# Copper Bonded Earth Rods and Accessories

**The connection you can count on**

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## PLP Australia

PLP (Preformed Line Products) is an Australian manufacturing company that has been supplying patented products to the electricity power utility, telecommunication, cable television and data network industries as well as specialised niche markets for more than 50 years.

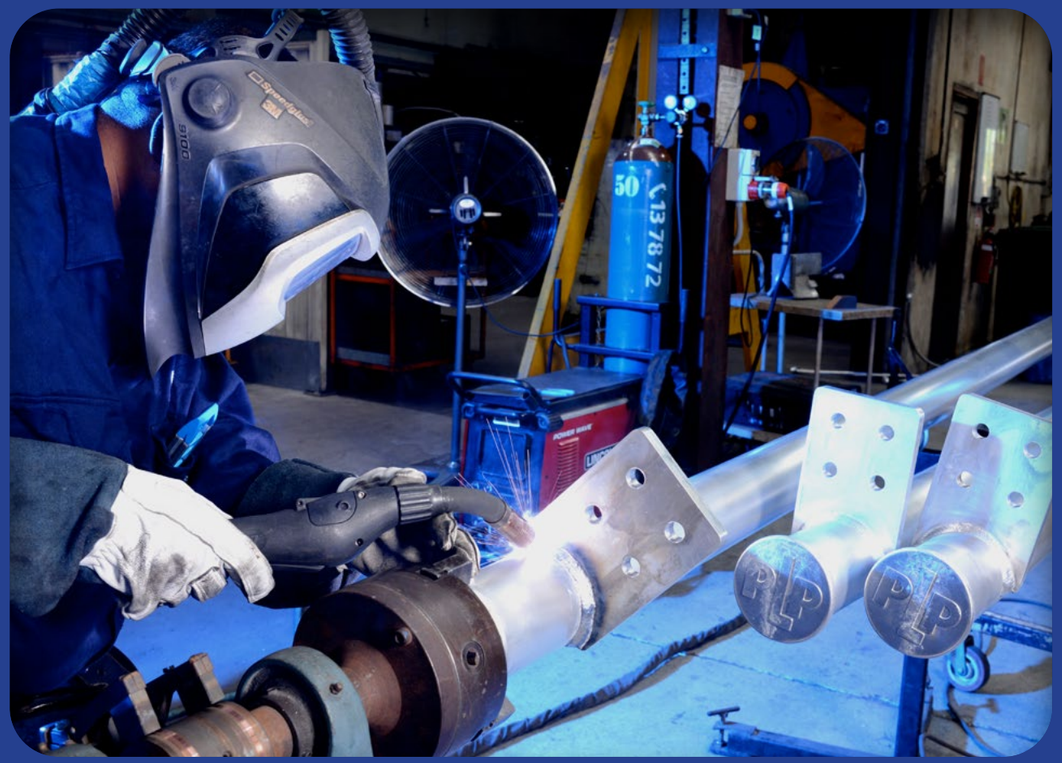
PLP is a designer, manufacturer and supplier of high quality cable anchoring and control hardware systems for supporting, protecting, terminating and splicing transmission and distribution lines.

Experienced engineers provide technical support and inspection services comprising in-depth data analysis from unmanned aerial inspection vehicles for critical infrastructure.

Inventiveness, integrity and foresight are the foundations of PLP and the company continues to improve power utility networks by creating and building innovative new products for the industries it serves.

PLP has an extensive product range and the ability to provide solutions from experienced industry professionals to ensure the best outcome for your project.

PLP Australia has a dedicated team of on-site customer service staff and industry experienced external sales professionals to assist customers.



# About Earth Rods

### Types of earth rods

At one time or another, all manner of conductor materials and shapes have been installed in the ground to provide an electrical earth. These materials range from cast iron plates, tubes, galvanised steel stakes, copper strip, metallic rod, wire and water pipe.

Taking into account conductivity, high resistance to atmospheric corrosion and soil attack, ease and economy of installation and overall reliability, the steel rod clad with either copper or stainless steel has proven its superiority over all others.

The copper bonded steel rod is simple to install and the connection to the earthing system is easily made. The installation is readily accessible for inspection and testing.

With the use of deep driving techniques, extendable earth rods have been developed to reach underlying strata of low permanent resistivity unaffected by seasonal drying.

### Steel core earth rods

Electrically, a good earth rod should have a low intrinsic resistance and be of sufficient cross-section to carry high currents without damage when required.

Mechanically, its physical properties should exhibit strength, have a rigid core for easy driving and be of durable, corrosion resistant material.

PLP has extensive experience in the design and production of a variety of copper and stainless steel earth rods for domestic, industrial and substation applications.

The range includes the specially designed extendable earth rods which may be joined end to end to reach into the deeper levels of moist soil.

## Earth rod length is more important than diameter

There is little advantage to be gained from increasing the diameter of the earth rod to increase the surface area in contact with the soil.

The usual practice is to select an earth rod with a diameter that will have enough strength to be driven into the soil without bending or splitting.

Large diameter rods may be more difficult to drive into the earth than smaller diameter rods.

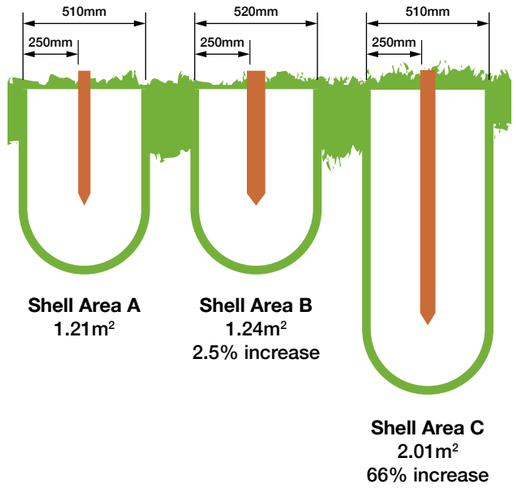



Image 7

## Earth Rod length is more important than quantity

The combined resistance of parallel rods is a complex function involving the number of rods, rod diameter, rod length, rod separation, the configuration of earth rods and soil resistivity.

In most cases, fewer rods coupled together for deep driving will achieve a lower resistance than the same number in parallel.

The earth rod spacing should not be less than the earth rod length to avoid overlap of resistance areas. This is because multiple earth rods, unless spaced well apart, do not follow the law of resistance in parallel as their earth conducting paths overlap.

The installation of multiple earth rods at sufficient distances apart takes up a large area, requires long cabling and many connections that all add up to higher costs in time, labour and equipment.

## Electrical resistance

The depth to which an earth rod is driven into the earth has much more influence on its electrical resistance characteristics than its diameter.

This is because it is not the actual area of contact with the soil that counts, so much as the total resistance area of the sheath or shell surrounding the earth rod.

The resistance of an earthing installation by an earth rod is calculated according to the following formula:

$$R = \frac{\rho}{2\pi L}\left(\ln\frac{8L}{d} - 1\right) \text{ Ohms}$$

Where

R = resistance of earth rod in Ohms

ρ = soil resistivity in Ohm metres

L = length of earth rod in metres

d = diameter of earth rod in metres

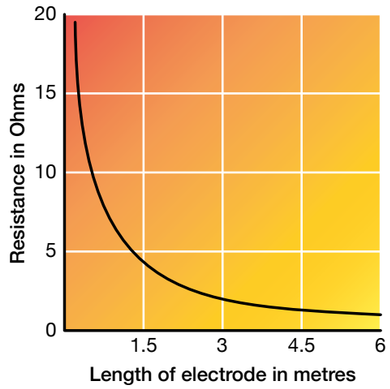


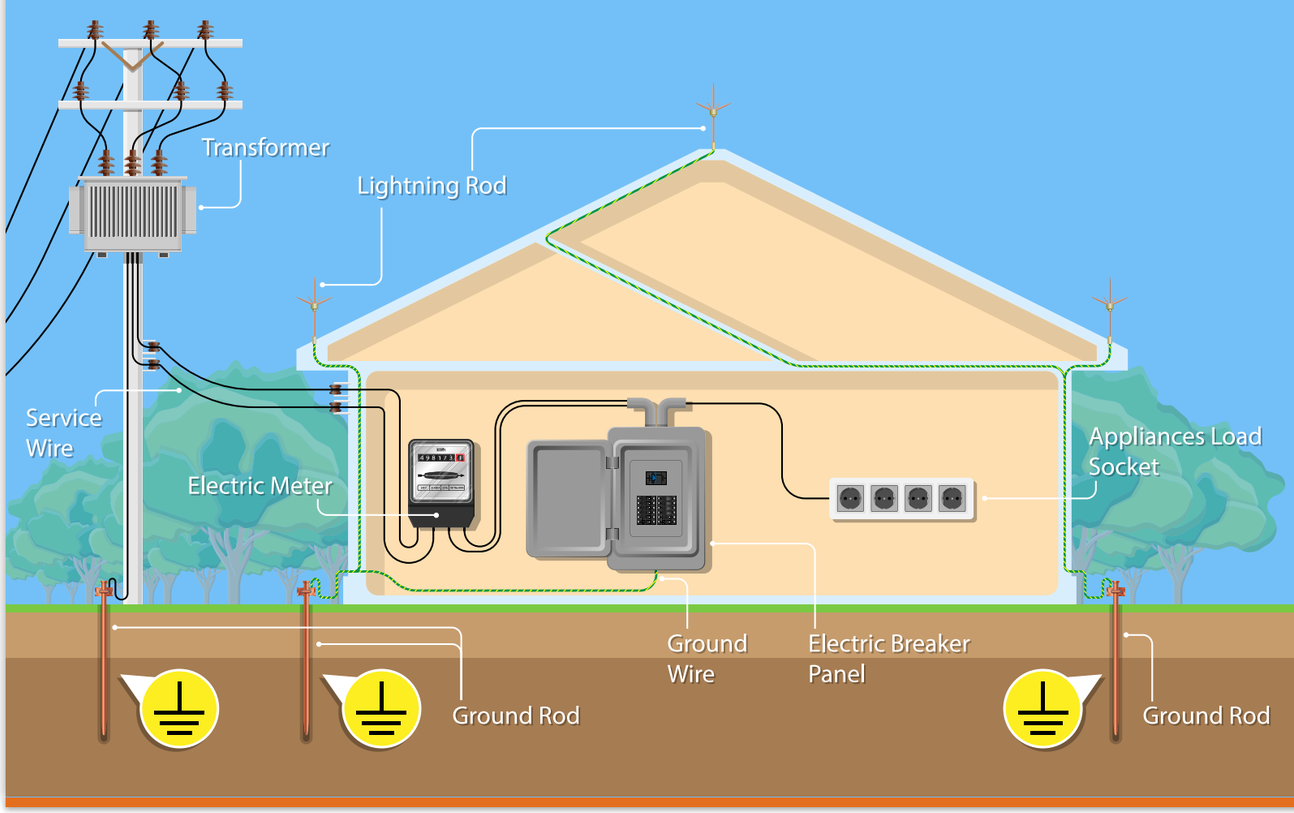

Image 8

The curve in Image 8 is based upon the above formula where the earth resistance using a 25mm diameter earth rod is plotted against its length for soil having a resistivity of 10 Ohm metres.

The curve shows a dramatic change when the length of the earth rod is increased.

**Note:** If the diameter of the earth rod is halved or doubled, the resistance is changed by 12.5%.






# Earthing Basics

## What is earthing?

Earthing may be described as a system of electrical connections to the general mass of earth.

The characteristic primarily determining the effectiveness of an earth electrode is the resistance which it provides between the earthing system and the general mass of earth.

## The purpose of earthing

Earthing an electrical installation has two purposes:

1. To provide protection for persons or animals against the danger of electric shock, and
2. To maintain the proper function of the electrical system.

## Good earthing requires low soil resistivity

Soil resistivity is usually measured in Ohm metres, one Ohm metre being the resistivity the soil has when it has a resistance of one Ohm between the opposite faces of a cube of soil having one metre sides.

The other unit commonly used is the Ohm centimetre. To convert Ohm metres to Ohm centimetres, multiply by 100.

Soil resistivity varies greatly from one location to another. For example, soil around the banks of a river have a resistivity in the order of 1.5 Ohm metres. In the other extreme, dry sand in elevated areas can have values as high as 10,000 Ohm metres.

The resistance of the earth path is determined by:

1. The resistivity of the soil surrounding the earth rod,
2. Its contact resistance between the earth rod and the surrounding soil, and
3. The resistance of the earth rod and connecting conductors.

## The earth path

When an electrical current passes into the soil from a buried earth rod, it passes from a low resistance metal into an area of high resistance soil.

Images 1 and 2 below depict what happens when a current flows from an earth rod into the surrounding earth. The areas of resistance can be described as being that of a number of sheaths of ever increasing diameters.

Image 1

Image 2

The current path passes into the first sheath immediately adjacent to the earth rod and then into the second sheath which is of a larger cross-section with a greater area for current flow, and therefore, of lower resistance than the first sheath. And so on into a succession of sheaths or shells of ever increasing area, and because of this, of ever decreasing resistance.

Eventually at a distance of three or four metres, the area of current dissipation becomes so large, and the current density so small, the resistance at this point is negligible. Measurements show that 90% of the total resistance around an earth rod is within a radius of three metres.

However, it is this resistance at the interface where the current leaves the earth rod and flows into the main body of the earth that is important and explains why soil resistivity tests are very necessary in order to secure lowest overall resistance.

## Factors affecting soil resistivity

The factors affecting soil resistivity are:

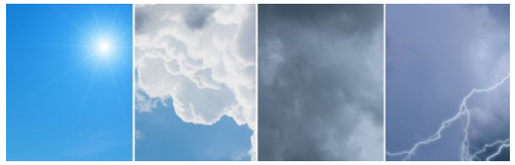
### Types of Soil

Soil composition can be clay, gravel, loam, rock, sand, shale, silt or stones. In many locations soil can be quite homogeneous, while other locations may be mixtures of these soil types in varying proportions. Very often soil composition is in layers or strata, and it is the resistance of the varying strata, especially at sub-soil level and lower where the moisture content is not subject to drying out, that is important in securing a good electrical earth. Refer Table 1 (page 6) for typical soil resistivity values.

### Climate

Obviously arid and good rainfall climates are at opposite extremes for conditions of soil resistivity.

### Seasonal conditions



The effects of heat, moisture, drought and frost can introduce wide variations in “normal” soil resistivity. Soil resistivity usually decreases with depth, and an increase of only a few percent of moisture content in a normally dry soil will markedly decrease soil resistivity. Conversely, soil temperatures below freezing greatly increase soil resistivity, requiring earth rods to be driven to even greater depths. See Table 2 for variations of soil resistivity with moisture content, and Table 3 for variations of soil resistivity with temperature.

### Other factors

Other soil properties conducive to low resistivity are chemical composition, soil ionisation, grain distribution and homogeneous grain size.

All these factors relate to the retention of soil moisture, and provide good conditions for a closely packed soil and good contact with the earth rod.

In view of all the above factors, there is a large variation of soil resistivity between different soil types and moisture contents.





## Essential site testing

Every earth is an individual and the only way to know that an earthing installation meets code requirements is to carry out proper resistance measurements on site.

There are a variety of test instruments available. However, they can be generally categorised as three-terminal or four-terminal test instruments.

### Measuring resistance

Image 3 illustrates the test setup for measuring the resistance in Ohms between the installed earth rod and the general mass of earth. Refer to the instrument manufacturer’s manual on how to carry out the test. As a general rule, the distance between the earth rod under test and the current probe “C” is not less than 15 metres.

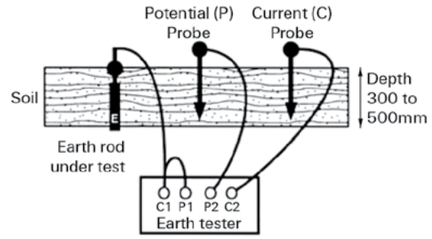



Image 3

### Measuring soil relativity

Image 4 illustrates the simple test setup for measuring soil resistivity. The test results give a resistivity profile of the earth beneath the surface.

A four-terminal instrument is required for soil resistivity. The probes are installed in a straight line with an equal spacing and inserted to a depth of no more than 20 metres. For example, for a spacing of two metres the depth must be less than 100mm.

Keeping the centre position the same, resistance measurements are taken at increasing spacings. For example a = 2m, 3m, 4m, etc. Always ensure that the spacing between individual test probes are identical.

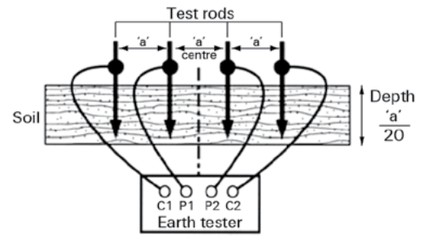



Image 4

### Soil resistivity formula

The soil resistivity can be obtained from the following formula:

$\rho = 2\pi a R$ (Ohm metres)

Where

ρ = apparent soil resistivity

a = spacing of probes in metres

R = resistance value in Ohms (as indicated on the tester)

The resistivity at probe spacing ‘a’ metres and the average resistivity to a depth of ‘a’ metres is a good approximation for most circumstances.

Using the above formula, the soil resistivity versus depth profile can be drawn from Images 5 and 6.

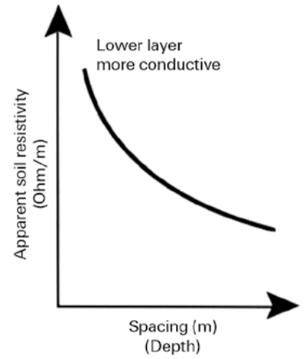



Image 5

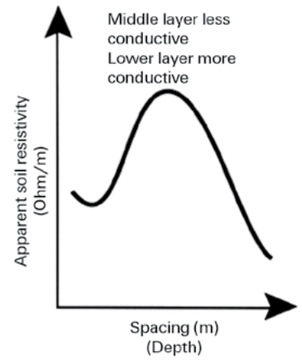



Image 6

The profile can be used to identify where low resistivity soil occurs so that appropriate installation techniques can be used. As the soil resistivity decreases with depth, deep driving earth rods are recommended.

If the soil resistivity increases with depth, earth rods should be installed in parallel to obtain a lower resistance reading. Best results are achieved when the spacing of the parallel earth rods is greater than their depth.

### Table 1 – Resistivity values for several types of soils and water

| Type of Soil or Water | Typical Resistivity Ωm | Usual Limit Ωm |
|---|---|---|
| Sea Water | 2 | 0.1 to 10 |
| Clay | 40 | 8 to 70 |
| Ground well and spring water | 50 | 10 to 150 |
| Clay and sand mixtures | 100 | 4 to 300 |
| Shale, slates, sandstone | 120 | 10 to 1,000 |
| Peat, loam and mud | 150 | 5 to 250 |
| Lake and brook water | 250 | 100 to 400 |
| Sand | 2,000 | 200 to 3,000 |
| Morane gravel | 3,000 | 40 to 10,000 |
| Ridge gravel | 15,000 | 3,000 to 30,000 |
| Solid granite | 25,000 | 10,000 to 50,000 |
| Ice | 100,000 | 10,000 to 100,000 |

### Table 2 – Variations of soil resistivity with moisture content

| Moisture Content % of Weight | Typical Value of Resistivity Ωm | |
|---|---|---|
| | Clay mixed with sand | Sand |
| 0 | 10,000,000 | – |
| 2.5 | 1,500 | 3,000,000 |
| 5 | 430 | 50,000 |
| 10 | 185 | 2,100 |
| 15 | 105 | 630 |
| 20 | 63 | 290 |
| 30 | 42 | – |

### Table 3 – Variations of resistivity with temperature

**Temperature with a mix of sand and clay and a moisture content of about 15% by weight.**

| Temperature °C | Typical Value of Resistivity Ωm |
|---|---|
| 20° | 72 |
| 10° | 99 |
| 0° (Water) | 138 |
| 0° (Ice) | 300 |
| -5° | 790 |
| -15° | 3,300 |



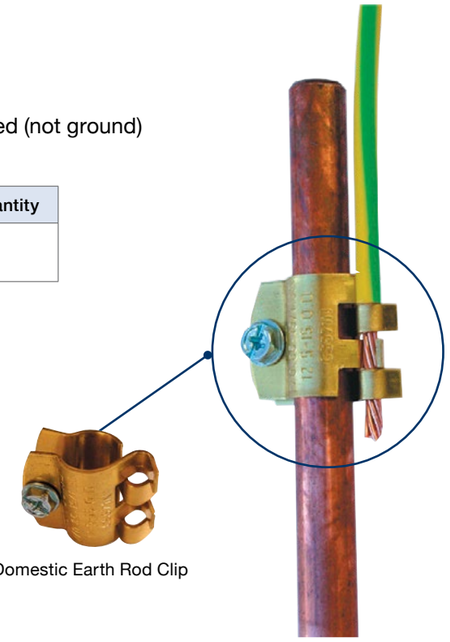
# The Earthing Range

## Non-Extendable Bonded Earth Rod – Domestic

Each earth rod incorporates an integral driving point, machined (not ground) to preserve the strength and rigidity of cold-drawn steel.

| Part Number | Description | Pack Quantity |
|---|---|---|
| CBE-127-1400-DOM | Domestic earth rod assembly (includes earthing clips and tags) | 10 |


Note: Non-extendable earth rods are supplied completed with rod and tag.



Domestic Earth Rod Clip

## Copper Bonded Earth Rod – Domestic and Commercial

The CBE Copper Bonded Earth Rod provides an effective solution for domestic as well as commercial earthing applications.

Manufactured from low carbon high tensile steel with pure copper plating at >250 microns, molecularly bonded onto the steel rod. All Copper Bonded Earth Rods supplied by PLP are tested in accordance with IEC62561-2 : 2018.

## Copper Bonded Earth Rod – Pointed

| Rod Diameter mm | Part Number | Length mm |
|---|---|---|
| 12.7 | CBE-127-1400 | 1400 |
| 12.7 | CBE-127-1800 | 1800 |
| 14.2 | CBE-142-1500 | 1500 |
| 14.2 | CBE-142-1800 | 1800 |
| 14.2 | CBE-142-2400 | 2400 |
| 19 | CBE-190-1800 | 1800 |
| 19 | CBE-190-2400 | 2400 |
| 19 | CBE-190-3000 | 3000 |

## Copper Bonded Earth Rod – Threaded

| Rod Diameter mm | Part Number | Length mm |
|---|---|---|
| 13 | CBET-130-1400 | 1400 |
| 13 | CBET-130-1800 | 1800 |
| 15 | CBET-150-1800 | 1800 |
| 15 | CBET-150-2400 | 2400 |
| 15 | CBET-150-3000 | 3000 |
| 19 | CBET-190-1400 | 1400 |
| 19 | CBET-190-1800 | 1800 |
| 19 | CBET-190-3000 | 3000 |

## Threaded Rod Couplers

| Rod Diameter mm | Part Number |
|---|---|
| 13 | CBET-130-COUPLER |
| 15 | CBET-150-COUPLER |
| 19 | CBET-190-COUPLER |

## Unthreaded Rod Couplers

| Rod Diameter mm | Part Number |
|---|---|
| 12.7 | CBE-127-COUPLER |
| 14.2 | CBE-142-COUPLER |
| 19 | CBE-190-COUPLER |

## Threaded Rod Driving Stud

| Rod Diameter mm | Part Number |
|---|---|
| 13 | DS-13 |
| 15 | DS-15 |
| 19 | DS-19 |





## STE Series Stainless Steel Clad Rods

| Rod Length | 13mm Dia. | Pack/ Bulk Quantity | 14mm Dia. | Pack/ Bulk Quantity |
|---|---|---|---|---|
| 1200 | STE1312 | 10/500 | STE1412 | 10/500 |
| 1440 | STE1314 | 10/500 | STE1415 | 10/500 |
| 1800 | STE1318 | 5/500 | STE1418 | 5/500 |
| 2400 | STE1324 | 5/500 | STE1424 | 5/500 |
| 3000 | STE1330 | 1/50 | STE1430 | 1/40 |

## Stainless Steel Earth Rod Accessories

| Coupling | SCT13 | 10/100 | SCT15 | 10/100 |
|---|---|---|---|---|
| Point | DPT12 | 50/200 | DPT15 | 50/200 |
| Star Point | SDP12T | 10/100 | SDP15T | 10/100 |

## Driving Points

| Part Number | Description |
|---|---|
| DPT12 | Average Driving Point 13mm |
| DPT15 | Average Driving Point 19mm |
| SDP12T | Hard Driving Point 13mm |
| SDP15T | Hard Driving Point 19mm |

Stainless Steel Clad Rod

## Connection Boxes

These enclosures provide a tidy means of protecting the connection of the main earth conductor to the earth rod. Manufactured from high strength aluminium alloy or polymer concrete, they are well suited to use in high traffic areas. Hinged covers allow easy access for inspection or testing.


ERB1– Aluminium alloy casting


ERB3 – Polymer concrete

ERBP3 – Plastic

| Part Number | Material | Dimensions | Entry holes | Load rating |
|---|---|---|---|---|
| ERB1 | Aluminium | 138 x 144 x 74mm | 2 x 19mm | 5000kg |
| ERB3 | Polymer Concrete | 220 x 220 x 150 | 1 x 40mm | Pedestrian |
| ERBP3 | Plastic | 300 x 300 x 207 | Without Holes* | 4000kg |

*Customer to drill holes

## Earthing Enhancement Compounds

### Features

Stable, high conductivity providing long term low ground resistance. High expansion, low shrink characteristics. Non-toxic, non-corrosive.

### Packaging

20kg non-tear, plastic lined bags.

### Installation

1. Apply as a dry mix or pourable slurry.
2. Dry mix will yield a volume of approximately 0.0176m$^3$ (roughly 57 bags to the cubic metre).
3. Slurry will yield a volume of approximately 0.030m$^3$ when mixed with 20 to 25 litres of water (roughly 33 bags to the cubic metre)


| Description | Composition | Standard |
|---|---|---|
| EARTHRITE | Bentonite, Gypsum, Sodium Sulphate | N/A |
| EARTH5050 | Calcium, Bentonite, Natural Gypsum | Conforms to AS2239 |





## Earth Rod Clamps

### Single Conductor – Parallel

The Pinch and U-Bolt clamps are simple, robust and have a ‘V’ groove in the casting to accommodate the earthing cable.

**Material:** Copper alloy casting, bronze set screw or stainless steel U-Bolt and nuts.

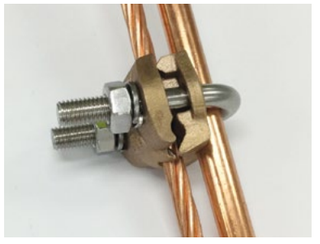
Type GRC5

Clamp 210

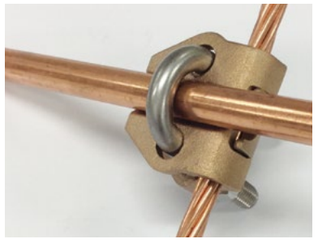
| | | | Conductor Size | |
|---|---|---|---|---|
| Part Number | Pack Quantity | Rod Diameter mm | CSA mm$^2$ | Diameter mm |
| GRC5 | 100 | 13 - 15 | 10 - 35 | 4.05 - 7.65 |
| CLAMP 210 | 10/50 | 13 - 15 | 16 - 120 | 5.10 - 14.21 |
| EP1 | 40 | 17 - 19 | 16 - 120 | 5.10 - 14.21 |

### Single Conductor – Versatile

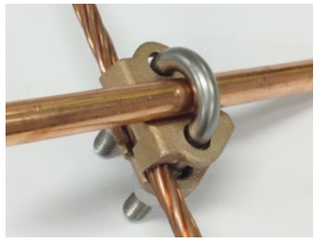
The clamps are designed for either parallel or right angle connections.



Parallel Connection



Right Angle Connection



Right Angle Connection

**Material:** High copper content alloy castings with stainless steel U-Bolt, spring washers and nuts.

Type GB1

Type GB2

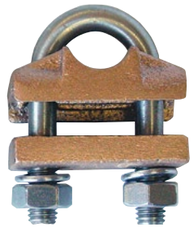
| | | | Conductor Size | |
|---|---|---|---|---|
| Part Number | Pack Quantity | Rod Diameter mm | CSA mm$^2$ | Diameter mm |
| GB1 | 25 | 13 - 19 | 16 - 35 | 5.1 - 7.7 |
| GB2 | 20 | 13 - 19 | 50 - 120 | 8.9 - 14.2 |
| GB3 | 10 | 13 - 19 | 150 - 185 | 15.7 - 17.6 |
| EL21090 | 10 | 12 - 15 | 35 - 120 | 7.6 - 14.2 |

## Multiple conductor installations for multi-conductor earthing

For two earth conductors parallel to rod or two or three earth conductors at right angles to rod.

**Material:** High copper content alloy castings with stainless steel U-Bolt, spring washers and nuts.

Type EP3



Type ET1

## Earth rod clamp configurations

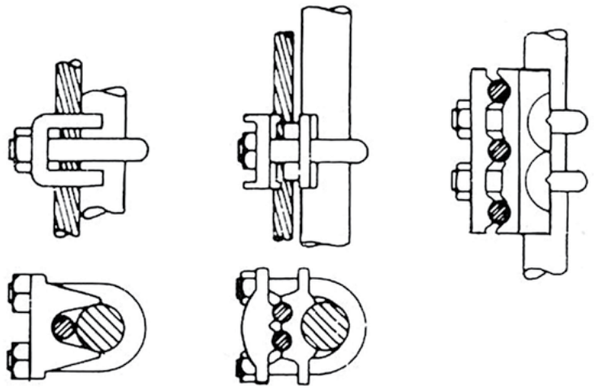


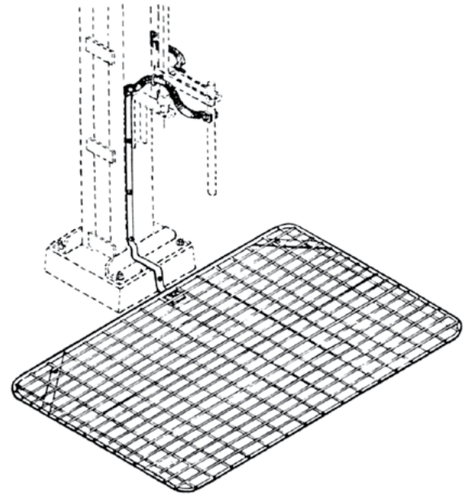
Image No. 1 Image No. 2 Image No. 3

| | | | Conductor Size | | | |
|---|---|---|---|---|---|---|
| Part Number | Pack Quantity | Rod | CSA mm² | Diameter mm | No. Of Conductors | Image No. |
| EP3 | 20 | 13 - 19 | 16 - 35 | 5.1 – 7.7 | 2 | 1 |
| EP4 | 20 | 13 - 19 | 50 - 120 | 8.9 – 14.2 | 2 | 1 |
| ET1 | 25 | 13 - 19 | 16 - 35 | 5.1 – 7.7 | 2 | 2 |
| ET2 | 15 | 13 - 19 | 50 - 120 | 8.9 – 14.2 | 2 | 2 |
| ET4 | 10 | 13 - 19 | 50 - 120 | 8.9 - 14.2 | 3 | 3 |

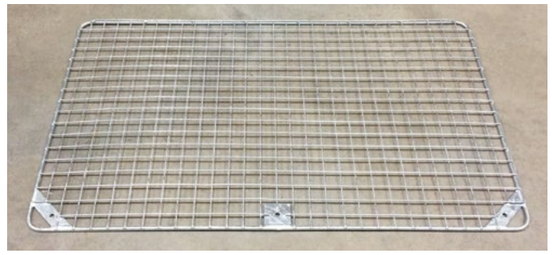




# Earth Mats and Installation Kits



Earth Mat and Kit



Earth Mat

## Earth Mat Table

| Part Number | Material | Size mm | Mesh Size mm |
|---|---|---|---|
| Earthmat | Galvanised Steel | 1500 x 900 | 75 x 60 |
| Earthmat-1 | Galvanised Steel | 2500 x 1200 | 75 x 50 x 5 |
| Earthmat-2 | Galvanised Steel | 2500 x 1000 | 75 x 50 x 5 |
| Earthmat-3 | Galvanised Steel | 1500 x 1000 | 75 x 50 x 5 |
| Earthmat-4 | Galvanised Steel | 1800 x 1200 | 75 x 50 x 5 |
| **Note:** Other sizes are available, please contact PLP. | | | |
| KITY | Installation kit for type RDB rotary switches with earth switch. | | |

Earth Mat and Kit

Earth Mat and Kit

## Earthing Bond

### For commercial earthing installations

The Earthing Bond system provides an earth connection welded to the steel reinforcement, providing a stable and low resistance path to earth.

Earthing Bond

Earthing Bond on Ribar

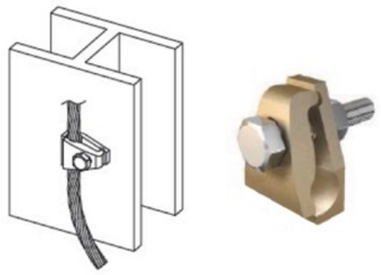
### Earth Bond Assembly Table

| Part Number | Bonding Conductor mm² | Length of Bonding Conductor | Lug Diameter | Fault Rating kA for 1 Sec | Terminal Thread and Depth |
|---|---|---|---|---|---|
| C70 | 70 | 3m | Ø12mm | 5 | M10 x 20mm |
| C70-1 | 70 | 1m | Ø12mm | 5 | M10 x 20mm |
| C95 | 95 | 3m | Ø16mm | 8.5 | M10 x 20mm |
| C95-1 | 95 | 1m | Ø16mm | 8.5 | M10 x 20mm |
| C120 | 120 | 3m | Ø20mm | 10.5 | M10 x 20mm |
| C120-1 | 120 | 1m | Ø20mm | 10.5 | M10 x 20mm |

# Additional Products

## Tower Bond

### For bonding copper cables or wires to steel structures



Tower Earth Bond with Plate

Material: High Grade Copper Alloy, Bolt: Stainless Steel – SS304

### Tower Bond Table

| Conductor Range mm² | Channel Thickness mm | Bolt Size | Part Number |
|---|---|---|---|
| 16 – 35 | 10 | M10 | TEB1635 |
| 50 – 70 | 10 | M10 | TEB5070 |
| 95 – 120 | 10 | M10 | TEB95120 |
| 185 – 240 | 10 | M10 | TEB185240 |





## Copper Clad Steel Wire Conductor

Copper Clad Steel (CCS) wire conductor comprises strands of single copper clad steel wire.

CCS has the strength of steel and the conductivity and corrosion resistance of copper. Other advantages include low density and low cost.

The copper clad steel conductor is an excellent replacement for traditional pure copper wire and there is also less theft as the copper cannot be recovered by scrap dealers.

Copper Clad Steel Wire Conductor

### Advantages of Copper Clad Steel Conductors

- Higher tensile strength than pure copper wire conductor
- 13% lighter than pure copper wire conductor
- Less expensive than pure copper wire conductor
- Reduced incidence of copper theft
- Reduced production costs while ensuring the same quality

### Copper Clad Steel Stranded Conductor Table

| Part Number | CSA mm² | Stranding | Overall Diameter | Weight (kg/km) |
|---|---|---|---|---|
| CCS-19-70 | 70mm² | 19/2.14mm | 10.60 mm | 550 |
| CCS-19-95 | 95mm² | 19/2.52mm | 12.60 mm | 766 |
| CCS-19-120 | 120mm² | 19/2.84mm | 14.00 mm | 980 |

## Earth Stubs

Brass Earth Stubs

### Earth Stubs Table

| Part Number | Length | Diameter | A/F | Thread Depth | Thread Size |
|---|---|---|---|---|---|
| ESB-M12-1 | 80mm2 | 25mm | 30 A/F | 40mm | M12 |
| ESB-M16-120 | 120mm2 | 25mm | 30 A/F | 50mm | M16 |

Other custom versions are available upon request.

# CEC Connectors

## A heavy duty compression connector for earth rods and conductors

CEC 6

CEC070

CEC095

PLP CEC connectors were specifically developed to dissipate surges of high fault current quickly and effectively to limit any potential damage to equipment, and to safeguard personnel close to that equipment.

Manufactured from pure wrought copper, the CEC connector is fitted by use of standard compression tools to form a dependable, tamper-proof joint from conductor to earth rod or buried earthing cable.

## Earthing Grid Applications

By joining two Compression Connectors with the same or different part numbers, various combinations of conductor size and grid connections are possible. This enables a quick and economical assembly.

## Features and benefits

- **Simple installation** – one crimp from a standard compression tool
- **Connector design** – current carrying capacity greater than that of the conductor
- **Corrosion resistant** - identical material to the conductor eliminates problems caused by electrolytic corrosion and the corrosive effects to some soil
- **Pre-coated with Coppalube** – a specially formulated jointing compound heavily laden with copper particles, to increase the mechanical and electrical integrity of the connection, exclude moisture and resist rotation of the connector on the earth rod
- **All weather application** – this connector may be installed in damp or fire risk areas with no adverse effects on the joint or the environment
- **Easy identification** – each CEC connector is clearly stamped with the appropriate catalogue number, conductor size and installation die reference
- **Individually packed** – for cleanliness and ease of handling.





## Installation Notes

- Standard “C” head compression tool of minimum 12 tonne capacity recommended
- Full compressive force of the tool is utilised as application is not limited by die halves meeting, but the pressure release valve in the tool
- Regular use of a load test cell to check compression performance of the tool is recommended

## CEC Connector Table

| Part Number | Conductor Combination mm² | | Die Set Part Number | Profile |
|---|---|---|---|---|
| CEC070 | 35 | 35 | DUOT | C |
| | 50 | 35 | DUOT | C |
| | 50 | 50 | DUOT | C |
| | 70 | 50 | DUOT | C |
| | 70 | 70 | DUOT | C |
| CEC095 | 70 | 95 | DU1315 | C |
| | 95 | 95 | DU1315 | C |
| CEC120 | 95 | 120 | DU1315 | C |
| | 120 | 120 | DU1315 | C |

| Part Number | Open Section | Tap Conductor Diameter mm | Tap Conductor mm² | Profile |
|---|---|---|---|---|
| CEC15035 | Conductors 50-120mm² OR Earth Rods 13-15mm dia | 8.4 | 25-40 | 6 |
| CEC15070 | | 11 | 50-70 | 6 |
| CEC15120 | | 15 | 95-120 | 6 |
| CEC15150 | | 16.5 | 120-150 | 6 |
| Die Set Part Number for “6 Profile” is DU1315 | | | | |

## Exothermic Welding Connection

Exothermic connections are the best bond for copper and steel as they provide an irreversible molecular bond that is far superior to any other type of connection.

Although the temperatures reached to achieve this weld are extremely high, the process is instant when compared to brazing, soldering and all types of mechanical connections.

### Exothermic connections provide:

- Permanent connection, unaltered throughout the facility's lifetime
- A cross-sectional area that in most cases is twice that of the conductors
- A connection without contact pressures that tend to loosen and corrode over time
- High electrical current, equal to or higher than the conductors. On short-circuit tests, the conductors melt before the exothermic connection
- Capability to withstand repeated high electrical currents without any wear or erosion
- Quick and easy visual inspection

### Exothermic connections are suitable for welding copper to:

- Mild steel
- Stainless steel
- Copper clad steel
- Galvanised steel
- Copper
- Bronze
- Brass
- Monel Metal

PLP supplies the **Apliweld® Secure+** exothermic system that uses a unique tablet format compound for every weld type, eliminating the traditional multiple powders required for different welds.

This unique tablet format also eliminates all explosive and flammable materials, whilst the robust electronic ignition with remote Bluetooth activation offers the user the safest exothermic welding system on the market.

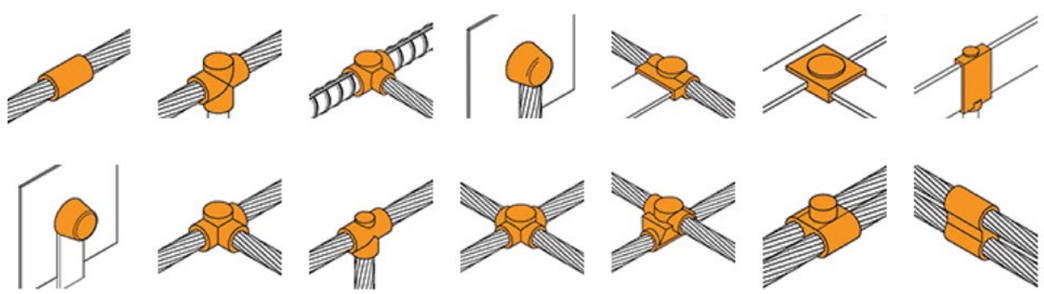

### Apliweld® Secure+ is the safe, versatile and reliable exothermic system for:

- Electrical systems earthing
- Busbar connections
- Energy transport and communications
- Industrial equipment earthing

### Apliweld® Secure+ exothermic connections are:

- Self-contained
- Use zero flammable and explosive materials
- Does not require flammable and explosive gas cylinders
- Does not require external power source

Illustrated below are various types of connections used in earthing systems above and below ground. Contact PLP for more information.







## Airport Earthing Terminal

### Static electricity earthing terminals

Part Number: AET1918 (Surface)
Part Number: AET1918F (Flush)

The standard length is 1800mm, other lengths are available via special order.

Type AET electrodes provide for the earthing of airport tarmac areas where any generation of static electricity could be hazardous, i.e. aircraft refuelling, servicing and cargo loading areas. The heavy duty capping has a ribbed design affording a fast and positive earthing connection by means of earth lead connector clips.

**Material:** Solid steel core overlaid with copper bonding and a heavy bronze cap.

**Installation Procedure:** Drive electrode into ground to required depth. Remove protruding portion of rod above cap and finish flush.

## Methods of installing Earth Rods

Earth rods are installed by one of two methods. The rod can be driven into the ground by either a hand held hammer or mechanically operated hammer. However, where driving is difficult the only option is to drill a hole to take the earth rod.

Where holes are drilled, the gap between the earth rod and wall of the drilled hole is commonly filled with a water expanding compound such as EARTHRITE. This is a mixture of Bentonite and Gypsum with a small amount of Sodium Sulphate to reduce the resistivity of the backfill.

### Driving Methods

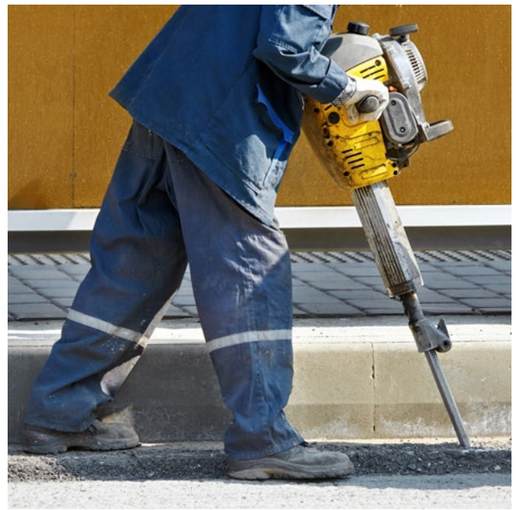
Earth rods up to 3m long can be driven satisfactorily in one length. Where rods have to be longer than 3m, it is preferable to use one of the PLP extendable series earth rods.

There are a variety of methods for driving earth rods into the ground from the simple hand held hammer to power operated mobile rigs. Their use is dictated by the nature of the soil and terrain, the length of drive needed to secure minimum resistance, and the number of rods to be driven.

The Hand Held Hammer is an effective method for most domestic installations. The earth rod should be driven lightly using a hammer of around 1.5 to 3 kgs, keeping the force of the blows axial to the rod to obviate the risk of whipping.

A large number of comparatively light hammer blows are more effective, and preferable, to heavy blows which are destructive to the metal and can cause deformation to the rod end as well as bending and possible splitting. The fitting of a guide to the rod will assist rigidity and reduce whipping when the rod comes up against resistance to penetration.

The Mechanical Hammer can be one of three types, electric, pneumatic or petrol engine driven. These power operated aids are used when soil conditions are not suited to hand driving and when long earth rods have to driven to great depths.



Mechanical Hammer

### Driving Method Precautions

Driving an earth rod with a mechanical hammer calls for special care to ensure the force of the blows are axial to the rod. While it may be possible to maintain this when manually using a light type hammer such as an electric Kanga, it is certainly advisable to use rig mounting to ensure correct driving especially when it comes to driving the longer earth rods.

Very light and very heavy hammers with a long stroke are not suited for earth rod driving. Medium tools in the 7.5 to 12 kgs range with a stroke of approximately 58 to 108mm delivering 2200 blows per minute are ideal for normal applications.

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