of three categories based on how the fiber is terminated:

- Simplex connectors terminate only a single fiber in the connector assembly.
- Duplex connectors terminate two fibers in the connector assembly.
- Array connectors terminate more than two fibers (typically 12 or 24 fibers) in the connector assembly.

The disadvantage of simplex connectors is that you have to keep careful track of polarity. In other words, you must always make sure that the connector on the “send” fiber is always connected to the “send” receptacle (or adapter) and that the “receive” connector is always connected to the “receive” receptacle (or adapter). The real issue is when normal working folk need to move furniture around and disconnect from the receptacle in their work area and then get their connectors mixed up. Experience has shown us that the connectors are not always color coded or labeled properly. Getting them reversed means, at the least, that link of the network won’t work.

Array and duplex connectors and adapters take care of this issue. Once terminated, color coding and keying ensures that the connector can be inserted only one way in the adapter and will always achieve correct polarity.

The SFF Connector

As transmission rates increase and networks require the cramming in of a greater number of connections, the industry has developed small-form-factor (SFF) connectors and adapter systems for fiber-optic cables. The SC, ST, and **FC Connectors** shown in Table 10.5 all take up more physical space than their RJ-45 counterparts on the copper side. This makes multimedia receptacle faceplates a little crowded and means that you get fewer terminations (lower density) in closets and equipment rooms than you can get with copper in the same space. The goal for the designers of the SFF connector was to create an optical-fiber connector with the same or lower crosssectional footprint as an RJ-45-style connector in order to increase the number of connections per area (higher density). The LC, the VF-45, and the MT-RJ SFF fiber-optic connectors were initially developed to support the increase in density of fiber connections. The **LC Connector**is gaining greater use and is regarded by many optical-fiber professionals.

This entry was posted in **Cable Management** and tagged **110-Block**, **FC connectors**, **fiber optic connectors**, **LC Connector** by **Admin**. Bookmark the **permalink [https://www.fiber-optic-components.com/three-types-of-cable-connectors-used-in-cabling-installation-techniques.html]** .

JONARD TOOLS®

Tools for Telecom, Fiber Optics CATV, Satellite, Security & Alarm, Wireless and Electronics Industries

Catalogue No. 114

JONARD TOOLS®

MADE FOR LIFE®

WE ARE JONARD TOOLS

jonard.com

Just scan the link to see the new more user friendly Jonard Website. Notice our new name – JONARD TOOLS. This isn't simply a cosmetic change, this is a dramatic metamorphosis of our business and how user friendly our new website is to use. Find what you're looking for with our new and improved search options. Get greater details including tool specifications, helpful videos, enhanced quality photos, complementary products and more. And best of all you still get the GREAT QUALITY you've grown to expect from Jonard. Find out for yourself why our tools are MADE FOR LIFE®.

WHAT'S NEW? Since 2007 Jonard Industries has introduced well over 250 new tools. Follow us on Facebook, Twitter and sign up for our newsletter for exciting events and new product announcements.

BLOG THIS! Yes, Jonard Tools now has a blog with interesting and entertaining news, happenings and other pertinent information. Just go to our website and click the blog icon for the latest blog as well as our previous postings.

WARRANTY

Lifetime warranty – see details on our website www.jonard.com

CUSTOMER SERVICE

Our distribution network is present in all 50 states and over 100 countries. Check the "Where to Buy" section of our website to locate a dealer near you. Jonard Industries maintains stock in depth, provides technical support and we will meet your individual service requirements.

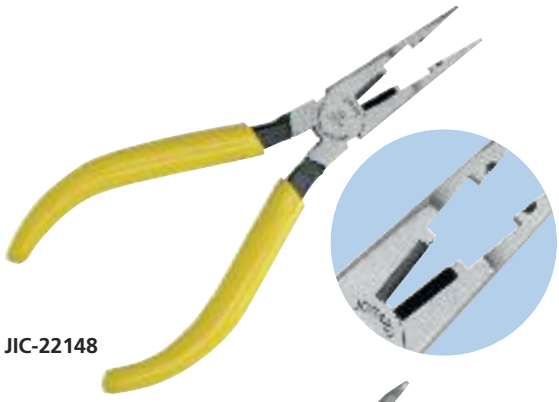
JonardTools

www.facebook.com/JonardTools

Jonard Industries

134 Marbledale Road, Tuckahoe, New York 10707 • email: sales@jonard.com
Phone: (914) 793-0700 • Fax: (914) 793-4527
Website: www.jonard.com

TABLE OF CONTENTS



JIC-22148

COMBO CRIMPER LONG NOSE PLIERS

Five tools in one, combines crimper for UR/UY/UG, AMP tel splice connectors, 709 series connectors, crimping "B" type connectors and a long nose pliers. With a crusher, cutter, .030" stripping hole, and yellow plastic handle. Made of chrome vanadium steel.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	CUTTER LENGTH	WEIGHT
JIC-22148	6 7/8"	1 7/8"	13/16"	3/8"	13/32"	5.4 oz

JIC-891

CONNECTOR-CRIMPING PLIERS WITH SIDE CUTTERS

Connector-Crimping Pliers with Side Cutters designed to press UG, UR, UY, 709 series connectors, crimping "B" type connectors, and AMP tel splice connectors.
A special stop behind cut out prevents damage to connectors. Utilized on combinations of plastic and pulp insulated 19, 22, 24 and 26 gauge copper conductors as well as 20 gauge plastic insulated copper steel wire. Comes with side cutter and yellow plastic handle.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	CUTTER LENGTH	WEIGHT
JIC-891	5 3/16"	1"	13/16"	3/8"	1/2"	5.9 oz

JIC-725

COAX CABLE CUTTER STEEL

A plier designed specifically for coax cables with a steel center conductor. This plier has been tested (over 25,000 cuts) on cables with steel centers, and specifically CCSC (copper clad steel center) conductor cables without degradation to the cutting blades. Made from chrome vanadium steel. Plier will also cut many other cable types.

JONARD PART NO.	LENGTH	JAW THICKNESS	JAW WIDTH	WEIGHT
JIC-725	6 1/4"	1/4"	1.0"	6.5 oz

JIC-750

3/ 4" COAX CABLE CUTTER

Also known as a Banana Cutter, this cutter is designed to cut 3/ 4" coaxial cable. Tool cuts cleanly without compressed or frayed ends. Functions like a tube cutter – eliminates cable distortion during cable prep. NOT designed to cut steel cable. Yellow plastic handles. Made of chrome vanadium steel.

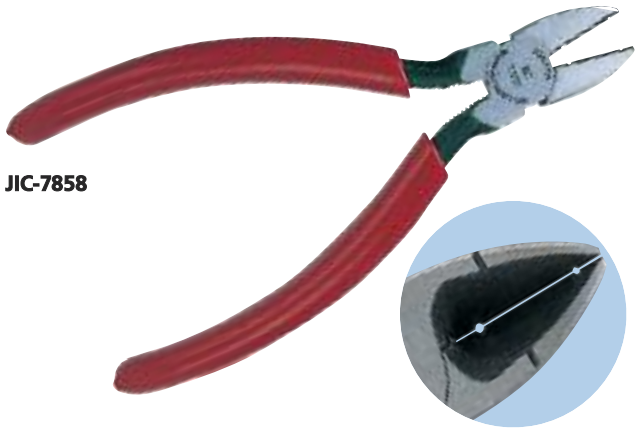
JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
JIC-750	8 3/4"	1 1/4"	5/8"	1/4"	12.6 oz

PLS-5

HEAT COIL PLIERS

Designed for installing and extracting heat coils, fuses from line amplifiers and other cylindrical shaped components. The thin nosed jaw allows easy access to tight restricted areas. Yellow plastic handle.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
PLS-5	5"	1 13/16"	1/2"	5/16"	3.4 oz

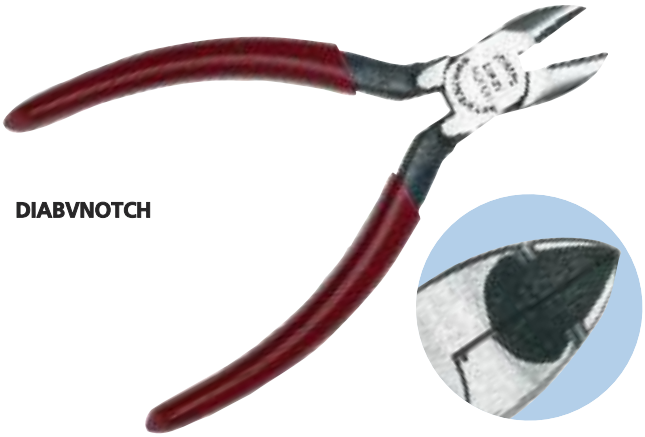


JIC-7858

TELECOM DIAGONAL CUTTER PLIERS

Tapered nose diagonal cutting pliers with standard-bevel knives with .030" and .045" skinning holes, with crusher used for multi-purpose wire work, with two V-shaped stripping notches. Red plastic handle. Made of chrome vanadium steel.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
JIC-7858	6 1/2"	7/8"	3/4"	3/8"	6.4 oz



DIABVNOTCH

DIAGONAL PLIERS – CRUSHING & SLITTING

Used for cutting soft copper conductors. Has a "V" shaped notch between jaws, near the joint, for crushing the flameproof type of insulation on distributing frame wire. Also provides a "W" shaped notch on the plier jaws for slitting textile insulation. Red plastic handle. Made of chrome vanadium steel.

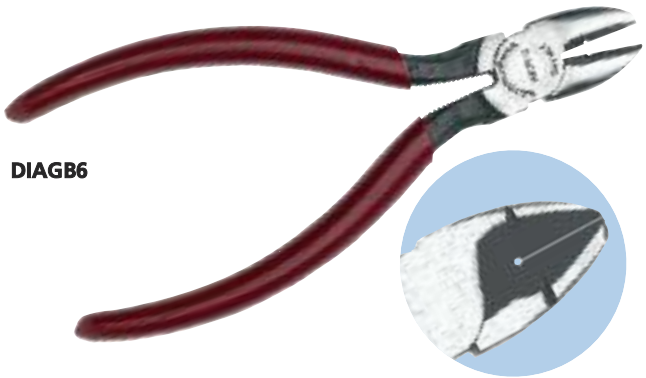
JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
DIABVNOTCH	6 3/16"	13/16"	1/2"	11/32"	4.3 oz

DIAGB5

DIAGONAL GENERAL USE PLIERS

These are plain diagonal pliers for general use, for cutting soft copper conductors. Red plastic handle. Made of chrome vanadium steel.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
DIAGB5	5 1/8"	13/16"	1/2"	11/32"	4.3 oz



DIAGB6

DIAGONAL PLIERS – SKINNING & STRIPPING

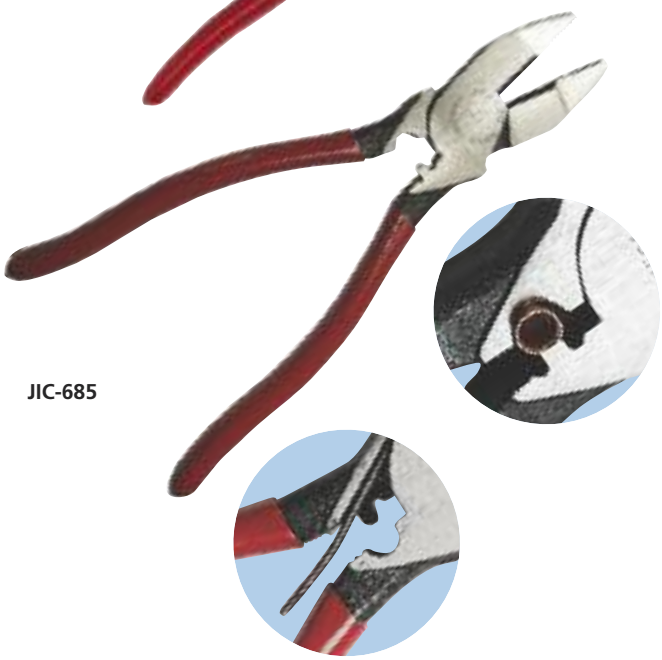
Tapered nose diagonal cutting pliers with standard-bevel knives with one .045" skinning hole, crusher used for multipurpose wire work, and two V shaped stripping notches. Red plastic handle. Made of chrome vanadium steel.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
DIAGB6	6 1/2"	7/8"	3/4"	3/8"	6.4 oz

JIC-2488

JIC-2288

JIC-683



JIC-685

HIGH LEVERAGE DIAGONAL CUTTER ANGLED HEAD

13° angled head for heavy-duty wire cutting and crafted for heavy duty wire cutting. Made from chrome vanadium steel. with improved heat treatment to the cutting edges for increased strength. Use for the most demanding applications, precision machined cutting edges provide exceptionally smooth action.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
JIC-2488	8 5/8"	13/16"	1 3/16"	3/8"	13.8 oz

HIGH LEVERAGE DIAGONAL CUTTER

Crafted for heavy duty wire cutting. Made from chrome vanadium steel. with improved heat treatment to the cutting edges for increased strength. Use for the most demanding applications, precision machined cutting edges provide exceptionally smooth action.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
JIC-2288	8 1/4"	7/8"	1 3/16"	7/16"	13.8 oz

LINEMAN'S B SIDE CUT PLIERS

Designed for heavy duty use in construction and maintenance work. These pliers are high leverage for cutting bolts, nails, and many gauges of wire including high-strength wire. Induction hardened cutting edges cut clean and remain sharp. Precision machined handles and hot riveted joint provide smooth movement with no side play. The cushioned-grip, comfortable handles are red plastic to approximately .007". Made of chrome vanadium steel.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	CUTTER LENGTH	WEIGHT
JIC-683	9 1/2"	1 19/32"	1 1/4"	5/8"	13/16"	14.4 oz

LINEMAN PLIER WITH CRIMPER & FISH TAPE PULLER

Designed for heavy duty use in construction and maintenance work. These pliers are high leverage for cutting bolts, nails, and many gauges of wire including high-strength wire. Cutting edges cut clean and remain sharp. Fish tape pulling feature easily pulls 1/8" or 1/4" steel fish tape without damaging the tape. Built in crimper feature works best on non-insulated connectors, lugs and terminals. Cushioned grip, comfortable handles are yellow plastic coated to approximately .007". Made of chrome vanadium steel.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	CUTTER LENGTH	WEIGHT
JIC-685	9 1/2"	1 19/32"	1 1/4"	5/8"	3/4"	14.4 oz

JIC-63050

HIGH LEVERAGE CABLE CUTTERS

High leverage design for superior cutting ability. Designed with a shear-type jaw for cutting aluminum and soft copper. Not for use on steel or ACSR type cables. Cuts up to 100-pair cables. Red plastic handle. Made of chrome vanadium steel.

JONARD PART NO.	LENGTH	JAW WIDTH	JAW THICKNESS	JAW LENGTH	WEIGHT
JIC-63050	9 1/4"	13/16"	1/2"	1 3/8"	15.8 oz

RC-600

RATCHETING CABLE CUTTER

Cuts up to 600 mcm stranded copper cable, 750 mcm stranded aluminum cable. Maximum capacity is 1 3/4" (45mm) diameter. Cleanly cut copper or aluminum & multi-conductor cable up to 600 mcm. Unique design to hold and cut cable quickly, easily with minimum effort. Spring design to hold cutter in the open position when needed. Quick release for easy opening. Large ergonomic handle design (Not designed for cutting ACSR or steel)

JONARD PART NO.	LENGTH	DESCRIPTION	WEIGHT
RC-600	12"	Ratcheting Cable Cutter	34.0 oz

TS-850

TABBING SHEAR

Also known as a cable sheath shear. Designed for making longitudinal cuts in the cable sheath and the metallic shield for placement of inner sheath bond clamps. Made of chrome vanadium steel with a special hardening process for durability, with a precision ground blade for superior cutting. Plastic formed ergonomic handles for safety and comfort and a latch to keep the handles closed when not in use. The volute spring allows for easy opening and closing.

JONARD PART NO.	LENGTH	DESCRIPTION	WEIGHT
TS-850	8 1/2"	Tabbing Shear	10.5 oz

BCOMB

SLIP JOINT SIDE CUT PLIERS

For heavy-duty use. Polished head, red plastic handles and flush bolt. Machined gripping teeth and 3/8" hardened wire cutter.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	CUTTER LENGTH	WEIGHT
BCOMB	7 5/8"	1 3/4"	1 1/4"	3/8"	3/8"	9.8 oz

JIC-842

TELECOM LONG NOSE D PLIERS

Pliers are for general use looping, bending and cutting. Grips small wires and parts and reaches into tight spaces. Jaws are knurled, serrated and have side cutting blades. Cushion gripped yellow plastic handle.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	CUTTER LENGTH	WEIGHT
JIC-842	6 3/4"	1 7/8"	11/16"	3/8"	1/2"	6.5 oz

JIC-203

LONG NOSE SWITCHBOARD PLIER

Pliers are for general use looping, bending and cutting. Grips small wires and parts and reaches into tight spaces. Jaws are knurled, serrated and have side cutting blades. Two stripping holes for 19 & 22 AWG wire. Cushion gripped yellow plastic handle. Made of chrome vanadium steel.

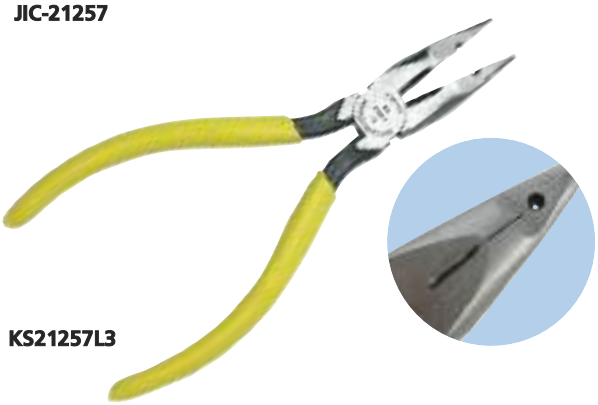
JONARD PART NO.	STRIP HOLES AWG	LENGTH	WEIGHT
JIC-203	19 & 22	6 7/8"	6.5 oz

JIC-21257

TELECOM LONG NOSE PLIERS

Long nose have side cutting blades, a crushing slot, one .030" stripping hole, and a thin knurled nose to facilitate handling of the wire at the terminals. Cushion gripped yellow plastic handle. Made of chrome vanadium steel.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	CUTTER LENGTH	WEIGHT
JIC-21257	6 7/8"	1 7/8"	13/16"	3/8"	1/2"	6.6 oz



KS21257L3

LONG NOSE CUT CRUSH STRIP L3 PLIERS

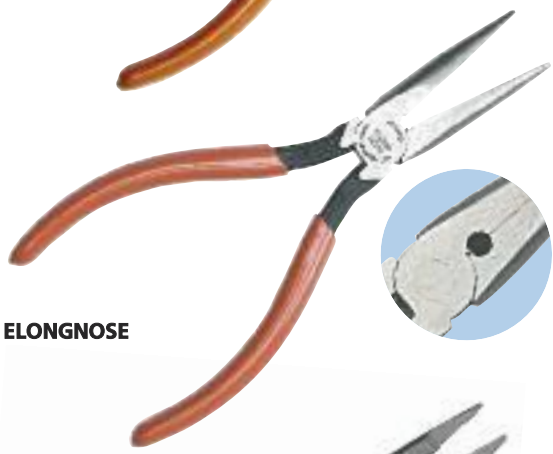
Long nose with side cutter, crushing slot, one .030" stripping hole and a thin knurled nose to facilitate handling wire at the terminals. Cushion gripped yellow plastic handle.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	CUTTER LENGTH	WEIGHT
KS21257L3	6 1/2"	1 1/2"	3/4"	3/8"	7/16"	6.1 oz

JIC-3026

JIC-3385

BLONGNOSE



ELONGNOSE

BSHORTNOSE

CURVED LONG NOSE PLIER

Nose is bent 70° for maximum visibility. Used in confined areas. Design includes knurled jaws for sure wrapping and looping. Comfortable ergonomic yellow plastic handles.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
JIC-3026	6 7/8"	2"	11/16"	3/8"	7.2 oz

CURVED NEEDLE NOSE PLIER

Nose is bent 60° for maximum visibility. Used in confined areas for bending and forming fine wire. Inside jaws and jaw edges are polished to prevent nicking the wire. Plier has a spring loaded ergonomic design. With a dark blue plastic handle.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
JIC-3385	5 1/2"	1 1/2"	1/2"	1/4"	3.2 oz

LONG NOSE GENERAL USE PLIERS

Chain nose pliers for general use. Inner surface of the jaws are knurled near the end to facilitate gripping wire, binding post nuts etc. Orange plastic handle.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
BLONGNOSE	6 7/8"	1 1/2"	3/4"	3/8"	6.1 oz

LONG NOSE GRIPPING PRESSING PLIERS

Long nose pliers for gripping and pressing. Inner surface of the jaws are knurled near the end to facilitate gripping wire, binding post nuts etc. Aluminum oxide insulation coating on the outside nose surface. The inside gripping jaws are provided with mated grooves near the joint for use in pressing .032/.035" brass sleeves. One stripping hole .054" diameter Orange plastic handle.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
ELONGNOSE	6 7/8"	1 7/8"	11/16"	3/8"	6.1 oz

SHORTNOSE PLIERS

Intended for use in skinning 22-24 AWG wire and crushing insulation in nose slot. The front portion of the jaws are narrowed, and a portion of the inner face of one jaw is relieved to skin insulation from wire. The inner surface of the jaws are serrated to facilitate gripping wire. Orange plastic handle.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
BSHORTNOSE	6 1/2"	1 1/2"	3/4"	3/8"	6.1 oz

JIC-5026

JIC-50210

JIC-50212

PUMP PLIERS

Manufactured with a secure tongue and groove design for a non-slip grip (even under heavy pressure). The jaws provide a wide range of openings with a smooth, positive interlock between halves. Handles are plastic coated,but are not insulated and do not protect against electric shock.

JONARD PART NO.	LENGTH	MAX. JAW OPENING	NUMBER POSITIONS	WEIGHT
JIC-5026	6″	1″	4	7.8 oz
JIC-50210	10″	1 3/4″	6	14.4 oz
JIC-50212	12″	2 1/4″	7	24.0 oz

JIC-453

SEMI-FLUSH CUT PLIERS

A close cutting plier used to trim conductors from the 710 connector modules without leaving exposed conductors. Ideal for close trimming of gates and sprue on injection molded plastic parts. Jaw design aids in use in confined areas. Turquoise color handle. Plier made from chrome vanadium steel.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
JIC-453	4 1/2″	5/8″	7/16″	1/4″	2.4 oz

JIC-2755

FLUSH CUT PLIER

Made of high carbon steel, this lightweight flush cutter can be used on wire up to 18 AWG while minimizing fly-off. Cantilevered spring automatically opens the plier, and the head fits easily in confined work areas.

JONARD PART NO.	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
JIC-2755	5″	1/2″	1/2″	1/16″	2.2 oz

All Jonard Industries Pliers come with a LIFETIME WARRANTY. For complete details see our website

FOD-2000

FIBER OPTIC DROP CABLE SLITTER

The FOD-2000 Fiber Optic Drop Cable Slitter is a Patented tool that simplifies the slitting of drop cable jackets at the end of the cable or mid-span. Designed for .250" flat drop cable.
The FOD-2000 puts a slit on both sides of the jacket allowing easy access to the fiber or strength member. The ease of use makes this tool truly unique. To use just position the tool around the cable, pull and slit. A simple solution for a vital task. The FOD-2000 comes completely assembled with two blades, which can be reversed once the blades are worn.

JONARD P/N	DESCRIPTION
FOD-2000	Fiber Optic Drop Cable Slitter
FOD-RB25	Replacement Blades 25/pk

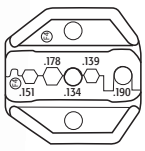
JIC-1022

FIBER JACKET STRIPPER

The Wire Stripper and Cutter is designed to strip and cut the most commonly used stranded and solid wire gauges 10 to 22 AWG and 1.6-3 mm fiber jackets.

JONARD P/N	DESCRIPTION
JIC-1022	Fiber Jacket Stripper

UC-8039



UCD-2685

UNIVERSAL CRIMPER WITH FIBER OPTIC DIE

Fully ratcheted crimper designed for minimal closing force.

JONARD P/N	DESCRIPTION
UC-8039	Universal Crimper with Fiber Optic Die
UC-2685	Fiber Optic Crimping Die

CST-1900

ROUND CABLE STRIPPER

The CST-1900 is designed for fast and precise jacket removal of PVC, rubber, PE and other jacket materials, and works well on round cables with diameters ranging from 3/16" to 1-1/8" (4.5-29 mm). This is a Triple Action Tool, cutting longitudinally for end stripping, spiral for end stripping and mid-span cuts, and circular for jacket removal. A simple versatile easy to use tool your customers will love. The Replaceable Cutting Blade is spring loaded, adjustable for various cable diameters, provides a 90° blade rotation and is designed for long life.

JONARD P/N	DESCRIPTION
CST-1900	Round Cable Stripper
CST-7915	Replaceable Cutting Blade

RB-2060

JIC-4366

RB-2878

OPTICAL FIBER CABLE SHEATH STRIPPER & RING TOOL

This Cable Sheath Stripper is used to ring-cut many types of tight buffer, loose tube buffer, breakout cables and other types of jacketed fiber cables. A slitting blade is built into the tool and can be used to slit open the cable sheath if needed.
Depth of the cut has two adjustments for .018" or .031" thick plastic, rubber or fabric insulation, and can handle cable diameters from 1/8" to 3/8". One spare blade of each style is included with the tool. Also known as CT2860.

JONARD P/N	DESCRIPTION
JIC-4366	Optical Fiber Sheath Stripper & Ring Tool
RB-2060/6	Pkg. of 6 Replacement Blades for ring feature of tool
RB-2878/6	Pkg. 6 replacement blades for stripper feature of tool

JIC-375

FIBER OPTIC STRIPPER THREE HOLE

Three hole Fiber Optic Stripper performs all common fiber stripping functions. Strips the 1.6-3 mm fiber jacket down to the 900 micron buffer coating. The second hole strips the 600-900 micron buffer coating down to the 250 micron coating and the third hole is used to strip the 250 micron cable down to the 125 micron glass fiber. JIC-375 is 6" long.

JONARD P/N	DESCRIPTION
JIC-375	Fiber Optic Stripper- 3 Hole

JIC-175

ERGONOMIC FIBER OPTIC STRIPPER

Used for stripping the 250 micron coating from the 125 micron optical fiber. Preset at the factory so no adjustments are necessary. Yellow plastic formed handles, tool is 6" long.

JONARD P/N	DESCRIPTION
JIC-175	Fiber Optic Stripper Ergonomic

JIC-125

FIBER OPTIC STRIPPER

For stripping 250 micron buffer coating from 125 micron optical fiber. Preset at the factory so no adjustments are necessary. Yellow plastic dipped handles 5 3/16" long

JONARD P/N	DESCRIPTION
JIC-125	Fiber Optic Stripper

MS-6

MID SPAN SLITTER

Designed to provide easy access to optical fibers in loose buffer tubes 1.2mm – 3.3mm diameter. With 6 precision grooves buffer tube slitting is done without damage to the fiber. The blades are replaceable.

Easy to use:
Select the correct groove for the cable being slit
Place the cable in the proper channel, squeeze and pull.

JONARD P/N	DESCRIPTION
MS-6	Mid Span Slitter
MSB-1533	Replacement Blade 1.2 – 3.3 mm (pkg of 2)

JIC-375 H-35 ES-1964

THREE PIECE FIBER OPTIC KIT

Kit includes the JIC-375 Fiber Optic Stripper three hole, ES-1964 Electrician's Scissor, and convenient molded plastic pouch made of durable PVC material and will accommodate belts up to 2" in width.

JONARD P/N	DESCRIPTION
TK-375	3 Piece Fiber Optic Kit
H-35	Plastic Molded Pouch
JIC-375	Fiber Optic Stripper- 3 Hole
ES-1964	Electrician Scissor

JIC-375 H-60 JIC-186

FIBER KIT WITH KEVLAR CUTTER

Kit includes the JIC-375 Fiber Optic Stripper Three Hole, JIC-186 Ergonomic Fiber Optic Kevlar Cutter and the convenient H-60 molded plastic pouch with metal clip.

JONARD P/N	DESCRIPTION
TK-350	Fiber Kit with Kevlar Cutter
H-60	Plastic Moulded Pouch
JIC-375	Fiber Optic Stripper- 3 Hole
JIC-186	Ergonomic Fiber Optic Kevlar Cutter

VFL-25125

VFL-25

TECHNICAL SPECIFICATIONS

Light Source:	Class IIIA Laser Diode
Wavelength:	650nm
Battery Life:	60 Hours
Connector:	2.5mm universal
Working Temperature:	-4F (-20C) to 140F (60C)
Storage Temperature:	-40F (-40C) to 185F (85C)
Power:	2 AAA Batteries

VISUAL FAULT LOCATOR

This pen style VFL is specially designed for field personnel who need a portable light source tool for fiber tracing, fiber routing, continuity testing, to locate breakpoints (bending or cracking in fiber optic cables), and poor connections.

The VFL works in an OTDR dead zone and is used for end-to-end visual fiber identification. Operates in either CW (continuous wave) or pulsed mode. Not recommended For use on dark colored or armored cables.

JONARD P/N	DESCRIPTION
VFL-25	Visual Fault Locator and 2 AAA Batteries
VFL-150	Visual Fault Locator Kit - Includes: VFL-25, 2 AAA Batteries, VFL-25125 FC/LC Adapter
VFL-25125	FC/LC Adapter

TSAB-40

TSPE-125

TSPF-125

TSUC-40

For Fitel, Fujikura and Ericsson fiber holders use the corresponding platforms, for LDF and all others without fiber holders use the Jonard Universal Clamp.

JONARD P/N	DESCRIPTION
TSPE-125	Ericsson Style Platform
TSPF-125	Fitel/Fujikura Style Platform
TSUC-40	Universal Clamp

TSUC-5000

TSUC-510

TSUC-518

TSUC-516

TSUC-512

THERMAL FIBER OPTIC STRIPPER FIXED BLADE
Thermo-mechanically remove coatings from optical fibers. High strength thermal stripper supports standard 125µm optical fibers, including 250 µm, 400 µm, and 900 µm coated fibers. The heater is adjustable to 200°C and facilitates stripping difficult and baked-on coatings. Adjustable temperature and time settings to adapt to a variety of different coatings. Compact design, weighs less than a pound. Includes A/C power supply, cord and cleaning brush. Platforms supplied separately.

THERMAL FIBER OPTIC STRIPPER ADJUSTABLE BLADE
Thermo-mechanically remove coatings from optical fibers. High strength thermal stripper with adjustable stripping blade, which supports cladding diameters 30µm to 1000 µm acrylate coated fibers with buffer diameters up to 1200 µm. The heater is adjustable to 200°C and facilitates stripping difficult and baked-on coatings. Adjustable temperature and time settings to adapt to a variety of different coatings. Compact design, weighs less than a pound. Includes A/C power supply, cord and cleaning brush. Platforms supplied separately.

JONARD P/N	DESCRIPTION
TSFB-125	Thermal Stripper Fixed Blade
TSAB-40	Thermal Stripper Adjustable Blade

ULTRASONIC CLEANER
The Jonard Industries TSUC-5000, compact, low maintenance Ultrasonic Cleaner is a purpose-built ultrasonic fiber cleaner that has been designed specifically for fiber splicing applications. The unit comes with a power supply, power cord, alcohol dispenser and user manual. Easy to use, an audible and visual indicator will signify when the fiber should be removed. Versatile settings allow user to adjust for cycle duration and intensity levels for maximum results. Options include a solid lid to reduce evaporation, and custom rails that can be adapted to the most popular fiber holders such as Fitel, Fujikura and Ericsson.

JONARD P/N	DESCRIPTION
TSUC-5000	Ultrasonic Cleaner
TSUC-510	Ultrasonic Cleaner Cover
TSUC-512	Ultrasonic Cleaner 12mm Ericsson Rail
TSUC-516	Ultrasonic Cleaner 16mm Fitel Fujikura Rail
TSUC-518	Ultrasonic Cleaner 18mm Fitel Rail

JIC-186

ERGONOMIC FIBER OPTIC KEVLAR® CUTTER

High carbon stainless steel blades designed to cut Kevlar®, cabling insulation, tape, cable ties and other material. Ergonomic handles for user comfort and durability. Adjustable joint screw under protective cap, serrated blades grip material, sharp and durable 6" long.

JONARD P/N	DESCRIPTION
JIC-186	Wire & Kevlar Cutting Shears

JIC-195

COMMUNICATION SCISSOR

High carbon stainless steel blades, 1/4" notch for cutting & stripping, two stripping notches for 18 & 22 AWG wire, one serrated non-slip blade, dual component handle. High carbon stainless steel blades that are both sharp and durable with serrated blade that grips and holds the wire. Ergonomic dual component nylon & santoprene handles, for user comfort and durability. Designed with an adjustable joint screw under the protective cap.

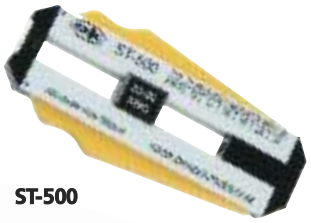
JONARD P/N	DESCRIPTION
JIC-195	Communication Scissor

SD-63

SCREWDRIVER, JEWELER'S TYPE

Used to terminate the battery backup in the fiber ONT. Screwdriver has concaved swivel knob to fit the finger and hexagonal shape to prevent rolling. Solid blade made of high quality hardened tool steel. .100" blade width. 4" long.

JONARD P/N	DESCRIPTION
SD-63	Jeweler's Screwdriver



ST-500

ADJUSTABLE PRECISION FIBER STRIPPER

This adjustable stripping tool is designed to strip 0.3mm–1.0mm diameter cable. It is capable of stripping the 900 micron buffer coating from optical fiber cables. Made with specially hardened blades (RC58) for long life. Easy to use, just squeeze and pull.

JONARD P/N	DESCRIPTION
ST-500	Adjustable Precision Fiber Stripper

CSR-1575

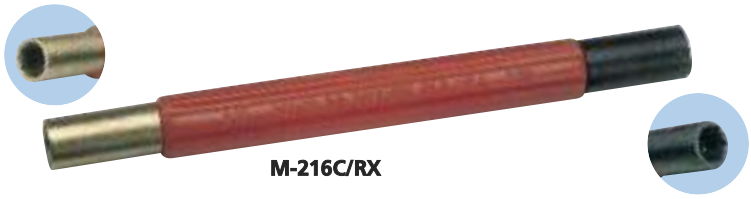
CABLE SLIT AND RING TOOL

The CSR-1575 is designed to slit and ring UTP, STP, Coax and other cables, buffer tubes and Jackets on fiber optic cables up to 7.5mm (0.3") in diameter. The tool features an easily adjustable slit blade and ring blade for nick-free strips. The removable/ reversible V block accommodates smaller and larger diameter cables.

JONARD P/N	DESCRIPTION
CSR-1575	Cable Slit and Ring Tool
CSR-2	Replacement Blades – set of 2


M-216C/EX


M-216C/REX


M-216C/RX

CAN SOCKET WRENCH

Double end can socket wrench, 3/8" and 7/16" hex, orange plastic handle in either our standard or ergonomic design. Used in placing fuses in cable terminals and connecting wires to fuses and binding posts. The walls on both sockets are thin enough so they can be used to work locking devices on most terminals and cabinets. 7" long.

JONARD P/N	DESCRIPTION
M-216C/EX	Ergonomic 1" Dia. Handle, Hex Outer Socket
M-216C/REX	Ergonomic 1" Dia. Handle, Round Outer Socket
M-216C/RX	Standard Handle, Round Outer Socket
M-216CS22	Ergonomic 1" Dia. Handle, Hex Outer Socket with 22 AWG Stripper Blade
M-216CKIT	Ergonomic 1" Dia. Handle, Hex Outer Socket with 22 AWG Stripper Blade Can Wrench and Security Key Insert


M-216CS22


M-216CKIT

SK-51632

SECURITY KEY INSERT

Designed with a double-ended hex adapter for two sizes of pin-in-head security fasteners. Simply slip the key into the 3/8" side of a can wrench and you are ready for either a 5/16" or 5/32" hex security screw. This is a reversible insert tool. One end is for SLC Cabinets and the other is for most network interface boxes.

JONARD P/N	DESCRIPTION
SK-51632	Security Key Insert


BW-532


BW-532-3

BOOTH WRENCH

Tamperproof hex screwdriver, also known as a booth wrench or security wrench. It features a 1" diameter screwdriver handle, 5/32" hex shaft with a hole drilled in the tip for use with security tamperproof screws used for telephone and CATV applications. BW-532 Booth Wrench is 9" long and the BW-532-3 Booth Wrench is 6" long.

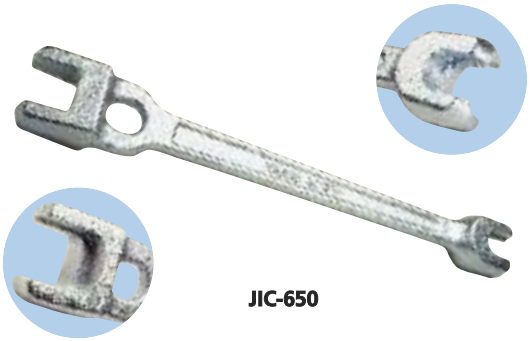
JONARD P/N	DESCRIPTION
BW-532	Booth Wrench -Ergonomic design 9"
BW-532-3	Booth Wrench -Ergonomic design 6"


BW-516

T HANDLE SECURITY WRENCH 5/16"

T handle tamper proof 5/16" wrench for use on tamper-proof cross-connect cabinets, MESA and CATV closures. Recessed at both ends and they are 1/4" deep. Red plastic handle for user comfort

JONARD P/N	DESCRIPTION	HOLE DIA.	LENGTH	RECESS
BW-516	T Handle Security Wrench	0.15"	7.5"	1/4"

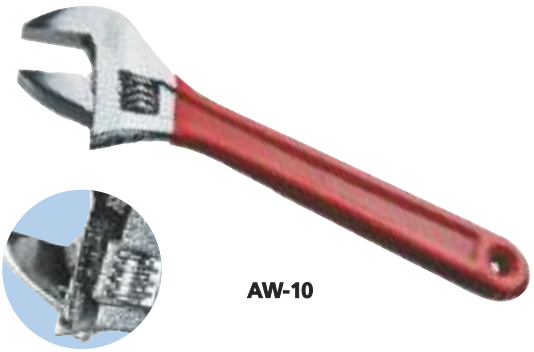


JIC-650

LINEMAN'S B WRENCH

Forged and heat treated, this wrench is used on pole line hardware. It is open-end double-end type with two sizes of openings at each end and an oval hole for turning pole steps. The end openings accommodate nuts for 3/8", 1/2", 5/8" and 3/4" bolts and the head of the 1/2" drive screw. The faces of the wrench openings are offset to provide handle clearance.

JONARD P/N	DESCRIPTION
JIC-650	Lineman's B Wrench

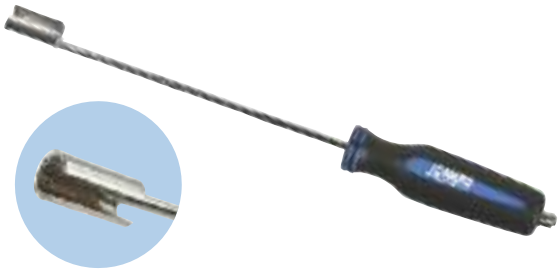


AW-10

ADJUSTABLE WRENCHES WITH EXTRA WIDE JAW

All wrenches are made of chrome vanadium steel with a chrome plated finish. Wrenches are forged and heat treated for greater strength. Handles are covered with a red transparent plastic for user comfort. The knurl is precision formed and the operation is smooth and trouble free. For accurate adjustments use the metric or English scales on either side of the jaws.

JONARD PART NO.	DESCRIPTION	LENGTH	JAW CAPACITY	WEIGHT
AW-6	Adjustable Wrench 6"	6" (152 mm)	15/16" (24mm)	5.2 oz
AW-8	Adjustable Wrench 8"	8" (203mm)	1 1/8" (29mm)	10.6 oz
AW-10	Adjustable Wrench 10"	10" (254mm)	1 5/16" (33mm)	14.6 oz
AW-12	Adjustable Wrench 12"	12" (305 mm)	1 1/2" (38mm)	24.0 oz
TK-6810	Wrench set-3 piece includes 6", 8" & 10"			



RF-12

F CONNECTOR TOOL

Designed to provide easy access to connectors in high-density locations. The head measures 7/16" and is used specifically for "F" connectors and BNC connectors. The socket extends 8" from the handle, the overall length is 12" and the back of the handle has an insertion device to aid in making connections. Will also work with BNC connectors.

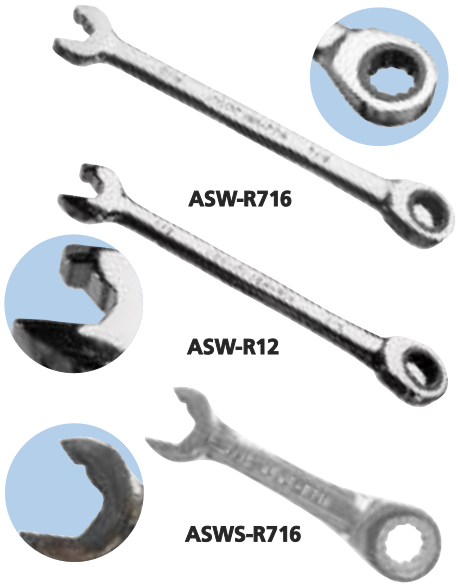
JONARD P/N	DESCRIPTION
RF-12	F Connector Tool

RBNC-12

BNC CONNECTOR TOOL

Designed to provide easy access to connectors in high density locations. The head is formed specifically for a wide variety of BNC connectors. The socket extends 8" from the handle and the overall length is 12".

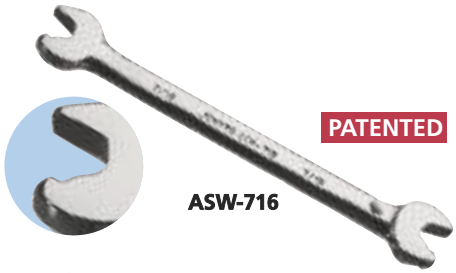
JONARD P/N	DESCRIPTION
RBNC-12	BNC Connector tool



RATCHETING SPEED WRENCH

Speed head makes tightening and loosening quick and easy while the ratcheting box end offers 12 points of contact. Polished to a high gloss finish and made of chrome vanadium steel. ASW-R716 - Combination wrench measures 7/16" at both ends. This is the perfect tool for cable and satellite installers. Designed to work on F Connectors, on splitters, and all 7/16" connections. ASW-R12 Combination wrench measures 1/2" at both ends.

JONARD P/N	DESCRIPTION	LENGTH
ASW-R716	Ratcheting Speed Wrench 7/16" (works on F Connectors)	6 1/2"
ASW-R12	Ratcheting Speed Wrench 1/2"	6 1/2"
ASWS-R716	Ratcheting Speed Wrench 7/16" Stubby	4"



SPEED WRENCH DOUBLE ENDED–PATENTED

ASW-716 measures 7/16" at both ends. ASW-12 measures 1/2" at both ends and ASW-916 measures 9/16" at both ends. Speed head makes tightening and loosening quick and easy, plus head is angled (15°) to ease access. Speed wrenches are 6 1/2" long with a hole on the handle for a clip or other hanging device. High gloss chrome finish, and made of high carbon alloy steel.

JONARD P/N	DESCRIPTION	LENGTH
ASW-12	Speed Wrench double Ended 1/2"	6 1/2"
ASW-716	Speed Wrench double Ended 7/16"	6 1/2"
ASW-916	Speed Wrench double Ended 9/16"	7 1/2"
ASW-7916	Speed Wrench double Ended 7/16" + 9/16"	7 1/2"
ASWS-716	Speed Wrench Double Ended 7/16" Stubby	4"

COMBINATION WRENCH

Wrench measures 7/16" at both the open end and box end. Both ends have an angle offset (15°) to ease access in confined areas. The box end offers 12 points of contact. High gloss chrome finish and made of chrome vanadium steel.

JONARD P/N	DESCRIPTION	LENGTH	WEIGHT
CW-716	Combination Wrench	6 5/8"	2.88 oz

TORQUE WRENCH

Designed for "F" Connectors, these wrenches help prevent over tightening. An audible click tells you the connection has been properly achieved. These wrenches all have angle heads, and are designed with an ergonomic cushioned handle for user comfort and protection. The last two digits of the part number indicate the inch pounds of torque (either 20, 30 or 40 inch pounds) and the first four letters indicate whether the head is a speed head or a full head (TWAF is full and TWAS is speed). Note that these wrenches work in tightening mode only.
Full Head - is a full size open end wrench that behaves like a traditional open end wrench.
Speed Head - is designed to act like a ratcheting wrench. The tool skips over the corners of the bolt or nut being turned so no repositioning of the tool is required (allowing continuous turning).

TORQUE WRENCHES 7/16"

JONARD P/N	DESCRIPTION	TORQUE IN INCH-LBS	TORQUE IN NEWTON METERS
TWAF-71620	Torque Wrench Full Head	20	2.26
TWAS-71620	Torque Wrench Speed Head	20	2.26
TWAF-71630	Torque Wrench Full Head	30	3.39
TWAS-71630	Torque Wrench Speed Head	30	3.39
TWAF-71640	Torque Wrench Full Head	40	4.52

TORQUE WRENCHES 1/2" & 9/16"

JONARD P/N	DESCRIPTION	TORQUE IN INCH-LBS	TORQUE IN NEWTON METERS
TWAF-1220	Torque Wrench Full Head 1/2"	20	2.26
TWAF-91620	Torque Wrench Full Head 9/16"	20	2.26
TWAF-91630	Torque Wrench Full Head 9/16"	30	3.39

TORQUE WRENCH WITH SECURITY SHIELD ATTACHED

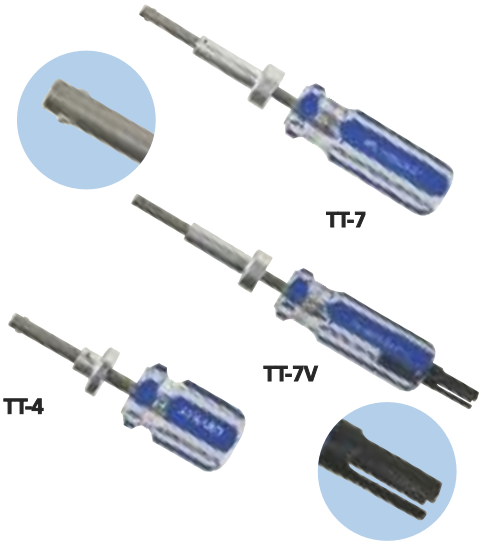
Torque wrench is set at 30 in./lb. with security shield attached. Security shield measures 4 ¾" (120mm), is permanently attached and pivots in 90 degree increments. Ideal for hard to reach shielded F connector fittings where a pre-set torque is required.

JONARD P/N	DESCRIPTION
TWAFST-71630	Torque Wrench with 7/16" Security Shield Attached

TORQUE WRENCH SWIVEL HEAD

Used to properly torque cable shield bond connectors and other ground connections. Head swivels 90° in 2 directions and is factory set for 40 in./Lb. Can be used with any 3/8" drive sockets. Audible click when proper torque is achieved.

JONARD P/N	DESCRIPTION	
TWSW-40	Torque Wrench Swivel Head	40 inch pounds
TWS-38/10	3/8" Socket for TWSW-40 (Pkg. of 10)	



TERMINATOR TOOLS

Tool is used for various locking terminators including the Gilbert Engineering GTP (Morlock), PRC (Production Products Company), LFT, PCT (International Technology), TPG, TR 75 GTL (Viewsonics), and SV-LT & SV-LTA (Signal Vision) locking terminators. Ergonomic handle provides greater leverage and a superior grip. Available in three sizes 4 1/2", 8", and 9" Pronged locking terminators. Ergonomic handle provides greater leverage and a superior grip.

JONARD P/N	DESCRIPTION
TT-4	Terminator Tool 2 1/2" shaft, overall length 4 1/2"
TT-7	Terminator Tool 4" shaft, overall length 8"
TT-7V	Pronged Terminator Tool 4" shaft, overall length 9"

CAM STYLE LOCKING TERMINATOR TOOL

A Cam Style locking terminator tool for Corning Gilbert style terminators. Works on Gilbert NS-5762-3 (plus -9, -11, -13 & -15 terminators). High quality aluminum construction, blue color.

JONARD P/N	DESCRIPTION	LENGTH	WEIGHT
TTCG-6270-5	Locking Terminator Tool	5 inches	1.75 oz
TTCG-6270-9	Locking Terminator Tool	9 inches	7.50 oz

BARREL LOCK PLUNGER KEY

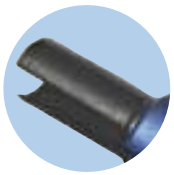
This barrel lock plunger key is compatible with several types of Highfield and Innertite barrel locks with inside diameters ranging from 0.176" to 0.196". Key is made of high carbon steel with smooth plunger and heavy duty spring for strength and durability. Serialized for added protection for authorized personnel only.

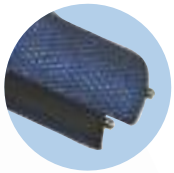
JONARD P/N	DESCRIPTION
TTB-6	Barrel Lock Plunger Key

P KEY FOR SELF LOCK PEDESTAL LOCK

This P Key is designed to work with Channell Locks and other similar pedestal locks. This P key fits many popular pedestals and opens most heavy duty spring lock cabinets. Also referred to as a skeleton key, made of brass and fits easily on a key chain.

JONARD P/N	DESCRIPTION	LENGTH	WEIGHT
TTK-225	P Key for Self Lock Pedestal Locks	2.25"	0.75 oz





SECURITY SHIELD TOOL 7/16”

Used with 7/16" hex shielded F Connectors. Design includes extended 7/16" shank for ease of use with Torque Wrenches in security shield applications. Machined and heat-treated steel for maximum durability with black oxide finish. Knurled handle for secure gripping and includes a steel loop for turning leverage and carrying.

Note: SST-716AT is designed for use where security shield applications for PPC AquaTight® EX Series and Gilbert GF URS-6 connectors are used.

SECURITY SHIELD TRAP TOOL 9/16”

Used with 9/16” Hex shielded F connectors (RG11 connectors). Machined and heat treated high carbon steel for maximum durability with nickel plated finish. Loop attachment to allow for connecting to your key ring or carabiner for easy access. Shaft Length 1.625”

JONARD P/N	DESCRIPTION
SST-716	Security Shield Tool 7/16”
SST-716AT	Security Shield-Aqua Tight Tool
SST-916	Security Shield Tool 9/16”

TRAP SECURITY COMBO TOOL

Two tools in one - a trap wrench with a security wrench. The perfect tool for all standard traps and equally adaptable for all sizes of metal security shields (The security wrench fits all metal 7/16" hex fittings). Made of lightweight aluminum with a security socket made of hardened steel for longer life. Lightweight just 2 oz. (57g) and just 7 1/2" long

JONARD P/N	DESCRIPTION	LENGTH	WEIGHT
TTS-716	Trap Security Combo Tool	7.5"	2 oz

FUSE PULLER PLIERS

Designer for installing and extracting fuses from line amplifiers and other cylindrical shaped components including heat coils. The thin nosed jaw allows easy access to tight restricted areas. Handle is yellow colored plastic.

JONARD P/N	LENGTH	JAW LENGTH	JAW WIDTH	JAW THICKNESS	WEIGHT
FP-600	5”	1 13/16”	1/2”	5/16”	3.4 oz

FLARING & INSERTION TOOL

The flaring end of the tool facilitates the expansion of the cable providing easier insertion of “F” connectors. The insertion end makes “F” connector insertion fast and easy, even in cold weather. This tool is recommended for use on polyethylene jacketed cables and plenum cables, and is especially helpful when using tri-shield and quad-shield cables. 4 1/4” long

JONARD P/N	DESCRIPTION
FT-6	Flaring & Insertion Tool


UST-500


UST-205


UST-215


UST-210


UST-225

UNIVERSAL CABLE STRIPPING TOOL

Use for Coax, Round Network Cables and Flat Cables - This versatile tool is five tools in one. Simply reverse the blade for RG59/6 & 7/11 Coax Cables. Insert the Round Cable into the second hole (adjustable) for a fast and easy strip. Will strip CAT6 cables with outside diameter up to 0.250". The third hole is for cutting all styles of cable while the fourth hole is designed for Flat Cable and 4P/6P style cable. The perfect wire stripper for most stripping applications. Includes Velcro strip for holding back the braided shield of the cable.

JONARD P/N	DESCRIPTION	BLADE INCLUDED
UST-500	Coaxial Cable Stripper (RG59/6 & 7/11)	UST-205
UST-525	Coaxial Cable Stripper with cable stop	UST-225
UST-596	Universal Cable Stripping Tool (59/6)	UST-210
	REPLACEMENT BLADES	
UST-205	Repl Blade for RG59/6 & 7/11	
UST-210	Repl Twin Blade RG59/6 with Cable Stop.	
UST-215	Repl Blade for RG59/6 with Cable Stop & Untwisted Pair	
UST-220	Repl Blade for UST-175 Mini-coax only	
UST-225	Repl Blade for RG59/6 & RG7/11 with Cable Stop	


UST-100


UST-150

COAXIAL CABLE STRIPPER TOOL

The UST 100 Series strips a multitude of cables. Virtually all the blades are interchangeable with the exception of the UST-220. This blade is matched exclusively to the UST-175 handle. For replacement blades or complete tools see table above. Includes Velcro strip for holding back the braided shield of the cable.

JONARD P/N	DESCRIPTION	BLADE INCLUDED
UST-100	Coaxial Cable Stripper (RG59/6 & 7/11)	UST-205
UST-125	Coaxial Cable Stripper with UST-225 Blade	UST-225
UST-150	Coaxial Cable Stripper with UST-215 Blade	UST-215
UST-175	Mini-Coaxial Cable Stripper	UST-220
UST-1596	Coaxial Cable Stripper (59/6) w/Twin Blade	UST-210


UST-1596


UST-175


UST-220

MINI-COAX CABLE STRIPPER

The UST-175 is a three level coax stripper for mini-coax cables (CommScope73508, Belden 735A1 and similar cables). The mini strips 0.625" of the outer jacket in the first level, the second level strips the braid exposing 0.156" of dielectric, and the third level strips the dielectric exposing 0.156" of the 26 AWG center conductor. Includes Velcro strip for holding back the braided shield of the cable.

JONARD P/N	DESCRIPTION
UST-175	Mini-Coax Cable Stripper
UST-220	Replacement Blade for the UST-175

CT-200

UNIVERSAL COMPRESSION TOOL CT-200

This universal compression tool is designed for use on F Connectors (RG59, RG6, & RG11), BNC Connectors (RG59 & RG6) and RCA Connectors (RG59 & RG6). BNC connectors must be over 1.5" in length. Tool is designed with a dual head and adjustment dial for each unique connector application. COMPATIBLE CONNECTORS: PPC - CMP6, CMP62, CMP59Q, CMP11, EX6XL, EX59XL, EX59XLHE, EX6XLW9, EX7, EX7N716, EX11, EX11N716, EX320QR, EX320N716. T & B - Snap -n-Seal Digicon - DS6, DS59, DS59Q, DS11, DS7 Gilbert UE - GF-UE-59, GF-UE-59Q, GF-UE-6, GF-UE-6Q, GF-UE-5.1, RCA-UE, BNC-UE *Plus many other brands and styles including F, RCA & BNC Types.*

CTF-200

FIXED COMPRESSION TOOL CFT-200

Compression tool with a fixed design for use on many manufacturers longer style F Connectors. Some compatible connectors are **Thomas & Betts**: Snap-N-Seal, **Digicon**: DS6, DS59, DS6Q, DS59Q, DS11, DS7, **Gilbert UltraEase**: GF-UE-59, GF-UE-59Q, GF-UE-6, GF-UE-6Q, GF-UE-5.1, **PPC**: CMP6, CMP6Q, CMP59, CMP59Q, CMP11, EX6XL, EX59XL, EX59XLHE, EX6XLWS, EX6LP, EX7, EX7N716, EX11, EX11N716, EX320QR, EX320N716

CTF-300

FIXED COMPRESSION TOOL CTF-300

Compression tool with a fixed designed for use on the shorter style F connectors (Such as PPC® Aquatight Connector EX or shorter connectors and other similar length connectors). PPC: EX6/59, EX6W9, EX59HE, EX6P, EX7, EX7N716, EX11, EX11N716, EX320QR, EX320N716

JONARD P/N	DESCRIPTION
CT-200	Universal Compression Tool
CTF-200	Fixed Compression Tool - for longer style F connectors
CTF-300	Fixed Compression Tool - for shorter style F connectors

PATENTED

UC-864

MODULAR CRIMPING TOOL

This modular crimping/stripping connector tool for voice and data applications. Designed to cut, strip and crimp paired conductor cables (round STP/UTP and flat satin phone cables). Crimps: 4, 6, 8, position modular connectors (RJ22, RJ11, RJ45)

JONARD P/N	DESCRIPTION
UC-864	Modular Crimping tool 6 in 1

MTC-468

MCT-468 MODULAR CABLE TESTER

The MCT-468 is designed to check and troubleshoot the pin connections of cables with RJ45, RJ11 and RJ12 connectors. It is also ideal for testing the continuity of these cables prior to installation.

FEATURES INCLUDE:

1. Can test RJ45 and RJ11 and RJ12 connected cables.
2. Tests for opens, shorts and miswiring.
3. Full LED indication lights on both main and remote unit
4. Auto tests when switched on. Move switch to S to slowdown auto test feature for greater visibility.
5. Small size and lightweight
6. Carrying case and 9V battery included

JONARD P/N	DESCRIPTION
MCT-468	Modular Cable Tester

CM-8

CABLE MAPPER & TONER - CM-8

FIND & IDENTIFY MULTIPLE COAX CABLES IN MAIN CABLE BOXES For use on Coax Cables for CATV, Satellite Installations, Audio Video Equipment, CCTV and Security & Alarm Installations. The CM-8 Coax Cable Mapper & Toner is designed to quickly find and identify multiple cables and easily map runs to and from a central cable bundle.

FEATURES INCLUDE:

1. Eight numbered & color coded cable identifiers.
   #1 White, #2 Red, #3 Black, #4 Blue,
   #5 Green, #6 Yellow, #7 Purple & #8 Brown.
2. Two Alligator clip sets
   1x F-Male coax adapter
   1x F-Female coax adapter
3. Built-in tone generator
4. Auto power off 30 minutes in "Tone" mode
5. Test for Opens and shorts
6. Auto power off 12 seconds after Pass/Fail results
7. Maximum cable length for testing 5,000 feet
8. Powered by two 3V CR2032 batteries
9. Low battery warning light
10. Maximum DC cable resistance 100 Ohms
11. Live Voltage detection

NOTE: This Cable Mapper & Toner will not test cable runs with AC or DC voltage present, Power Amplifiers, Isolation Splitters, Attenuators, Directional Line Tap, Power Dividers or Matching Transformers & DC blocking devices

CMI-SET8

CM-8 Kit contains:

Cable Mapper & Toner
8 Cable Identifiers
(Numbered & color coded)
2 Alligator Clip Sets
Cordura Case
Instruction Sheet

CM-17 Kit contains:

Contents of the CM-8 kit
9 RJ45 connectors

CMI-RJ45

JONARD P/N	DESCRIPTION
CM-8	Cable Mapper & Toner
CMI-SET8	8 Cable Identifiers (Numbered & Color Coded)
CM-17	Cable mapper and tower for Coax and LAN
CMI-RJ45	Nine RJ45 adapters

TETP-900

MULTI-FUNCTION CABLE TESTER TONER & PROBE KIT

Ideal for VDV (voice – data – video) professionals in telecommunications, network and digital communications. This is a multi-function cable tester for RJ45 LAN cable, BNC/F coaxial cable, 6P2C/4P2C jacks and provides tone generation.

Kit includes: cable tester, tone tracing probe, (2) BNC male to F female connectors, BNC cable terminator 50Ω, RJ45 jumper, two 9V batteries, nylon bag, belt clip, user's manual

JONARD P/N	DESCRIPTION
TETP-900	Multi-Function Cable Tester Toner & Probe Kit
TET-700	Multi-Function Cable Tester & Toner
TEP-200	Tone Tracing Probe
TET-6	Accessory Kit for TET-700

PT-300

PT-350

POCKET CONTINUITY TESTER AND TONER

Drop cable continuity tester - accurate up to 5,000 feet (1,500 m). Identify cables in an MDU, and detect troublesome short circuits.

FEATURES

1. Loud tone identifies line carrying signal
2. LED light indicates splitters, DC shorts and other self grounding devices in cable
3. Right angle male push-on connector for working in confined areas
4. Accurate up to 5,000 feet (1,500 m)
5. Common AAA battery for operation
6. Voltage protected to 52V DC
7. Just 5" long, weighs 2 oz. (57 g)
8. Built in on/off switch

Comes complete with LED light indicator, detachable tone detector, female push-on connector and 1.5V AAA battery.

JONARD P/N	DESCRIPTION
PT-300	Pocker Continuity Tester and Toner
PT-350	Pocker Tester Replacement Speaker

UCD-2045

UC-8012

UNIVERSAL CRIMPER

This fully ratcheted crimper is designed for minimal closing force (higher crimp force).

JONARD P/N	DESCRIPTION
UC-8012	Universal Crimper with COAX Die

JONARD P/N		DIE SPECIFICATIONS	CABLE SIZE
UCD-2045	COAX	.068"/.262"/.324"/.360" 1.73mm/6.65mm/8.23mm/9.14mm	CATV "F" Connectors RG59/RG6

FIVE PIECE TELECOM INSTALLERS KIT

The perfect kit for simple installations–includes the basic necessities. Kit includes the M-216CS22 Can Wrench, KN-7 Ergonomic Cable Splicing Knife, ES-1964 Electrician's Scissors, JIC-22035 Spudger and the H-50 Pouch made of durable PVC material with metal clip.

JONARD P/N	DESCRIPTION
TK-50	Five Piece Telecom Installers Kit
H-50	Plastic Molded Pouch
KN-7	Ergonomic Cable splicing Knife
M-216CS22	Can Wrench with 22 AWG wire stripper
JIC-22035	Probe Pick Spudger
ES-1964	Electrician Scissor

TELEPHONE INSTALLER SPLICER KIT

Designed for stripping, splicing and crimping. The perfect kit for telephone installers. Kit contains the ES-1964 Electrician's Scissors, JIC-22148 Combo Crimper Long Nose Plier and the H-36 Pouch made of durable PVC material with metal clip.

JONARD P/N	DESCRIPTION
TK-22148	Telephone Installer Splicer Kit
H-36	Plastic Molded Pouch
JIC-22148	Combo Crimper Long Nose Plier
ES-1964	Electrician Scissor

SPLICER'S KIT

This compact kit contains an ergonomic splicers knife, scissor and leather pouch. The knife features a 1 3/4" tough, cutlery-steel blade and a non-slip handle. The scissors are made of high carbon steel with scraper and file on one side and 2 stripping notches on the other. Both items fit securely in the leather pouch which can be mounted on belts up to 2" wide.

JONARD P/N	DESCRIPTION
TK-400	3 Piece Splicer's Kit
H-40	Leather Pouch
KN-7	Ergonomic Cable Splicing Knife
ES-1964	Electrician Scissor

FIBER KIT WITH KEVLAR CUTTER

Kit includes the JIC-375 Fiber Optic Stripper Three Hole, JIC-186 Ergonomic Fiber Optic Kevlar Cutter and the convenient H-60 molded plastic pouch with metal clip.

JONARD P/N	DESCRIPTION
TK-350	Fiber Kit with Kevlar Cutter
H-60	Plastic Moulded Pouch
JIC-375	Fiber Optic Stripper- 3 Hole
JIC-186	Ergonomic Fiber Optic Kevlar Cutter

TK-82

TK-83

TK-85

COAX TOOL KITS

A CATV technician's service kit designed for repair and maintenance of CATV cable networks

JONARD PART NO.	DESCRIPTION
TK-82	Coax Tool Kit with CTF-200 Compression Tool – Long Style
TK-83	Coax Tool Kit with CTF-300 Compression Tool – short style
TK-85	Coax Tool Kit with CT-200 Compression Tool – Universal

Each Kit Contains:

JONARD PART NO.	DESCRIPTION	TK-82	TK-83	TK-85
FL-2000	Flashlight	X	X	X
JIC-2288	High Leverage Diagonal Cutter	X	X	X
SD-61	Screwdriver 6-in-1	X	X	X
PT-300	Pocket Continuity Tester & Toner	X	X	X
TWAF-71630	Torque Wrench 7/16" 30 in./lb.	X	X	X
UST-125	Cable Stripper RG59/6 cable stop	X	X	X
H-85	Pouch	X	X	X
CT-200	Universal Compression Tool			X
CTF-200	Compression Tool–Long Style	X		
CTF-300	Compression Tool–Short Style		X	

TWAF-71630

SD-61

JIC-2288

FL-2000

UST-125

PT-300

H-85

CT-200

(for kit **TK-85**)

CFT-200

(for kit **TK-82**)

CFT-300

(for kit **TK-83**)

TK-21

UST-500

NETWORK INSTALLATION SERVICE KIT

The affordable and reliable punchdown tool kit that features six tools performing over 21 functions to complete any installation or repair.
Kit contains: EPD-914116 punchdown tool with 66 & 110 blades, UST-500 multipurpose Universal Cable Stripping Tool, ES-1964ERG Ergonomic Electrician Scissor, JIC-22035 Spudger, M-216CS22 Can Wrench with 22 AWG Wire Stripper, JIC-22148 multipurpose needle nose crimping plier with cutter and the H-1000 Cordura Pouch.

JONARD P/N	DESCRIPTION
TK-21	Network Installation Service Kit

JIC-22035

EPD-914116

1964-ERG

M-216CS22

JIC-22148

H-1000

TK-450M

UST-500

CT-200

KN-7

JIC-683

CATV/TELECOM INSTALLERS KIT

Assembled in a convenient, easy to carry Cordura case, this kit contains the basic service tools essential for equipment installation, repairs and cable preparations. Whether it's Fiber Optic, Coax, or Copper this versatile kit contains the perfect tools for today's demanding technician. The TK-450M Kit is perfect for the VOIP installer, Fiber Technician or Communications Specialist and comes with Jonard's lifetime warranty.
Each Kit contains: ASW-716, CT-200, UST-500, ES-1964, KN-7, JIC-683, JIC-22148, JIC-22035, JIC-1626, JIC-750, TWAF-71630, M-216CS22, SK-51632, TT-7V, SST-716, PT-300 & secured in a convenient easy to carry Cordura case.

JONARD P/N	DESCRIPTION
TK-450M	CATV/Telecom Installers Kit

ES-1964

JIC-1626

JIC-750

ASW-716

JIC-22035

M-216CS22

SK-51632

JIC-22148

TT-7V

SST-716

PT-300

TWAF-71630

ES-1964DS

FREE-FALL ELECTRICIAN'S SCISSOR

A Free-Fall Electrician's Scissor, designed for heavy duty use and loose enough to allow fingertip operation. Drop forged High Quality steel for greater durability. Notched to strip 18-20 and 22-24 AWG wire and one blade is serrated. A scraper and file are on the back of the blade.

JONARD P/N	DESCRIPTION
ES-1964DS	Free-Fall Electrician's Scissor

ES-1964

ELECTRICIAN SCISSOR

The Electrician Scissors are designed for heavy duty use. Made of high carbon steel with a special hardening process for greater durability and nickel plated for that professional look. Notched to strip 18-20 and 22-24 AWG wire and one blade is serrated. A scraper and file are on the back of the blade.

JONARD P/N	DESCRIPTION
ES-1964	Electrician Scissor

ES-1964ERG

ERGONOMIC ELECTRICIAN SCISSOR

These Ergonomic Electrician scissors are designed for heavy duty use. Made of high carbon steel with a special hardening process for greater durability and nickel plated for that professional look. Notched to strip 18-20 and 22-24 AWG wire and one blade is serrated. A scraper and file are on the back of the blade.

JONARD P/N	DESCRIPTION
ES-1964ERG	Ergonomic Electrician Scissor

KSS-1

KNIFE & SCISSOR SHARPENER

Sharpen knives and scissors with one convenient sharpener. Made of high-grade tungsten-carbide steel and diamond polished. Will restore the edge on either scissors or knives with 3-4 simple strokes. Safety finger guard, lightweight compact design makes this the ideal tool for all your sharpening needs.

JONARD P/N	DESCRIPTION
KSS-1	Knife & Scissor Sharpener

TK-400

ES-1964 KN-7 H-40

SPLICER'S KIT

This compact kit contains an ergonomic splicers knife, scissor and leather pouch. The knife features a 1 3/4" tough, cutlery-steel blade and a non-slip handle. The scissors are made of high carbon steel with scraper and file on one side and 2 stripping notches on the other. Both items fit securely in the leather pouch which can be mounted on belts up to 2" wide.

JONARD P/N	DESCRIPTION
TK-400	3 Piece Splicer's Kit
H-40	Leather Pouch
KN-7	Ergonomic Cable Splicing Knife
ES-1964	Electrician Scissor

ERGONOMIC FIBER OPTIC KEVLAR® CUTTER

High carbon stainless steel blades designed to cut Kevlar®, cabling insulation, tape, cable ties and other material. Ergonomic dual component handles polypropylene and TPR for user comfort and durability. Adjustable joint screw under protective cap, serrated blades grip material, sharp and durable 6" long.

JONARD P/N	DESCRIPTION
JIC-186	Wire & Kevlar Cutting Shears
TK-325	JIC-186 Scissor & Pouch with Belt Clip
H-25	Pouch Only for JIC-186 or JIC-195

HEAVY DUTY SCISSOR WITH WIRE STRIPPER

Heavy duty multi-function scissor designed to cut copper, aluminum, leather, plastic and other materials. Not designed to cut stainless steel or other hardened/heat treated metals. Three stripping holes for 18, 14 & 12 AWG wire. One blade serrated for a secure grip and handles are dual component polypropylene and TPR. Includes safety locking mechanism and adjustment screw.

JONARD P/N	DESCRIPTION
JIC-183	Heavy Duty Scissor with Wire Stripper

COMMUNICATION SCISSOR

High carbon stainless steel blades, 1/4" notch for cutting & stripping, two stripping notches for 18 & 22 AWG wire, one serrated non-slip blade, dual component handle. High carbon stainless steel blades that are both sharp and durable with serrated blade that grips and holds the wire. Ergonomic dual component nylon & santoprene handles, for user comfort and durability. Designed with an adjustable joint screw under the protective cap.

JONARD P/N	DESCRIPTION
JIC-195	Communication Scissor

CABLE SPLICING KNIFE

The tough cutlery steel blade is extremely sharp and cuts easily through many types of insulation. It holds its edge with repeated use and features a non-slip easy grip handle for better control and reduced hand fatigue. Blade length is 1 3/4" and overall length is 6 1/4".

JONARD P/N	DESCRIPTION
KN-7	Cable Splicing Knife

EPD SERIES PUNCHDOWN TOOLS

Sleek ergonomic design for easy effective wire termination. Tested up to 100,000 cycles at high-impact setting. Use to properly set, seat and terminate wire. Simply position the wire, push tool, and listen for confirming pop. Wire is properly seated.

EPD-91461

Features include:

- Hi/Low impact setting
- Combination Hook/Spudger stored in the chassis
- Color coded yellow on the CUT side
- Enlarged blade storage compartment
- Lifetime Warranty (Essentially means unlimited impacts)

JONARD PART NO.	DESCRIPTION
EPD-914	Punchdown Tool
EPD-91466	Punchdown Tool with 66 Blade
EPD-914110	Punchdown Tool with 110 Blade
EPD-914KR	Punchdown Tool with Krone Blade
EPD-914116	Punchdown Tool with Combination Blade 66 & 110
EPD-91461	Punchdown Tool with two Blades 66 & 110
EPD-9Krone	Punchdown Tool with the EPB-Krone Blade
EPD-914630	Punchdown Tool with 630 Modified Jack Blade

EPB-66 EPB-110 EPB-116 EPB-KR EPB-630 EPB-KRONE

EPB STANDARD DOUBLE-ENDED BLADES

JONARD PART NO.	DESCRIPTION
EPB-66	66 Blade with & without cutter
EPB-110	110 Blade with & without cutter
EPB-116	Combination 66 & 110 blade
EPB-KR	Krone Blade with & without cutter
EPB-630	Blade for 630 Modified Jack
EPB-KRONE	Krone blade scissor style

TK-17 JIC-22148 SD-61 JIC-22035 CST-1i EPB-66 EPB-110 H-75

EPD-914116 FL-2000

Kit contains:

CST-1i Cyclops UTP/STP Cable Stripper
EPD-914 Punchdown Tool
EPB-66 Punchdown 66 Blade with & without cutter
EPB-110 Punchdown 110 Blade with & without cutter
FL-2000 LED Flashlight with Zoom Lens
JIC-22035 Probe Pick Spudger
JIC-22148 Combo Crimper Long Nose Plier
SD-61 6-In-1 Screwdriver
H-75 Molded Pouch

PUNCHDOWN TOOL KIT

An ideal combination of tools for electrical technicians, main frame telecommunications professionals, security & alarm and datacom professionals. Kit includes: punchdown tool with 66 & 110 blades, Ergonomic Electrician scissor, LED Flashlight with zoom lens, spudger, multi-bit screwdriver, Cyclops wire & cable stripper, Combo crimper long nose plier and convenient pouch

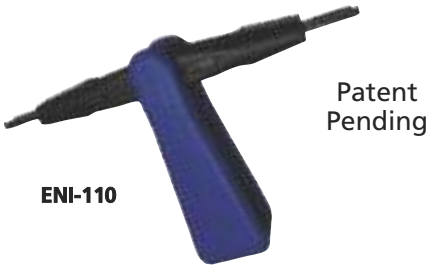
JONARD P/N	DESCRIPTION
TK-17	Punchdown Tool Kit

EP-QTH38B

TERMINATION & REMOVAL TOOL

This tool is used for terminating, bridging, and removing wires from 2-beam or 3-beam, insulating-slicing, quick clip terminals found on QCM468 (MPC) and 391Q connectors and on Versablocks with quick-clip pins.

JONARD P/N	DESCRIPTION
EP-QTH38B	Termination & Removal Tool



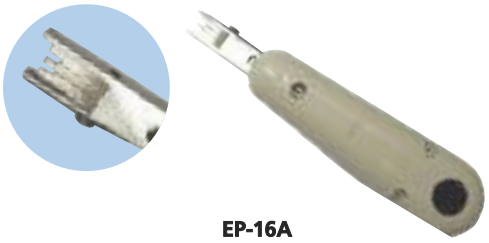
ENI-110

Patent Pending

NON-IMPACT PUNCHDOWN TOOL

A non-impact punchdown tool. Perfect for do-it-yourself small jobs on a 110 terminal block. Fits neatly in the palm of your hand. Quickly and easily switch from cutting and non-cutting blade side with one hand. Simple - Fast - Easy.

JONARD P/N	DESCRIPTION
ENI-110	Non-Impact Punchdown Tool

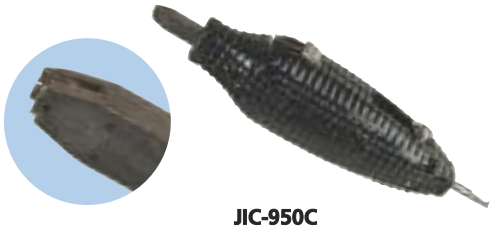


EP-16A

BIX PUNCHDOWN TOOL

This tool is designed to terminate cables, pigtails, and jumper wires on all GigaBIX, BIX and UMOXS cross-connect system connectors. This single action, spring activated tool will terminate 22-26 AWG plastic insulated solid copper conductors. Button on the handle adjusts the tool for seating only, or for seating and cutting the conductors.

JONARD P/N	DESCRIPTION
EP-16A	BIX Punchdown Tool



JIC-950C

QUICK CLIP INSERTION TOOL

This multipurpose wire insertion tool performs several vital functions. The wire cutter is designed to cut 22 & 24 gauge wire, the hook at the back of the tool is used for both jumper and back-tap removal, and the bit inserts 22 or 24 gauge (0.5 mm or 0.6 mm) wire into the terminal block. Ideal for wire insertion in 3-beam (112 type blocks) and 4 beam (78 type blocks) terminals in Cosmic and Cosmic II distributing frames.

JONARD P/N	DESCRIPTION
JIC-950C	Quick Clip Insertion Tool
JIC-955	JIC-950C Replacement Blade

BATTERY PUNCHDOWN TOOL

PATENTED

Features:

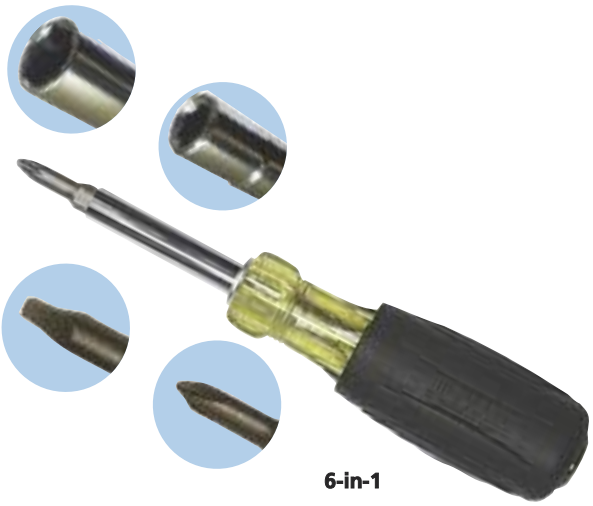
- Over 1,000 impacts between charges
- Dual action trigger for LED task lighting and impact
- Quick-easy blade lock and release
- 90° Blade orientation adjustment for any angled impact
- Hi/Low impact settings easily adjusted
- Powerful, lightweight 7.2V lithium ion battery
- Quick charge battery charger

JONARD PART NO.	DESCRIPTION
EPB-1200	Punchdown Tool, Battery, 115V Charger (no blades included)
EPB-1066	Punchdown Tool, Battery, 115V Charger, 66 blade
EPB-1110	Punchdown Tool, Battery, 115V Charger, 110 blade
EPB-11066	Punchdown Tool, Battery, 115V Charger, 110 & 66 blades
EPB-1000KR	Punchdown Tool, Battery, 115V Charger, Krone blade
EPB-2200	Punchdown Tool, Battery, 230V Charger (no blades included)
EPB-2066	Punchdown Tool, Battery, 230V Charger, 66 blade
EPB-2110	Punchdown Tool, Battery, 230V Charger, 110 blade
EPB-211066	Punchdown Tool, Battery, 230V Charger, 110 & 66 blades
EPB-2000KR	Punchdown Tool, Battery, 230V Charger, Krone blade

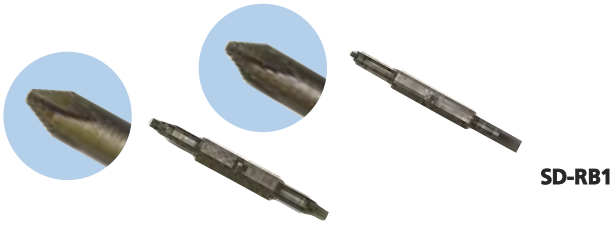
EPB-1000 ACCESSORIES

JONARD PART NO.	DESCRIPTION
EPB-B	EPB-1000 Lithium Ion Battery
EPB-BC1	EPB-1000 115V Battery Charger
EPB-BC2	EPB-1000 230V Battery Charger

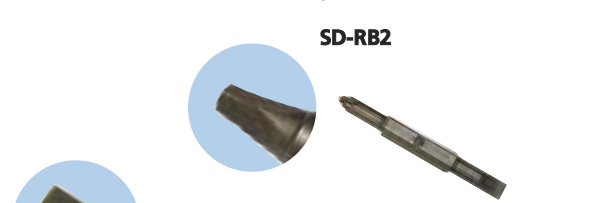
Jonard Slotted, Phillips and Robertson Screwdrivers are made of special alloy steel for exceptional strength, long life and corrosion resistant. Soft rubber handles offer comfort and greater torque. The end of the handle is marked to identify the tool's size, and the tips are magnetic. Meets and exceeds applicable ASME/ANSI specifications.



6-in-1

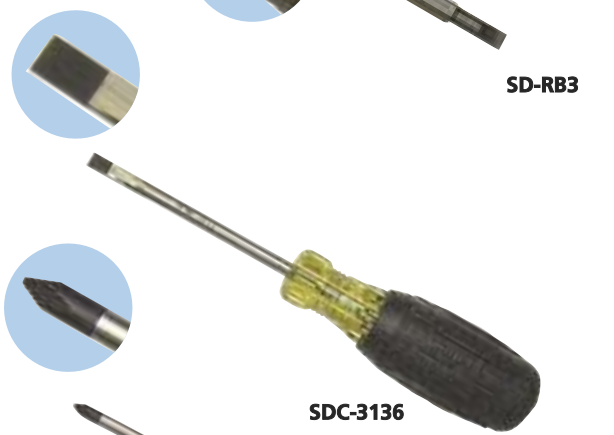


SD-RB1



SD-RB2

SD-RB3



SDC-3136

SDP-1

6-IN-1 SCREWDRIVER

The Jonard 6-in-1 Screwdrivers eliminate the need for multiple tools in your belt. This tool is configured to include: 2 bits with four heads and two nut drivers 5/16" & 1/4"

JONARD P/N	DESCRIPTION	BITS INCLUDE
SD-61	6-in-1 Screwdriver	SD-RB1, SD-RB2,
SD-1223	6-in-1 Robertson Screwdriver	SD-RB1, SD-RB3

REPLACEMENT BITS

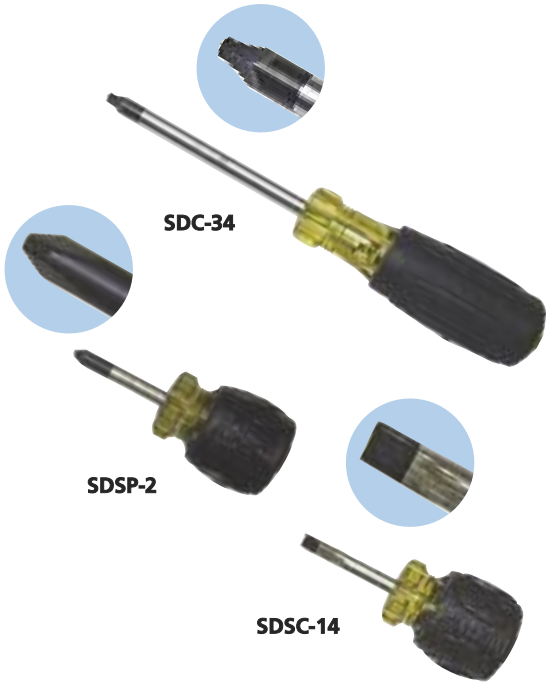
JONARD P/N	DESCRIPTION	OVERALL LENGTH	WEIGHT	SHAFT DIAMETER
SD-RB1	Replacement Bit Phillips #1 & Slot 3/16"	3"	0.42 oz	1/4" HEX
SD-RB2	Replacement Bit Phillips #2 & Slot 9/32"	3"	0.42 oz	5/16" HEX
SD-RB3	Replacement Bit Robertson S1 & S2	2 1/2"	0.78 oz	1/4" HEX

SLOTTED SCREWDRIVERS

SLOTTED P/N	DESCRIPTION	OVERALL LENGTH	WEIGHT
SDC-3163	Slotted 3/16"x 3"	6 3/4" (87mm)	1.6 oz
SDC-3166	Slotted 3/16"x 6"	9 3/4" (248mm)	2.4 oz
SDC-144	Slotted 1/4"x 4"	8 11/32" (212mm)	4.0 oz
SDC-3810	Slotted 3/8"x 10"	14 3/8" (365mm)	10.0 oz
SDC-5166	Slotted 5/16"x 6"	10 3/8" (264mm)	5.6 oz

PHILLIPS

PHILLIPS P/N	DESCRIPTION	OVERALL LENGTH	WEIGHT
SDP-1	Phillips #1 x 3"	6 3/4" (171mm)	2.4 oz
SDP-2	Phillips #2 x 4"	8 5/16" (211mm)	4.0 oz
SDP-3	Phillips #3 x 6"	11" (279mm)	5.6 oz



ROBERTSON SCREWDRIVERS

JONARD P/N	DESCRIPTION	OVERALL LENGTH	WEIGHT
SDC-24	Robertson #2 x 4"	8 1/2" (216mm)	3.8 oz
SDC-34	Robertson #3 x 4"	8 1/2" (216mm)	3.8 oz

STUBBY SCREWDRIVERS

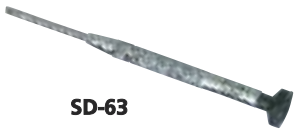
JONARD P/N	DESCRIPTION	OVERALL LENGTH	WEIGHT
SDSP-2	Phillips #2 Stubby	3 1/2" (89mm)	1.9 oz
SDSC-14	Slotted 1/4" Stubby	3 1/2" (89mm)	1.9 oz

EIGHT PIECE SCREWDRIVER SET

KIT CONTAINS:

- SDSP-2 Phillips #2 stubby
- SDP-1 Phillips #1 x 3"
- SDP-2 Phillips #2 x 4"
- SDP-3 Phillips #3 x 6"
- SDSC-14 Slotted 1/4" Stubby
- SDC-3163 Slotted 3/16" x 3"
- SDC-144 Slotted 1/4" x 4"
- SDC-5166 Slotted 5/16" x 6"

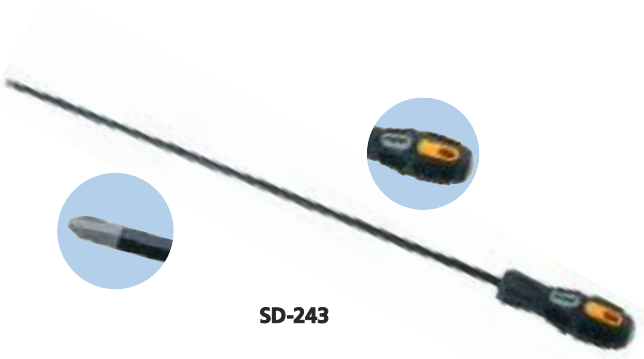
JONARD P/N	DESCRIPTION
SDK-8	8 Piece Screwdriver Set



SCREWDRIVER, JEWELER'S TYPE

Used to terminate the battery backup in the fiber ONT. Screwdriver has concaved swivel knob to fit the finger and hexagonal shape to prevent rolling. Solid blade made of high quality hardened tool steel. .100" blade width. 4" long.

JONARD P/N	DESCRIPTION
SD-63	Jeweler's Screwdriver



24 INCH LONG #3 PHILLIPS HEAD SCREWDRIVER

This 24" long #3 Phillips Head Screwdriver is designed for use when you need an extra long screwdriver to reach the diodes in back of the various rectifiers. Made of chrome vanadium steel with a matte finish and a custom ergonomic tri-color handle.

JONARD P/N	DESCRIPTION
SD-243	#3 Philips Head Screwdriver 24" long

Jonard Insulated Tools are manufactured to IEC 60900 Standards for hazardous work environments. Our tools are tested to 10,000 VAC and rated for 1,000 VAC live use.

1000V
IEC 60900

TK-70INS

JONARD P/N	DESCRIPTION
TK-70INS	7 Piece Insulated Screwdriver Set Screwdriver Set contains: 3 Philips, 4 Slotted as shown below

INSULATED SCREWDRIVERS- SLOTTED HEAD

JONARD P/N	DESCRIPTION
INS-475	3/32 X 3 Slotted Screwdriver
INS-4100	5/32 X 4 Slotted Screwdriver
INS-6150	1/4 X 6 Slotted Screwdriver
INS-8175	5/16 X 7 Slotted Screwdriver

INSULATED SCREWDRIVERS- PHILLIPS HEAD

JONARD P/N	DESCRIPTION
INS-180	#1 X 3 Phillips Screwdriver
INS-2100	#2 X 4 Phillips Screwdriver
INS-3150	#3 X 6 Phillips Screwdriver

TK-110INS

JONARD P/N	DESCRIPTION
TK-110INS	11 Piece Insulated Tool Kit Kit contains: 7 Screwdrivers in kit **TK-70INS** plus **INP-1072, INP-2065, INP-3062 & INP- 4065**

INSULATED PLIERS

JONARD P/N	DESCRIPTION
INP-2065	Long Nose Plier 6 1/2" Long
INP-3062	Diagonal Plier 6 1/4" Long
INP-1072	Lineman's Combo Plier 7 1/4" Long

INSULATED WIRE STRIPPER

JONARD P/N	DESCRIPTION
INP-4065	Wire Stripper 6 1/2" Long

TK-19

SMARTPHONE & TABLET REPAIR TOOL KIT

For opening and repairing all series of smartphones, tablets and many "i" series computers (iPhones & iPads). Kit contains all the tools you need to take apart these highly specialized electronic devices. Perfect for DIY repair jobs. Tools are neatly organized and labeled in a convenient storage case. This kit is also suitable for other repair work where fine tipped screwdrivers are required (this includes eyeglass repair).

Kit contains:

- Ergonomic Handle
- Thirteen 4mm bits:
  - PH00, PH0, PH1
  - SL1.5, SL2.0
  - Torx: T4, T6, T8, T10
- Hex1.5, Hex2.0
- Pentalobe 0.8 & 1.2
- 2 Plastic Prying Tools
- Guitar Pick Opening Tool
- Suction Vacuum Opener
- SIM Eject Tool
- Tweezer

JONARD P/N	DESCRIPTION
TK-19	Smartphone & Tablet Repair Tool Kit

AW-6
AW-8
AW-10
AW-12

ADJUSTABLE WRENCHES WITH EXTRA WIDE JAW

All wrenches are made of chrome vanadium steel with a chrome plated finish. Wrenches are forged and heat treated for greater strength. Handles are covered with a red transparent plastic for user comfort. The knurl is precision formed and the operation is smooth and trouble free. For accurate adjustments use the metric or English scales on either side of the jaws.

JONARD PART NO.	DESCRIPTION	LENGTH	JAW CAPACITY	WEIGHT
AW-6	Adjustable Wrench 6"	6" (152 mm)	15/16" (24mm)	5.2 oz
AW-8	Adjustable Wrench 8"	8" (203mm)	1 1/8" (29mm)	10.6 oz
AW-10	Adjustable Wrench 10"	10" (254mm)	1 5/16" (33mm)	14.6 oz
AW-12	Adjustable Wrench 12"	12" (305 mm)	1 1/2" (38mm)	24.0 oz

ND-631

HOLLOW SHAFT NUT DRIVERS

These are full length hollow shaft nut drivers intended for working with long bolts. They are designed with cushion gripped ergonomic color coded handles. Handles provide greater torque and user comfort. Overall length 7". ASME Standard/YR: B107.12-2004

JONARD P/N	DESCRIPTION
ND-631	Nut Driver Set – 7 Piece 3/16", 1/4", 5/16", 11/32", 3/8", 7/16" & 1/2"
ND-630316	Nut Driver 3/16" (Black)
ND-63014	Nut Driver 1/4" (Red)
ND-630516	Nut Driver 5/16" (Yellow)
ND-6301132	Nut Driver 11/32" (Green)
ND-63038	Nut Driver 3/8" (Blue)
ND-630716	Nut Driver 7/16" (Brown)
ND-63012	Nut Driver 1/2" (Red)
ND-SET4	Nut Driver Set 4 piece, 1/2", 11/32",3/8", 5/16"

WBK-100

PANEL KNOCKOUT KIT–Patent Pending

Remove panel knockouts without cutting holes in the drywall (For use on electrical, security, alarm, and datacom panels)

JONARD P/N	DESCRIPTION
WBK-100	Panel Knockout Kit

PATENTED

MP-700

MAGNETIC CABLE RETRIEVAL SYSTEM

A magnetic cable retrieval system which couples the cable with the pulling device through drywall, allowing the user complete control. Designed for both residential and commercial applications.

MP-700 KIT INCLUDES:

- Retriever Unit
- 3/4" Drop Magnet with pull line
- Jack Chain
- Convenient Carrying Case

Magnepull by Jonard Industries

JONARD P/N	DESCRIPTION
MP-700	Magnetic Cable Retrieval System
MP-100	1/2" Drop magnet with leader
MP-210	3/4" Drop Magnet with leader
MP-220	3/4" Drop Magnet without leader

MP-800

MAGNESPOT – Intelligent Reference Point Locator

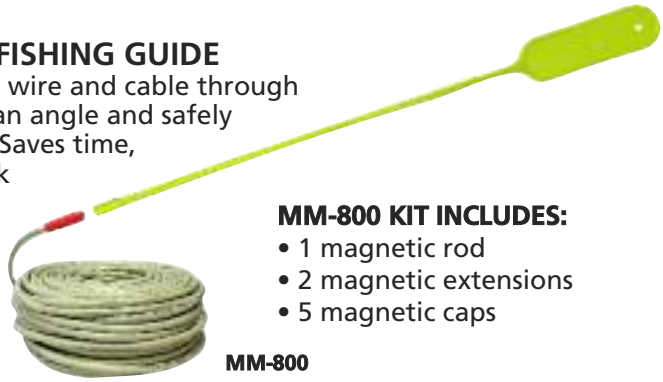
Used to drill through exterior walls, drill from attics/basements into wall cavities, or drill on angles or corners. Also used to locate reference points in complicated construction and commercial buildings. Accurate to within ½" from 20" and within an inch up to 40". Kit includes: transmitter, receiver, two 9V batteries, tack adhesive, operating instructions and carrying case

JONARD P/N	DESCRIPTION
MP-800	Intelligent Reference Point Locator

MAGNAMOLE MAGNETIC CABLE FISHING GUIDE

Wire Fishing Made Easy! Quickly threads wire and cable through cavity walls and void spaces. Threads at an angle and safely through other wire and cable obstacles. Saves time, saves money, and sharply reduces the risk of accidents.

- 44% TIME SAVINGS Six Sigma certified
- Dramatically reduces shock risk
- Easy to use- No experience required
- Diamond Award Winning Design



MM-800

MM-800 KIT INCLUDES:

- 1 magnetic rod
- 2 magnetic extensions
- 5 magnetic caps

PATENTED

JONARD P/N	DESCRIPTION	CAP COLOR & CABLE DIAMETER ACCOMMODATION	USED WITH THE FOLLOWING CABLE	QUANTITY
MM-800	Magnamole Magnetic Cable retrieval System			
MM-110	Replacement Magnets	(Red) .169" to .205" (Blue) .230" to .295	CAT5 RG6, RG6 TRI, RG6 QUAD	Includes 3 magnetic caps of each color
MM-120	Replacement Magnets	(White) .145" to .169" (Gray) .173" to .201" (Black) .205" to .232"	CAT3, 3.1mm Simplex fiber Optic Cable, CAT5, CAT5e RG59, 12AWG Romex	Includes 2 magnetic caps of each color


RDT-18

TELESCOPIC POLE

The RDT-18 is the perfect tool to install or retrieve a cable in drop ceilings or other hard to reach places. This Telescopic Pole is self-supporting, so it is perfectly suited for spanning ceilings and voids to route or retrieve cable.

The Jonard Industries RDT-18 Telescoping pole is constructed with a series of tapered tubes which interlock and extend a full 18 feet, collapsed length is only 33 inches. The pole is made from fiberglass with a polyester resin baked enamel coating for greater durability. The RDT-18 is considerably more rigid than rod or coil based products, and gives the installer far more control and greater accuracy over longer distances. The RDT-18 telescoping pole comes with two hooks. A conventional C type hook, an S hook to help grab and/or push cables, plus a special adapter for tight applications.

When not in use, the RDT-18 is compact and lightweight and is easily carried using the shoulder strap. Weights 2.44 lbs.

JONARD P/N	DESCRIPTION
RDT-18	Telescopic Pole


MF-1/25


MF-4


MF-25/25


MF-75/25


MF-5/25

MAGNETIC CABLE HOLDERS

Made of neodymium (a rare earth magnet), these cable holders quickly and easily allow the technician to install cables without any drilling, screwing or nailing required. These powerful magnets can hold a substantial number of cables based on the size chosen. Hang wires in high places from the ground using a telescopic pole with the cable pole adapter. A Quick Easy Permanent installation that can easily be removed in seconds.

JONARD P/N	DESCRIPTION
MF-1/25	Magnetic Cable Holder 1" (pkg. of 25)
MF-75/25	Magnetic Cable Holder 3/4" (pkg. of 25)
MF-5/25	Magnetic Cable Holder 1/2" (pkg. of 25)
MF-25/25	Magnetic Cable Holder – for Zip ties & Velcro (pkg. of 25)
MF-4	Cable Pole Adapter


RDG-30


RDG-4

GLOW ROD KIT

Can extend a full 30 feet. These Rods glow in the dark to facilitate use in low lit areas. Designed to perform splinter free over the life of the product while also providing excellent flexibility. The luminescence of the rods is brighter and lasts longer than other similar products. The metal ends of the rods are glued and crimped to provide superior strength. The threads on the metal ends are standard 8-32 so the rods and accessories can be used with many other manufacturers glow rods.

The Jonard Industries RDG-30 Glow Rod Kit includes:

- Six 5 foot long Rods, 3/16" diameter, for greater flexibility
- Eyelet
- Ball Chain attachment
- Wisk
- Hook

The four piece replacement kit includes the eyelet, ball chain attachment, wisk & hook.

JONARD P/N	DESCRIPTION
RDG-30	Glow Rod Kit
RDG-4	Four Piece Replacement Kit

CABLE SEWING NEEDLE-METAL

Durable red anodized aluminum handle with curved notched sewing needle. Designed to harness or lace multiple lead bundles. 5 3/4" long. Replacement needles are also available.

JONARD P/N	DESCRIPTION
JIC-287	Cable Sewing Needle
RB-287/6	Pkg. of 6 Replacement Needles

WIRE LOOP PULLER-METAL

Durable red anodized aluminum handle facilitates pulling wire through terminal blocks, rings on main frame or fanning strip holes. JIC-2257M overall length is 8 1/2" and JIC-2257M-12 overall length is 15".

JONARD P/N	DESCRIPTION
JIC-2257M	Wire Loop Puller Overall Length 8 1/2" loop 4 1/2"
JIC-2257M-12	12" Wire Loop Puller Overall Length 15" loop 11"
RB-2257/6	Pkg. of 6 Replacement Loops for JIC-2257M only

WIRE LOOP PULLER- INSULATED

Xylan insulated wire loop puller facilitates pulling wire through terminal blocks, rings on main frame, or fanning strip holes. The yellow plastic lightweight handle fits snugly and is easy to hold in your hand. 8" long.

JONARD P/N	DESCRIPTION
JIC-2257	Wire Loop Puller

CABLE SEWING NEEDLE-INSULATED

Xylan insulated cable sewing needle has a yellow lightweight molded grip handle that will harness or lace multiple lead bundles. 5 1/2" long.

JONARD P/N	DESCRIPTION
JIC-3209	Cable Sewing Needle

STRAIGHT METAL NEEDLE

This"Chicago type" straight metal needle is designed for cable sewing. This tool, made of the finest steel is for anyone in the cable industry. Needle is .016" thick and 12" long.

JONARD P/N	DESCRIPTION
JIC-284	Straight Metal Needle

COTTER PIN REMOVAL TOOL

Used for removing cotter pins on automotive, materials handling, and all other types of mechanical equipment that employ cutter pin locking devices.

JONARD P/N	DESCRIPTION
CP-4284	Cotter Pin Removal Tool

ADJUSTABLE PRECISION WIRE STRIPPERS OK-3907 SERIES

The OK-3907 Series is the industry's leading cut-and-strip tool for copper interconnect applications. Installers and telecom technicians enjoy its rugged construction, ergonomic plastic grips, and high-leverage handle design, which allows time savings through the simultaneous cutting of multiple wires. Blades are made from specially tempered spring steel for clean, nick-free wire stripping.

JONARD P/N	Wire Size AWG	Wire Size mm	Adjustable Strip-Off Length Inches	Adjustable Strip-Off Length mm	Replacement Blade
OK-3907-2224	22-24	0.65-0.50	1-1/2" to 1-3/4"	38.10 to 44.45	SB-2224
OK-3907-2426	24-26	0.50-0.40	1-1/2" to 1-3/4"	38.10 to 44.45	SB-2426
OK-3907-2830	28-30	0.32-0.25	7/8" to 1 1/8"	22.22 to 28.57	SB-2830
JIC-4473*	22-24	0.65-0.50	1-1/2" to 1-3/4"	38.10 to 44.45	SB-2224

* Supplied with 2 blades, SB-2224 and SB-2426

WIRE CUT-AND-STRIP TOOLS ST-100 SERIES

A revolutionary concept for easy and clean stripping of wires for wire wrapping, electronic and appliance applications. Biomechanically designed for maximum efficiency. Easy to operate... place wire (up to 4) in stripping slot with ends extending beyond cutter blades... press tool and pull... wire is cut and stripped to proper "wire wrapping" length. The hardened steel cutting blades and sturdy construction of the tool ensure long life. Strip length easily adjustable for your application. Blades are made from specially tempered spring steel for clean, nick-free wire stripping.

JONARD P/N	Wire Size AWG	Wire Size mm	Adjustable Strip-Off Length Inches	Adjustable Strip-Off Length mm	Replacement Blade
ST-100	22-24	0.65-0.50	1 5/16" to 1 9/16"	33.33 to 39.68	SB-2224
ST-100-2426	24-26	0.50-0.40	1 15/16" to 1 11/16"	39.68 to 42.86	SB-2426
ST-100-2830	28-30	0.32-0.25	7/8" to 1 1/8"	22.22 to 28.57	SB-2830

CABLE RING TOOL

This cable ring tool is designed to cut/strip the outer jacket (sheath) of many types of cables where the jackets are made from plastic, fabric or rubber. The tool accommodates cable diameters from 3/16" (3.1mm) to 1/2"(12.7mm) cables. It can also accommodate larger diameter cables with thinner wall jackets up to 1" (25.4mm) in diameter. Designed with a metal slide, which allows you to put more or less tension on the cable.

JONARD P/N	DESCRIPTION
JIC-2060	Cable Ring Tool
RB-2060/6	Pkg. of 6 Replacement Blades

OPTICAL FIBER CABLE SHEATH STRIPPER & RING TOOL

This Cable Sheath Stripper is used to ring-cut many types of tight buffer, loose tube buffer, breakout cables and other types of jacketed fiber cables. A slitting blade is built into the tool and can be used to slit open the cable sheath if needed. Depth of the cut has two adjustments for .018" or .031" thick plastic, rubber or fabric insulation, and can handle cable diameters from 1/8" to 3/8". One spare blade of each style is included with the tool. Also known as CT2860.

JONARD P/N	DESCRIPTION
JIC-4366	Optical Fiber Sheath Stripper & Ring Tool
RB-2060/6	Pkg. of 6 Replacement Blades for ring feature of tool
RB-2878/6	Pkg. 6 replacement blades for stripper feature of tool

CST-1i

PATENTED

CYCLOPS UTP/STP CABLE STRIPPER

Fast easy removal of outer insulation from all unshielded twisted pair, shielded twisted pair and multicore cables. The Cyclops features a self-adjusting blade and is perfect for PVC and plenum type insulation, plus other materials without damaging the inner braids, foils or conductors. Cable performance is not impacted using this cable stripper.

JONARD P/N	DESCRIPTION
CST-1i	Cyclops Cable Stripper

CST-1900

CST-7915

PATENTED

ROUND CABLE STRIPPER

The CST-1900 is designed for fast and precise jacket removal of PVC, rubber, PE and other jacket materials, and works well on round cables with diameters ranging from 3/16" to 1-1/8" (4.5-29 mm). This is a Triple Action Tool, cutting longitudinally for end stripping, spiral for end stripping and mid-span cuts, and circular for jacket removal. A simple versatile easy to use tool your customers will love. The Replaceable Cutting Blade is spring loaded, adjustable for various cable diameters, provides a 90° blade rotation and is designed for long life.

JONARD P/N	DESCRIPTION
CST-1900	Round Cable Stripper
CST-7915	Replaceable Cutting Blade

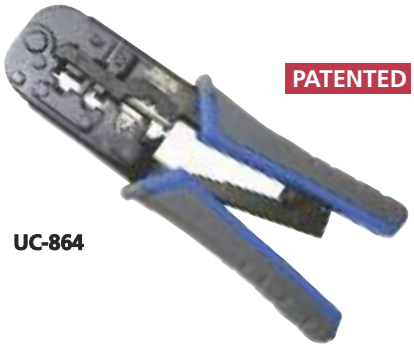
FOD-2000

PATENTED

FIBER OPTIC DROP CABLE SLITTER

The FOD-2000 Fiber Optic Drop Cable Slitter is a Patented tool that simplifies the slitting of drop cable jackets at the end of the cable or mid-span. Designed for .250" flat drop cable. The FOD-2000 puts a slit on both sides of the jacket allowing easy access to the fiber or strength member. The ease of use makes this tool truly unique. To use just position the tool around the cable, pull and slit. A simple solution for a vital task. The FOD-2000 comes completely assembled with two blades, which can be reversed once the blades are worn.

JONARD P/N	DESCRIPTION
FOD-2000	Fiber Optic Drop Cable Slitter
FOD-RB25	Replacement Blades 25/pk



UC-864

PATENTED

MODULAR CRIMPING TOOL

This is a modular crimping/stripping connector tool for voice and data applications. Designed to cut, strip 6mm & 12 mm lengths and crimp paired conductor cables (round STP/UTP and flat satin phone cables). Crimps 4,6 & 8 position modular connectors (RJ22, RJ11, RJ12 & RJ45).

JONARD P/N	DESCRIPTION
UC-864	Modular Crimping tool 6 in 1

CSR-1575

CABLE SLIT AND RING TOOL

The CSR-1575 is designed to slit and ring UTP, STP, Coax and other cables, buffer tubes and Jackets on fiber optic cables up to 7.5mm (0.3") in diameter. The tool features an easily adjustable slit blade and ring blade for nick-free strips. The removable/ reversible V block accommodates smaller and larger diameter cables.

JONARD P/N	DESCRIPTION
CSR-1575	Cable Slit and Ring Tool
CSR-2	Replacement Blades – set of 2

WIRE STRIPPER AND CUTTER

JIC-1022

The JIC-1022 Wire Stripper and Cutter is designed to strip and cut the most commonly used stranded and solid wire gauges 10 to 22 AWG and 1.6-3 mm fiber jackets. The JIC-1626 Wire Stripper and Cutter is designed for 16 to 26 AWG wire. The JIC-2030 Wire Stripper and Cutter is designed for 20-30 AWG wire. Other features include a coil spring opening to reduce fatigue, wire looping, bending holes conveniently located, black oxide finish, locking mechanism, and cutting surfaces that are hardened, tempered and ground for superior performance. 6 3/4" long and weighing just 4.5 ounces.

Part No.	Description
JIC-1022	Wire Stripper and Cutter 10-22 AWG
JIC-1626	Wire Stripper and Cutter 16-26 AWG
JIC-2030	Wire Stripper and Cutter 20-30 AWG

ADJUSTABLE PRECISION WIRE STRIPPERS

These Precision Wire Strippers feature an adjustment dial that allows the operator to select one of six different settings. A calibrated wire stop can then be adjusted for the desired insulation strip length. In a single motion, the operator squeezes and pulls the tool. This action engages four specially hardened blades to cleanly cut the wire insulation while the pulling motion breaks the insulation / conductor bond.

ST-500

ST-500ESD

- Adjustable to six wire gauges:
  ST-450 26 to 36 AWG (0.40 to 0.12mm)
  ST-500 20 to 30 AWG (0.80 to 0.25mm)
  ST-500ESD 20 to 30 AWG (0.80 to 0.25mm)
  ST-550 18 to 28 AWG (1.00 to 0.30mm)
- Calibrated Wire Stop adjustable to 2" (50.8mm)
- Clean, precise strip of any insulation type
- Lightweight-weighs 1 oz.
- Blade is hardened steel (RC58)
- Dimensions 3.9" x 1.6" x 0.6" (99 mm x 42 mm x 14 mm)

Part No.	ST-450	ST-500	ST-500ESD For ESD Use	ST-550
Wire Gauge	26-36 AWG 0.40 to 0.12mm	20-30 AWG 0.80 to 0.25mm	20-30 AWG 0.80 to 0.25mm	18-28 AWG 1.00 to 0.30mm
Housing Material	ABS	ABS	ESD Safe Polycarbonate	ABS

UST-500

UST-205

UST-210

UST-215

UST-225

UNIVERSAL CABLE STRIPPING TOOL

Use for Coax, Round Network Cables and Flat Cables - This versatile tool is five tools in one. Simply reverse the blade for RG59/6 & 7/11 Coax Cables. Insert the Round Cable into the second hole (adjustable) for a fast and easy strip. Will strip CAT6 cables with outside diameter up to 0.250". The third hole is for cutting all styles of cable while the fourth hole is designed for Flat Cable and 4P/6P style cable. The perfect wire stripper for most stripping applications. Includes Velcro strip for holding back the braided shield of the cable.

JONARD P/N	DESCRIPTION	BLADE INCLUDED
UST-500	Coaxial Cable Stripper (RG59/6 & 7/11)	UST-205
UST-525	Coaxial Cable Stripper with cable stop	UST-225
UST-596	Universal Cable Stripping Tool (59/6)	UST-210
	REPLACEMENT BLADES	
UST-205	Repl Blade for RG59/6 & 7/11	
UST-210	Repl Twin Blade RG59/6 with Cable Stop.	
UST-215	Repl Blade for RG59/6 with Cable Stop & Untwisted Pair	
UST-220	Repl Blade for UST-175 Mini-coax only	
UST-225	Repl Blade for RG59/6 & RG7/11 with Cable Stop	

UST-100

UST-150

COAXIAL CABLE STRIPPER TOOL

The UST 100 Series strips a multitude of cables. Virtually all the blades are interchangeable with the exception of the UST-220. This blade is matched exclusively to the UST-175 handle. For replacement blades or complete tools see table above. Includes Velcro strip for holding back the braided shield of the cable.

JONARD P/N	DESCRIPTION	BLADE INCLUDED
UST-100	Coaxial Cable Stripper (RG59/6 & 7/11)	UST-205
UST-125	Coaxial Cable Stripper with UST-225 Blade	UST-225
UST-150	Coaxial Cable Stripper with UST-215 Blade	UST-215
UST-175	Mini-Coaxial Cable Stripper	UST-220
UST-1596	Coaxial Cable Stripper (59/6) w/Twin Blade	UST-210

UST-1596

UST-175

UST-220

MINI-COAX CABLE STRIPPER

The UST-175 is a three level coax stripper for mini-coax cables (CommScope73508, Belden 735A1 and similar cables). The mini strips 0.625" of the outer jacket in the first level, the second level strips the braid exposing 0.156" of dielectric, and the third level strips the dielectric exposing 0.156" of the 26 AWG center conductor. Includes Velcro strip for holding back the braided shield of the cable.

JONARD P/N	DESCRIPTION
UST-175	Mini-Coax Cable Stripper
UST-220	Replacement Blade for the UST-175

UL Listed

KYNAR® Insulated, Silver Plated Copper Conductor

Ideally suited for wire wrapping and many other applications. OFHC (oxygen free high conductivity) provides a flexible yet abrasion resistant wire

Wire Size		Insulation Dia.		Roll Size							
AWG	mm	In.	mm	Feet	Meters	Blue	Yellow	White	Black	Red	Green
24	0.50	.030	0.76	100	30.4	R24B-0100	R24Y-0100	R24W-0100	R24BLK-0100	R24R-0100	
26	0.40	.027	0.69	100	30.4	R26B-0100	R26Y-0100	R26W-0100	R26BLK-0100	R26R-0100	
28	0.32	.024	0.60	100	30.4	R28B-0100	R28Y-0100	R28W-0100	R28BLK-0100	R28R-0100	
30	0.25	.020	0.50	100	30.4	R30B-0100	R30Y-0100	R30W-0100	R30BLK-0100	R30R-0100	R30G-0100
				1000	304.4	R30B-1000	R30Y-1000	R30W-1000	R30BLK-1000	R30R-1000	R30G-1000

KSW Wire Wrapping Wire Rolls for Cut/Strip/Wrap Applications

Low strip force Kynar® insulated silver plated copper conductor wire is further processed to provide a low strip force for use with CSW bits and sleeves. Ideally suited for wire wrapping and many other applications. OFHC (oxygen free high conductivity) provides a flexible yet abrasion resistant wire

Wire Size		Insulation Dia.		Roll Size							
AWG	mm	In.	mm	Feet	Meters	Blue	Yellow	White	Black	Red	Green
24	0.50	.030	0.76	100	30.4	KSW 24B-0100	KSW 24Y-0100	KSW 24W-0100	KSW 24BLK-0100	KSW 24R-0100	
26	0.40	.027	0.69	100	30.4	KSW 26B-0100	KSW 26Y-0100	KSW 26W-0100	KSW 26BLK-0100	KSW 26R-0100	
28	0.32	.024	0.60	100	30.4	KSW 28B-0100	KSW 28Y-0100	KSW 28W-0100	KSW 28BLK-0100	KSW 28R-0100	
30	0.25	.020	0.50	100	30.4	KSW 30B-0100	KSW 30Y-0100	KSW 30W-0100	KSW 30BLK-0100	KSW 30R-0100	KSW-30G-0100
				1000	304.0	KSW 30B-1000	KSW 30Y-1000	KSW 30W-1000	KSW 30BLK-1000	KSW 30R-1000	KSW-30G-0000

Wire Dispenser - WD-30 Series

- With 50ft. (15.2m) Roll of 30 AWG (0.25mm) Kynar® wire-wrapping wire
- Built-in Plunger cuts wire to desired length
- Built-in Stripper strips 1" (25.4mm) of insulation
- Refillable

WD-30-B

Part No.	Description
WD-30-B	Dispenser with 50' of Blue wire
WD-30-Y	Dispenser with 50' of Yellow wire
WD-30-W	Dispenser with 50' of White wire
WD-30-R	Dispenser with 50' of Red wire
WD-30-TRI	Dispenser with 50' each Blue, White and Red wire

Replacement Rolls of Wire For WD-30 Series

Wire for wire-wrapping.
30 AWG (0.25mm) Kynar® wire, 50ft. (15.2m) roll, silver plated, solid conductor easy stripping.

R-30R-0050

Part No.	Description
R-30B-0050	30 AWG (0.25mm) Blue 50ft. for WD-30-B
R-30Y-0050	30 AWG (0.25mm) Yellow 50ft. for WD-30-Y
R-30W-0050	30 AWG (0.25mm) White 50ft. for WD-30-W
R-30R-0050	30 AWG (0.25mm) Red 50ft. for WD-30-R
R-30-TRI	30 AWG (0.25mm) Red, White, Blue 50ft (15.2m) roll, each color for WD-30-TRI

Pre-Cut and Pre-Stripped Wire Wrapping Wire

- 50 pieces per package
- Kynar® insulated
- Silver plated copper conductor
- UL listed
- 1" of stripped wire on either end
- Add 2" to the insulation length (see chart below) for total length of wire

30 AWG (0.25mm) Pre-Cut/Pre-Stripped Wire 50 Pieces/Pkg.

Insulation Length		White	Yellow	Blue	Red
In.	mm				
1	25	30-W-50-010	30-Y-50-010	30-B-50-010	30-R-50-010
2	51	30-W-50-020	30-Y-50-020	30-B-50-020	30-R-50-020
3	76	30-W-50-030	30-Y-50-030	30-B-50-030	30-R-50-030
5	127	30-W-50-050	30-Y-50-050	30-B-50-050	30-R-50-050

KA-260

CONNECTOR INSERTION AND EXTRACTION TOOLS

These tools service virtually all connectors conforming to Mil-C-26482, Mil-C-26500 with front release contacts made by such manufacturers as Amp, Amphenol, Bendix, Burndy, Cannon, Cinch, Continental, Elco, Flight, Pyle National and Deutsch. These tools contain strong, durable, stainless steel probes & color coded handles.

A-4598 A-4599 A-4600

KR-260

JONARD P/N	MILITARY STANDARD (MS)	COLOR CODE	CONTACT SIZE	DIA
A-4598	MS24256-A20	RED	20	0.040"
A-4599	MS24256-A16	BLUE	16	0.063"
A-4600	MS24256-A12	YELLOW	12	0.093"
KA-260 Insertion Tool Kit (contains above 3 tools) in leather case				

R-4601 R-4602 R-9461

JONARD P/N	MILITARY STANDARD (MS)	COLOR CODE	CONTACT SIZE	DIA
R-4601	MS24256-R20	RED	20	0.040"
R-4602	MS24256-R16	BLUE	16	0.063"
R-9461	MS24256-R12	YELLOW	12	0.093"
KR-260 Removal Tool Kit (contains above 3 tools) in leather case				

R-5926

S-339

AR-910672

PIN EXTRACTOR

A plunger style pin extractor for pushing pins out from behind the connector blocks for contact sizes 16-20. 3" long.

JONARD P/N	DESCRIPTION
R-5926	Pin Extractor

LAMP EXTRACTOR

Mechanical type extractor used to remove or insert miniature lamps with bayonnet type bases in panels and switchboards by firmly and gently grasping lamps. Grasp lever includes a return spring for fast lamp insertion and removal. Lamp grasp is limited to 5/16" to prevent shorts. Handle diameter 1/2". 4" long.

JONARD P/N	DESCRIPTION
S-339	Lamp Extractor

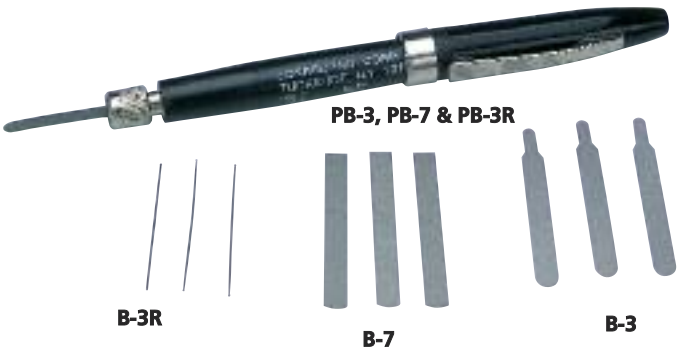
CONTACT INSERTION-EXTRACTION TOOL

A pin & socket insertion & extraction tool for contact size 20. Tool constructed of brass and ABS plastic with the red side for insertion and the white side for extraction. Mil standard M81969/1-02.

For use on TE Connectivity Amplimite series HDP-20 plugs and pins and other similar manufacturers products.

Use with:
215712-1 Plug 15 POS Crimp Snap
215711-1 Plug 9 POS Crimp Snap
1218266-1 Pin 18 AWG Gold Crimp
194081-1 Pin 1.04mm without Louver Band
205089-2 D-sub Pin 20-24 AWG Crimp

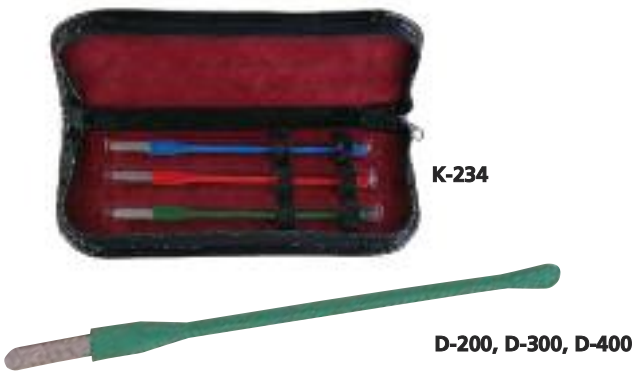
JONARD P/N	DESCRIPTION
AR-910672	Contact Insertion-Extraction Tool



POCKET TYPE BURNISHERS

Adjustment of flexible blade-length and rigidity - is possible by varying depth in chuck. Supplied with replaceable blades stored in pen barrel at other end. Plastic barrel and cap made of sturdy plastic for dielectric work. Length 4 1/2", diameter 3/8". Blades are 3/16" Wide x 1 1/2" long. Rods are .020" diameter x 1 1/4" long.

JONARD P/N	DESCRIPTION
PB-3	Pen With 6 Blades .0035" Thick
PB-3R	PB-3 plus 6 abrasive rods .020"
PB-7	Pen With 6 Blades, .007" thick
B-3/25	Pkg. 25 Replacement Blades for PB-3 (.0035")
B-3R/25	Pkg. 25 Replacement Rods for PB-3R (.020")
B-7/25	Pkg. 25 Replacement Blades for PB-7 (.007")



DIAMOND BURNISHERS

These diamond contact burnishing spatulas consist of uniform abrasive diamond particles, set in a special metal for precise effective cleaning, polishing and burnishing with minimum pressure, so very little metal is removed. Diamond face 1" x 1/4". Total length 6".

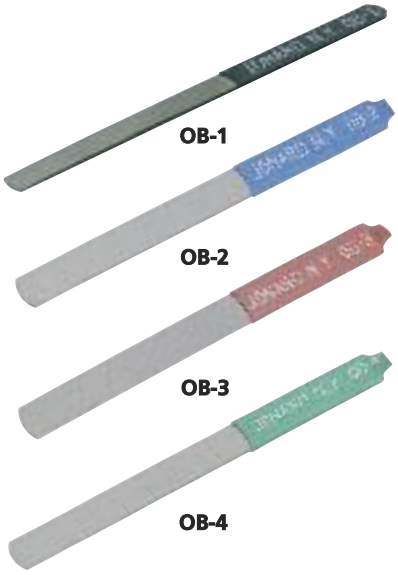
JONARD P/N	DESCRIPTION	
D-200	Diamond Burnisher	Coarse
D-300	Diamond Burnisher	Medium
D-400	Diamond Burnisher	Fine
K-234	Diamond Burnisher	Assortment Kit

D-200 Coarse (grit for rapid cleaning),
.019" Thick, two diamond faces, green shaft.

D-300 Medium (grit for intermediate size contacts),
.017" Thick, two diamond faces, red shaft.

D-400 Fine (grit for small sensitive contacts),
.011" Thick, single diamond face, blue shaft.

K-234, Three assorted spatulas in a leather case.

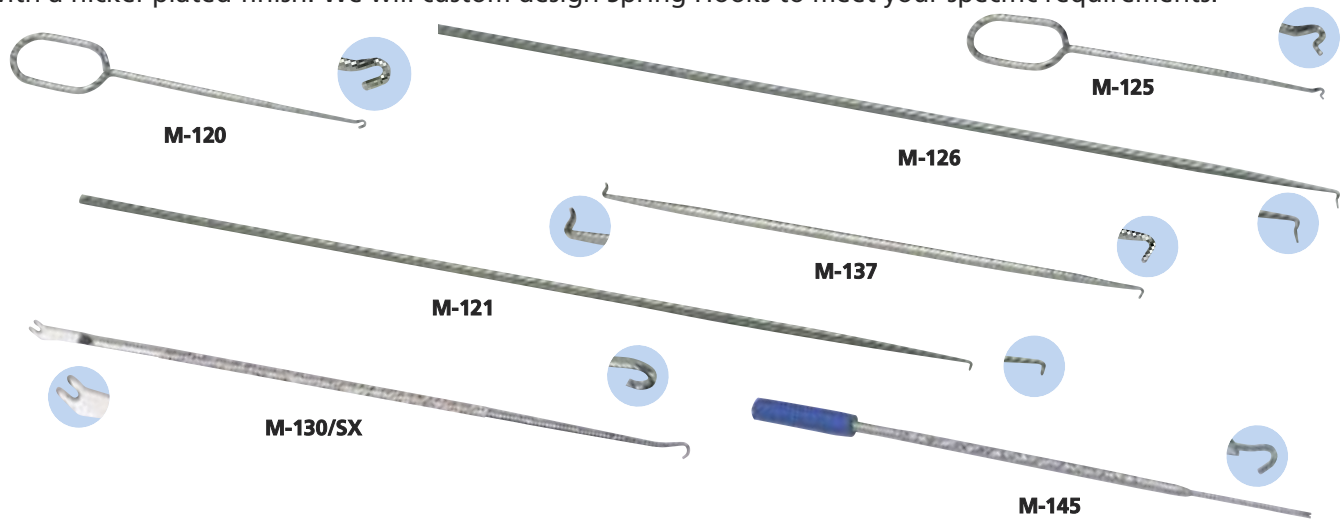


CONTACT BURNISHERS

Plastic insulated handles for working on live contacts. Available in four styles for fine, extra sensitive, general purpose and industrial use.

JONARD P/N	DESCRIPTION
OB-1/3	**For Fine Contacts.** Black handle 3/16" wide, .007" thick. 3" long, Package of 3
OB-1/12	**For Fine Contacts.** Black handle 3/16" wide, .007" thick. 3" long, Package of 12
OB-2/12	**For Extra Sensitive Points.** Blue handle. 1/4" wide, .007" thick. 3" long, Package of 12
OB-3/12	**For General Purpose Contacts.** Red handle. 1/4" wide, .010" thick. 3" long, Package of 12
OB-4/12	**For Industrial Use.** Green handle. 1/4" wide. .020" thick 3" long, Package of 12

Used for inserting, removing and adjusting fine springs and other small parts in tight areas. Indispensable for precision work in production and maintenance of precision products, electronics, electromechanics and even maintenance jobs. All spring hooks are tapered to a fine point. Produced of the finest quality high carbon steel with a nickel-plated finish. We will custom design Spring Hooks to meet your specific requirements.



M-120 Pull Hook with looped handle for maximum control 6" long.
M-121 Pull Hook for difficult to reach areas, 11" long.
M-125 Push Hook with looped handle for maximum control 6" long.

JONARD P/N	DESCRIPTION
M-120	Pull Hook
M-121	Pull Hook
M-125	Push Hook

M-126 Push Hook for difficult to reach areas, 11" long.
M-130/SX Pull Hook and lifter. With a knurled grip. 8" long.
M-137 Push & Pull 2 sided Hook, 7" long.

JONARD P/N	DESCRIPTION
M-126	Push Hook
M-130/SX	Pull Hook

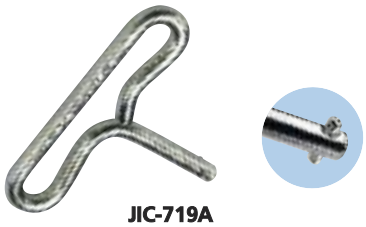
M-145 Captive Spring Hook. Spring loaded hook is exposed by depressing plunger on top of tool. Internal spring retracts hook automatically. This hook is ideal for capturing small wires, springs or parts and holding them. 7" long.

JONARD P/N	DESCRIPTION
M-137	Push & Pull Hook
M-145	Captive Spring Hook

CLIP SETTER

Clip Setter used for setting and withdrawing E and C clips with a inside diameter of .156" min. and thickness of .025" min. Max inside diameter of 3" and thickness of .093" One end of this tool has a hook with leaf spring tension for removing the clip. Other end of tool has leaf spring for holding clip in position to insert. Narrow shape allows access to confined places. This tool is 6 3/4" long .275" wide and 1/16" thick.

JONARD P/N	DESCRIPTION
CS-1022	Clip Setter



T KEY TOOL

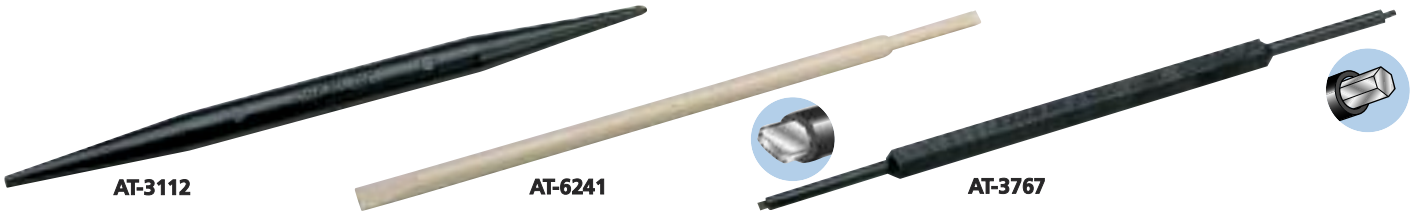
Pay telephone Tool
The key is used to release the housing and door locking mechanism of the no. 1A type coin telephone sets 2 1/2" long.

JONARD P/N	DESCRIPTION
JIC-719A	T Key Tool

COIN LEVELING TOOL

Pay telephone Tool
Tool used for leveling coins in coin collectors when the coin receptacle becomes so full as to interfere with operation of the collector. May also be used to measure the degree of fullness by means of a calibrated scale and metal slider. 7" long.

JONARD P/N	DESCRIPTION
JIC-139B	Coin Leveling Tool



SPUDGER

Plastic pencil type tool tapered to a point on one end and screwdriver tip on other end. Used to form, shape, guide, spudge and separate fine computer wire terminals, telephone wires and cables. Also used for breaking solder bridges, probing or positioning loose components. Made of a high impact non-conductive thermoplastic material. 6" long double ended 5/16" diameter.

JONARD P/N	DESCRIPTION
AT-3112/10	Spudger

ALIGNMENT TOOL

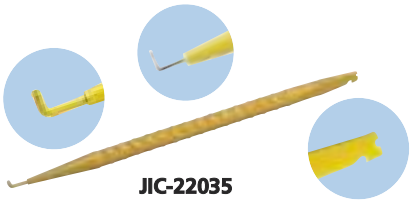
2-in1 nonconductive Alignment Tool 1/4" in diameter, stepped down to 5/32" in diameter. Ideal for most variable capacitors, coils and resistors. Also used to harness and separate fine wire terminals in computers, telephones and cables. Made of non-conductive thermoplastic material. 7" long.

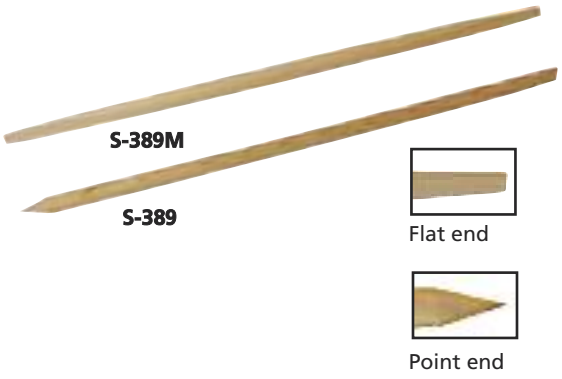
JONARD P/N	DESCRIPTION
AT-6241/10	Alignment Tool

TRIMPOT

Double ended Trimpot with a hex (allen) steel .050" and 3/32" long steel screwdriver tip. Ideal for aligning, adjusting, calibrating and fine tuning of electronic circuitry, potentiometers, oscilloscopes and electronic equipment. Made of a high impact non-conductive thermoplastic material. 5" long.

JONARD P/N	DESCRIPTION
AT-3767/10	Trimpot





PROBE PICK

Tough resilient yellow nylon probe "spudger". One end is tapered to a 1/16" diameter point having an insulated "L" shaped wire hook extension. The other end tapers to a flat, 3/16" wide and 1/16" thick, with 2 small notches. Used in electrical contacts. 7" long.

JONARD P/N	DESCRIPTION
JIC-22035	Insulated Probe Pick
JIC-22035NT	Uninsulated Probe Pick

ALIGNMENT TOOL KIT

This 5 piece pocket kit contains a selection of the most popular non-conductive tools for aligning and adjusting components.

AT-3767 Trimpot, AT-6241 Alignment Tool, AT-3112 Spudger, S-389 Orange Stick, JIC-22035 Probe Pick

JONARD P/N	DESCRIPTION
TK-AT5	Alignment Tool Kit

ORANGE STICKS

Static free double ended economical tool made of birch wood. Used for cleaning electrical components and separating contact points, fine wires and other delicate components. 3/16" diameter x 7" long. The S-389 has one end tapered to a point and the other end to a flat screwdriver type tip. The S-389M has both ends tapered with a flat screwdriver type tip.

JONARD P/N	DESCRIPTION
S-389/10	Orange Sticks Point & Flat end Pk. of 10
S-389/100	Orange Sticks Point & Flat end Pk. of 100
S-389M/10	Orange Sticks 2 Flat ends Pk. of 10
S-389M/100	Orange Sticks 2 Flat ends Pk. of 100

Jonard force gauges are all ergonomically designed and have become the industry standard for measuring force. Our 3 different lines of force gauges are used by a multitude of industries and these gauges are being used in over 1000 different applications for measuring, calibrating, standardizing, testing and evaluating.

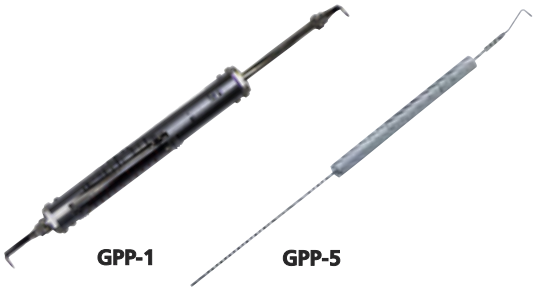
Measurement is extremely simple. Just place point of gauge arm perpendicular to the force to be measured. Reading can be taken in both directions - clockwise and counter-clockwise. Gauges offer extreme precision and durability. The measuring springs are made of hard tempered annealed beryllium copper. All gauges equipped with maximum reading pointer.

Small Gauges
(Flat Tip, Dial Diameter 1 1/2")

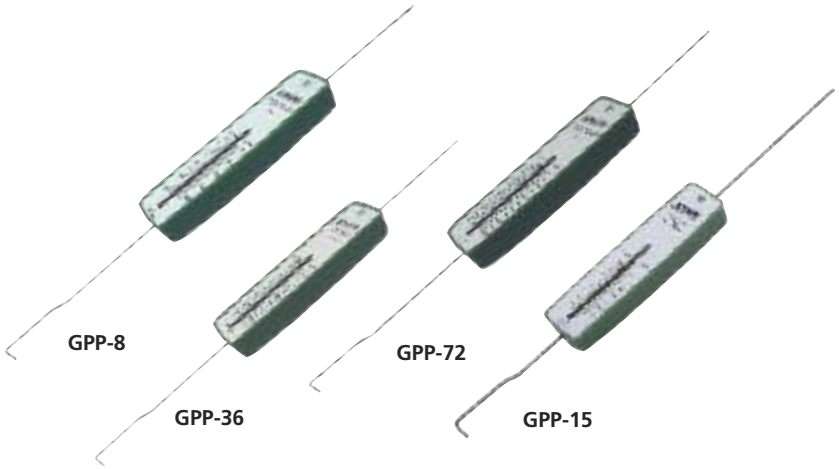
JONARD PART NO.	RANGE IN GRAMS	GRADUATION IN GRAMS	ACCURACY
GD-1	0-10	.20	± .20
GD-3	5-35	1.00	± 1
GD-5	10-50	1.00	± 1
GD-10	20-100	2.00	± 2
GD-15	50-150	5.00	± 5
GD-25	50-250	10.00	± 10
GD-30	40-350	10.00	± 10

Large Gauges
(Round Tip, Dial Diameter 2 1/2")

JONARD PART NO.	RANGE IN GRAMS	GRADUATION IN GRAMS	ACCURACY
GD-50	60-500	20.00	± 20
GD-100	150-1000	25.00	± 25
GD-200	300-2000	50.00	± 50
GD-400	700-4000	100.00	± 100



GPP-1 **GPP-5**



GPP-8 **GPP-72** **GPP-36** **GPP-15**

PUSH-PULL PRECISION TENSION GAUGE

Precision, compact tubular-type mechanical force gauge slender shape permits its use in confined areas. GPP-5 is graduated in two scales: grams and ounces, GPP-1 in grams only. Precision springs are individually calibrated. Full scale accuracy and factory calibration is held to ± 1 graduation. Construction is brass with satin chrome finish. Size: 1/2" diameter x 15" long.

JONARD P/N	AVOIRDUPOIS CAPACITY	METRIC CAPACITY
GPP-1		1000 g X 50 g
GPP-5	1 lb X 1 oz.	500 g X 50 g

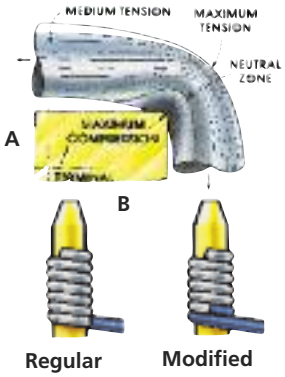
ECONOMY PUSH-PULL TENSION GAUGES

These high impact polystyrene cased instruments accurately measure push pull forces. Gauge is graduated in two scales: grams and ounces. Precision springs. Full scale accuracy is held to ± 1 graduation.
Size: 11/2" wide x 1" deep x 14" long.

JONARD P/N	AVOIRDUPOIS CAPACITY	METRIC CAPACITY
GPP-8	8 oz. x 0.25 oz	220 g x 5 g
GPP-36	36 oz. x 0.5 oz.	1,020 g x 20 g
GPP-72	72 oz. x 1 oz.	2,025 g x 25 g
GPP-15	15 lb. x 4 oz.	6,804 x 100 g

In February 2003 Jonard Industries acquired OK Industries and merged their operation into the "Jonard Family of Companies". Established in 1946, OK Industries blossomed as a major force in the telecommunications and electronic industries with a special proficiency in the manufacture of Wire Wrapping Tools. These same tools have continously been supplied by Jonard Tools.

Wire Wrapping is a method of making a wire connection by coiling the bare wire around the sharp corners of a terminal under mechanical tension. The technology was developed as an alternative to soldering, which presents various safety and reliability problems in many applications. A principal advantage of wire wrapping is that it provides a high-reliability connection that is also easily removed to correct or modify a wiring layout. Wire wrapping subjects the wire to tremendous tension and compression forces, causing the oxide layer on both wire and terminal to be crushed or sheared, resulting in a clean, oxide-free metal-to-metal contact. A standard wrap is generally used for 24 AWG and larger diameter wires; a modified wrap is typically used for 26 AWG and smaller wires, and is used almost exclusively for 28 to 30 AWG wires. In either case, the wrap style affects only the the connection's mechanical stability; both styles provide suitable electrical connections.



METAL-TO-METAL CONTACT

By bending the wire around the sharp corner of the terminal, the oxide layer on both wire and terminal is crushed or sheared, and a clean, oxide-free metal-to-metal contact is obtained.

TYPES OF WRAP

A "Regular" bit wraps the bare wire around the terminal. A "Modified" bit wraps a portion of insulation around the terminal in addition to the bare wire.This greatly increases the ability to withstand vibration.

STRIP FORCE CHART*

Wire Size AWG	Dia. inches	Dia. mm	Min. number of turns (Bare Wire)	Min. strip force lbs.	gms
16	.051	1.30	4	15	6800
18	.0403	1.00	4	15	6800
20	.032	0.80	5	8	3600
22	.0253	0.65	5	8	3600
24	.0201	0.50	6	7	3200
26	.0159	0.40	7	6	2700
28	.0126	0.32	7	5	2200
30	.0100	0.25	7	3.3	1500

*Conforms to MIL-STD-1130B

HOW TO MAKE WIRE WRAPPED CONNECTIONS

Step 1: Bit, Sleeve and Pre-Stripped Wire

Step 2: Wire Insertion

Step 3: Wire Anchoring

Step 4: Terminal Insertion

Step 5: Finished Connection

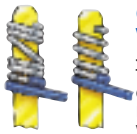
SOME HINTS ON MAKING WRAPPED CONNECTIONS

OVERWRAP

Do not press too hard. Let the OK tools do the work. Excessive pressure can lead to overwrapping. Backforce "BF" to prevent overwrapping is available on most power tools and is recommended for use with 26 through 30 AWG wire.

INSUFFICIENT TURNS

It's easy to feed wire into the slot in the OK bit correctly. Be sure the stripped end of the wire is "pushed-in" all the way.



OPEN WRAP & SPIRAL WRAP

Just keep the OK tool on the terminal until the wrap is complete. Early removal can result in spiral and open wraps.

PIGTAIL

Wire wrapping is a precision technique and the wrong bit and sleeve just cannot do the job. Improper selection can cause problems ranging from "Pigtails" to loose wraps.

TERMINAL DIAGONAL CHART

DIMENSION B

DIMENSION A	.010 0.25	.015 0.38	.020 0.51	.025 0.64	.030 0.76	.035 0.89	.040 1.02	.045 1.14	.050 1.27	.055 1.40	.060 1.52	.065 1.65	.070 1.78	.075 1.91	.080 2.03	.085 2.16	.090 2.29	.095 2.41	.100 2.54
.010 0.25	.014 0.36	.018 0.46	.022 0.56	.027 0.69	.032 0.81	.036 0.91	.041 1.04	.046 1.17	.051 1.30	.056 1.42	.061 1.55	.066 1.68	.071 1.80	.076 1.93	.081 2.06	.086 2.18	.091 2.31	.096 2.44	.101 2.57
.015 0.38	.018 0.46	.021 0.53	.025 0.64	.029 0.74	.033 0.84	.038 0.97	.043 1.09	.047 1.19	.052 1.32	.057 1.45	.062 1.58	.067 1.70	.072 1.83	.077 1.96	.082 2.08	.087 2.21	.092 2.34	.097 2.46	.102 2.59
.020 0.51	.022 0.56	.025 0.64	.028 0.71	.032 0.81	.036 0.91	.040 1.02	.045 1.14	.049 1.25	.053 1.35	.058 1.47	.063 1.60	.068 1.73	.073 1.85	.078 1.98	.083 2.11	.088 2.24	.093 2.36	.098 2.49	.103 2.62
.025 0.64	.027 0.69	.029 0.74	.032 0.81	.035 0.89	.039 0.99	.043 1.09	.047 1.19	.050 1.27	.056 1.42	.060 1.52	.065 1.65	.069 1.75	.074 1.88	.079 2.01	.084 2.13	.089 2.26	.094 2.39	.099 2.52	.104 2.64
.030 0.76	.032 0.81	.033 0.84	.036 0.91	.039 0.99	.042 1.07	.046 1.17	.050 1.27	.054 1.37	.058 1.47	.062 1.58	.067 1.70	.071 1.80	.076 1.93	.080 2.03	.085 2.16	.090 2.29	.095 2.41	.100 2.54	.105 2.67
.035 0.89	.036 0.91	.038 0.97	.040 1.02	.043 1.09	.046 1.17	.049 1.25	.052 1.32	.056 1.42	.060 1.52	.064 1.63	.069 1.75	.073 1.85	.078 1.98	.082 2.08	.087 2.21	.091 2.31	.096 2.44	.101 2.57	.106 2.69
.040 1.02	.041 1.04	.043 1.09	.045 1.14	.047 1.19	.050 1.27	.052 1.32	.056 1.42	.060 1.52	.064 1.63	.068 1.73	.072 1.83	.076 1.93	.080 2.03	.084 2.13	.089 2.26	.092 2.34	.097 2.46	.102 2.59	.107 2.72
.045 1.14	.046 1.17	.047 1.19	.049 1.25	.050 1.27	.054 1.37	.056 1.42	.060 1.52	.063 1.60	.067 1.70	.071 1.80	.074 1.88	.078 1.98	.083 2.11	.087 2.21	.091 2.31	.096 2.44	.101 2.57	.105 2.67	.109 2.77
.050 1.27	.051 1.30	.052 1.32	.053 1.35	.056 1.42	.058 1.47	.060 1.52	.064 1.63	.067 1.70	.071 1.80	.074 1.88	.078 1.98	.082 2.08	.086 2.18	.090 2.29	.094 2.39	.098 2.49	.103 2.62	.107 2.72	.111 2.82

Example: If "A"=.020". "B"=.060". The terminal diagonal is .063" as shown on chart.

The ergonomic and patented PTX series wire wrap tools are the telecom industry standard for wire wrapping needs on main distribution frames as well as local and remote installations. Its rugged construction and high speed motor make the tool suitable for electronic assembly work and many other wire wrapping applications.

PTX BATTERY POWERED WIRE WRAPPING TOOLS

Part No.	Description	Weight	Voltage	RPM
PTX	Battery Wrap/Unwrap Tool (Battery not included)	1.1 lb	3.6V*	3700
PTXFL	PTX plus Flashlight Attachment	1.1 lb	3.6V*	3700
PTX-KIT1	115V battery tool kit (tool, charger, (2) batteries)	3.5 lb	3.6V*	3700
PTX-KIT1FL	PTX Kit1 plus Flashlight Attachment	3.5 lb	3.6V*	3700
PTX-KIT1DH	PTX-KIT1 w/DFB224 and H-1000	3.6 lb	3.6V*	3700
PTX-KIT1DHFL	PTX-KIT1DH plus Flashlight Attachment	3.6 lb	3.6V*	3700
PTX-KIT2	230V battery tool kit (tool, charger, (2) batteries)	3.5 lb	3.6V*	4200
PTX-KIT2FL	PTX-KIT2 plus Flashlight Attachment	3.5 lb	3.6V*	4200
PTX-KIT2DH	PTX-KIT2 w/DFB224 and H-1000	3.6 lb	3.6V*	4200
PTX-KIT2DHFL	PTX-KIT2DH plus Flashlight Attachment	3.6 lb	3.6V*	4200

*NiMH Battery

PTX ELECTRIC POWERED WIRE WRAPPING TOOLS

Part No.	Description	Weight	Voltage	RPM
PTX-1	Electric Wrap/Unwrap Tool - 115V	2.0 lb	115V	3700
PTX-1FL	PTX-1 plus Flashlight Attachment	2.0 lb.	115V	3700
PTX-1BF	Electric Wrap/Unwrap Tool w/Backforce – 115V	2.0 lb	115V	3700
PTX-1BFFL	PTX-1BF plus Flashlight Attachment	2.0 lb.	115V	3700
PTX-2	Electric Wrap/Unwrap Tool - 230V	2.2 lb	230V	4200
PTX-2FL	PTX-2 plus Flashlight Attachment	2.2 lb.	230V	4200
PTX-2BF	Electric Wrap/Unwrap Tool w/Backforce - 230V	2.2 lb	230V	4200
PTX-2BFFL	PTX-2BF plus Flashlight Attachment	2.2 lb	230V	4200

DFB SERIES WRAP & UNWRAP BIT & SLEEVE SETS

Part No.	Description	Wire Size AWG MM	Min. Terminal Diagonal IN.	Min. Terminal Diagonal MM	Max. Terminal Diagonal IN.	Max. Terminal Diagonal MM	Terminal Hole Depth IN.	Terminal Hole Depth MM	Terminal Hole Diameter IN.	Terminal Hole Diameter MM	Effective Radius IN.	Effective Radius MM
DFB224	Wrap/Unwrap Bit/Sleeve Set 22-24 AWG	22/24 .50/.65	.054	1.37	.073	1.85	0.50	12.70	.075	1.90	.111	2.82
DFB2426	Wrap/Unwrap Bit/Sleeve Set 24-26 AWG	24/26 .40/.50	.054	1.37	.065	1.65	0.50	12.70	.066	1.67	.098	2.48

DFB224 Consists of KB-DF224 bit, P-DF224 sleeve **DFB2426** Consists of KB-DF2426 bit, P-DF2426 sleeve

ACCESSORIES

PTX-B PTX Battery, 3.6V
PTX-BC1 115V Battery Charger
PTX-BC2 230V Battery Charger
H-1000 Cordura Tool Pouch
PTX-FLA Flashlight Attachment
DFB224 Wrap/Unwrap Bit & Sleeve Set
DFB2426 Wrap/Unwrap Bit & Sleeve Set

MANUAL WIRE WRAPPING

G100/R3278 Aluminum

G200/R3278 Lexan™

G100/R3278FL

G100/R3278INS Insulated

- G200/R3278 : Lexan™
- G100/R3278 : Aluminum
- G100/R3278INS : Aluminum insulated
- G100/R3278FL Aluminum Insulated with LED Flashlight
- Bits & Sleeves : see pages 53-54

Also available– bits and sleeves for old style chuckless wire wrapping tools

For precise reliable wraps, choose the tool you want. We offer durability with our rugged aluminum tool, G100/R3278, added protection with our insulated version, G100/R3278INS, providing 1000V of dielectric strength across most of the housing, and the same reliability, light weight plus a lower cost with our Lexan® model, G200/R3278. G100/R3278FL is the insulated version with an LED flashlight attached. These tools accommodate wire sizes from 18 AWG (1.00mm) thru 32 AWG (0.20mm).

WIRE WRAPPING FLASHLIGHT KIT

G100-FL

G100-FLA

Part No.	Construction	For Use With
G100-FL	Metal	G100/R3278, G100/R3278INS,
G100-FLA	Plastic	Universal-for use with most manual wire wrapping guns

G100/R3394CT

MANUAL WIRE UNWRAPPING TOOL

The combination of the G100/R3394CT unwrap tool and the PUW unwrap bit & sleeve set gives you the best tool for high speed wire unwrapping. High production, long life, low maintenance. Use Unwrap Set PUW2226 for wire AWG 20 thru 26 (0.80 thru 0.40mm).

- G100/R3394CT : Manual Wire Unwrapping Tool (See bit & sleeve listed below)

Unwrap Bit Part No.	Unwrap Sleeve Part No.	Bit and Sleeve Set Set No.	Wire Size AWG	Wire Size mm	Terminal Hole Diameter Inches	Terminal Hole Diameter mm
2026UB	SOK2230	PUW2226	20-26	0.80-0.40	.070	1.77

Fully compatible with any make or model wire wrapping tool. Modified bits provide 1 1/2–2 turns of insulation.

3" BITS AND SLEEVES CHART

Wire Gauge	Regular	Modified	Bit Part No.	Sleeve Part No.	Maximum Insulation Diameter	Minimum Terminal Diagonal	Maximum Terminal Diagonal	Terminal Hole Depth	Effective Radius	Terminal Hole Diameter
18 AWG	●		KB18	P194LN		.060"	.073"	1.000"	.150"	.075"
1.00mm	●		KB18	P194LN		1.52mm	1.85mm	25.40mm	3.81mm	1.90mm
20 AWG		●	WB20M	P194LN	.059"	.042"	.073"	1.000"	.150"	.075"
0.80mm		●	WB20M	P194LN	1.50mm	1.07mm	1.85mm	25.40mm	3.81mm	1.90mm
20-22 AWG	●		KB2075	P2224		.042"	.073"	1.000"	.123"	.075"
0.65-0.80mm	●		KB2075	P2224		1.07mm	1.85mm	25.40mm	3.12mm	1.90mm
22 AWG	●		KB22	P2224		.054"	.073"	.750"	.117"	.075"
0.65mm	●		KB22	P2224		1.37mm	1.85mm	19.05mm	2.97mm	1.90mm
22 AWG		●	WB2275M	P2224	.052"	.049"	.074"	1.000"	.132"	.075"
0.65mm		●	WB2275M	P2224	1.32mm	1.24mm	1.87mm	25.40mm	3.35mm	1.90mm
22-24 AWG	●		KB224LH	P2224		.061"	.085"	1.000"	.117"	.086"
0.50-0.65mm	●		KB224LH	P2224		1.54mm	2.15mm	25.40mm	2.97mm	2.18mm
22-24 AWG	●		KB224-1	P2224		.054"	.073"	1.000"	.111"	.075"
0.50-0.65mm	●		KB224-1	P2224		1.37mm	1.85mm	25.40mm	2.82mm	1.90mm
22-24 AWG	●		KB224	P2224		.054"	.073"	.807"	.111"	.075"
0.50-0.65mm	●		KB224	P2224		1.37mm	1.85mm	20.50mm	2.82mm	1.90mm
22-24 AWG		●	WB224M	P2224	.050"	.049"	.074"	1.250"	.121"	.075"
0.50-0.65mm		●	WB224M	P2224	1.27mm	1.24mm	1.87mm	31.75mm	3.07mm	1.90mm
24 AWG		●	WB24DH	P2224	.046"	.054"	.073"	1.750"	.117"	.075"
0.50mm		●	WB24DH	P2224	1.17mm	1.37mm	1.85mm	44.50mm	2.97mm	1.90mm
24 AWG	●		KB24	P2426		.055"	.074"	.750"	.100"	.075"
0.50mm	●		KB24	P2426		1.39mm	1.87mm	19.05mm	2.54mm	1.90mm
24 AWG		●	WB24SM*	P3032LN	.044"	.024"	.043"	.750"	.098"	.044"
0.50mm		●	WB24SM*	P3032LN	1.11mm	0.60mm	1.09mm	19.05mm	2.48mm	1.11mm
24-26 AWG		●	WB2426M	P2224	.046"	.054"	.073"	.750"	.118"	.075"
0.40-0.50mm		●	WB2426M	P2224	1.17mm	1.37mm	1.85mm	19.05mm	2.99mm	1.90mm
24-26 AWG	●		KB2466	OK8519		**.054"**	**.065"**	**1.000"**	**.098"**	**.066"**
0.40-0.50mm	●		KB2466	OK8519		**1.37mm**	**1.65mm**	**25.40mm**	**2,48mm**	**1.67mm**
26 AWG	●		KB26	P2426		.058"	.073"	1.000"	.100"	.075"
0.40mm	●		KB26	P2426		1.47mm	1.85mm	25.40mm	2.54mm	1.90mm
26 AWG		●	WB26SM*	P26LN	.031"	.023"	.038"	.750"	.075"	.040"
0.40mm		●	WB26SM*	P26LN	0.79mm	0.58mm	0.96mm	19.05mm	1.90mm	1.02mm
26 AWG		●	WB26M	P2224	.046"	.054"	.073"	1.000"	.118"	.075"
0.40mm		●	WB26M	P2224	1.17mm	1.37mm	1.85mm	25.40mm	2.99mm	1.90mm
26 AWG		●	WB2644M*	P3032LN	.046"	.024"	.043"	.750"	.098"	.044"
0.40mm		●	WB2644M*	P3032LN	1.17mm	0.60mm	1.09mm	19.05mm	2.48mm	1.11mm
26 AWG		●	WB2669M	P2426	.041"	.053"	.068"	1.000"	.109"	.069"
0.40mm		●	WB2669M	P2426	1.04mm	1.34mm	1.72mm	25.40mm	2.77mm	1.75mm
28 AWG		●	WB28SHM	P3032	.030"	.031"	.035"	.750"	.066"	.036"
0.32mm		●	WB28SHM	P3032	0.76mm	0.79mm	0.89mm	19.05mm	1.67mm	0.91mm
30 AWG		●	SB30MSH-B*	P3032	.027"	.031"	.035"	.750"	.064"	.036"
0.25mm		●	SB30MSH-B*	P3032	0.69mm	0.79mm	0.89mm	19.05mm	1.62mm	0.91mm
30-32 AWG		●	WB3032M*	P3032	.027"	.034"	.038"	.750"	.064"	.040"
0.20-0.25mm		●	WB3032M*	P3032	0.69mm	0.86mm	0.96mm	19.05mm	1.62mm	1.02mm
30-32 AWG		●	WB3032MIL†	P3032	.027"	.034"	.038"	.750"	.064"	.040"
0.20-0.25mm		●	WB3032MIL†	P3032	0.69mm	0.86mm	0.96mm	19.05mm	1.62mm	1.02mm
30-32 AWG	●		KB3032	P3032		.034"	.038"	.750"	.064"	.040"
0.20-0.25mm	●		KB3032	P3032		0.86mm	0.96mm	19.05mm	1.62mm	1.02mm

*These tools are recommended for .025" square terminals on .100" center to center of the pins † Provides 2.5 turns of insulation

P2224INS

KB22

3" BITS AND INSULATED SLEEVES

The insulated sleeves are covered with a material that provides 1000V dielectric strength which helps to prevent shorting between pins and enhances worker safety.

Bit Part No.	Sleeve Part No.	Wire Size AWG	Wire Size mm	Regular	Minimum Terminal Diagonal In.	Minimum Terminal Diagonal mm	Maximum Terminal Diagonal In.	Maximum Terminal Diagonal mm	Terminal Hole Depth In.	Terminal Hole Depth mm	Effective Radius In.	Effective Radius mm	Terminal Hole Diameter In.	Terminal Hole Diameter mm
KB22	P2224INS	22	0.65	●	.054	1.37	.073	1.85	.750	19.05	.117	2.97	.075	1.90
KB224	P2224INS	22-24	0.50-0.65	●	.054	1.37	.073	1.85	.807	20.50	.111	2.82	.075	1.90
KB24	P2426INS	26	0.50	●	.055	1.39	.074	1.87	.750	19.05	.100	2.54	.075	1.90
KB26	P2426INS	26	0.40	●	.058	1.47	.073	1.85	1.000	25.40	.100	2.54	.075	1.90
KB3032	P3032INS	30-32	0.32	●	.034	0.86	.038	0.96	0.750	19.05	.064	1.62	.040	1.02

P2426-5INS

KB24-5

5" BITS AND SLEEVES (EXTENDED LENGTH) INSULATED AND NON INSULATED SLEEVES

These bits and sleeves are designed for wire wrapping in areas requiring deep penetration. Their 5" (127mm) length ensures "true" connections in hard-to-get-at locations. Available with or without insulation.

Bit Part No.	Insulated Sleeve Part No.	Uninsulated Sleeve Part No.	Wire Size AWG	Wire Size mm	Regular	Minimum Terminal Diagonal In.	Minimum Terminal Diagonal mm	Maximum Terminal Diagonal In.	Maximum Terminal Diagonal mm	Terminal Hole Depth In.	Terminal Hole Depth mm	Effective Radius In.	Effective Radius mm	Terminal Hole Diameter In.	Terminal Hole Diameter mm
KB22-5	P2224-5INS	P2224-5	22	0.65	●	.054	1.37	.073	1.85	.750	19.05	.117	2.97	.075	1.90
KB24-5	P2426-5INS	P2426-5	24	0.50	●	.055	1.39	.073	1.85	.750	19.05	.100	2.54	.075	1.90
KB26-5	P2426-5INS	P2426-5	26	0.40	●	.058	1.47	.073	1.85	.750	19.05	.100	2.54	.075	1.90

3" BIT & SLEEVE SETS WITH INSULATED COLOR CODED SLEEVES

Enjoy the convenience of pre-assembled sets with insulated color-coded sleeves for easy identification of wire sizes based on color.

Kit Number	Bit Part No.	Sleeve Part No. Color	Wire Size AWG	Wire Size mm	Regular	Modified	Maximum Insulation Diameter In.	Maximum Insulation Diameter mm	Minimum Terminal Diagonal In.	Minimum Terminal Diagonal mm	Maximum Terminal Diagonal In.	Maximum Terminal Diagonal mm	Terminal Hole Depth In.	Terminal Hole Depth mm	Effective Radius In.	Effective Radius mm	Terminal Hole Diameter In.	Terminal Hole Diameter mm
KT22B	KB22	P2224INS Blue	22	0.65	●		–	–	.054	1.37	.073	1.85	.750	19.05	.117	2.97	.075	1.90
KT224B	KB224	P2224INS Blue	22-24	0.65-0.50	●		–	–	.054	1.37	.073	1.85	.807	20.05	.111	2.82	.075	1.90
KT24Y	KB24	SW-2426 Yellow	24	0.50	●		–	–	.055	1.39	.074	1.87	.750	19.05	.100	2.54	.075	1.90
KT26G	KB26	P2426-G-INS Green	26	0.40	●		–	–	.058	1.47	.073	1.85	1.000	25.40	.100	2.54	.075	1.90

WIRE WRAPPING EXTENSION ATTACHMENT

Precision device which attaches easily to your manual or power wire wrapping tool for applications requiring extra "reach".

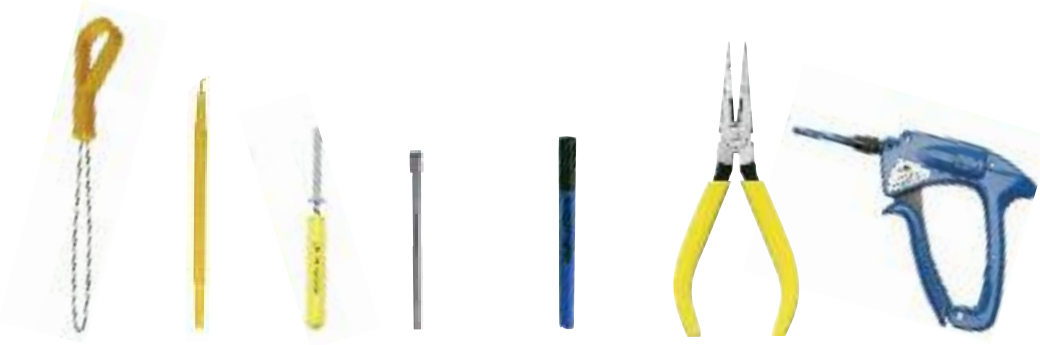
EXT-400

Part No.	Extension
EXT-400	Inches: 4.0 mm: 100

These are complete kits for technicians working at a Main Distributing Frame or for field service where wire wrapping is required.

WWK-CO Insulated Wire Wrapping Kit- designed specifically for the Central Office.

WWK-CO



JIC-2257 JIC-22035 UW4 KB224 P2224INS JIC-21257 G100/R3278INS

Kit Contains: G100/R3278INS, Insulated Wire Wrapping Tool, KB224 bit, 22-24 AWG, P2224INS Insulated sleeve, 22-24 AWG, H-1000 Cordura Pouch, JIC-21257 Telecom long nose pliers, JIC-22035 Probe pick, UW4 Sleeved unwrapping tool, JIC-2257 Insulated wire loop puller

Part No.	Description
WWK-CO	Wire Wrapping Kit, Central Office

WWK-1

P2224 KB224 ST-100 HW-UW-224 G200/R3278

Kit Contains: G200/R3278 Wire Wrapping Tool, KB224 bit 22-24 AWG, P2224 sleeve 22-24 AWG, HW-UW-224 Wrap/unwrap tool, ST-100 wire stripper 22-24 AWG, H-1000 Cordura Pouch

Part No.	Description
WWK-1	Wire Wrapping Kit

WWK-1INS

UW4 ST-100 KB224 P2224INS G100/R3278INS

Kit Contains: G100/R3278INS Insulated Wire Wrapping tool, KB224 bit 22-24 AWG, P2224INS Insulated sleeve 22-24 AWG, UW4 sleeved unwrapping tool 20-26 AWG, ST-100 Wire stripper 22-24 AWG, H-1000 Cordura Pouch

Part No.	Description
WWK-1INS	Insulated Wire Wrapping Kit

HAND WRAPPING TOOLS

These Hand Wrapping Tools are carefully designed to produce perfect wire wrapped connections. Precision, long-lasting tools for use where occasional wraps are required or where power wire-wrapping tools are not practical. Compact and convenient.

Part No.	Reg.	Mod.	Type	Wire Size		Max. Insulation Diameter		Terminal Hole Diameter		Terminal Hole Depth		Outside Diameter	
				AWG	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm
HW-20	●		A	20	0.80	–	–	.075	1.90	1.000	25.40	.218	5.53
HW-224	●		A	22-24	0.65-0.50	–	–	.075	1.90	.807	20.50	.218	5.53
HW-26	●		A	26	0.40	–	–	.075	1.90	1.000	25.40	.218	5.53
HW-30*		●		30	0.25	.027	0.69	.036	0.91	.750	19.05	.125	3.17

*This tool is recommended for .025" (0.63mm) square terminals on .100" (2.54mm) centers

HAND UNWRAPPING TOOLS

These tools are used to remove wire connections made with 20 thru 32 gauge wire.

Part No.	Type	Wire Size		Type of Unwrap	Terminal Hole Diameter		Terminal Hole Depth		Outside Diameter	
		AWG	mm		Inches	mm	Inches	mm	Inches	mm
UW1	D	20-26	0.80-0.40	Left Hand	.070	1.77	1.000	25.40	.156	3.96
UW2	C	20-26	0.80-0.40	Left and Right Hand	.070	1.77	1.000	25.40	.156	3.96
UW4	B	20-26	0.80-0.40	Left Hand	.070	1.77	2.360	60.00	1.95	4.95
UW5	B	20-26	0.80-0.40	Left and Right Hand	.070	1.77	2.360	60.00	1.95	4.95
UW093R	D	24-32	0.50-0.20	Left Hand	.038	0.96	1.000	25.40	.093	2.36
UWD93-93	C	24-32	0.50-0.20	Left and Right Hand	.038	0.96	1.000	25.40	.093	2.36
UW2832C	B	28-32	0.32-0.20	Left and Right Hand	.038	0.96	.750	19.05	.156	3.96

WRAP/STRIP/UNWRAP TOOLS

Each WSU tool wraps, unwraps and even strips the appropriate wire diameter with a unique built-in stripper blade. Ideal for bench use or tool kit in all service and repair applications. In addition to versatility, convenience, and reliability, the WSU Series offers exceptional value.

Part No.	Reg	Mod	Wire Size		Max. Insulation Diameter		Terminal Hole Diameter		Terminal Hole Depth		Outside Diameter		Square Post	
			AWG	mm	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm
WSU-2224	●		22-24	0.65-0.50			.075	1.90	1.50	38.1	.213	5.4	.045	1.14
WSU-24M		●	24	0.50	.036	0.92	.075	1.90	1.50	38.1	.213	5.4	.045	1.14
WSU-26M		●	26	0.40	.034	0.86	.075	1.90	1.50	38.1	.213	5.4	.045	1.14
WSU-30	●		30	0.25			.036	0.91	1.50	38.1	.125	3.2	.025	0.63
WSU-30M		●	30	0.25	.021	0.53	.036	0.91	1.50	38.1	.125	3.2	.025	0.63

These tools are recommended for .025" (0.63mm) square terminals on .100" (2.54mm) centers

HAND WRAPPING AND UNWRAPPING TOOLS

These Hand Wrapping and Unwrapping Tools are carefully designed to produce perfect wire wrapped connections. Precision, long-lasting tools for use where occasional wraps are required or where power wire-wrapping tools are not practical. Compact and convenient.

HW-UW-224INS

HAND WRAPPING AND UNWRAPPING TOOLS

To switch from wire wrapping to unwrapping takes only seconds - just a quick change of the cap from one end to the other.

WRAPPING SIDE													UNWRAPPING SIDE							
JONARD Part No.	Reg	Mod	Wire Size AWG	Wire Size mm	Max. Insulation Diameter In.	Max. Insulation Diameter mm	Terminal Hole Diameter In.	Terminal Hole Diameter mm	Terminal Hole Depth In.	Terminal Hole Depth mm	Outside Diameter In.	Outside Diameter mm	Wire Size AWG	Wire Size mm	Terminal Hole Diameter In.	Terminal Hole Diameter mm	Terminal Hole Depth In.	Terminal Hole Depth mm	Outside Diameter In.	Outside Diameter mm
HW-UW-18-19	●		18-19	1.00-0.91	-	-	.075	1.90	1.000	25.40	.250	6.35	18-19	1.00-0.91	.075	1.90	1.000	25.40	.187	4.74
HW-UW-20	●		20	0.80	-	-	.075	1.90	1.000	25.40	.218	6.35	20-26	1.00-0.91	.070	1.77	1.000	25.40	.156	3.96
HW-UW-224	●		22-24	0.65-0.50	-	-	.075	1.90	.807	20.50	.218	5.53	20-26	0.80-0.40	.070	1.77	1.000	25.40	.156	3.96
HW-UW-224-1	●		22-24	0.65-0.50	-	-	.075	1.90	1.000	25.40	.218	5.53	20-26	0.80-0.40	.070	1.77	1.000	25.40	.156	3.96
HW-UW-2426	●		24-26	0.50-0.40	-	-	.075	1.90	.750	19.05	.218	5.53	20-26	0.80-0.40	.070	1.77	1.000	25.40	.156	3.96
HW-UW-26	●		26	0.40	-	-	.075	1.90	1.000	25.40	.218	5.53	20-26	0.80-0.40	.070	1.77	1.000	25.40	.156	3.96
HW-UW-26SM*		●	26	0.40	.031	0.79	.040	1.02	.750	19.05	.125	3.17	24-32	0.50-0.20	.038	0.96	1.000	25.40	.093	2.36
HW-UW-2829M*		●	28-29	0.32-0.29	.036	0.91	.040	1.02	.750	19.05	.156	3.96	24-32	0.50-0.20	.038	0.96	1.000	25.40	.093	2.36
HW-UW-30*		●	30	0.25	.027	0.69	.036	0.91	.750	19.05	.125	3.17	24-32	0.50-0.20	.038	0.96	1.000	25.40	.093	2.36
INSULATED HAND WRAPPING AND UNWRAPPING TOOLS																				
HW-UW-224INS†	●		22-24	0.65-0.60	-	-	.075	1.90	1.000	25.40	.218	5.53	20-26	0.80-0.40	.070	1.77	1.000	25.40	.156	3.96
WDUD-26DS†	●		26	0.40	-	-	.075	1.90	1.000	25.40	.218	5.53	20-26	0.80-0.40	.070	1.77	1.000	25.40	.156	3.96

*These tools are recommended for .025" (0.63mm) square terminals on .100" (2.54mm) centers. A modified wrap provides 1.5 – 2 turns of insulation.
† Insulated handle for dielectric protection.

NOTE: WDUD-26DS and HW-UW-224INS have insulated handles to prevent shocks.

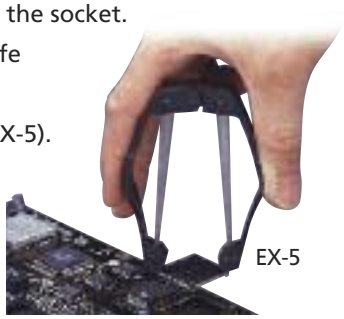
UNIVERSAL PLCC EXTRACTION TOOL EX-5/EX-6

EX-6

Features

- Extracts a range of PLCC sizes from 20 pins through 128 pins from any socket without damage to the chip.
- Spring loaded one-hand design requires no pulling, just squeeze handles and chip is lifted from the socket.
- ESD safe handles for use on all static safe components (EX-5).
- Machined stainless steel for long-life (EX-5).
- EX-6 - ABS handles and stamped steel.

STATIC SAFE



EX-5

Part No.	Description
EX-5	ESD safe PLCC extraction tool
EX-6	PLCC extraction tool

INSERTION/EXTRACTION KIT WK-7

WK-7 kit includes DIP IC extractors and inserters to accommodate all IC's from 8 to 40 pins. All tools are CMOS safe and include grounding lugs where appropriate except EX-1. The kit consists of extractors EX-1 for 8-24 pin devices, and EX-2 for 24-40 pin ICs, plus inserters MOS-1416, MOS-2428, and MOS-40 for 14-16, 24-28 and 36-40 pin IC's respectively.

S-340

DIP/IC EXTRACTOR

This is a one-piece insulated spring steel extractor used to extract LSI, MSI and SSI devices from 8 to 24 pins. Will remove all types of DIP/IC's without bending pins. 4" long.

Part No.	Description
S-340	DIP/IC Extractor

EX-1 | EX-2 | MOS-1416 (.3" Pitch) | MOS-40 (.6" Pitch) | MOS-2428 (.6" Pitch)

WK-7 Kit Includes

- EX-1 Extraction Tool (8-24 Pins).
- EX-2 Extraction Tool (24-40 Pins).
- MOS-1416 Insertion Tool (14-16 Pins).
- MOS-40 Insertion Tool (36-40 Pins).
- MOS-2428 Insertion Tool (24-28 Pins).

Part No.	Description
WK-7	5 piece insertion/extraction kit

Note: WK-7 items may be purchased individually.

HIGH-VACUUM DESOLDERING PUMPS

A specially engineered desolder pump made to exacting specifications and providing precise repeatable operation. Fitted with a Teflon Tip with ID .125", OD .22" and included cleaning mechanism. DP-100 and DP-200. 13" long including tip, DP-140 8" long.

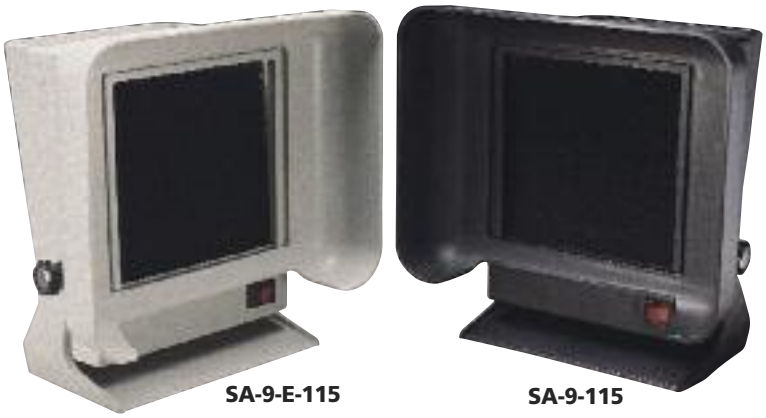
Features

- Durable corrosion resistant plastic construction.
- Precision metal plunger.
- Corrosion treated springs.
- Insulated vacuum pulse.
- Regulated return (1 millisecond ±30%).
- Uniform reset pressure (11in. lbs. ±20%).
- Cushioned shock reduction (pulse release to minimize board damage).

Part No.	Description
DP-100	High Vacuum Desoldering Pump
DP-200	High Vacuum Desoldering Pump, ESD Safe
DPT-100	1 Replacement Tip, DP-100/DP-140
DPT-200	1 Replacement Tip, DP-200

Part No.	Description
DP-140	Desoldering Pump
DPT-100	1 Replacement Tip, DP-100/DP-140

BENCHTOP FUME ABSORBERS



- Aerodynamic hood design effectively draws irritating soldering fumes away from the work area.
- Carbon-impregnated filters trap a limited portion of the flux fumes.
- Compact size, low profile and adjustable stand allows convenient placement 6" to 8" (152 to 203mm) from work area.
- SA-9-E-115 feature static-dissipative housings.
- Dimentions: 8 1/2" H x 8 1/4" W x 4" D
- Articulating arm allows optimized positioning and saves bench space.
- Bench mounting clamp and 3 filters come complete with unit.
- SA-91-E features a static-dissipative housing.

Benchtop

Part No.	Description
SA-9-115	Benchtop fume absorber, 115V AC with 3 filters
SA-9-E-115	ESD-Safe benchtop fume absorber, 115V AC with 3 filters

Articulating Arm

Part No.	Description
SA-91	SA-9-115 with Articulating Arm, & Bracket
SA-91-E	SA-9-E-115 with Articulating Arm, & Bracket
SAK-90	Arm Assembly Kit Retro-fits SA-9/9-E to SA-91/SA-91-E
SAF-1	Replacement Filter Set, 3pcs.

Specifications		
Part No.	SA-9-115 SA-9-E-115	SA-91 SA-91-E
Input Voltage	115V 60Hz	115V 60Hz
Maximum Air Volume	105 to 126 CFM	105 to 126 CFM
Activated Carbon Wt.	12g	12g
Unit Weight	2.2 lbs. (1 kg)	4 lbs. (1.8 kg)
Arm Length	-	24" (607mm)

JONARD TOOLS®

MADE FOR LIFE®

SINCE 1958

134 Marbledale Road, Tuckahoe, NY 10707 I Tel 914.793.0700 I jonard.com

Understanding and Selecting the Best MDF Boards

Shahala · Follow
3 min read · Feb 3, 2024

Listen Share

Medium Density Fiberboard (MDF) boards have become a staple in modern construction and interior design due to their versatility, durability, and affordability.

boards and how to make informed decisions when choosing the right ones for your needs.

What is MDF?

Medium Density Fiberboard (MDF) is an engineered wood product made by compressing wood fibers and resin under high pressure and temperature. The result is a dense, uniform panel that offers excellent strength, stability, and versatility. Best MDF boards are commonly used in various applications, including furniture, cabinetry, molding, shelving, and decorative panels.

Characteristics of MDF Boards:

- **Uniformity:** MDF boards have a consistent density and composition throughout, making them ideal for precision cutting and machining.
- **Smooth Surface:** MDF boards feature a smooth and flat surface, perfect for painting, laminating, or veneering to achieve different finishes.
- **Edge Profile:** While MDF boards have a smooth surface, their edges may be rough and require edge banding for a finished look.
- **Strength and Durability:** Despite being denser than plywood or particleboard, MDF boards are susceptible to moisture and should be used in dry environments or sealed properly.
- **Cost-Effective:** MDF boards are generally more affordable than solid wood or plywood, making them a budget-friendly option for various projects.

Applications of MDF Boards:

Best MDF boards find applications in a wide range of residential, commercial, and industrial projects, including:

- **Furniture:** MDF is commonly used for manufacturing furniture pieces such as tables, chairs, cabinets, and bed frames due to its smooth surface and ease of machining.
- **Cabinetry:** MDF panels are ideal for constructing cabinet boxes, drawer fronts, and door panels in kitchens, bathrooms, and other storage areas.
- **Interior Trim:** MDF trim, molding, and baseboards offer a cost-effective alternative to solid wood for adding architectural detail and finishing touches to interior spaces.
- **Decorative Panels:** MDF boards can be routed, carved, or embossed to create decorative wall panels, room dividers, or artistic installations.

How to Select the Best MDF Boards:

When choosing MDF boards for your project, consider the following factors:

- **Density and Thickness:** Higher density MDF boards offer better strength and durability. Choose the appropriate thickness based on the intended application and load-bearing requirements.
- **Surface Finish:** Determine whether you need raw MDF for painting or laminated MDF for a pre-finished surface. Consider the desired color, texture, and sheen level.
- **Moisture Resistance:** If your project involves high-humidity environments such as bathrooms or kitchens, opt for moisture-resistant MDF or apply a waterproof coating.
- **Formaldehyde Emissions:** Look for best MDF boards with low formaldehyde emissions to promote indoor air quality and environmental sustainability.
- **Brand Reputation and Certification:** Choose reputable brands that adhere to industry standards and certifications such as CARB Phase 2 compliance or FSC certification for sustainable sourcing.
- Understanding the characteristics, applications, and selection criteria for best MDF boards is essential for making informed decisions in your construction or renovation projects. By considering factors such as density, surface finish, moisture resistance, emissions, and brand reputation, you can ensure that you choose the best MDF boards that meet your specific requirements and deliver optimal performance and aesthetics.

Written by Shahala

0 Followers

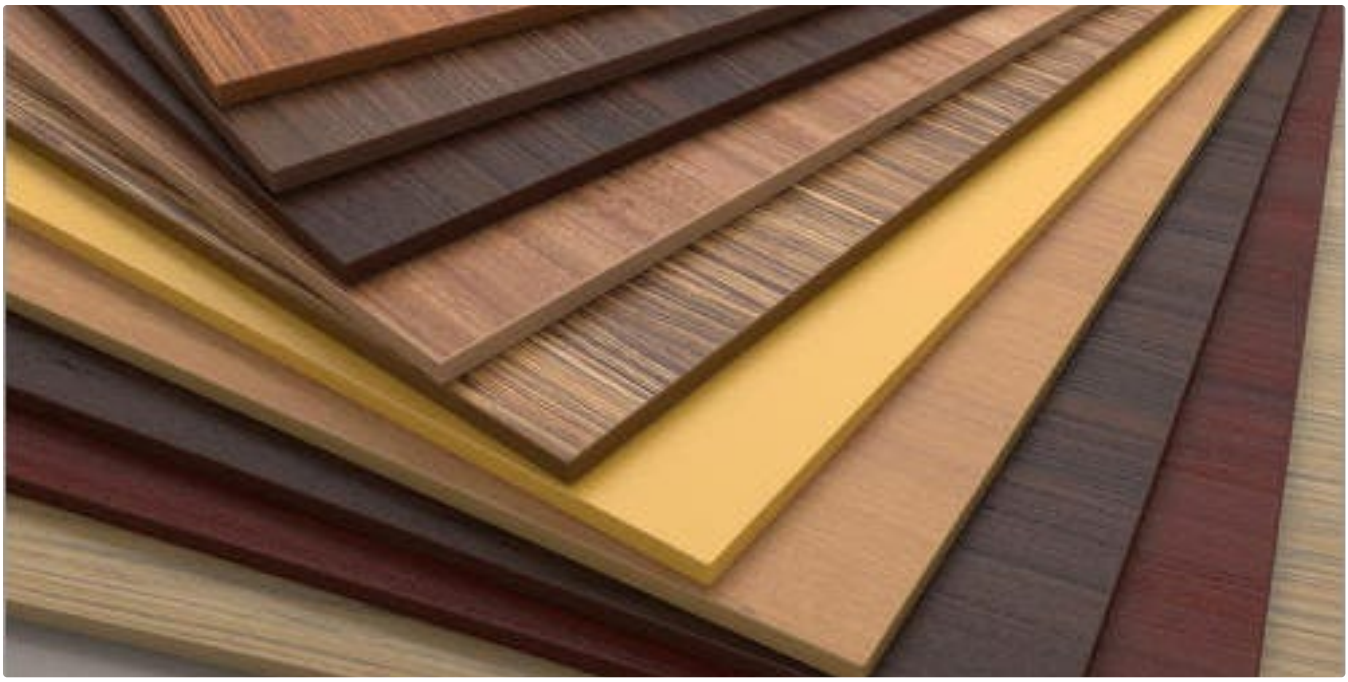
More from Shahala

Shahala

Particle Board Furniture Hacks: Creative Ways to Upgrade Your Pieces

Particle board furniture is a budget-friendly and versatile choice for many households. Fortunately, there are numerous creative ways to...

3 min read · Oct 23, 2023



Shahala

Understanding Different Laminates for MDF Boards

Laminates play a crucial role in enhancing the aesthetics, durability, and functionality of Medium Density Fiberboard (MDF) boards. They...

3 min read · Aug 5, 2023

Shahala

Different Laminates and Finishes for Particle Board

Particle board is a widely used engineered wood product known for its cost-effectiveness and versatility. Pre-laminated particle board...

3 min read · Aug 18, 2023

Shahala

Particle Board Characteristics: Essential Information to Learn!

Particle board, often referred to as chipboard, is a versatile and cost-effective engineered wood product widely used in furniture and...

3 min read · Aug 15, 2023

1

See all from Shahala

Recommended from Medium

James Presbitero Jr. in Practice in Public

These Words Make it Obvious That Your Text is Written By AI

These 7 words are painfully obvious. They make me cringe. They will make your reader cringe.

5 min read · Jan 1, 2024

38K 1020

Rebecca Designs A Life in Read or Die!

I Was Fired For Writing On Medium

Heed this warning

· 2 min read · Feb 8, 2024

20K 355

Lists

Staff Picks

584 stories · 761 saves

Stories to Help You Level-Up at Work

19 stories · 485 saves

Self-Improvement 101

20 stories · 1362 saves

Productivity 101

20 stories · 1251 saves

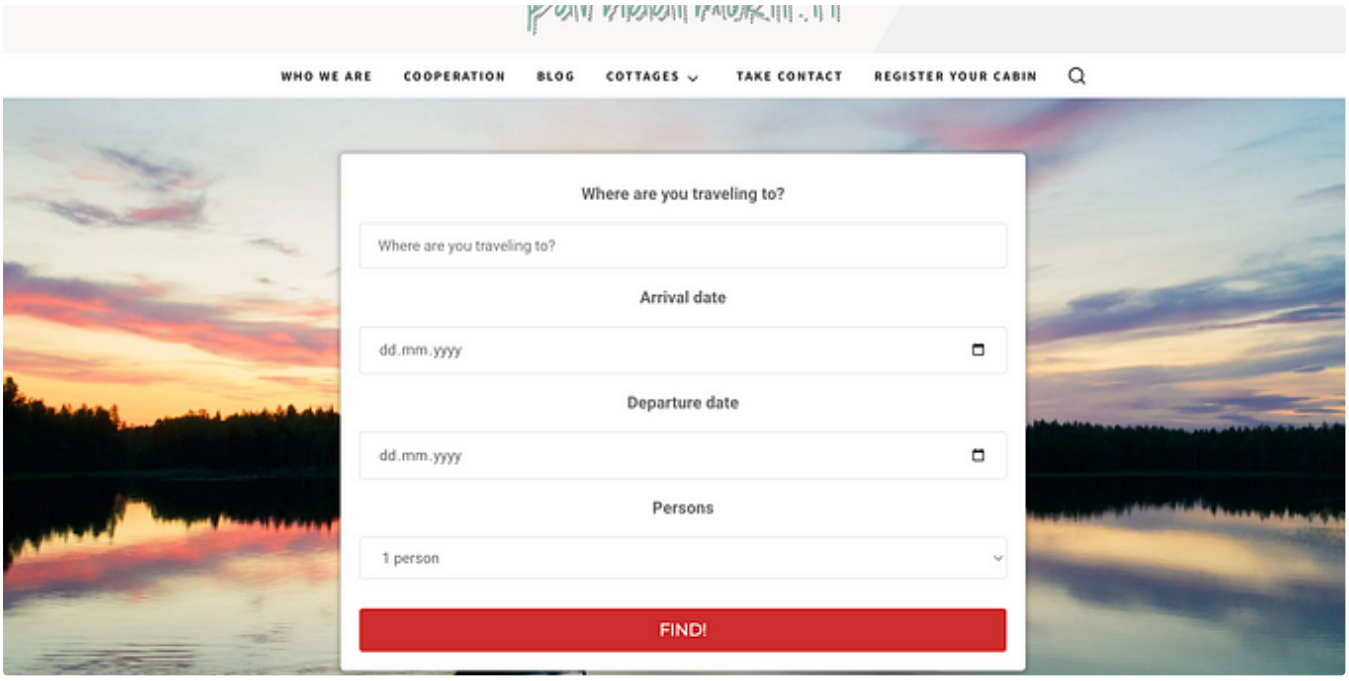
Iain Stanley in Digital Global Traveler

I Went Speed-Dating in Tokyo: It Explains Japan's Sexless Population Explosion!

Exclusive conversations with a bevy of beautiful, single girls? What could go wrong...

· 8 min read · Jan 17, 2024

11.5K 138



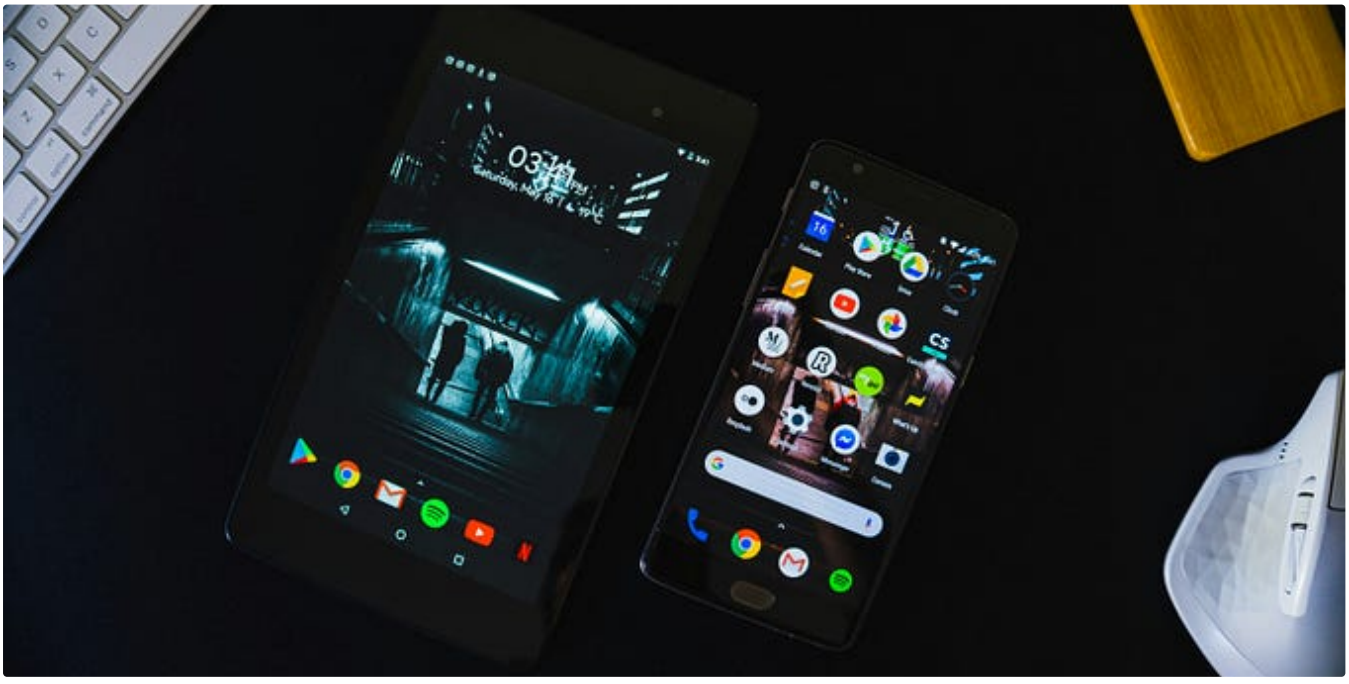
Artturi Jalli

I Built an App in 6 Hours that Makes $1,500/Mo

Copy my strategy!

· 3 min read · Jan 24, 2024

9K 118



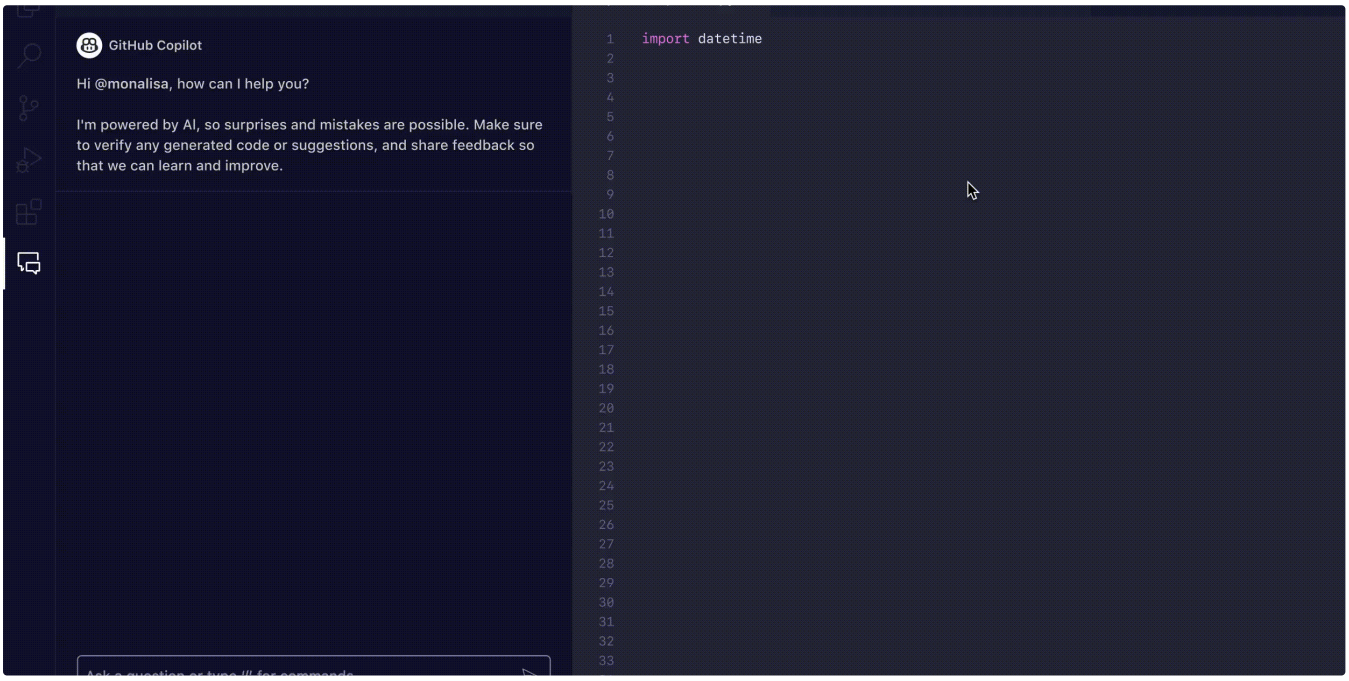
Andrew Zuo

Google's Gemini Is Better Than GPT

I recently put GPT 4 into my app and it was pretty good at first. But then it was not so good. GPT 4, for whatever reason, decided to take...

· 4 min read · Feb 11, 2024

713 8



Jacob Bennett in Level Up Coding

The 5 paid subscriptions I actually use in 2024 as a software engineer

Tools I use that are cheaper than Netflix

· 5 min read · Jan 5, 2024

9.2K 99

See more recommendations

ENGINEERING DEPARTMENT

SEPTEMBER, 2007

GUIDELINES FOR UTILITY INSTALLATIONS

Part 1 - Wire Lines and Communications Cables

General Requirements

This section applies to all public and private utilities, including electric power, telephone, fiber optics, telegraph, cable television, and other communication and data transmission facilities, both overhead and underground.

Installations crossing Metra property shall be, to the extent feasible, perpendicular to the right of way. Utilities shall not be placed within culverts or under railroad bridges, buildings or other structures.

Wire lines and cables shall be located so as to provide a safe environment and shall conform to the current *National Electric Safety Code* and the *American Railway Engineering and Maintenance Association Specifications.* Where local laws or authorities prescribe a more stringent specification, that specification shall supersede the specification in this manual.

Metra may request that an Inductive Interference study be performed, at the expense of the utility owner, for the proposed crossing. Inductive interference has the potential to disrupt railroad signal systems causing failures in track signals and grade crossing warning devices and safety concerns for people working on or near the tracks. Metra's Chief Engineer will determine the need for such a study on a case by case basis.

All wire line applications shall include a plan and cross section view, at a clear and legible scale, of the proposed installation. Plan views shall include the following:

- Date of plan, scale and north arrow
- Centerline of all railroad tracks
- Distance (in feet) to nearest railroad milepost or grade crossing (centerline of road)
- Right of way dimensions
- Angle of crossing relative to right of way
- Location of all railroad signal facilities and pole lines
- Location of all existing utility pole lines and above ground utilities
- Location of all existing underground utility markers
- Location of proposed poles and distance from centerline of nearest track to edge of pole
- Length of wire line span across tracks from pole to pole

Cross section views shall include the following:

- Date of plan, scale
- All railroad tracks
- Right of way dimensions
- Vertical clearance from bottom of sag to top of rail on all tracks
- Location of poles and distance from centerline of nearest track to edge of pole
- Length of span across tracks from pole to pole
- Location of all existing railroad pole lines and utility lines
- Location of all grade crossing signal equipment (gates, flashers, masts, cantilevers, etc.) if located near or within a road crossing

Specifications for Overhead Wire Line Crossings

1. These specifications shall apply to overhead electric power line crossings over railroad rights of way, tracks, and signal and communication wires.

2. The Crossing Company shall submit plans showing proposed construction for review and approval with its application. A signed easement agreement, formal approval of plans, and subsequent contractor right of entry (see right of entry application) is required prior to commencement of construction.

3. The poles or towers supporting the line shall preferably be outside Metra's right of way

4. The poles or towers shall preferably be in a straight line.

5. Crossing poles and towers shall be located as far as possible from combustible structures. The space around the poles and towers shall be kept free from underbrush, grass, and other combustible material.

6. The side clearance from the pole or tower from the nearest rail may not be less than 12 feet l, with a minimum distance of 8.5 feet from the nearest rail to any cross arm, guy, or other attachment. Unguyed poles must be located a minimum distance equal to the height of the pole above the ground line plus 10 feet from the centerline of the nearest track.

7. Where necessary for unobstructed view of wayside signals, signs, etc., Metra may require greater clearances than specified above.

8. Wooden poles supporting the crossing span shall be side-guyed in both directions, if practicable, and be head-guyed away from the crossing span. Braces may be used instead of guys. **All down guys shall have high visibility guarding.**

9. The poles or towers shall be plainly marked with the name, initials, or trademark and the pole numbers, if used, of the Crossing Company. When required by Metra, the Crossing Company shall place, on all crossing structures located on Metra property, warning signs of approved design.

10. In general, lines shall be arranged in the order of their operating voltages, conductors of the greatest voltage occupying the highest position. Where lines of lower voltage are permitted to cross over circuits of higher voltage, their mechanical strength shall conform to that required for the higher voltage lines.

11. Where the wires or cables of the crossing span are supported on both crossing supports by pin type insulators, or by suspension type insulators in a suspended position or in a strain position, the vertical clearance between the wires or cables of the crossing span and the top of rail, at 60° Fahrenheit and no wind, shall not be less than the following:

    a. Where the distance from the nearer crossing support to the point where the line crosses the farthest rail is 75 feet or less, the minimum clearance above the top of rail shall be:

i. 28 feet for lines carrying 0 – 15,000 volts

ii. 30 feet for lines carrying 15,000 – 50,000 volts

iii. Lines over 50,000 volts – 30 feet plus 0.4 inches for each 1,000 volts above 50,000.

b. Where the distance from the nearer crossing support to the point where the line crosses over the farthest rail is more than 75 feet, the clearance of (a) above shall be increased by 0.2 feet for each 10 feet in excess of 75 feet in length.

c. For the protection of railroad crane and pile driver operations, and the protection of the wire line crossing, it is preferred that any wire or cable crossing be located at least 1,000 feet from any railroad bridge, trestle or large culvert. When it is necessary to locate less than 1,000 feet from such a structure, the vertical clearance shall not be less than 50 feet.

12. The clearance between any two wires crossing each other and carried on different supports shall be not less than the following:

a. Where the upper conductor or wire has fixed supports, the sum of the distances from the point of intersection of the two crossing wires to the nearer supporting structure of each span does not exceed 100 feet:

NATURE OF WIRES CROSSED OVER	Communication	Supply cables having permanently grounded metal sheath – all voltage		Open supply wires:		Guys, Messengers, span wires, lightning protection wires, service drops 0 - 750 volts
		Line Wires	Service Drops	0 – 8,700 volts	8,700 – 50,000 volts	
	Feet	Feet	Feet	Feet	Feet	Feet
Communication	2	4	2	4	6	2
Supply cables having permanently grounded metal sheath – all voltage	4	2	2	4	4	2
Open supply wires:						
0 - 750 volts	4	2	2	2	4	2
750 – 8,700 volts	4	2	4	2	4	4
8,700 – 50,000 volts	6	4	6	4	4	6
Guys, Messengers, span wires, lightning protection wires, service drops 0 - 750 volts	2	2	2	4	4	2

Note: for voltage exceeding 50,000, the clearances given above shall be increased at the rate of 0.4 inches for each 1,000 volts in excess of 50,000.

b. Where the upper conductor or wire has fixed supports, and the sum of the distances from the point of intersection of the two crossing wires to the nearer supporting structure of

each span exceeds 100 feet, the clearances listed in the above table shall be increased by 0.10 feet for each 10 feet in excess of the 100 feet.

c. Conductors supported by suspension type insulators at crossings over communication wires shall be increased by such an amount that the values specified in the above table will be maintained in the event of a broken conductor in either adjacent span, provided such conductor is supported as follows:

- At one support by suspension type insulators in a suspended position, and at the other support by insulators not free to swing (including semi-strain type insulator).

- At one support by a strain insulator, and at the other support by a semi-strain type insulator.

13. Splices shall not be made in the crossing span, and preferably not in the adjacent spans, which are depended upon for withstanding the longitudinal tension of the crossing conductors. Taps shall not be made in the crossing span. If a splice or tap is made in any conductor in the span adjacent to the crossing span, it shall, where practicable, be placed at a point nearer to the crossover support than is the nearest conductor crossed over.

14. Cradles, baskets, and overhead bridges are generally not acceptable and shall not be used except under unusual conditions where it is economical to build such a structure of sufficiently substantial nature and when approved by Metra. Drop outs shall not be used.

15. The crossing construction shall be subject at all times to the inspection and approval of Metra.

16. All parts of the supporting structures of the crossing span shall be inspected annually by the owner and all defective parts shall be promptly restored to a safe condition.

17. The details of construction and maintenance of the crossing, unless otherwise specified herein, shall be in accordance with the current specifications of the National Electrical Safety Code, except when modified construction is permitted by Metra.

Specifications for Overhead Communication Line Crossings

1. These specifications shall apply to the construction of overhead communication lines crossing or paralleling the right of way. Wires covered by these specifications shall not carry more than 400 volts.

2. Spans crossing the right of way shall preferably have the supporting poles located outside the right of way. The crossing span, where practicable, shall not exceed 175 feet. Where practicable, the adjacent spans shall not exceed the length of the crossing span by more than 50%. Where practicable, the poles supporting the crossing span and the adjacent spans shall be in a straight line.

3. Pole lines paralleling the right of way shall have the poles located not less than 12 feet from the nearest rail, with a minimum distance of 8.5 feet from the nearest rail to any cross arm, guy, or other attachment. When necessary to provide safe operating conditions which require unobscured view along the track for signal, signs, etc., Metra may require clearances greater than those specified above.

4. Wood poles shall be new and structurally sound. If guys are omitted, poles shall be located a minimum distance from the centerline of any track equal to the height of the pole above the ground line plus 10 feet. Gains shall not be cut to a depth of more than one-half inch. Spliced poles shall not be used in the crossing span.

The following table specifies the minimum depth of setting for un-guyed poles in average soil and in rock.

MINIMUM DEPTH OF SETTING FOR UN-GUYED POLES Depth in feet in average soil for different classes of poles				
Length of Pole (feet)	**Class 4**	**Class 5 and 6**	**Class 7**	**Depth in Feet in Rock for all Classes**
16		4.00	3.75	3.00
18		4.25	4.00	3.25
20	4.25	4.25	4.00	3.25
22	4.75	4.50	4.25	3.50
25	5.25	4.75	4.50	3.75
27	5.50	5.00	4.75	4.00
30	5.75	5.25	5.00	4.25
35	6.00	5.50	5.25	4.50
40	6.25	5.75	5.50	4.75
45	6.50	6.00	5.75	5.00
50	6.75	6.25	6.00	5.25
55	7.00	6.50		5.50
60	7.25	6.75		5.75

Where soil conditions are such that the above depths of setting will not develop the strength of the pole, the pole shall be set to a greater depth, or other means shall be used to properly support the pole.

5. Wood crossarms supporting the crossing span shall be of fir, treated yellow pine, or other suitable timber. They shall have a nominal cross-section of not less than the value given in the table below. Galvanized or painted steel or iron crossarms of equal or greater strength than those of the wood crossarms specified in the table may also be used.

DIMENSIONS OF WOOD CROSSARMS			
Number of wires	Nominal Length		Nominal Cross Section (Inches)
	Feet	Inches	
2	1	4 ½	2 5/16 X 3 5/16
4	3	4 ½	2 5/16 X 3 5/16
6	6	0	2 ¾ X 3 ¾
10	8	6	2 ¾ X 3 ¾
10	10	0	3 X 4

6. All pole line hardware shall be galvanized.

7. Insulator pins shall have strength sufficient to withstand the loads to which they will be subjected. Iron or steel pins shall have a shank diameter of not less than ½ inch. Wood pins shall be sound and straight grained with a shank diameter of not less than 1 ¾ inch.

8. Each insulator shall be of such pattern, design, and material that, when mounted on its pin, it will withstand, without damage, and without being pulled off its pin, the ultimate strength of the conductor which it supports.

MINIMUM WIRE SIZES				
Conductor	Spans 125 feet or less		Spans 125 to 150 feet	
	Gauge	Diameter (inches)	Gauge	Diameter (inches)
Copper, hard drawn	10 AWG	0.102	9 AWG	0.114
Steel, galvanized	10 BWG	0.134	8 BWG	0.165

Note: If spans in excess of 150 feet are necessary, the size of the conductors specified above, or the sags of the conductors shall be increased accordingly.

9. Conductors shall be of material, or combination of materials, which will not corrode excessively under the prevailing conditions. The minimum allowable sizes of conductors in a span crossing over a railroad which does not, in the same span, cross over supply conductors exceeding 750 volts shall be as listed in the following table. Conductors of material other than those specified in the table below shall be of such size and so erected as to have mechanical strength not less than the sizes of the copper conductors specified.

10. Poles supporting the crossing span shall be guyed in both directions, if practicable, and shall be head guyed away from the crossing span when the crossing span places undue stress on the crossing poles. Guys shall be of galvanized steel or stainless steel **and shall have high visibility guarding.**

11. Suspension strands shall be of galvanized steel or other material that will not corrode excessively under the prevailing conditions.

12. The construction shall be subject to the inspection of Metra and shall comply with the requirements of these specifications. Defective material shall be rejected and replaced with acceptable material.

13. The crossing shall be maintained in a safe condition. The poles, crossarms, guys, wires, and other parts and materials used in the structure of the crossing shall be periodically inspected, and all defects shall be promptly repaired by the owner of the line. The guys and anchors shall be maintained so that the guys are kept taut and serve the purpose fro which they are intended. The line wires shall be kept to the proper sag. Underbrush, grass, or other combustible material shall be kept removed, by the crossing owner, from the poles for a sufficient distance to reduce fire hazard to a minimum.

14. The following table lists minimum required vertical clearances:

Wire Line Clearance Chart

VOLTAGE (to ground)	MINIMUM CLEARANCE REQUIRED ABOVE TOP OF RAIL
Insulated Communication Wirelines	23.5 ft.
Non-insulated Communication Wirelines	24 ft.
Shielded or insulated power wirelines 0-750 volts	24 ft.
Shielded or insulated power wirelines (Lashed to bare ground messenger) 751V to 22kV	24.5 ft.
Open supply conductors 0-750 volts	24.5 ft.
Open supply conductors 751V – 22kV	26.5 ft.
50kV	27.5 ft.
100kV	29.2 ft.
150kV	30.8 ft.
200kV	32.5 ft.

Specifications for Underground Electric Power Lines

1. Wire lines located within the right of way must be located as far as possible from existing tracks and other railroad facilities and as close to the right of way line as possible due to the fact that Metra occupies the right of way for the purpose of operating a commuter railroad. All installations shall be designed and constructed so the railroad operations and facilities are not interfered with. Additionally, the proposed installation shall be located to minimize encumbrance to the right of way in order that Metra will have unrestricted use of the property for current and future operations.

2. Wire lines shall be located to cross tracks at approximately right angles where conditions permit.

3. A Metra signal department employee must locate any buried signal cables prior to construction.

4. The tops of ducts and cable systems structures of underground cable crossings shall be located at a depth of not less than 5 feet - 6 inches below base of rail and not less than 36 inches below bottoms of ditches or 48 inches below natural ground, with the lowest depth governing. Deeper installations may be required to avoid underground railroad facilities.

5. Underground crossings of power supply cables with maximum voltage of 750 volts and communication cables of low voltage may be installed by pushing a galvanized steel pipe under the tracks at a depth specified above to serve as a conduit, provided such pipe extends the full width of the right of way. All ducts and/or encasements beneath the tracks must be capable of withstanding E-80 loading and conform to AREMA Specifications. Any conduits and/or encasements larger than four inches will be governed entirely by those specifications which normally cover pipelines (see “Specifications for Pipelines). Jacking or boring installation is preferred, and no water is to be used in the installation of the encasement. Plastic casing pipe is not permitted.

6. Underground crossings of power supply cables operating above 750 volts will be installed at depths specified above and in addition, between the points where the underground crossing enters and leaves METRA property, the cable is to be enclosed in galvanized steel pipe or approved concrete encased duct for mechanical protection of the cable. No unprotected cable of this potential will be permitted.

7. All underground installations must be located a minimum of 50 feet from the end of any railroad bridge, centerline of any culvert or switch area to the centerline of the wire line crossing.

8. If the proposed location of the wire line crosses existing culverts, the top of the buried wire line must be installed a minimum of 5' below the culvert invert. If the location crosses a ditch beyond the end of the culvert (field side) then the top of the buried encroachment must be installed 5' below the bottom elevation of the ditch.

9. Manholes must be capable of withstanding H-20 highway loading requirements and must be installed so as not to create a stumbling hazard.

10. All underground installations carrying power or communication wires and cables shall be constructed and properly marked with signs.

11. In addition to the requirements of these specifications, the underground crossing is to conform to the requirements of the National Electrical Safety Code, current edition. The crossing is also to conform to the requirements of any local or state laws or regulations of any local code enforcing authority that may be in effect at the time of the installation.

energysafe VICTORIA

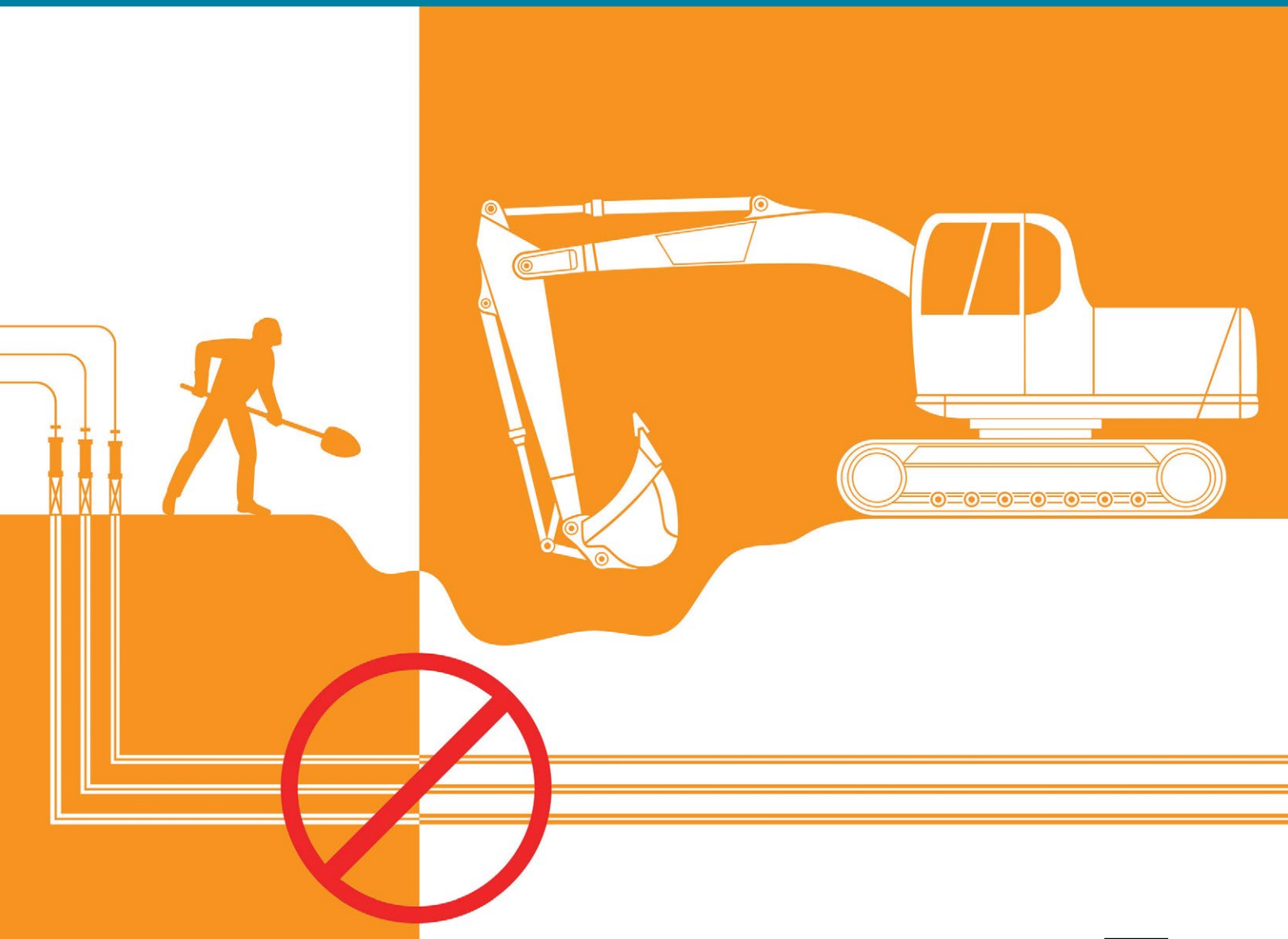
WorkSafe VICTORIA

Guidebook

Undertaking work near underground services

Edition 1

October 2022



VICTORIA State Government

Contents

Part 1: Introduction

Purpose and scope

Underground services such as electricity and telecommunications distribution cables, gas and water pipelines may supply entire communities. It is important to ensure hazards and risks associated with working near underground services are effectively managed and that underground services are not damaged in any way.

This guidebook has been produced by WorkSafe Victoria and Energy Safe Victoria to provide practical guidance on the principles and requirements for safely undertaking work that involves penetrating or excavating the ground where underground services may exist.

It is intended for employers, employees and any other persons who have responsibilities managing hazards and risks associated with undertaking work near underground services. However, it can also be used by members of the public to ensure their own safety and the safety of others.

This guidebook details No Go Zones, which are areas surrounding underground services that WorkSafe Victoria and Energy Safe Victoria recommend be applied as best practice to ensure safe working distances that:

- protect employees, independent contractors and other persons from serious or fatal injuries
- reduce the risk of damage to underground services and mobile plant
- avoid service interruptions and failures
- avoid additional associated costs

While the No Go Zones recommended in this guidebook will assist responsible parties to meet their obligations under the current safety legislation when working near underground services, responsible parties still need to consider their own specific circumstances.

For example, some work environments, such as rail corridors, may have industry-specific asset protection and risk management frameworks. Responsible parties must ensure they comply with those industry-specific frameworks and meet their obligations under the current safety legislation, ensuring no lesser degree of safety protection than what is outlined in this guidebook.

This guidebook is not intended to provide detailed information in relation to the excavation work. For further information, refer to the *Excavation Compliance Code* at www.worksafe.vic.gov.au

Part 1: Introduction

Definitions

Cable(s): a wire, conductor or form of material designed for carrying electric current or communications signals.

Competent person: a suitably trained individual with sufficient experience to safely perform, with minimal supervision, work outlined in this guidance material.

ESV: Energy Safe Victoria

Excavation: the movement or placement of soil or other surface materials by removing, boring or forcing objects into the ground or earth surface.

Hazard: a source of potential harm or a situation with a potential to cause loss

High Voltage or HV: a nominal voltage exceeding Low Voltage (LV)

Installation: a place (public or private) where underground services (including, gas, electricity telecommunications) have been installed

Low Voltage or LV: a nominal voltage exceeding 50 volts but not exceeding 1000 volts for AC and exceeding120 volts but not exceeding 1500 volts for DC.

Manual excavation includes the use of hand held tools and equipment, including shovels and manual augers.

Near: a distance of 2000mm (2m) from any underground service and 4500mm (4.5m) from any underground services registered under the *Pipelines Act* or an underground electrical cable with an in-service voltage greater than 66kV.

No Go Zone: the area surrounding underground services being 300mm for individuals and 500mm for plant or equipment or 3000mm of any underground services registered under the *Pipelines Act* or an underground electricity cable with an in- service voltage of greater than 66kV.

Note: Some service owners may have a requirement for greater clearances than articulated here to ensure the integrity of their services at a specific worksite. Any information pertaining to this additional requirement will be provided with the response to a service enquiry.

Operator: the individual in control of a piece of plant or equipment at a workplace.

Out of service includes services that are abandoned, disused, retired underground services or services left in-situ

Permission: A written or verbal approval for people to undertake work laid out by the service owners e.g. these may be, but not limited to, covering letters, permits to work and emails.

Permit to Work (PTW): A written authority from the service owners which should include specific conditions and/or requirements that must be adhered to at all times.

Plant: Plant includes:

- any machinery, equipment, appliance, implement and tool
- any component of any of those things, and
- anything fitted, connected or related to any of those

Plant operator: see 'Operator'.

Pressurised: a constrained flow of a substance in pipeline which may be of varying diameters and thicknesses, the flow of which may or may not be directly controlled by a service owner.

Risk: the likelihood of injury or illness or disease arising from exposure to or contact with overhead or underground services.

Part 1: Introduction

Safe system of work: work practices in which the health and safety risks to employees have been controlled so far as practicable.

Safe Work Method Statement (SWMS): A document that:

- identifies work that is high risk construction work; and
- states the hazards and risks of that work; and
- sufficiently describes measures to control those risks; and
- describes how the risk control measures are to be implemented; and
- is set out and expressed in a way that is readily accessible and comprehensible to the persons who use it.

Service: There are two service asset types 'Network' and 'Installation' services these are equally important for the management of risk and are underground water/drainage/sewerage, electricity, gas or communications services. The term Service used throughout this document covers both the network and installation of underground services.

- **Network Service:** Supply assets owned, managed by Network organisations/companies
- **Installation Service:** privately owned assets managed by owners of property/ businesses

Service Owner: the owner of a service or the provider of a utility service.

Spotter: a competent person or trained person who undertakes the task of observing and warning against unsafe approach to underground services. This spotter shall have successfully completed an endorsed training course and be registered with ESV.

Spotter Zone: means the area near an underground service

Step potential: means the potential electrical difference between any two points, typically on the ground, which can be touched simultaneously by a person.

Underground service: means an underground asset or underground installation on public or private land

Trenchless techniques: use equipment to install or replace underground infrastructure without causing disturbance to the ground above. These may include but not be limited to horizontal boring, pipe jacking, directional drilling or tunnelling.

WorkSafe Victoria: the regulator for occupational health safety in Victoria

Disclaimer

This guidebook is designed to give practical guidance to assist responsible persons to meet their obligations under the current energy and safety legislation when working near underground assets. It does not cover all of the requirements under the various energy and safety legislation administered by WorkSafe Victoria and Energy Safe Victoria, and is not a substitute for legal advice.

We encourage you to seek your own advice to find out how the various energy and safety legislation applies to you, as it is your responsibility to determine your obligations. Additionally, this guidebook avoids legal language wherever possible and may contain generalisations about the application of the various energy and safety legislation for illustrative purposes.

While WorkSafe Victoria and Energy Safe Victoria have made reasonable efforts to ensure the accuracy of information in this document, we do not make any representations or warranty as to the accuracy, completeness, reliability or suitability for particular circumstances. We do not accept liability for any loss or damage which may be incurred by any person as a result of relying on the information in this document, except insofar as liability under any Victorian and Commonwealth statute cannot be excluded.

Part 2: Legal duties

Who has Occupational Health and Safety duties?

Employers

1. Employers have a general duty to provide and maintain, so far as is reasonably practicable, a working environment for their employees, including independent contractors, that is safe and without risks to health. Occupational Health and Safety Act 2004 (OHS Act) s21
2. Employers must also provide employees with the necessary information, instruction, training or supervision to enable employees to perform their work in a way that is safe and without risks to health. OHS Act s21(2)(e)
3. Employers must also, so far as is reasonably practicable, ensure that persons other than their employees (such as members of the public) are not exposed to risks to their health or safety arising from the business activities undertaken by the employer. OHS Act s23
4. Employers must not allow an employee to perform high risk work unless the employee holds an appropriate high risk work licence. Occupational Health and Safety Regulations 2017 (OHS Regulations) r129
5. A safe work method statement is required for high risk construction work. OHS Regulations r327.

Employer's duties to prevent falls

6. Employers have specific duties under the OHS Regulations to prevent involuntary falls from more than two metres in the workplace, such as a duty to:
   - identify, so far as is reasonably practicable, all tasks that involve a fall hazard. OHS Regulations r43
   - control any risk, so far as is reasonably practicable, associated with a fall at the workplace in accordance with the hierarchy of control. OHS Regulations r44

Other duties apply in relation to the prevention of falls. For further information, refer to the *Prevention of Falls Compliance Codes* at www.worksafe.vic.gov.au

Note: Section 21 of the OHS Act imposes duties on employers to, so far as is reasonably practicable, provide and maintain a working environment that is safe and without risks to health. **This includes managing risks associated with falls of two metres or less**.

Part 2: Legal duties

Employer's duties regarding plant

7. An employer's primary duty is to eliminate any risk associated with plant, so far as reasonably practicable. OHS Regulations r98(1)

8. Where a risk cannot be eliminated, an employer must work through the hierarchy of control in order to reduce the risks so far as reasonably practicable. OHS Regulations r98(2)

9. Other duties apply in relation to the use of plant in the workplace. For further information, refer to the *Plant Compliance Code* at www.worksafe.vic.gov.au

Self-employed persons

10. A self-employed person must ensure, so far as is reasonably practicable, that persons are not exposed to risks to their health or safety arising from the business activities of the self-employed person. OHS Act s24

Employees

11. Employees, while at work, must take reasonable care for their own health and safety, and that of others who may be affected by their acts or omissions in the workplace. Employees must also co-operate with their employer's actions to make the workplace safe (e.g. by following any information, instruction or training provided). OHS Act s25(1)

Persons in management and control of a workplace

12. A person who has, to any extent, the management or control of a workplace must ensure, so far as is reasonably practicable, that the workplace and the means of entering and leaving it are safe and without risks to health. OHS Act s26

Who has Energy Safety duties?

Underground electricity and gas services are regulated in Victoria by Energy Safe Victoria (ESV), under the *Electricity Safety Act 1998* (Vic) (ES Act), Electricity Safety (General) Regulations 2019 (ES Regs), *Gas Safety Act 1997 (Vic)* (GS Act), parts of the *Pipelines Act 2005 (Vic)* and the regulations, collectively known as Energy Safety legislation.

Excavations works are subject to a number of specific requirements in the Energy Safety legislation, including:

- ES Act s76 – s78
- ES Regs r608
- GS Act s79B and s79C
- Pipelines Act s118

All persons undertaking work including employers, employees, contractors, utility service owners have specific duties under the Energy Safety legislation, when excavating or boring/penetrating the ground, uncovering or exposing energy assets.

Individuals undertaking work have a responsibility to positively locate underground services by electronic detection and manual excavation or other approved methods such as non-destructive excavation.

The No Go Zone rules outlined in this guidebook apply to all persons undertaking excavation or penetrating activities.

Electricity Safety legislation requires that records must be maintained on underground electricity cables including by electricity distribution companies and electrical installation owners who control those lines. These records can be maintained in the form of plans drawn to a suitable scale or on computer-aided geographical mapping systems.

There are specific requirements for permanent installation of underground electricity cables on public and private lands; these are defined in Electricity Safety legislation.

Part 2: Legal duties

Underground No Go Zone clearances

No Go Zone rules can be divided into two distinct types, depending on the service:

- services greater than 66kV and all pipelines licensed under the *Pipelines Act*
- services LESS than or equal to 66kV and pipelines NOT licensed under the *Pipelines Act*

The recommended No Go Zone rules are designed to ensure compliance with Energy Safety legislation. For the most current Energy Safety legislation, visit the ESV website at www.esv.vic.gov.au

Note for electrical services:

- No Go Zone: Works within this area requires a No Go Zone site assessment and a Permit to Work/permission and compliance with the permit conditions.
- Spotter Zone: Works within this area requires a No Go Zone site assessment and possible Permit to Work.

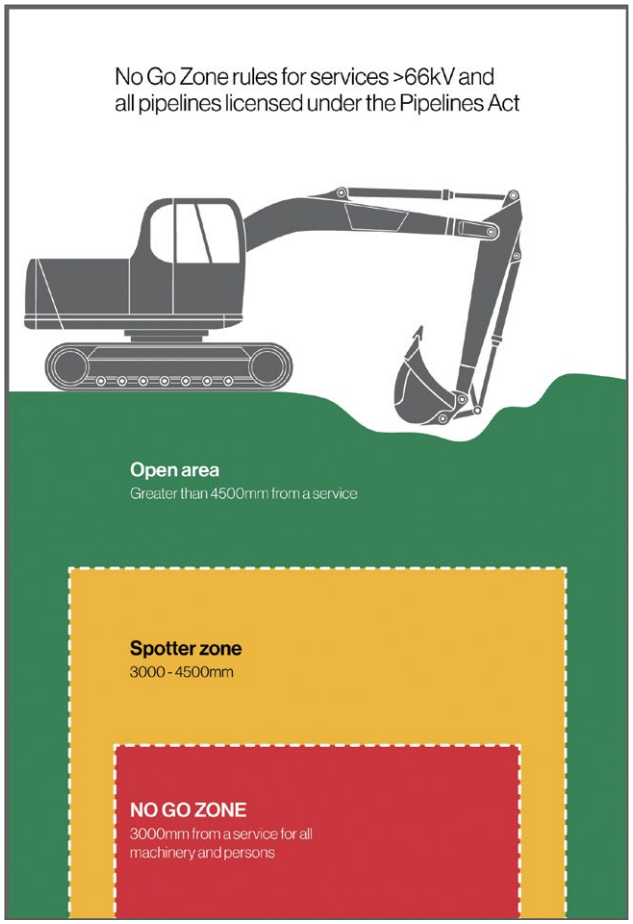


Figure 1: No Go Zone rules for electrical services greater than 66kV and all pipelines licensed under the Pipelines Act 2005

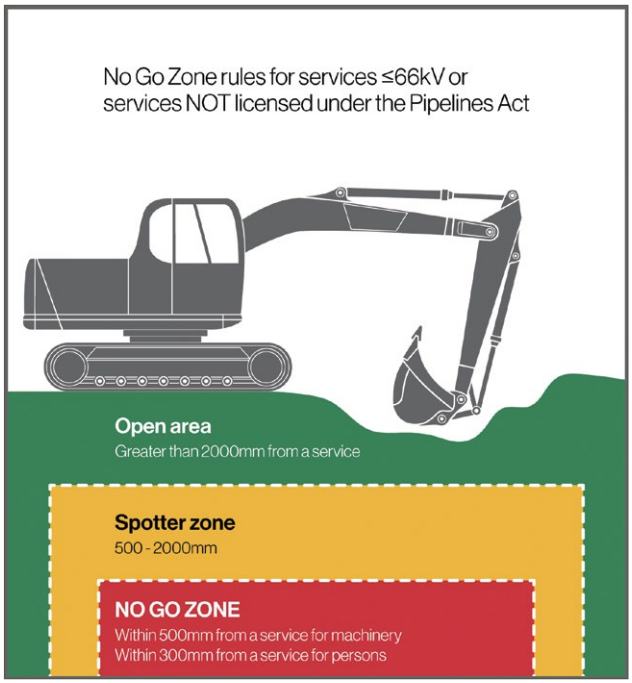


Figure 2: No Go Zone rules for electrical services LESS than and equal to 66kV or services NOT licensed under the Pipelines Act 2005

Part 2: Legal duties

Information, instruction, training and supervision

Under OHS legislation, employers must provide employees with the necessary information, instruction, training or supervision to enable employees to perform their work in a way that is safe and without risks to health. This duty also extends to independent contractors (including any employees of the independent contractor) engaged by the employer in relation to matters over which the employer has control.

The information, instruction, training and supervision required will depend on the type of hazards in the workplace, and employees' understanding about the hazards, risks and control measures.

Employers should ensure that employees understand the hazards and risks associated with excavation work and controls, for example:

- the nature of the hazards associated with the excavation work
- the need for and proper use of risk control measures
- working near underground services

Employers should keep records of induction and training given to employees.

Note: See Appendix A for further information on training, construction induction training, site induction, high risk work (HRW) licensing and asbestos removal and licensing.

Part 3: Planning and pre-start site assessment

This section will assist persons to determine if there are services in the ground prior to commencing any works and to develop safe systems of work when working near underground services.

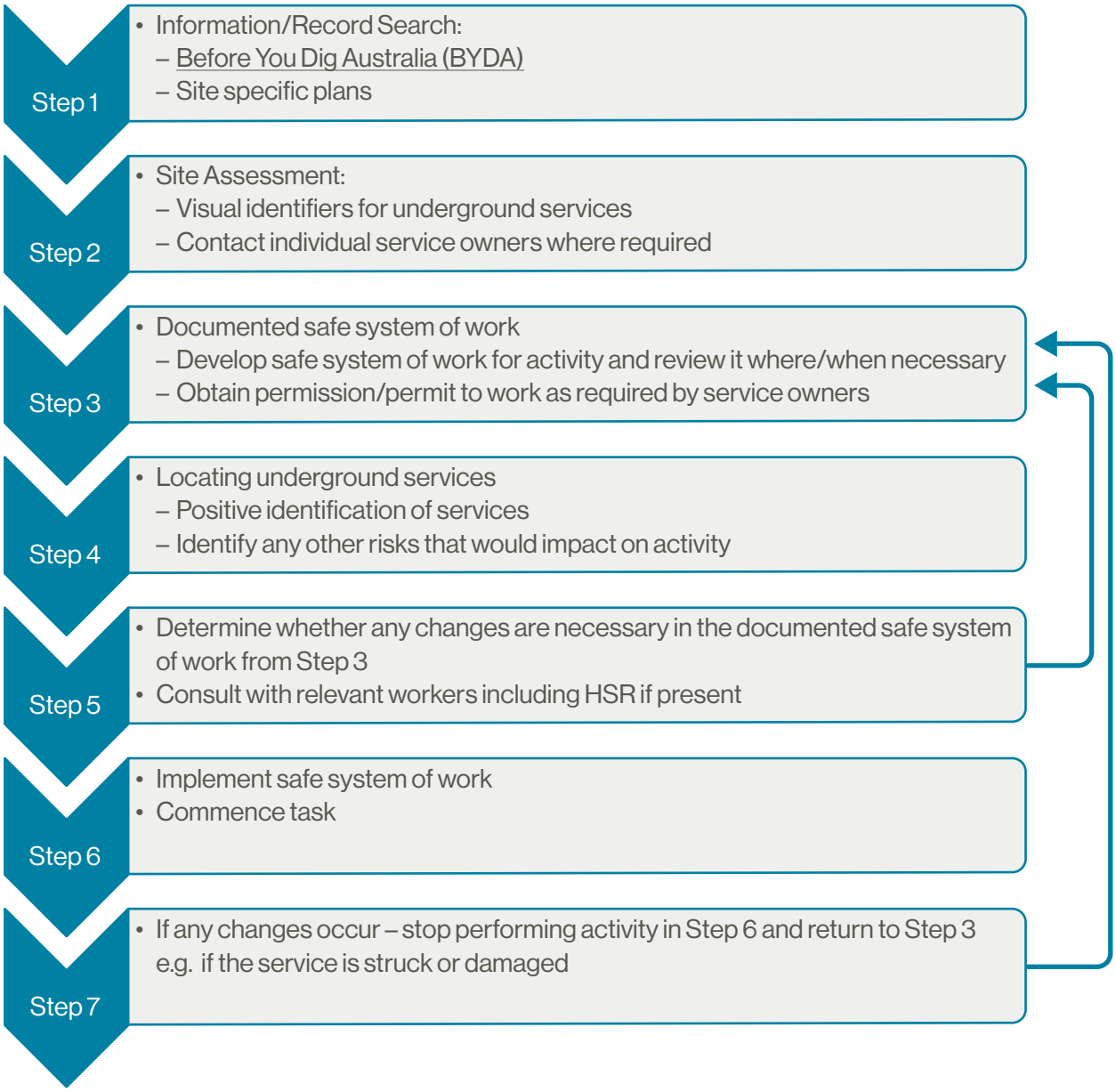


Figure 3: Process to identify underground services and develop a safe system of work

Part 3: Planning and pre-start site assessment

Step 1: Information/record search

This section will assist persons to develop safe systems of work when working near underground services, prior to commencing any works.

When planning a job requiring excavation, Electricity Safety legislation requires that a person undertake a complete record search to obtain information on all known underground services. It is recommended that a complete record search is undertaken when undertaking any excavation work (whether involving electricity, gas or pipeline assets) to ensure a safe system of work.

Some service utilities maintain records of their underground services under legislation, but this is not necessarily the case for all installations.

All efforts should be made to identify any possible services in the work area prior to any works commencing. This could include:

- Contacting the service owner
- Lodging an enquiry with free services such as 'Before You Dig Australia' (BYDA)
- Reviewing site-specific plans identifying services
- Communication/site visit/inspections with service owners

Step 2: Site assessment

A site assessment should be conducted before work starts, to determine if the scope of work (including the type of work, materials to be used and sequence of work) will be affected by the location of underground services and if so, what safety measures are necessary to protect services, persons and property.

Note: When carrying out emergency work, if the work must commence prior to the records being obtained, it should be carried out on the basis that underground services are present.

The assessment should include the following:

- Identification of potential site safety risks
- A visual inspection of the work area: visual indications that underground services may be in the area, for example, pits, cables, conduits or pipes are entering the ground, signs etc.
- A documented Safe System of Work such as a completed job safety analysis (JSA), and/or a risk assessment or any other document describing a systematic process of evaluating and managing the potential risks that may be involved in an activity.
- For high risk construction work (HRCW), a completed safe work method statement (SWMS) must be completed and readily accessible
- If there are overhead electrical assets in the proximity of the works, including powerlines that cross or run alongside the workplace, or powerlines that cross or run alongside access routes, maintain the minimum safe working distances according to the overhead No Go Zone rules
- Information, documents, plans, drawings obtained as part of job planning (remain readily accessible)

- As part of SWMS, where positive identification is required of services located in the ground, trenchless techniques such as non-destructive digging (NDD) or potholing should be used
- Investigation using locating devices to determine and mark service (network and installation) location using the techniques as per Australian Standard (AS) 5488.1:2019 *Classification of subsurface utility information*

Table 1: Examples of standard paint colours used to mark service assets

Utility	Colour
Communications	White (or black when on white background)
Drainage	Green
Electricity	Orange
Fire Service	Red
Gas	Yellow
Water	Blue
Recycled Water	Purple

Contact service owners

Under Energy Safety legislation, permission must be sought from service owners prior to excavation, in particular electrical and gas services will require written permission.

Visual identifiers for underground services

The following are examples of some visual identifiers for the different underground services.
Note: The visual identifiers are not limited to those shown below and there may or may not be a visual identifier above underground services.

Figure 4: Example of paints used to mark underground services on roads and footpaths

Examples of visual identifiers for electrical services

Figure 5: An electrical connection box providing warning that there are shallow underground electrical cables. Two arrow indicators showing the direction of the cables.

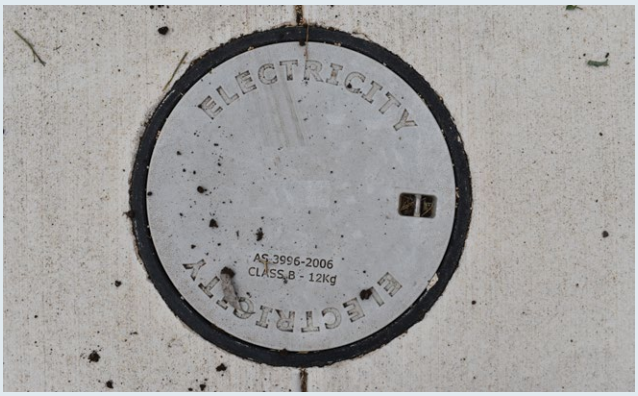


Figure 6: A pit indicating electrical cables below ground.

Figure 7: The markings "ET" (stands for Electrical Telecommunications) on concrete guttering indicates electricity and telecommunication assets beneath.

Figure 8: An underground pillar indicating low voltage electrical underground cables owned by the power company installed on public land.

Figure 9: A customer switchboard and supply point for an electrical installation on private property.

Figure 10: An underground connection pillar for an electrical installation on private property.

Examples of visual identifiers for gas/oil services

Figure 11: A warning sign advising of the presence of gas supply main in the area.

Figure 12: A warning sign advising of the presence of high pressure gas pipeline in vicinity.

Figure 13: The markings "GW" (stands for Gas Water) on concrete guttering indicates gas and water assets beneath.

Figure 14: A warning sign and an access pit for underground high pressure oil pipeline.

Examples of visual identifiers for water services

Figure 15: Hydrant connection points and water stop valves indicating water services underneath in close proximity.

Figure 16: Hydrant connection points and water stop valves indicating water services underneath in close proximity.

Examples of visual identifiers for telecommunication services

Figure 17: A telecommunication riser and pit indicating the presence of telecommunication cables in vicinity.

Figure 18: A pit indicating that there are telecommunication cables below ground.

Part 3: Planning and pre-start site assessment

Step 3: Documented safe systems of work

Persons in management and control of the activity must ensure a safe system of work is developed and where necessary, documented by a competent person.

The safe system of work should contain:

- notification to the relevant authorities if excavation exceeds 1.5 metres, where applicable (see Appendix B for more information)
- written approval from the owner of the service, where applicable
- the types of services in the ground
- adverse ground conditions (e.g. unstable ground) –that may be a risk of damage to plant, serious or fatal injuries to employees or services
- the location of the service and the No Go Zone distances
- the safety control measures to prevent encroaching into the exclusion area or No Go Zone
- how safety control measures will be implemented
- use and location of a registered ESV spotter where required
- communication methods used between spotter and operator
- the conditions of any *permission or permit to work* when issued from the service owner
  Note: keep this with the safe system of work document
- any signs, markings and visual warnings used to alert persons to the proximity of underground services
- mobile plant and equipment to be used
- location of where a mobile plant is working and traversing
- earthing mechanisms to be fitted to mobile plant where required
- any relevant training and competency required for a person to undertake the activity
- supervision and monitoring procedures including induction of all employees onto the site; and
- emergency procedures relevant to the risks, detailing actions to be taken in the event of an emergency.

Where HRCW is to be undertaken, the employer must ensure a SWMS is prepared before the work begins and ensure the work is performed in accordance with the SWMS. For further information on HRCW and SWMS, refer to the Safe work method statements (SWMS) at www.worksafe.vic.gov.au

Where it is not possible to avoid working near energised services, site specific safety measures must be specified in the SWMS. The following site specific measures should be included:

- work instructions explaining the risks, No Go Zone rules and the safe working distance required
- induction for contractors supplying materials
- BYDA or other service information, service owner or installation diagrams and instructions on No Go Zone distances
- location of the no go exclusion zones displayed in the cabins of mobile plant/vehicles
- using a spotter to assist the operator.

Part 3: Planning and pre-start site assessment

Step 4: Locating underground services

Before commencing the activity, the exact location of services must be found.

BYDA and other "as-installed" plans only give an indication of where services should be located; this should not be the only exploration prior to work commencing.

Individuals undertaking work must positively locate the underground services. Locating the service is to be undertaken before manual excavation or other permitted methods, for example non-destructive excavation.

Common 'as installed' risks

Plans supplied by the utilities, which contain basic installation depth requirements, may not provide the actual depth at which the underground service is buried. When reviewing utility plans for undertaking works on underground services, duty holders should be aware that the depths of existing services may be different due to changes or alterations to ground contours from the addition or removal of earth during road or other construction works.

A service may be laid with protection such as concrete surrounding it, to provide extra protection against excavation. In other cases, warning tape or polymeric, timber or concrete slabs may be laid over the service. The service could also be installed in conduit or pipe work. Asbestos reinforced pipelines and duct work have been widely utilised in the utility industry with much of this type of asset still in service. See Appendix A for further information on asbestos removal and licensing.

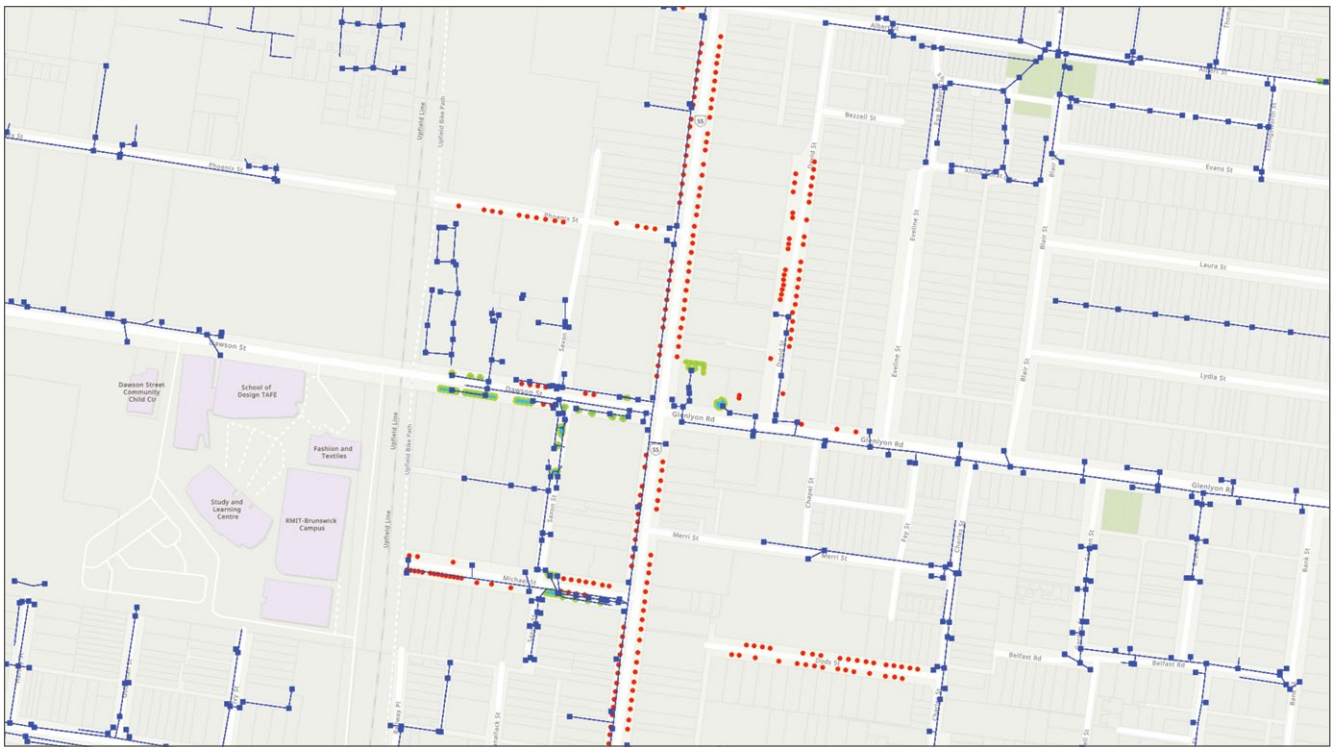


Figure 19: An example of a underground services map

Potholing

Potholing (or equivalent service location techniques) must be used to locate existing underground services to ensure adequate clearances are maintained between services and to locate other service crossings. Potholing at each service crossing and at regular spacing along services is recommended.

Note: Where hydro or air excavation is utilized, maximum pressure should be identified and adhered to. Maximum pressure will be identified by the service owner on each occasion.

Figure 20: Two images showing the potholing technique

Part 3: Planning and pre-start site assessment

Where clearances required by other services cannot be achieved at the proposed depth of service installation, alternative solutions should be sought in consultation with the relevant parties, which may include the regulatory authority. Alternative solutions may include:

- seeking alternative routes,
- relocation of existing services,
- installing the new service with reduced clearances,
- installing the new service well below the existing services.

Where trenchless boring techniques have been utilised to install new services, it is crucial to provide the 'as constructed' details on this type of installation for future reference, for the following reasons:

- The ground above the bore is typically undisturbed, not offering any indication of previous works.
- Inability to provide warning tape or mechanical protection above the service.
- The bore may not follow a direct route.

For more information on trenching and excavation safety, refer to *Compliance Code: Excavation* at www.worksafe.vic.gov.au

Note: See Appendix B for more information on trenching/excavation safety – engulfment protection systems

Part 4: Safe working procedures

Working inside the No Go Zone

Where work is to be undertaken inside the No Go Zone, duty holders should:

- Consider that there **may or may not** be any warning indicators (e.g. tapes, concrete slabs, tracer wire) of the presence of underground services
- Contact the service owner and arrange an onsite meeting
- Discuss the works to be completed and equipment to be used
- Discuss controls to be implemented
- Receive written permission to work and follow any requirements detailed by the service owner

Note:

- State Electricity Commission (SEC) markings identify the presence of an electrical service.
- Different colour warning tapes may be used to provide warning for the presence of different underground services

Examples of warning indicators above underground services

Figure 21: Orange marker tape to provide warning of underground electrical services.

Figure 22: Cover slabs (rigid barrier) to provide warning of underground electrical services

Figure 23: Yellow marker tape to provide warning of underground gas services

Figure 24: Yellow marker tape in a trench to provide warning of underground gas services

Using an ESV-registered spotter

If a spotter is required (see No Go Zone rules Figure 1 and Figure 2)[1], the spotter must have completed training endorsed by ESV and be registered with ESV. Spotters undertake training at the expiry of each three-year registration period and will be advised of any changes in the No Go Zone rules.

The ESV registered spotter should meet the following requirements:

- be dedicated to the spotting task at all times when an operator is at the controls of the mobile plant or where the engine/power source is operating;
- provide immediate and direct notice/warning to an operator (i.e. hand signals, whistle, hand held two-way communications as necessary) should the mobile plant or equipment's load breach the No Go Zone specified distance, example warning tape, sand or cover slabs;
- spot for one item of mobile plant at a time; and
- spot for the mobile plant that they are registered for (endorsement on spotters' card).

For more information about spotters go to www.esv.vic.gov.au.

Table 2: ESV Spotter competency classifications as of 2021

Competency class	Class Code
Backhoe	LB
Concrete placing boom	PB
Crane Chaser	CC
Crane – Bridge and Gantry	CB
Crane – Derrick	CD
Crane – Mobile Slewing (open/over 100 tonnes)	C0
Crane – Mobile Slewing (up to 100 tonnes)	C1
Crane – Mobile Slewing (up to 20 tonnes)	C2
Crane – Non-slewing	CN
Crane – Portal boom	CP
Crane – Tower	CT
Dogging	DG
Drilling Rig	DR
Elevating work platform (less than 11m)	WP<11m
Elevating work platform (longer than 11m)	WP>11m
Excavator	LE
Forestry equipment	FE
Forklift truck	LF
Front end loader	LL
Rigger – Basic	RB
Rigger – Intermediate	RI
Rigger – Advanced	RA
Road profiler	RP
Skid steer loaders	LS
Telescopic material handlers (less than 3 tonne)	TMH
Vacuum excavator	VE
Vehicle loading crane (less than 10 metre tonnes)	CV<10m/t
Vehicle loading crane (greater than 10 metre tonnes)	CV>10m/t

1 If spotter is required it should be reflected in the SWMS/JSA.

The ESV registered spotter should be clearly identifiable on site to the operator and to others on site, for example through use of a spotter arm band and/or a coloured safety helmet.

If the ESV registered spotter is concerned about the work, the work must stop, and the site supervisor or duty holder must reassess the risks and controls for the work and apply appropriate control measures. The service owner may need to be contacted for assistance/advice.

Figure 25: ESV spotter card

Figure 26: Example of spotter arm band

Part 4: Safe working procedures

Selection of powered plant and equipment

The type of plant and equipment to be used for the task will often depend on type and location of the underground service that the work is occurring on or near.

When selecting plant and equipment the following should be identified:

- ground condition(s) that the mobile plant is operating on for example on an incline, the soil type (soft, dry, clay, sand, etc.)
- potential loadings on the ground from the plant in its working operation
- whether overhead electrical assets are near the work area and access routes
- potential weather conditions, for example wind, rain, temperature, etc.
- the scope of the planned work, and its duration
- how the work is to be carried out
- the location of designated loading and/or unloading areas.

Operators of powered plant and equipment

Employers should ensure that employees (including independent contractors and their employees) are trained and competent and understand the following when operating powered plant and equipment near underground services:

- the No Go Zone
- operator manuals (should be with the plant)
- how to use or manage any limiting devices
- how to manage environmental or site conditions required for safe working of mobile plant, for example:
  - unstable or uneven surfaces
  - access routes
  - excavations
  - emergency procedures in the event of contact with underground services.

Signage and marking

Visual warnings including signage and markings should be used as warnings of hazards and reminders of safety requirements where work is undertaken near underground services. Visual warnings should not be relied on as the only control mechanism to reduce the risk of contact to the service.

Signs should be displayed at all hazardous locations to warn workers of the risk and how to avoid it. (Refer to Visual identifiers for underground services)

Part 4: Safe working procedures

Communication

Communication systems should be appropriate for the worksite and the type of work being undertaken.

Spotters communicating with mobile plant operators should communicate verbally. Alternatively, if verbal communication isn't appropriate, a combination of visual, audible, radio or buzzer system could be used.

The communication system should provide for emergency response. This may be from the site to the necessary response organisations or to a control point able to make the appropriate notification.

Supervision

Ongoing site supervision should be provided as site conditions and work activities change. As work progresses this may increase risk and ongoing supervision and monitoring may be required to ensure existing safety measures remain effective.

When making decisions about control measures, employers must, so far as is reasonably practicable, consult with employees of the employer (including HSRs, independent contractors and their employees) on matters that directly affect, or are likely to directly affect, their health and safety.

The employer should verify and document that each employee and contractor has received the required training. This includes, but is not limited to, training on the following:

- emergency procedures and provision of first aid
- underground service electrical hazard identification and risk control
- safe systems of work
- implementation of site specific SWMS
- the role and responsibility of the spotter
- effective communication systems
- equipment or machinery to be used.

Part 5: Hazards

Electricity

Hazards and risks of working near underground electrical services

Some of the hazards and risks of working near electrical underground services include:

- contact with underground cables,
- damage to live underground cables:
  - penetration of the cable by an object
  - cable is crushed or contact is made between the individual phases of a cable
  - power supply is not isolated in the event of damage,
- out of service underground cables:
  - treated as in-service unless otherwise positively proven out of service
  - If work is required near out of service underground cables, a permit or information relevant to the cable/service should be obtained
  - **Note:** Beware out of service cables may have voltage remaining in them from nearby live cables

Serious and fatal injuries, including electric shock and flash burns, can occur if these hazards and risks are not controlled. Interruptions to critical emergency service supplies, for example hospital power supply, can also occur.

Older electrical cables can discharge voltage or explode if disturbed or damaged. The discharge may not always occur at the site of disturbance or damage and may result in explosions at remote locations away from the job site.

Contact with earthing systems

Earthing systems are installed for the safe operation of the electrical network. Damage to, or contact with, this system may present electrical hazards to persons at the worksite.

If earthing systems are damaged or broken, no attempt should be made to repair them. The service owner should always be contacted and advised of the damage.

Single wire earth return (SWER) electricity systems

SWER systems are used in outer rural areas of Victoria and are identified by a single HV overhead wire.

Electricity Safety legislation states that no excavation work should be undertaken within a 10 metre radius of a pole with a SWER transformer mounted on it (see diagram below). Warning signage will usually be installed on these poles.

Figure 27: Example of warning signage installed on a pole

If a SWER earthing system is broken, a high voltage may exist across the break in the earthing system.

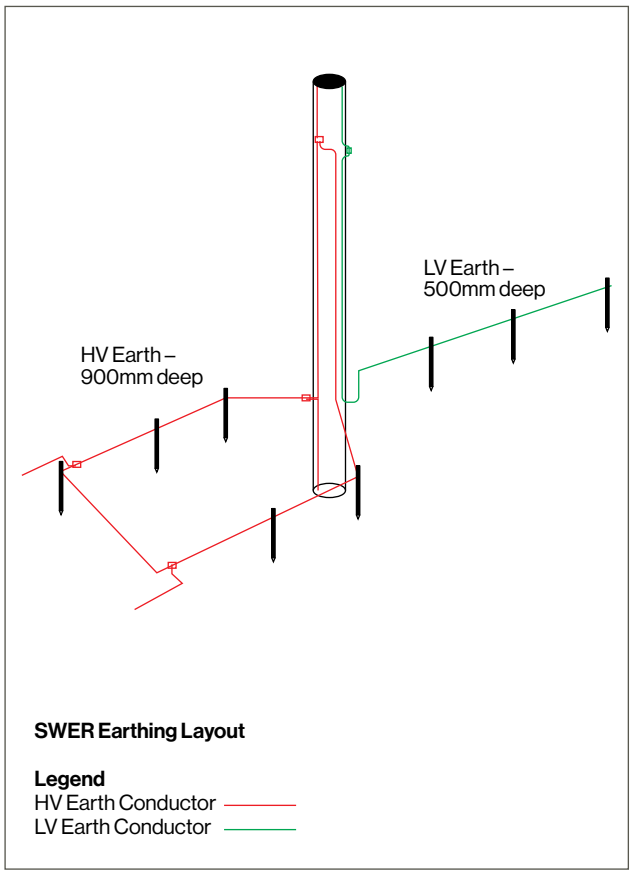


Figure 28: A diagram depicting the underground earthing systems at a SWER transformer pole.

For further information regarding work near SWER systems, contact your local electricity company.

Excavation near electrical services

Safety considerations recommended for excavation near underground electrical services include:

- No mechanical excavation shall be carried out within 500mm in any direction of a service, protective cover slab or conduit unless written permission has been obtained from service owners.
- Ensuring the underground cable, including any mechanical cover, for example concrete or polymeric cover slab is not disturbed.
- No manual excavation shall be carried out within 300mm in any direction of a service unless written permission has been obtained from service owners.

Excavation near overhead line structures

When using mobile plant/machinery near pole and tower structures, No Go Zone clearances need to be managed from the overhead conductors. For further information, refer to *Guidebook: Using powered mobile plant near overhead assets* at www.worksafe.vic.gov.au.

Where excavation is required near power line structures such as towers poles, stay or guy wires, the following exclusion zones apply **as per the Electricity Safety legislation**. This is to ensure that the structures do not have their stability compromised.

The following images depict the distances for the exclusion zones relevant to the depth of the excavation, for tower lines, poles and stay wires.

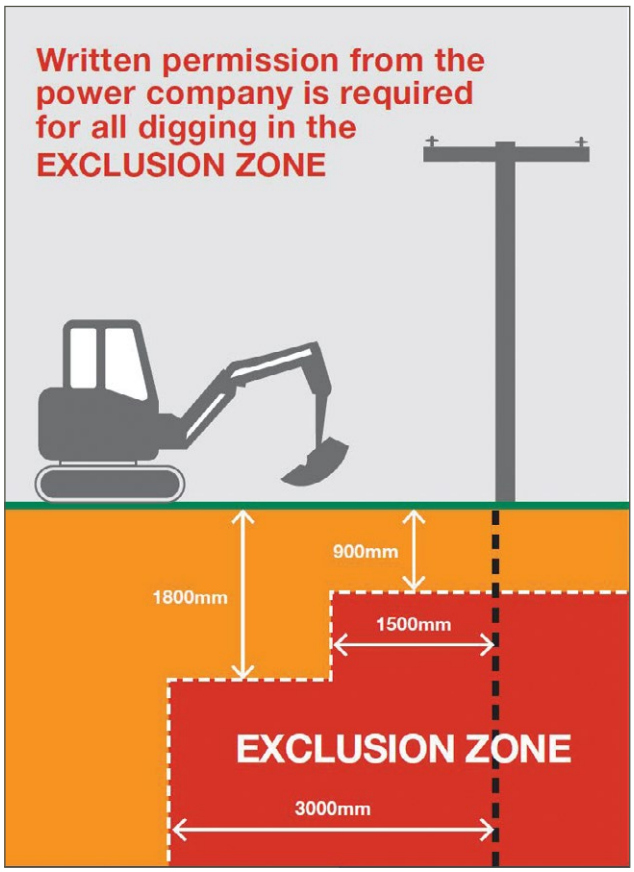


Figure 29: Excavation near poles

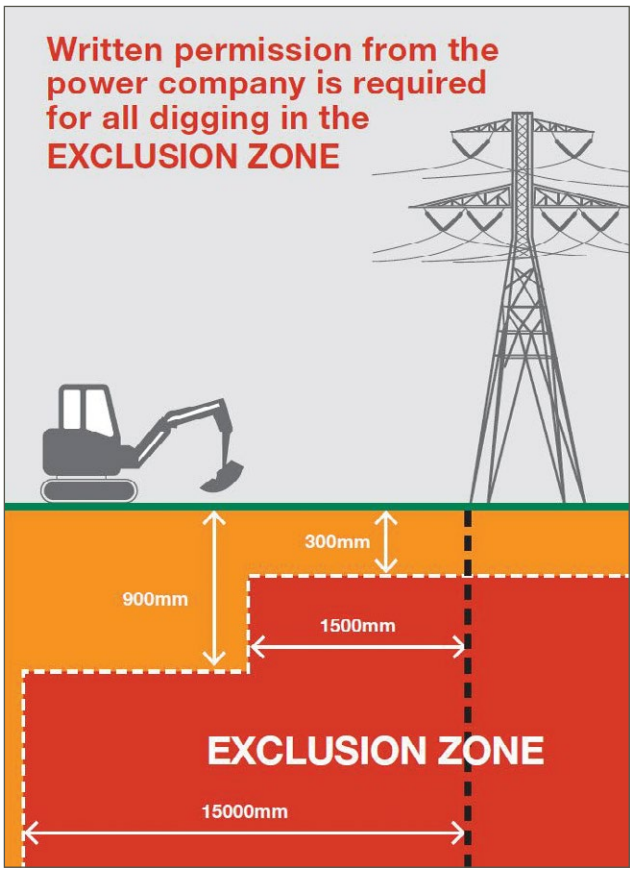


Figure 30: Excavation near towers

Excavation near poles and stay wires structures

No excavation is permitted deeper than 900mm and within 1500mm (1.5m) of the pole or where stay wires/rods enter the ground.

No excavation deeper than 1800mm (1.8m) and within 3000mm (3m) of the support structure.

For any excavation within the exclusion zone permission from the power company is required.

Note: Due to the variety of equipment installed on poles any excavation greater that 300mm in depth within 3000mm of the pole may affect its stability. Contact with the service owner to discuss the work required as support of the pole may be required.

Excavation near tower line/transmission structures

No excavation permitted deeper than 300mm within 1500mm (1.5m) of the support structure.

No excavation deeper than 900mm within 15000mm (15m) of the support structure.

For any excavation within the exclusion zone permission from the power company is required.

Note: Any excavation works within a transmission easement requires written approval from the service owner.

What to do if contact or arcing with an underground electrical cable

In the event contact is made with an underground cable or arcing occurs between the cable and an item of plant and or employee, the following actions may be taken to avoid injury from step and touch potential:

- All work must cease immediately.
- Operator should remain inside cabin. If it is essential to leave the cab (or operators station) due to fire or other life-threatening reasons, jump clear of the equipment.
- Do not touch the equipment and ground at the same time.
- When moving away from the equipment, the operator should hop slowly, shuffle or jump away from the plant (with feet together) until at least 10m from the nearest part of the plant item.
- Warn all other persons (including members of the public) to keep at least 10m from equipment.
  - Do not touch any part of the equipment or load;
  - Do not attempt to approach or re-enter the vehicle until the relevant authorities have determined the site is safe.
- Facilitate First Aid treatment and seek medical aid as required.
- Advise the organisations emergency contact and request they immediately notify the relevant authorities, including the appropriate utility service owner.
- Do not disturb site unless necessary to do so for safety reasons
- Initiate the emergency management plan and incident investigation process.

These two images show the two potential radiating circles from the bucket of a plant and the plant itself to illustrate the step potential risk if an underground electrical cable is hit by the bucket.

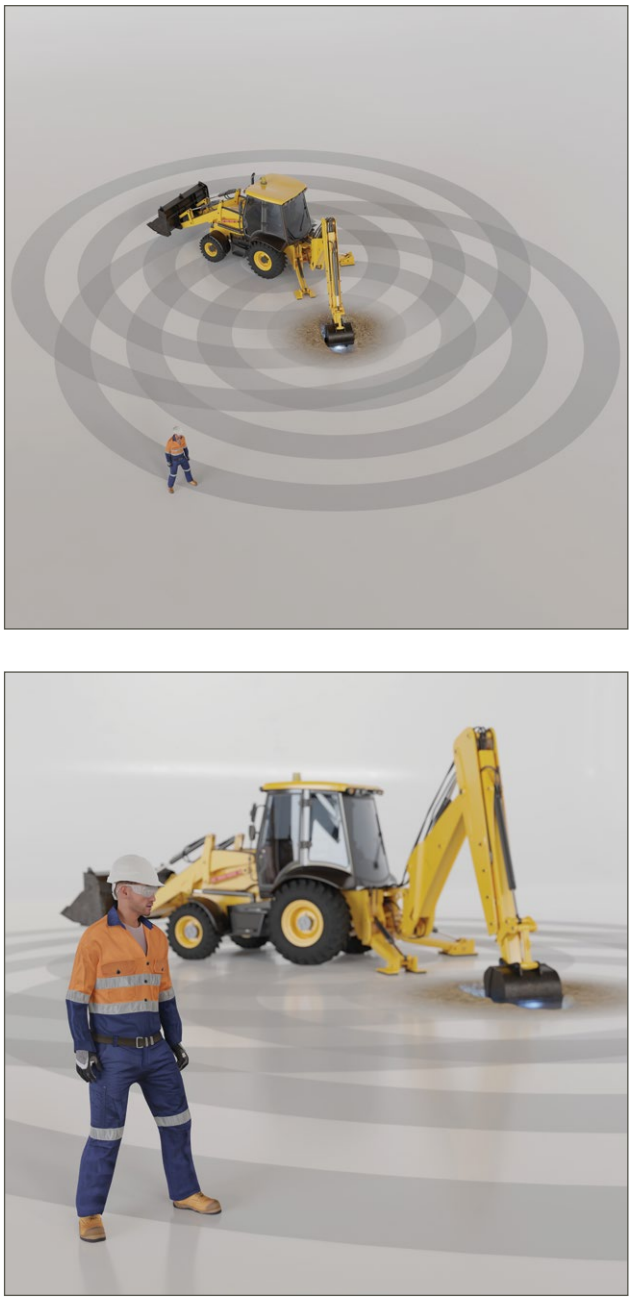


Figure 31: Step potential risk if an underground electrical cable is hit by the bucket

When there is a voltage difference and your body becomes part of a circuit, there will be current flow through the body. Touch potential is the voltage difference between where you are standing and what you touch. Step potential is the voltage difference between the ground at each foot where the ground may be energised.

Note: See Appendix C for more information on electricity cables, including types of electrical underground services, use of cables, cable records and cable installation.

Gas

Dangers of working near underground gas services

Some of the dangers which may arise when working near other underground services are damages to gas services, which can cause gas to escape. The escape of highly flammable gas (or liquid) poses a risk to persons at the worksite and the community through:

- Jet fires
- Explosion
- Burns
- Asphyxiation

There are two types of damage to the service that can occur:

- Damage which causes an immediate escape. In this case, there is a risk to those working at the site.
- Damage which causes an escape sometime after the incident. This may be through damage which weakens the service casing or the result of poor reinstatement practice. In this instance, the public is at risk.

Energy Safety legislation requires persons to:

- not to carry out any excavation, boring or open the ground to uncover or expose gas pipelines unless they have the authority or permission to do so, and
- not carry out any excavation or boring or open any ground within 3 metres of a transmission pipeline unless they have the authority or permission to do so.

Part 5: Hazards

Safety considerations for working near pressurised gas mains

The safety considerations which should be utilised when working near pressurised gas mains include:

- Dangers of poorly ventilated workplaces, see *Compliance Code: Excavation, and Compliance Code: Confined Spaces* at www.worksafe.vic.gov.au
- Having an appropriate fire extinguishing system
- Only one individual at a time should be excavating if manual excavation is being undertaken in a confined space. Another should act as an observer and be able to operate any breathing, escape or fire equipment required
- Eliminating an ignition source in the event of an escape
- A copy of the emergency plan in a prominent position on-site. This plan should include any contact details required.
- No mechanical excavation should be carried out within 500mm in any direction of a service, protective cover slab or conduit unless written permission has been obtained
- Ensure the underground cable, including any mechanical cover, for example concrete or polymeric cover slab, is not disturbed.
- No manual excavation should be carried out within 300mm in any direction of a service unless written permission has been obtained.

When working near gas transmission pipelines, no excavation should be carried out within 3000mm in any direction of a transmission pipeline service unless written permission has been obtained from service owners. All transmission pipelines involving gas, oil and petrochemicals have separate requirements and the service owners should be contacted.

What to do if contact or damage to gas services occurs

If a gas pipeline strike occurs, the following actions should be taken:

- Cease all work immediately
- Evacuate the area, shut down the plant/equipment, leave the cab or operator station, trench or enclosure
- Maintain an exclusion perimeter due to the risk of explosion or fire
  - Do not attempt to use any instrument which may provide an ignition source near the gas escape. This may include mobile phones, two way radios, etc.
- Warn all other persons (including members of the public) to keep clear from the worksite and equipment.
- **DO NOT** attempt to approach or re-enter or start the vehicle until the relevant authorities have determined the site is safe.
- Facilitate first aid treatment and seek medical aid as required.
- Advise the organisations emergency contact and request they immediately notify the relevant authorities, including the relevant gas distribution company.
- Do not disturb site unless necessary to do so for safety reasons
- Initiate the emergency management plan and incident investigation process.

Note: See Appendix D for more information on gas pipes including gas reticulation systems, types of gas pipelines, properties of gas and pipeline depths.

Other Pipes and Pipelines

Water pipes and sewers

There are other types of pipes to consider when undertaking excavation activities e.g. water, sewer, storm water, grey water. While the risk to the worker or the community is not as high as contact with electricity or gas, the risk is not insubstantial.

The risks to be considered include:

- Engulfment/flooding - water in trench, potential for drowning, pit/trench collapse.
- Environmental - damage to properties from water under pressure, water contacting power lines depending on pipe and pressure
- Hygiene – contact with contaminated substances (raw sewerage); contacting/breaking asbestos pipes, asbestos removal

More recently, water services have been co-located with other services in shared trenches. This raises the potential problem of simultaneous damage to several services.

Pipelines may not always be visible on plans. It is important that before commencing works, contact is made with Before You Dig Australia or the water authority in local area to confirm.

Trenchless techniques may be used to locate pipes, such as pothole digging. No Go Zone requirements need to be maintained.

Note: See Appendix E for more information on water pipes and sewers including pipeline types and location.

Other pipelines

There are many pipelines operated by individual companies on special licences (*Pipelines Act 2005*). Products in these lines could be liquid or gaseous and under high pressure. They may include the following:

- petroleum pipelines (oil, petrol, etc.)
- refinery gases
- liquid flammable gases
- privately owned water pipelines

It is important that thorough searches are made in areas where proposed construction is likely to take place and No Go Zones are maintained.

Having determined these pipelines may run in the general area of the worksite; the service owner should be approached for the necessary permission or records outlining the pipeline's exact location and characteristics.

Telecommunication

Telecommunication cables are designed for installation in pipe or direct burial in a suitable stone-free backfill. They are not designed to resist the impact of manual or machine tools or to be left unsupported over any great distance.

There are hazards associated with damage to telecommunication cabling, these include:

- Optic Fibre laser light – visible light into eye
- Contacting/breaking asbestos enclosures or pipes
- Damaging cables causing loss of communications for emergency services or essential home services requiring phone connection
- Financial risk – loss of telecommunications for shopping, banks etc.

What to do if contact or damage to telecommunication services

If telecommunication services strike occurs, the following actions should be taken:

- Immediately notify the service owner
- Cease work in the immediate vicinity to ensure no further damage occurs
- Initiate the incident investigation process

Note: See Appendix F for more information on telecommunication cables including cable installation, alignments, cable records and cable locations.

Appendix A: Further information on training, construction induction training, site induction, high risk work (HRW) licensing and asbestos removal and licensing

Training

Training should be task specific, site specific and practical. Training provided to employees should be reviewed, and if necessary revised, by employers if:

- there is change to work processes, plant or equipment
- there is an incident
- new control measures are implemented
- there is a request by an HSR
- changes are made to relevant legislation
- any other issues impact on the way the work is performed.

Employers need to provide such training as is necessary to enable employees to perform their work in a way that is safe and without risks to health. This may include training as appropriate for a particular workplace. OHS Act s21(1)&(2)(e)

The frequency of training should be determined having regard to the frequency with which employees and independent contractors are required to carry out tasks associated with excavation near underground services this may include but not be limited to:

- Spotters
- Traffic management
- Confined space entry

Construction induction training

An employer must ensure that any person employed to perform construction work has completed construction induction training before they start the construction work. An employer must not allow a person to perform construction work unless the person holds a current construction induction card. The construction induction training must be provided by a construction registered training organisation. OHS Regulations r338 and r342

Appendix A: Further information on training, construction induction training, site induction, high risk work (HRW) licensing and asbestos removal and licensing

Site induction

An employer must ensure that any person employed to perform construction work is provided with OHS training that relates to the particular workplace where the construction work will be performed. Site induction needs to be undertaken before the person starts work at the workplace (that is, before starting work on the construction site). OHS Regulations r330

The aim of site induction is to make sure that employees and contractors are familiar with site specific hazards, risk controls, and OHS rules and site procedures (e.g. the emergency procedures, arrangements for supervision of the work, and who the HSRs are).

The detail required in the site induction may vary between construction sites and between phases of a project. The length of time it takes may depend on things such as the size of the site, the number and variety of trades working on the site, and how much the site is expected to change as work progresses.

Where an employer has information about the particular site that would form part of a site induction (e.g. OHS information, site specific hazards or risk controls), they need to provide that information to persons (such as contractors) performing construction work.

High risk work (HRW) licensing

A person must not do any HRW unless they hold an appropriate HRW licence OHS Act s40(4), OHS Regulations r128 and r130. The range of HRW licences are listed in Schedule 3 of the OHS Regulations and include licences for the use of cranes, elevated work platforms, and for dogging and rigging. This is in addition to the duty to provide employees with any necessary information, instruction, training and supervision to enable them to perform their work in a way that is safe and without risks to health.

An employer must ensure that any employee who will be performing HRW holds an appropriate HRW licence in relation to that work OHS Regulations r129.

For information about licensing, including how to apply for a HRW licence and exceptions that apply, go to www.worksafe.vic.gov.au

Asbestos removal and licensing

Persons who manage or control workplaces and employers have specific duties in relation to asbestos, including licensing requirements. See Part 4.4 of the OHS Regulations.

For further information about asbestos removal and licensing, refer to the *Removal of asbestos in workplaces compliance code* at www.worksafe.vic.gov.au

Appendix B: Trenching/excavation safety – engulfment protection systems

Before commencing trenching works, planning must be undertaken taking into account risk associated with a trench or excavation. Some of the risks associated with trenches include:

- engulfment (from soil, sand, liquid) spill piles collapsing into the trench
- falls into trenches
- atmospheric contaminants (for example, gas leak in confined space)
- mobile plant toppling into trenches

All trenching work should be pre-planned so that work can be done safely, including;

- identifying causes of engulfment (soil, sand, liquid)
- identify the correct trenching techniques to be used and determining appropriate engulfment protection (battering, benching, shoring, shields)
- provide safe exit and entry access, for example;
  - trench shields with guard rails attached
  - tied-off access ladder
  - site security requirements

Employers and self-employed persons must develop a safe work method statement (SWMS) and implement it for all trenches where the depth exceeds 1.5 metres, or when powered mobile plant is involved.

An emergency procedure must also be in place, regardless of trench depth, where there is a risk of a person becoming engulfed.

Employers and self-employed persons should ensure:

- a competent person who has knowledge, skills and experience in trenching/excavation, supervises the work
- workers never work outside the engulfment control measures, including where protection is being progressively installed
- workers are trained in the emergency procedure and SWMS
- materials, spoil and plant are kept away from the trench edge
- the trench and work area is secure and will prevent unauthorised access
- the risks of a fall into the trench is controlled, for example by:
  - using trench box extensions or trench sheets with a height greater than the trench depth
  - installing guard rails or covers on trench shields
  - inserting guard rails and toe boards into the ground immediately next to the supported excavation side
  - installing landing platforms or access structures, such as scaffold towers, inside deep excavations
  - installing effective barriers or barricades
- clearly defined pedestrian detours are provided
- fencing is in place around excavations or trench shields
- the trench is regularly inspected while open, and immediately after an event that could affect the trench's stability, for example a weather event or ground slip

For further information on trenching and excavation safety including *notice of construction excavation work requirements*, please refer to *Compliance Code: Excavation* at www.worksafe.vic.gov.au

Appendix C: Electricity cables

Types of electrical underground services

The various types of electrical underground services include:

- Underground electrical equipment
- High Voltage and Low Voltage cables
- Supervisory and signalling cables
- Cathodic protection cables
- Earthing rods and conductors
- Cable pits and chambers
- Cable joints and joint enclosures (wooden boxes) and epoxy filled plastic enclosures
- Conduits and ducts
- Cabinets, pillars and transformers that underground cables enter into

Electrical cables are often identified by:

- operating voltage
- conductor size and material
- number of conductors in the core
- insulation type and design grouping

Electric cables consist of a conductor or conductors to carry the current, and insulation to isolate the conductors from each other and from their surroundings. For example:

- **Low voltage street lighting cables:** the two components may form the finished cable, but generally as the voltage increases, the construction becomes more complex.
- **Other cables:** components may include screening to obtain a radial electrostatic field, a metal sheath to keep out moisture or to retain a pressuring medium, armouring for mechanical protection and corrosion protection for any metallic components.

Cable systems may also have a variety of external additions such as earthing conductors or pipes to supply oil or gas to the cables.

Cables are designed for installation in ducts or to be buried directly in a suitable stone-free backfill. They are not designed to resist the impact of plant or machine tools and are not designed to be left unsupported over any great distance.

Some armour protected cables may have been ploughed directly into the ground with only warning tape and cable markers to identify the cable position.

Appendix C: Electricity cables

Use of cables

Underground (and overhead) service cables have four broad classifications:

Table 3: Underground and overhead service classifications

Classification	Description
Distribution systems	Local area distribution generally involves installation of low voltage cables (230/400V), and high voltage 6.6kV, 11 kV, 12.7kV, 22 kV or 66kV cables. These installations are common throughout city business districts, shopping centres, industrial centres, and rural and residential estates. It is common practice to provide underground electricity supply to street lighting on major roads and to traffic signalling equipment. Electricity cables may also be installed in parks, easements, rights of way, unformed road reserves, swamps, cemeteries, bridges and waterways. Most electricity cables are owned by the local electricity distribution companies. In some areas, buildings and street lights are supplied by underground cables as there are no overhead lines. However, even when a local area is supplied by overhead lines, an electrical underground cable network may still be present. These cables may interconnect the various supply points and load centres by the shortest available route.
Transmission systems	Transmission system cables are high voltage systems operating at 132kV, 220kV, 275kV, 330kV or 500kV AC and 400kV DC and which interconnect the generation centres with supply points or Terminal Stations. These are generally overhead systems. There are some 220kV AC and 400kV DC transmission underground cable systems in Victoria.
Traction industry (tram/train)	Traction industry (tram/train) have other electricity cables that may be present. These are owned by electricity generation, rail or tram companies, councils or road and traffic authorities. These systems run a 600V DC for the trams and 1500V DC for the train systems. The train system can also include 2.2kV and 22kV AC systems.
Customer installation	Customer installation cables are usually owned by the site owner or occupier. These can be low voltage or high voltage installations.

Appendix C: Electricity cables

Cable records

Under the *Electricity Safety Act 1998*, records are required to be maintained on electric lines and cables. These records can be in the form of plans drawn to a suitable scale or on computer-aided geographical mapping systems.

The detail of the records will vary with the type of installation. For cable installed in a standard location, the records may provide only general cross sectional arrangements of cable and conduits together with road crossing and street lighting information.

Maps may be supplied with a legend that needs to be understood to ascertain depths and offsets provided.

For transmission cable installations, it is common practice to negotiate a special alignment. These records are more detailed with reduced level and offset information provided. The details of local area distribution and of transmission cables are often shown on separate plans.

Cable installation

The specific requirements for permanent installation of underground electricity cables on public and private lands are detailed in Electricity Safety legislation.

The minimum depth of underground electricity cables may vary from 450mm to 1000mm. If in doubt, follow the advice indicated on your BYDA response form the service owner.

The cable installation methods and materials have changed over the years. Measures that have been used to identify the services in vicinity where digging may occur in future have included using one or more of the following:

- Conduits or ducts – Orange PVC, concrete, fibro asbestos concrete, earthenware, steel
- Bricks or tiles – terracotta, concrete
- Marker tape – plastic (orange in colour)
- Cover boards or slabs – polymeric, concrete, timber, washed sand

Note: State Electricity Commission (SEC) markings identify the presence of an electrical service.

Appendix D: Gas Pipes

Gas reticulation systems

There have been many and varied methods of gas reticulation systems used, from low pressure services through to transmission systems. These have been constructed from a wide range of materials including:

- coated welded steel
- cast iron
- uncoated steel
- a variety of plastics

In most areas, these are buried directly in a suitable stone-free backfill. They are not designed to resist the impact of tools or mechanical plant or to be left unsupported over any great distance.

These pipeline systems could convey different types of gases, such as natural gas or liquefied natural gas. The operating pressure of the distribution system could range from as low as 1.1kPa up to as high as 15mPa for a transmission system.

All high pressure steel pipelines have protection systems. These form part of the pipeline and incorporate test points and anodes at various points along its length. If these are broken or damaged, it should be reported to the gas utility immediately. Damage is easily rectified but can be extremely difficult to locate if the damage is not reported.

Types of gas pipelines

- Transmission pipelines – convey gas between gas supplier and distribution network. Transmission pipelines are shown on BYDA plans. These pipelines are required to be licensed under the *Pipelines Act 2005*
- Distribution network – includes mains and services conveying gas from the transmission pipelines to consumer pipework. These pipes are usually shown on BYDA plans.
- Installation and consumer piping – conveys gas between the meter and the appliance. These pipelines are located within the boundaries of a consumer's premises, including for example, substation, street mains to house, commercial properties gas supply, high volume customer.
- LPG network (including kiosks, valves and syphons) – stored in cylinders or tanks on private land. Involves pressures which range between 1750kpa – 2.75kpa. LPG pipelines maybe underground on private land, these pipelines may not be shown in BYDA plans.

Appendix D: Gas Pipes

Properties of gas

Gases have different properties. If a leak occurs, it is important to understand these properties.

Table 4: Different properties of gas

Types	Descriptions
Natural Gas	Natural gas is lighter than air, allowing most leakage to disperse rapidly into the atmosphere. This may include hydrogen blended natural gas.
Liquid Natural Gas	Liquid Natural Gas (LNG) is natural gas in its liquefied form. When cold LNG makes contact with warmer air, it becomes a visible vapour cloud. As it gets warmer, the vapour cloud becomes lighter than air and rises becoming potentially dangerous.
Liquid Petroleum Gas	Liquid Petroleum Gas (LPG) is generally stored in cylinders or tanks. LPG is heavier than air and tends to collect at ground level, particularly in any depressions such as trenches, pits, or underground storm water drains, etc. Leaking LPG may cause a potentially dangerous situation if the gas ignites. This may be at a considerable distance away from the actual leak.

Records of services

All gas distribution utilities are required to maintain records of the pipe network in a road reserve. The detail of the records will vary with the type of installation. Transmission pipelines may be in areas other than verges in road reserves. They may be under road pavements and either dedicated or shared easements on private lands.

Pipeline depths

Most pipelines laid in recent years may have a marking tape or polymeric slab laid above the pipeline for identification when excavating. However, these tapes or slabs may have been damaged by other excavations in the area since the initial construction and not replaced. For location purposes, plastic pipelines may have been laid with a metal detector wire or tracing tape.

It is important these tracer wires are not interfered with or broken, as it makes future location of these pipes very difficult. Other structures, such as siphon pots, valve pits, regulator pits and other varied components may be installed in the pipeline.

Care needs to be taken to locate these before excavation. While the plans may show the expected location of underground services, it is doubtful whether services entering properties will be identified. These services are generally at right angles to the pipeline and are easily damaged by excavation alongside the main pipeline. Properties should be checked to ascertain whether gas meters are present.

If so, the services normally run at right angles to the main pipeline to the service connection at the meter. The installed depth of pipelines varies from 600–800mm for gas mains to 900–1200mm for transmission pipelines.

Appendix E: Water pipes and sewers

Pipeline types

Water pipeline networks have been operating for more than 100 years. A wide variety of materials have been used for sewer and water pipes over this time. The table below provides information on common types of pipe that have been used and the durability of the pipes.

Underground water pipelines and services range in size from 15mm to 1800mm.

Table 5: Water and sewer pipe types

Types	Descriptions
Cast iron pipes Asbestos cement pipes	Cast iron and asbestos cement pipes are easily disturbed and very brittle, having been laid over 50 years ago and often joined with lead.
Mild steel pipes Ductile cast iron pipes	Mild steel and ductile cast iron pipes have external protective coatings which, when damaged, significantly reduce the pipe's lifespan.
Cement lined steel pipes	Cement lined steel pipes
Copper pipes	Copper pipes are very soft and easily compressed or bent. Though copper pipes are less prone to breaking, the water flow can be significantly reduced.
PVC pipes Earthenware pipes	PVC or earthenware are commonly used for sewerage and drainage services to houses.
Sewer lines	Larger sewer lines may be PVC, asbestos cement or concrete.

Appendix E: Water pipes and sewers

Location

Records of pipeline locations are maintained by water authorities. The depth of the pipelines can vary depending on their age and the amount of surface reconstruction over the years.

It is important to know the depth of pipelines before commencing works to avoid incidents occurring, such as:

- in rush of water or sewerage into a shaft, trench or excavation etc.
  - engulfment of persons in a trench or shaft
  - collapse of a trench
- contact with contaminated substance
- serious or fatal injuries to persons
- disruption of services
- water coming into contact with a power supply

Water pipelines are required to be installed at a minimum depth of 450mm under footpaths and a minimum of 600mm under roads. These depths may be much less depending on the requirements at the time the pipes were installed.

Major sewer lines are commonly installed at depths greater than 600mm; however this should not be assumed. Rising mains may have only 600mm of coverage. Major sewer lines will have manholes approximately every 90 to 130m or when there is a change in pipeline direction.

Appendix F: Telecommunications cables

Telecommunications cables developed for underground installations have changed in line with technology requirements.

Cable installation

Cables are designed for installation in pipe or direct burial in a suitable stone-free backfill. They are not designed to resist the impact of manual or machine tools or to be left unsupported over any great distance. Where agreement is reached between service owners, cables may share trenches with other utility assets. Power cables are often found in 'shared trenches'.

There have been many changes to installation methods and materials used for telecommunications cables over the years.

Understanding the depths cables may be buried at will assist in avoiding impacting or damaging them.

Cables may be buried directly or installed in one or more of the following:

- White PVC pipe – 10mm to 100mm internal diameter
- Fibro asbestos cement (FAC) pipes and ducting
- Galvanised iron (GI) pipe – various diameters
- Large numbers of conduits (100mm) may be encased in concrete to provide added support and security.
- Depth of cover

The depth cables are laid at has varied, often depending on the location and if there were obstructions.

Common depths that cables may be installed at include:

- Shared trenches and in private property at a depth of 300mm or more
- Public footpaths at a depth of approx. 450mm
- Beneath roadways at approx. 600mm

These measurements can vary according to surface level changes over time or where physical obstructions prevent achieving these depths.

Alignments

The majority of telecommunication services at joint locations are housed in pits or manholes. However, the route between these may not be straight if obstructions were encountered during installation.

Direct buried cable in rural areas may be identified by pits or manholes and marker posts. However, it cannot be assumed that a cable follows a direct path between these items.

Cable records

Cable records indicating the type of service installed are maintained by telecommunication carriers. The accuracy of information however can only be confirmed by either electrical location methods (metal content cables) or by manual excavation (non-metallic optical fibre cables).

Cable depths are not recorded.

Cable locations

Persons wanting to identify the location of telecommunications services should contact Before You Dig Australia.

More information

Australian Standards

Australian standards can be purchased from Standard Australia's Customer Service Centre on 1300 654 646 or at www.standards.com.au

- AS 5488.1:2019 *Classification of subsurface utility information*
- AS 2648.1 1995 *Underground Marking Tape*
- AS 1345-1995 I*dentification of the contents of pipes, conduits and ducts*
- AS 2566.2 2002 *Buried flexible pipelines*
- AS 4271 – *Interim – Geographic information Data dictionary*
- AS 1742.3 *Traffic control devices for works on roads*

Legislation

- *Electricity Safety Act 1998*
- *Electricity Safety (General) Regulations 2019*
- *Gas Safety Act 1997*
- *Occupational Health and Safety Act 2004*
- *Occupational Health & Safety Regulations 2017*
- *Pipelines Act 2005*
- *Telecommunications Act 1997* (Commonwealth)
- *Telecommunications Codes of Practice 1997* ACIF C524:2001
- *Water Act 1994*

WorkSafe Victoria Compliance Codes & Industry Standard

- *Compliance Code: Excavation*
- *Compliance Code: Confined spaces*
- *Compliance Code: First Aid in the Workplace*
- *Compliance Code: Plant*
- *Compliance Code: Prevention of falls in general construction*
- *Compliance Code: Removal of asbestos at workplaces*
- *Industry Standard: Civil Construction*

Notes

Notes

WorkSafe Victoria

WorkSafe Agents
Agent contact details are all available at
worksafe.vic.gov.au/agents

Advisory Service
Toll-free 1800 136 089
Email info@worksafe.vic.gov.au

Head Office
1 Malop Street, Geelong 3220
Phone (03) 4243 7000
Toll-free 1800 136 089
Website worksafe.vic.gov.au

Information in your language
For information about WorkSafe in your own language, call our Translating and Interpreting Service (TIS National) on **131 450**.

WorkSafe Victoria is a trading name of the Victorian WorkCover Authority
GUI0209/01/09.22