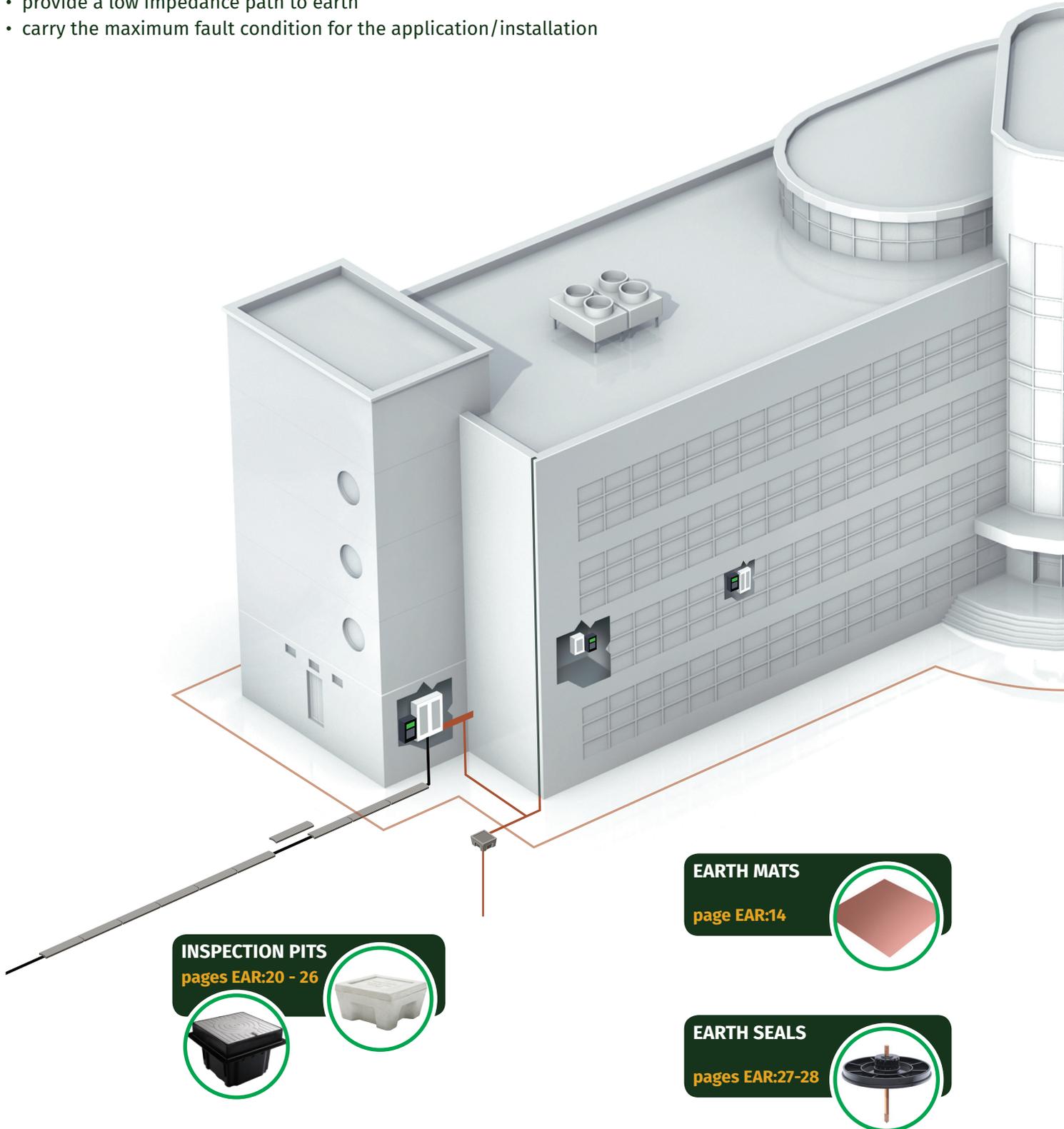


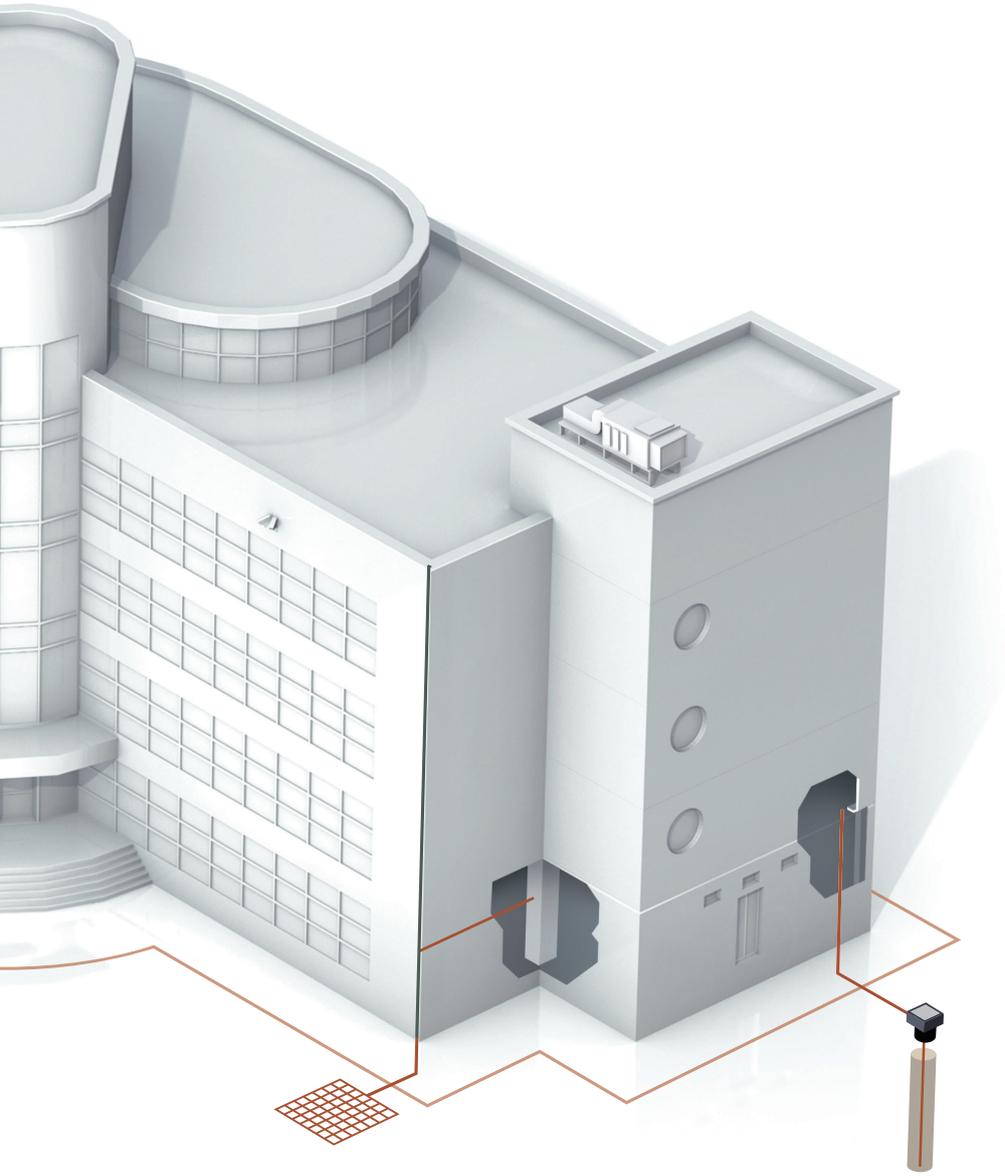
Introduction	EAR:2 - 3
Earth Termination Network The Earth Termination Network is a vital part of any Power or Lightning Protection installation	EAR:4 - 7
Earth Rods and Fittings Copperbond, solid copper and stainless steel Earth Rods and fittings	EAR:8 - 13
Plates and Mats Solid copper Plates and lattice copper Earth Mats	EAR:14
Soil Conditioning Agents Bentonite and Marconite	EAR:15 - 19
Concrete Inspection Pits, Cable Protection Covers, Markers & Posts Concrete Inspection Pits to enable testing of the earth electrode system, cable protection covers and markers to protect cables from damage	EAR:20 - 24
Plastic Inspection Pits Plastic Inspection Pits to enable testing of the earth electrode system	EAR:25 - 26
Earth Rod Seals Single and Double Earth Rod Seals for basement earthing installations	EAR:27 - 28
Clamps Rod to tape, cable and strand clamps for inter-connecting conductors, rods etc	EAR:29 - 31
Accessories	EAR:32

Copper is the recommended material to use in earthing applications, whether below or above ground. Materials used in earthing systems must be able to:

- withstand mechanical damage
- resist corrosion
- provide a low impedance path to earth
- carry the maximum fault condition for the application/installation



Our castings are high quality/high copper content complying to BS 7430 and BS 62561-1. Additional to our range are UL listed copperbond earth rods and exothermic welding.



EARTH ROD CLAMPS
pages EAR:29 - 31



INSPECTION PITS
pages EAR:20 - 26



EARTH RODS AND ACCESSORIES
pages EAR:8 - 13



EARTH PLATES
page EAR:14



CONDUCTIVE AGGREGATES
pages EAR:15 - 19



Earth Termination Network

It is important that both lightning and electrical fault currents are dispersed into the ground (soil) in a safe manner and that this installation will last in excess of 20 years (in average soil conditions).

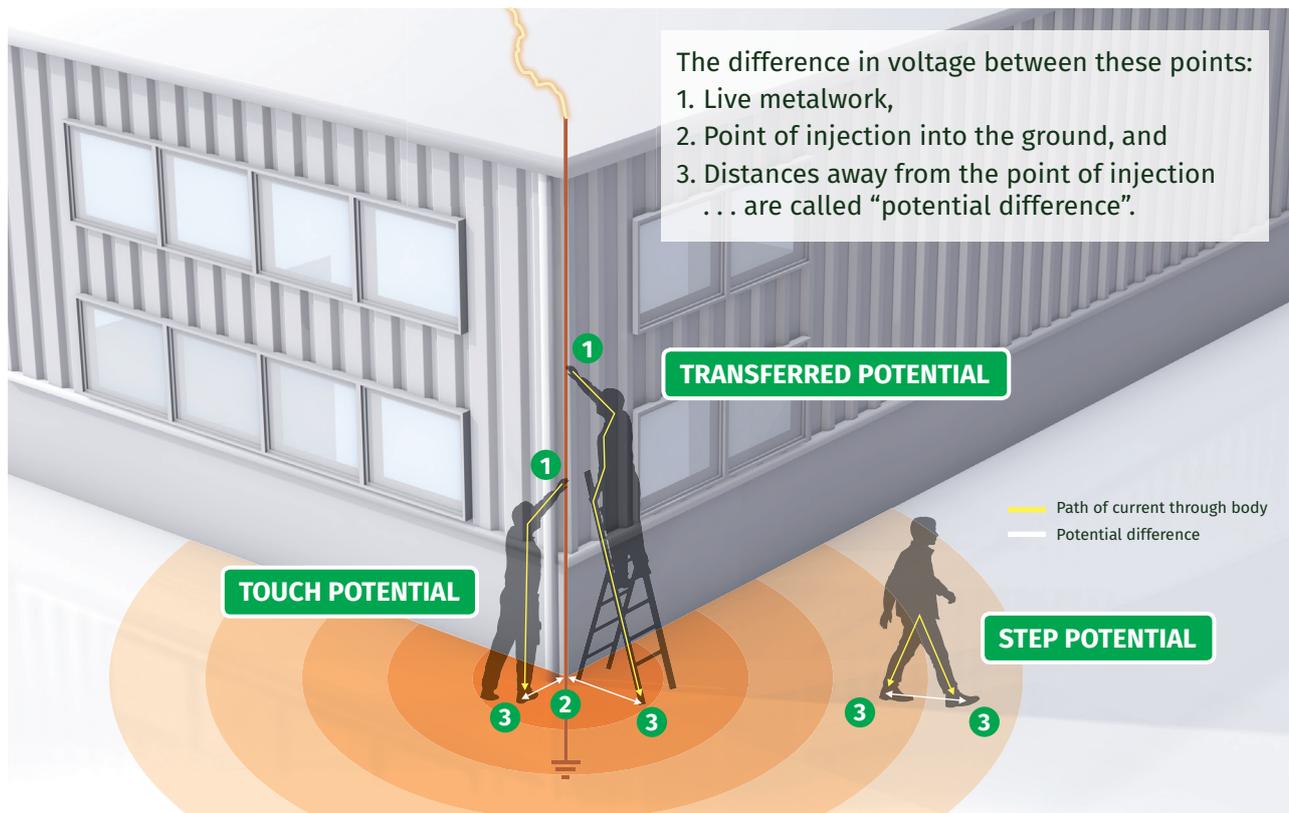
With this in mind, an Earth Termination Network must:

- protect life,
- provide a low resistivity path to earth,
- allow circuit protection devices to operate correctly,
- carry high currents repeatedly,
- have excellent corrosion resistance properties, and
- be mechanically robust.

Moreover, the careful design of an Earth Termination Network will avoid the potentially lethal hazards associated with live metalwork/lightning conductors and the potential difference arising from subsequent voltage gradients in the ground.

VOLTAGE GRADIENT

When lightning, or a fault current, is injected into the ground the voltage dissipates through the soil, radiating away from the point of entry. The further the distance from the point of entry, the lower the voltage that will present (much like the size of ripples in a pond, as they radiate away from the point where a stone was thrown into the water).



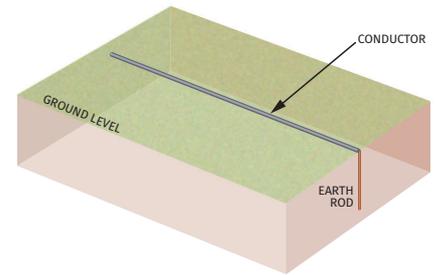
This is significant because a current passing through the heart causes fibrillation and can lead to death.

Mitigation of potential differences can be through the use of "equipotential grids" that equalise potential across an area, plus it is good practice to ensure that the conductors and rods are buried at least 1m deep and covered by a thick layer of insulating material eg rock.

An earth termination network can be installed in different ways . . .

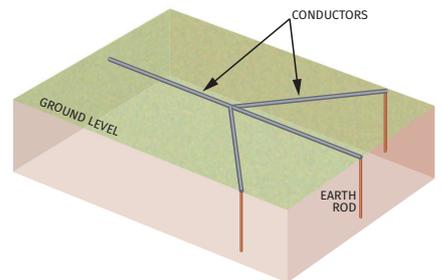
1. Simple Earth Electrode

This can be a driven Earth Rod, an Earth Plate, a Mat or a length of buried conductor - or a combination of both.



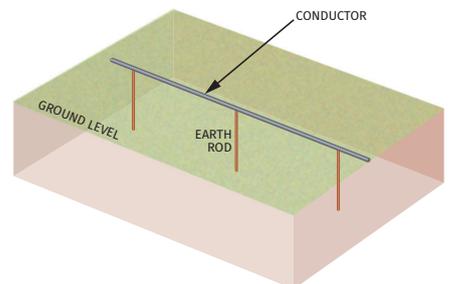
2. Crows Foot Electrode

Can incorporate Earth Rods - the rods would be spaced at least twice their driven length apart.



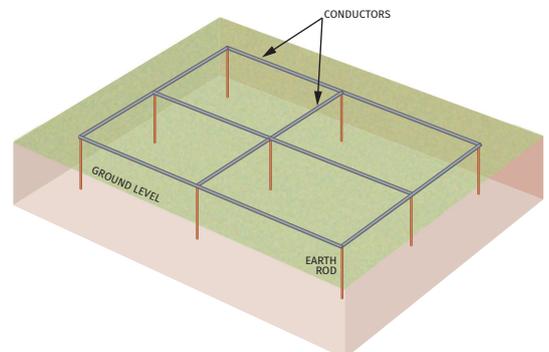
3. Counterpoise Conductor

Can incorporate Earth Rods - the rods would be spaced at least twice their driven length apart.



4. Grid Conductor

Can incorporate Earth Rods - the rods would be spaced at least twice their driven length apart. For example, in a sub-station or cell site.



5. Earth Plates/Mats

For example, for protection of an operator at switch positions.

The choice of Earth Termination layout design depends on multiple factors, but essentially . . .

- The purpose
- The ground conditions

From BS:EN 62305 . . .

For Lightning Protection, BS:EN 62305:3 advocates two types of Earthing System:

- **TYPE A** - simple earth electrode (*page EAR:5*)
- **TYPE B** - crows foot or counterpoise (*page EAR:5*)
These are ideally suited to areas of high soil resistivity and structures containing electronic equipment and hazardous materials.
- Foundation electrodes may be employed - these are similar to **TYPE B** and are installed within the building's foundation itself.

Factors influencing the ability to achieve a satisfactory earth resistivity value

The soil composition also affects the resistivity of the soil itself. The presence of salts can significantly reduce resistivity which also, with some other elements, can become extremely corrosive to the material used in an earthing system.

Corrosion resistance is of paramount importance.

Soil resistivity readings should be taken prior to designing an Earth Termination Network. The reason for this is that the nature of the soil has a major influence over the final resistivity of the Earth Termination network.

This can be illustrated in the following tables . . .

Effects of moisture content on resistivity

Moisture Content % by weight	Resistivity (Ωm)	
	Top soil	Sandy loam
0	10 x 10 ⁶	10 x 10 ⁶
2.5	2,500	1,500
5	1,650	430
10	530	185
15	310	105
20	120	63
30	64	42

Effects of temperature on resistivity

Temperature		Resistivity (Ωm)
°C	°F	
20	68	72
10	50	99
0	32 (water)	138
0	32 (ice)	300
-5	23	790
-15	14	3,300

Confused? Kingsmill are here to help you

Sometimes it is not possible to achieve the desired finished earth electrode resistance, due to the ground conditions being unfavourable - hard rocky ground, mountain tops, dry soil, etc.

For areas where the soil resistivity is very high, Kingsmill offer several “conductive aggregate” solutions to help improve resistivity - these are detailed on pages EAR:15 - 19.

We recommend the use of copper earth electrode systems due to their inherent low resistivity and corrosion resistance.

Our range encompasses:

- Solid copper earth electrodes and conductor
- Solid stainless steel electrodes
- Copperbond (copper covered steel) electrodes and conductor
- Copper conductors
- Earth bars and bonds
- Exothermic welding

Kingsmill do not recommend the use of galvanised, zinc plated or bare mild steel in buried (in direct contact with soil) earth termination networks for two reasons.

1. The high resistivity of steel compared to copper
2. Poor corrosion resistance when compared with solid copper or copperbonded steel

Similarly, the earth connection components must also be able to resist corrosion and carry the nominated fault rating of the conductor.

Exothermic Welding

It is important that all Earth Terminations can conduct the current that is required by the Earthing design.

Not only must this apply to the conductor itself, but also to the connectors used within the Earth Termination network. Exothermic joints carry 100% of the conductor fault rating, whereas bolted braided and crimped connections do not. With this in mind, Kingsmill supply a full range of exothermic welding equipment.

Exothermic welds permit the finished joint to carry the full fault rating of the conductors joined, they never loosen and being composed mainly of copper, provide first class corrosion resistance.

The Kingsmill exothermic joint provides:

- Full fault current carrying capacity
- Excellent corrosion resistance
- Ease of installation

However please note, there are instances where a bolted connection is required. For example, where the earth conductor needs to be disconnected from the earth electrode for testing, or where the installation of an exothermic weld is not possible.



KingsWeld Exothermic Welding

KingsWeld products, including applications and methods can be found in the KingsWeld section.

A chain is only as good as its weakest link . . .



. . . poor component selection can seriously impair a system!

Copperbond Earth Rods



Copperbond Earth Rods, deep driven, usually provide the most cost effective earth system. They are made from a low carbon, high tensile strength (minimum 600n/mm²) steel core with a coating of 99.9% pure electrolytic copper, that has been molecularly bonded to the steel core.

Extendable type rods have a rolled thread (UNC2A) at each end.

Rolled threads have a higher strength than cut threads. Additionally, they preserve the copper coating over the threaded sections thus improving corrosion resistance.

NOMINAL DIA. (in : mm)	LENGTH (mm)	THREAD SIZE UNC (in)	SHANK DIA. (mm)	WEIGHT (kg)	PART NO.
3/8 : 9	1200	3/8	9.5	0.61	ERCB1004
5/8 : 16	1200	5/8	14.2	1.50	ERCB1604
5/8 : 16	1500	5/8	14.2	1.88	ERCB1605
5/8 : 16	1800	5/8	14.2	2.27	ERCB1606
5/8 : 16	2400	5/8	14.2	2.99	ERCB1608
5/8 : 16	3000	5/8	14.2	3.75	ERCB1610
3/4 : 20	1200	3/4	17.2	2.19	ERCB2004
3/4 : 20	1500	3/4	17.2	2.79	ERCB2005
3/4 : 20	1800	3/4	17.2	3.34	ERCB2006
3/4 : 20	2400	3/4	17.2	4.46	ERCB2008
3/4 : 20	3000	3/4	17.2	5.44	ERCB2010

Material: Pure copper molecularly bonded on to a steel core

Standard: BS:EN 62561-2, BS 7430

Copper Thickness: 254 microns (minimum)



UL listed Copperbond Earth Rods

NOMINAL DIA. (in)	LENGTH (mm)	THREAD SIZE UNC (in)	SHANK DIA. (mm)	WEIGHT (kg)	PART NO.
5/8	2400	5/8	14.2	2.99	ERCB1608UL
5/8	3000	5/8	14.2	3.75	ERCB1610UL
3/4	2400	3/4	17.2	4.46	ERCB2008UL
3/4	3000	3/4	17.2	5.44	ERCB2010UL

Copperbond Earth Rods should have a minimum of 254 microns of copper thickness. This measurement results from research carried out in the USA, that studied the weight loss of copper (corrosion) under differing soil conditions. It was determined that 0.254mm (or 254 microns) will provide a lifetime of 20+ years in average soil conditions.

The thread must be rolled after plating to ensure maximum copper coverage over the threads. Rolled threads are also stronger than cut threads.



APPLICATION

Driving Stud + Earth Rod + Coupling + Earth Rod + Driving Spike =

COMPONENT ASSEMBLY:

Assemble Kingsmill **Copperbond Earth Rods** to the desired length with **Couplings** and add a **Driving Stud** to the top and a **Driving Spike** to the bottom for safe driving into the ground.

Couplings (Copperbond Earth Rods)

Kingsmill **Earth Rod Couplings** are counter-bored and of sufficient length to ensure that **Earth Rod** threads are completely enclosed within the coupling. Manufactured from high strength, high copper content alloy to ensure adequate strength and corrosion resistance.

DESCRIPTION	LENGTH (mm)	BODY DIAMETER ACROSS FLATS (mm)	WEIGHT (kg)	PART NO.
Rod Coupling 5/8" UNC	68	22	0.08	COUP16
Rod Coupling 3/4" UNC	79	24	0.14	COUP20

Material: High Copper Content Alloy

Standard: BS 7430, BS:EN 62561-2: 2012

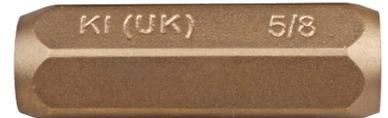
DESCRIPTION	LENGTH (mm)	ACROSS FLATS (mm)	WEIGHT (kg)	PART NO.
16mm Rod Coupling 5/8" UNC (HEX)	68	20	0.11	COUP16HEX
20mm Rod Coupling 3/4" UNC (HEX)	80	25	0.17	COUP20HEX

Material: High Copper Content Alloy

Standard: BS:EN 62561-2: 2012

DESCRIPTION	LENGTH (mm)	BODY DIA. (mm)	WEIGHT (kg)	PART NO.
5/8" Rod Coupling	80	25	0.20	COUP16S

Material: Silicon Aluminium Bronze



Driving Studs (Copperbond Earth Rods)

High strength **Driving Studs** for repeated use with power hammers.

DESCRIPTION	LENGTH (mm)	HEAD DIA. (mm)	WEIGHT (kg)	PART NO.
16mm Driving Stud 5/8" UNC	54	22	0.09	DRST16
20mm Driving Stud 3/4" UNC	62	25	0.15	DRST20

Material: High Tensile Steel with a socket-head cap screw

Standard: BS 7430



Driving Spikes (Copperbond Earth Rods)

Driving Spikes for use with our copperbond **Earth Rods**. They enable rods to be driven into hard/compacted ground with ease and are internally threaded for screwing directly onto the **Earth Rod**.

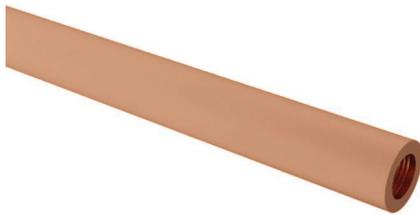
DESCRIPTION	LENGTH (mm)	HEAD DIA. (mm)	WEIGHT (kg)	PART NO.
Driving Spike for 16mm (5/8") copperbond Earth Rod	54	22	0.05	DRSP16-CB
Driving Spike for 20mm (3/4") copperbond Earth Rod	62	25	0.06	DRSP20-CB

Material: Case Hardened Steel

Standard: BS 7430



Solid Copper Earth Rods



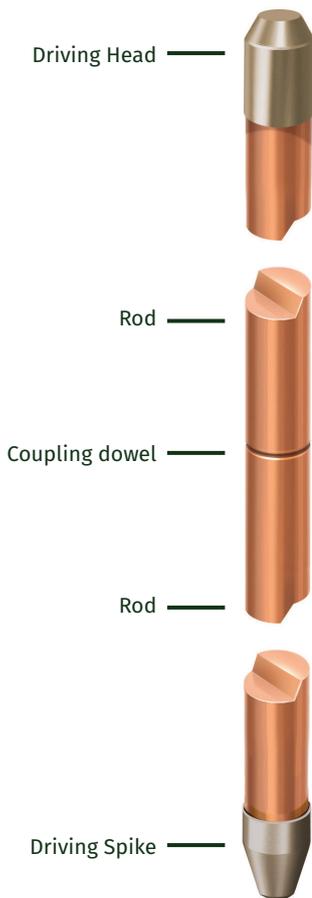
Used where soil conditions are aggressive, ie high salt content.

Solid Copper Earth Rods have a tapped hole at each end which allows them to be joined together by means of a coupling dowel.

LENGTH (mm)	DIAMETER (mm)	INTERNAL THREAD (mm)	WEIGHT (kg)	PART No.
1200	15	M10	1.85	ERSC1504
1200	16	M10	2.10	ERSC1604
1500	16	M10	2.49	ERSC1605
1800	16	M10	2.99	ERSC1606
2400	16	M10	3.99	ERSC1608
3000	16	M10	4.99	ERSC1610
1200	20	M10	3.30	ERSC2004
1500	20	M10	4.14	ERSC2005
1800	20	M10	5.02	ERSC2006
2400	20	M10	6.70	ERSC2008
3000	20	M10	8.38	ERSC2010
1200	25	M10	5.18	ERSC2504
1500	25	M10	6.48	ERSC2505
1800	25	M10	7.78	ERSC2506
2400	25	M10	10.37	ERSC2508
3000	25	M10	12.97	ERSC2510

Material: 99.9% Hard Drawn Copper

Standard: BS:EN 62561-2, BS 7430



APPLICATION

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+
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Driving Head Earth Rod Coupling Dowel Earth Rod Driving Spike

COMPONENT ASSEMBLY:

Assemble Kingsmill **Copperbond Earth Rods** to the desired length with **Couplings** and add a **Driving Stud** to the top and a **Driving Spike** to the bottom for safe driving into the ground.

Driving Heads (Solid Copper Earth Rods)

Kingsmill **Driving Heads** protect both the internal thread and the top of the **Solid Copper Earth Rod** whilst the rods are being driven into the ground.

DESCRIPTION	LENGTH (mm)	THREAD DIA. (mm)	WEIGHT (kg)	PART NO.
16mm Rod Driving Head	40	10	0.04	DRHD16
20mm Rod Driving Head	42	10	0.06	DRHD20
25mm Rod Driving Head	45	10	0.09	DRHD25

Material: Steel

Standard: BS 7430



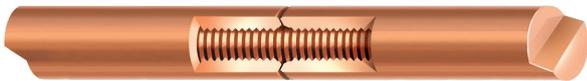
Coupling Dowel (Solid Copper Earth Rods)

Kingsmill **Coupling Dowels** are used to join solid copper Earth Rods.

DESCRIPTION	LENGTH (mm)	THREAD DIA. (mm)	WEIGHT (kg)	PART NO.
M10 Coupling Dowel	40	10	0.02	DWPB10

Material: Phosphor Bronze

Standard: BS 7430



Driving Spikes (Solid Copper Earth Rods)

Driving Spikes enable the **Solid Copper Earth Rod** to be driven into the ground easily while protecting the end of the rod from damage.

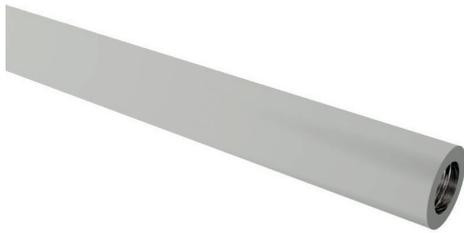
DESCRIPTION	LENGTH (mm)	THREAD DIA. (mm)	WEIGHT (kg)	PART NO.
16mm Rod Driving Spike	40	10	0.03	DRSP16
20mm Rod Driving Spike	55	10	0.06	DRSP20
25mm Rod Driving Spike	60	10	0.10	DRSP25

Material: Case Hardened Steel

Standard: BS 7430



Stainless Steel Earth Rods



Made from austenitic steel to British standards.

Stainless Steel Earth Rods are similar to our **Solid Copper Rods** but are more anodic than copper, and are useful where galvanic corrosion might occur due to buried dissimilar metals being in close proximity to each other. The current carrying capacity of the **Stainless Steel Earth Rod** in relation to copper is poor.

Stainless Steel Earth Rods have a tapped hole at each end which allows them to be joined together by means of a coupling dowel.

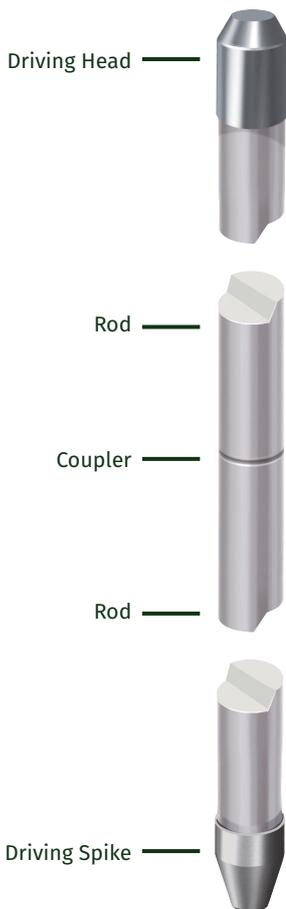
Stainless Steel Earth Rods can, if required, be supplied in different grades.

LENGTH (mm)	DIAMETER (mm)	INTERNAL THREAD (mm)	WEIGHT (kg)	PART NO.
1200	16	M10	1.87	ERSS1604
1500	16	M10	2.34	ERSS1605
1800	16	M10	2.81	ERSS1606
2400	16	M10	3.75	ERSS1608
3000	16	M10	4.69	ERSS1610
1200	20	M10	2.96	ERSS2004
1500	20	M10	3.65	ERSS2005
1800	20	M10	4.38	ERSS2006
2400	20	M10	5.84	ERSS2008
3000	20	M10	7.30	ERSS2010
1200	25	M10	4.89	ERSS2504
1500	25	M10	6.12	ERSS2505
1800	25	M10	7.34	ERSS2506
2400	25	M10	9.79	ERSS2508
3000	25	M10	12.24	ERSS2510

Material: Stainless steel

Standard: BS:EN 62561-2, BS 7430

Recommended for clay soils and marine/shore environments.



APPLICATION



COMPONENT ASSEMBLY:

Assemble Kingsmill **Stainless Steel Earth Rods** to the desired length with **Couplings** and add a **Driving Stud** to the top and a **Driving Spike** to the bottom for safe driving into the ground.

Driving Heads (Stainless Steel Earth Rods)

Kingsmill **Driving Heads** are designed to protect both the internal thread and the top of the **Stainless Steel Earth Rod** whilst the rods are being driven into the ground.

DESCRIPTION	LENGTH (mm)	THREAD DIA. (mm)	WEIGHT (kg)	PART NO.
16mm Rod Driving Head	40	10	0.04	DRHD16
20mm Rod Driving Head	42	10	0.06	DRHD20
25mm Rod Driving Head	45	10	0.09	DRHD25

Material: Steel

Standard: BS 7430



Coupling Dowel (Stainless Steel Earth Rods)

Kingsmill **Coupling Dowels** are used to join stainless steel earth rods.

LENGTH (mm)	THREAD DIA. (mm)	WEIGHT (kg)	PART NO.
40	10	0.02	DWSS10

Material: Stainless Steel

Standard: BS 7430



Driving Spikes (Stainless Steel Earth Rods)

Driving Spikes enable the **Solid Copper Earth Rod** to be driven into the ground easily while protecting the end of the rod from damage.

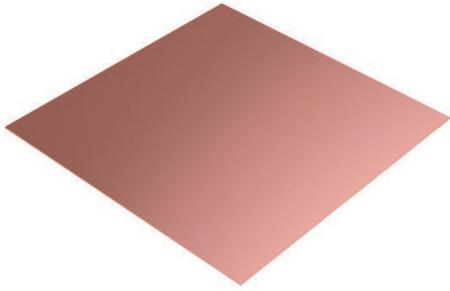
DESCRIPTION	LENGTH (mm)	THREAD DIA. (mm)	WEIGHT (kg)	PART NO.
16mm Rod Driving Spike	40	10	0.03	DRSP16
20mm Rod Driving Spike	55	10	0.06	DRSP20
25mm Rod Driving Spike	60	10	0.10	DRSP25

Material: Case Hardened Steel

Standard: BS 7430



Solid Copper Plates



Kingsmill **Solid Copper Earth Plates** are used as part of an earthing network. They provide a long lasting solution where it is not possible to use deep driven **Earth Rods**.

Generally used as an electrode where significant amounts of fault current can be encountered.

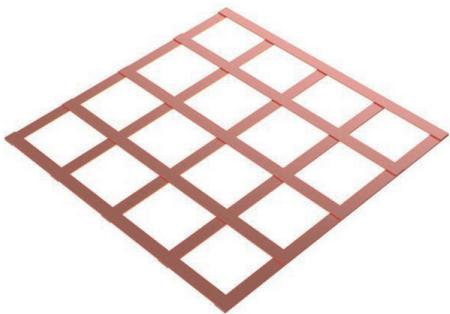
LENGTH x WIDTH (mm)	THICKNESS (mm)	SURFACE AREA (m ²)	WEIGHT (kg)	PART NO.
600 x 600	1.5	0.73	4.87	SCEP615
600 x 600	3.0	0.73	11.20	SCEP630
900 x 900	1.5	1.63	9.74	SCEP915
900 x 900	3.0	1.63	21.75	SCEP930

Material: Copper

Standard: BS:EN 12163 (formerly BS 2874)

OTHER SIZES ARE AVAILABLE UPON REQUEST

Lattice Copper Earth Mats



Kingsmill **Lattice Copper Earth Mats** are used where step potential could cause problems.

They are a lower cost option to the solid plates and when used with **Marconite**[®], they provide a long lasting earth solution.

Generally used as an electrode where significant amounts of fault current can be encountered.

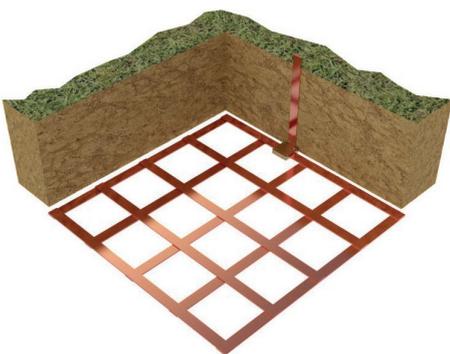
LENGTH x WIDTH (mm)	THICKNESS (mm)	SURFACE AREA (m ²)	GRID	WEIGHT (kg)	PART NO.
600 x 600	3.0	0.31	5 Bar	4.02	LCEM630
900 x 900	3.0	0.65	5 Bar	5.90	LCEM930

Material: Copper

Standard: BS:EN 12163 (formerly BS 2874)

OTHER SIZES ARE AVAILABLE UPON REQUEST

When buried horizontally, **Earth Mats** can provide an equipotential plane for protecting operators at switching positions.



Pre-Fabricated Earth Mats

Kingsmill can provide a bespoke service for large **Earth Mats**, which can be rolled-out on site.

Please contact us with your requirements.

Bentonite - Moisture Retaining Clay

Bentonite is used as a backfill to reduce soil resistivity. When mixed with water, it swells to several times its dry volume. This moisture content can be retained for a considerable time and further moisture can be absorbed during rainfall etc. Bentonite can be supplied in either powder or granular form.

Approximately 18 x 25kg bags create a volume of 1m³ (depending on soil and excavation conditions).

MATERIAL	WEIGHT (kg)	Part NO.
Granulated Moisture Retaining Clay	25	BENT01
Powdered Moisture Retaining Clay	25	BENT02



Earthing Compound

Granular: Granular is the preferred option for filling trenches. The conductor is surrounded with Bentonite and then water poured over and mixed in the trench.

Powder: Powder is the preferred product for pouring into bore holes, ensuring the mixture is of a thin enough consistency to reach the bottom of the bore hole.

Material: Sodium carbonate activated calcium montmorillonite clay. The product is a naturally occurring substance with no known ecological hazards, and can be disposed of as non-hazardous waste.

Marconite® - Granulated Conductive Aggregate



Marconite® is a granulated conductive medium designed to replace the conventional aggregate in concrete and thereby provide a permanent medium with good electrical conductivity and high strength.

It can provide a permanent solution to problems in electrical/ constructional situations.

Marconite® concrete is touch dry within hours, but it will be several days before it is fully cured.

Marconite® is chemically inert with very low soluble sulphate content. It can be used with all conventional types of cement, as well as most proprietary resin-based cements, adhesives and gypsum plasters.

MATERIAL	WEIGHT (kg)	Part No.
Marconite Concrete (Pre-Mixed)	25	MARCONITE-01
Marconite Concrete	25	MARCONITE-02

Marconite® is the ideal solution for use in problem earth situations

- a) In areas of poor soil conductivity (high resistivity) - eg rocky areas, sandy soil etc.
- b) In conjunction with lattice mats/plates (where the earth electrodes cannot be deep driven)
- c) Where space is limited

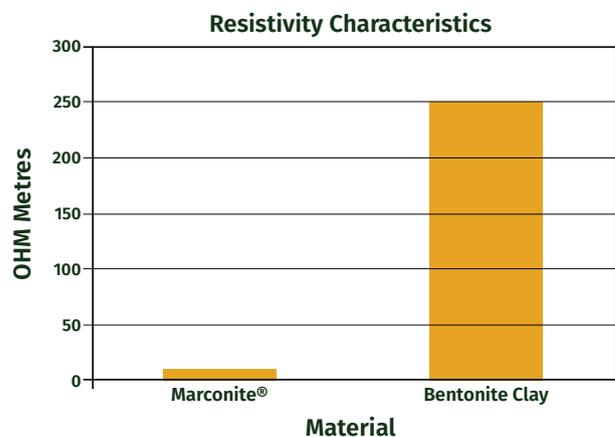
Depending on the surrounding soil conditions Marconite® can reduce electrode resistivity by up to 50%.

Electricity is conducted in much the same way as via metal, through the movement of electrons and direct contact with the carbonaceous particles that compose Marconite®.

This provides a huge advantage over materials such as Bentonite, that rely on conducting electricity through the movement of charged ions. Ions require the presence of an effective electrolyte - water and salts. Such ion type systems can dry out and without water cannot conduct electricity.

Marconite® has a resistivity that is many times lower than that of Bentonite (Marconite 0.001Ωm vs Bentonite 3Ωm) in its natural setting or untamped condition.

Through acting as a backfill, (Marconite® is a highly conductive material), the surface area of the electrode is increased, thus reducing the electrodes' resistance to earth.



Theft deterrent

When copper conductors are encased in a Marconite®/concrete surround, this acts as a deterrent to those intent on stealing copper from cell sites and substations.

Advantages

Marconite® is a granulated conductive medium designed to replace the conventional aggregate in concrete and thereby provide a permanent medium with good electrical conductivity and strength.

- Low resistivity, especially when compared to Bentonite.
- Does not rely on moisture to conduct electricity.
- No seasonal variation - does not rely on water to conduct, does not shrink.
- Does not require maintenance.
- Chemically inert and non-polluting - non-corrosive to steel and copper, it does not attack cement structures. Its PH is within the neutral range.
- Environmentally safe - it does not dissolve or dissipate like other chemical enhancers such as caustic soda, salt and acid based products.
- Easy to use - forms a concrete like material that can be poured as a slurry and in some situations, used dry.
- Acts as a theft deterrent.
- High strength - can be used as part of the building structure and achieve strengths of grade 25 concrete.
- Synthetic material manufactured specifically for earthing applications.

Mixing instructions

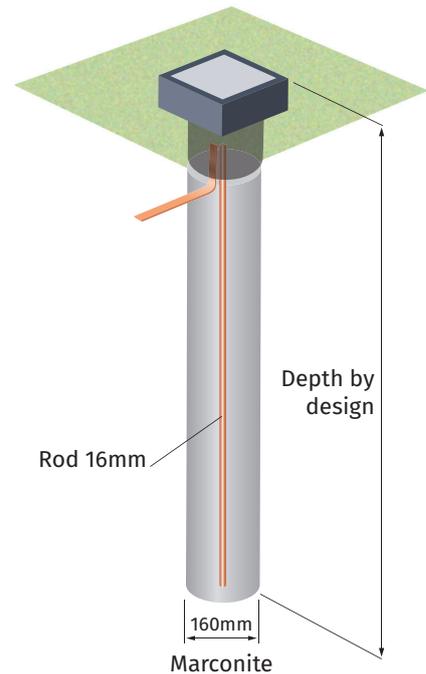
Plain Marconite®	<p>3:1 mix Marconite®/cement by weight plus 1 litre of water per 4kg. (ie 3 x 25kg bags of Marconite®, 1 x 25kg bag of cement, 6 litres of water.)</p> <p>It is possible to vary the ordinary portland cement and water content to suit local conditions, but this will affect the performance of the finished concrete.</p>
Marconite® Premix	<p>Cement and Marconite® have already been mixed, simply add 6 litres of water per 25kg bag of Marconite® Premix.</p> <p>When mixed as above, a relatively dry material is formed. Water content can be adjusted as the application requires, but this will affect drying times and resultant compressive strength. Typically, the mix is touch dry within hours but not fully cured until after several days.</p>
Density	<ul style="list-style-type: none"> • Pure dry Marconite® (Marconite-01) is approximately 1,000kg/m³ (40 x 25kg bag per one cubic metre) • Dry Marconite® pre-mix (Marconite-02) is approximately 1,250kg/m³ (50 x 25kg bags per one cubic metre) • The fully hardened density of Marconite® concrete, mixed as per instructions, is 1,500kg/m³

We recommend plain Marconite for export markets.

Application

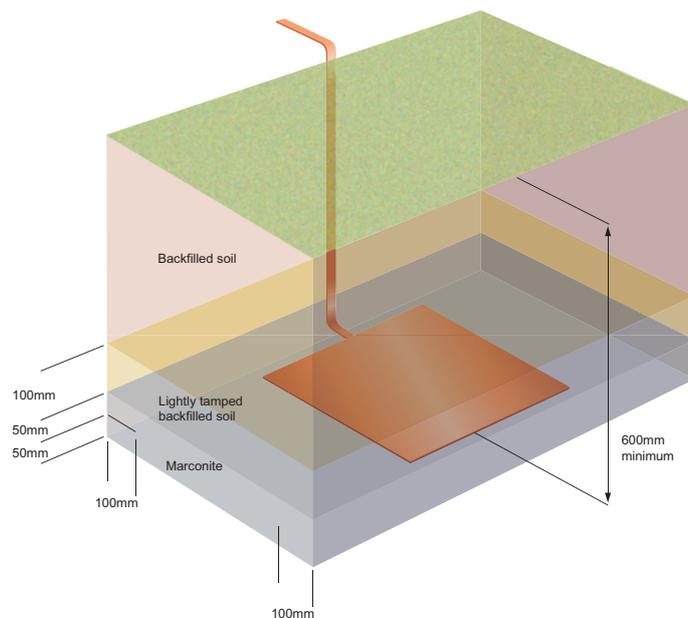
Earth Rod installation

- Drill a hole 10 x the diameter of the earth rod (16mm diameter rod = 160mm diameter hole)
- Centre the earth rod in the hole and lower it to the bottom
- Mix Marconite® into a slurry and pour into the hole
- Tamp down the mix during pouring to exclude air pockets
- Keep the earth rod central to the hole
- Take a resistivity reading immediately after installation and again 14 days later



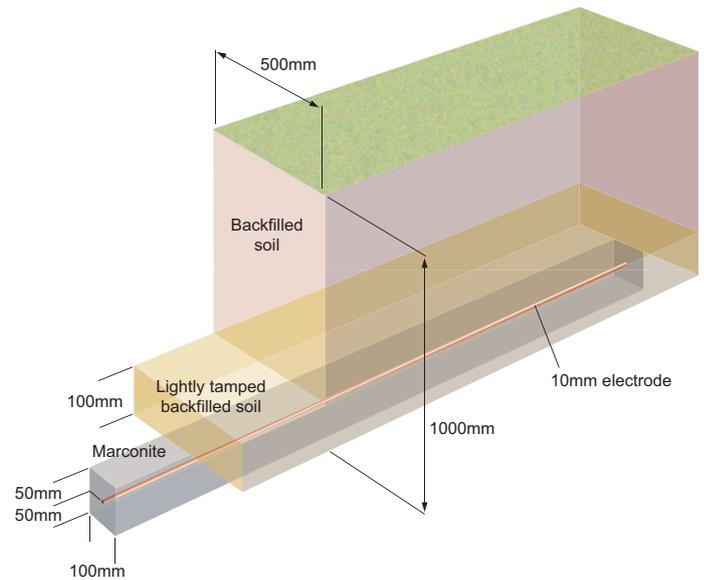
Trench installation (plate/mat)

- Excavate a trench to approximately 200mm larger, all round than the plate dimensions. The trench should typically be 1,000m deep (minimum 600mm)
- Mix the Marconite® into a slurry and pour into the trench to a depth of 50mm
- Connect the earth plate/mat to the connecting conductors
- Place the earth plate/mat on top of the first layer of Marconite® mix
- Cover the earth plate/mat with a second layer of Marconite® mix to a depth of 50mm
- Backfill the trench with native soil to a depth of 100mm and lightly tamp down
- Then backfill the trench according to the clients requirement
- The use of marker tape or tiles might be required
- Take a resistivity reading immediately after installation and again 14 days later



Trench installation (conductor)

- Excavate a trench, typically 1m deep and 0.5m wide. The length of the trench is determined by the resistivity of the native soil and the system requirement
- At the bottom of the trench excavate a small channel minimum dimensions 100mm wide and 100mm deep
- Mix the Marconite® into a slurry and pour into the channel to a depth of 50mm
- Lay the conductor on top of the first layer of Marconite® mix
- Cover the conductor with a second layer of Marconite® mix to a depth of 50mm
- Backfill the trench with native soil to a depth of 100mm and lightly tamp down
- Then backfill the trench according to the clients requirement
- The use of marker tape or tiles might be required
- Take a resistivity reading immediately after installation and again 14 days later



Concrete Inspection Pit



Kingsmill **Concrete Inspection Pits** are suitable for load rating to 4,500kg and are suitable for most types of Earthing and Lightning Protection installations.

The **Concrete Inspection Pit** protects the Earth Rod connection and makes it available for inspection. The **Concrete Inspection Pit** can have an Earth Bar fitted diagonally in slots provided for multiple conductor connections.

DESCRIPTION	DIMENSIONS (mm)	WEIGHT (kg)	PART NO.
Concrete Inspection Pit	315 x 315 x 165	25	CPIT

Material: Concrete

Standard: BS:EN 62561-5:2011



Inspection Pit Earth Bars (for Concrete Inspection Pit)



Kingsmill **Inspection Pit Earth Bars** are used to facilitate testing of the earth electrode or earthing system.

The **Earth Bar** can be fitted into slots, to provide for multiple conductor connections.

DESCRIPTION	SIZE (mm) L x W x T	HOLE SIZE (mm)	WEIGHT (kg)	PART NO.
5 hole pit Earth Bar	300 x 25 x 6	11	0.37	PBAR5
7 hole pit Earth Bar	300 x 25 x 6	11	0.36	PBAR7

Material: Copper

Standard: BS:EN 13601



Inspection Pit Earth Bars (tinned)

DESCRIPTION	SIZE (mm) L x W x T	HOLE SIZE (mm)	WEIGHT (kg)	PART NO.
3 hole pit Tinned Earth Bar	290 x 31 x 6	11	0.50	PBAR290
5 hole pit Tinned Earth Bar	290 x 31 x 6	11	0.49	PBAR316

Material: Tinned Copper

Standard: BS:EN 13601

Lightweight Concrete Inspection Pit

Kingsmill **Lightweight Concrete Inspection Pits** are suitable for load rating to 4,500kg and are suitable for most types of Earthing and Lightning Protection installations.

The **Lightweight Concrete Inspection Pit** protects the **Earth Rod** connection and makes it available for inspection. The Inspection Pit can have an **Earth Bar** fitted diagonally in slots provided. These **Earth Bars** (see below) allow for multiple conductor connections.

DESCRIPTION	DIMENSIONS (mm)	WEIGHT (kg)	PART NO.
Lightweight Concrete Inspection Pit		16	CPIT/LW

Material: Concrete
Standard: BS:EN 62561-8:2011



Inspection Pit Earth Bars (for Lightweight Concrete Inspection Pit)

Kingsmill **Inspection Pit Earth Bars** are used to facilitate testing of the earth electrode or earthing system.

The **Inspection Pit Earth Bar** can be fitted diagonally in slots provided in the **Lightweight Concrete Inspection Pit**. They are suitable for multiple - 5 or 7 - conductor connections.

DESCRIPTION	OVERALL SIZE (mm)	HOLE SIZE (mm)	WEIGHT (kg)	PART NO.
5 hole Earth Bar	230 x 25 x 6	11	0.29	PBAR5/LW
7 hole Earth Bar	230 x 25 x 6	11	0.28	PBAR7/LW

Material: Copper
Standard: BS:EN 13601



Concrete Inspection Pit - 500 x 500



Kingsmill **Concrete Inspection Pits - 500 x 500** are designed for use where more space is required in the chamber.

DESCRIPTION	WEIGHT (kg)	PART NO.
Concrete Inspection Pit 500 x 500 x 500	185	CPIT500

Material: Concrete

Inspection Pit Earth Bars (for 500 x 500 Concrete Inspection Pit)



Kingsmill **Inspection Pit Earth Bars** are used to facilitate testing of the earth electrode or earthing system.

Inspection Pit Earth Bars can be fitted diagonally in slots provided in the **Concrete Inspection Pits**. These allow for multiple conductor connections.

DESCRIPTION	OVERALL SIZE L x W x T (mm)	HOLE DIA. (mm)	FINISH	WEIGHT (kg)	PART NO.
5 hole bar for CPIT500	490 x 50 x 6	11	Bare	0.81	PBAR5CBP500
5 hole bar for CPIT500	490 x 50 x 6	11	Tinned	0.81	PBAR5CTP500
7 hole bar for CPIT500	490 x 50 x 6	11	Bare	0.80	PBAR7CBP500
7 hole bar for CPIT500	490 x 50 x 6	11	Tinned	0.80	PBAR7CTP500

Material: Copper

Standard: BS:EN 13601

Concrete Inspection Pits (with lifting eye/brass plate)

Kingsmill enhanced **Concrete Inspection Pits with lifting eye/brass plate** can be customised to your exact requirements.

The **lifting eye** makes it easy to remove the pit lid for applications where regular inspection is required.

Inlaid **brass plates** can be engraved as required. Typical engraving includes identification and safety notices and these can be produced in any language.

DESCRIPTION	WEIGHT (kg)	PART NO.
Concrete Inspection Pit c/w lifting eye	25	CPIT-LE
Concrete Inspection Pit c/w brass plate	25	CPIT-BP
Concrete Inspection Pit c/w lifting eye & brass plate	25	CPIT-LE-BP

Dimensions: 315mm x 315mm x 165mm
(W x D x H)

Material: Concrete



Inspection Pit Earth Bars (for Concrete Inspection Pit with lifting eye/brass plate)

Kingsmill **Inspection Pit Earth Bars** are used to facilitate testing of the earth electrode or earthing system.

The **Earth Bar** can be fitted diagonally in slots provided for multiple conductor connections.

DESCRIPTION	OVERALL SIZE (mm) L x W x T	HOLE DIA. (mm)	WEIGHT (kg)	PART NO.
5 hole Earth Bar	300 x 25 x 6	11	0.37	PBAR5
7 hole Earth Bar	300 x 25 x 6	11	0.36	PBAR7

Material: Copper

Standard: BS:EN 13601, BS:EN 62561-5:2011



Cable Protection Covers



Cable Protection Covers are wet cast concrete impressed with a warning of 'DANGER ELECTRICITY'.

Available in 3 standard lengths: 150mm, 230mm and 305mm.

WIDTH (mm)	LENGTH (mm)	WEIGHT (kg)	PART NO.
150	914	15	CCP6
230	914	23	CCP9
305	914	29	CCP12

Material: Concrete

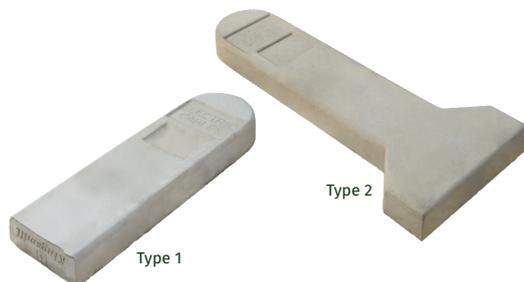
Care should be taken in selecting the cover size as the cover should be wider than the service line over which it is to be placed.

Cable Protection Covers can be supplied in red coloured concrete:

WIDTH (mm)	LENGTH (mm)	WEIGHT (kg)	PART NO.
150	914	15	CCP6R
230	914	23	CCP9R
305	914	29	CCP12R

Material: Concrete

Marker Posts



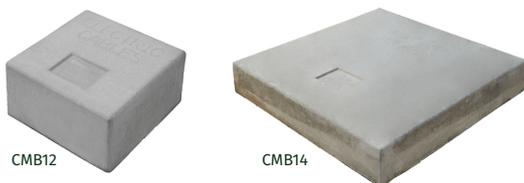
Marker Posts for the indication of electric cable junctions and field markers.

- Impressed with the words 'ELECTRIC CABLES'
- Manufactured using wet cast concrete
- 100 x 76mm recess for supplementary identification plates

TYPE	LENGTH (mm)	DEPTH (mm)	WEIGHT (kg)	QUANTITY (per pallet)	PART NO.
1	610	80	14	30	CMPT1
2	762	80	24	30	CMPT2

Material: Concrete

Marker Blocks



Marker Blocks for the marking of underground buried electrical services and junctions.

- Concrete blocks impressed with 'ELECTRIC CABLES'
- Manufactured using wet cast concrete
- 100mm x 76mm recess for supplementary identification plates

LENGTH (mm)	WIDTH (mm)	DEPTH (mm)	WEIGHT (kg)	QUANTITY (per pallet)	PART NO.
305	305	150	33	18	CMB12
610	610	100	87	10	CMB24

Material: Concrete

Plastic Inspection Pit

The **Plastic Inspection Pit** protects the **Earth Rod** connection and makes it available for inspection. The **Plastic Inspection Pit** can have up to 3 **Earth Bars** fitted in the slots provided for multiple connections.

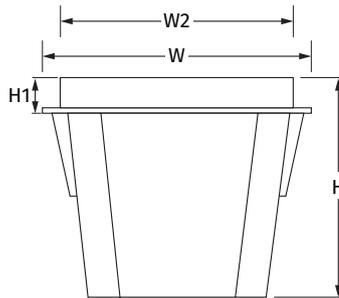
DESCRIPTION	W	W2	H	H1	WEIGHT (kg)	PART NO.
Plastic Inspection Pit	306	260	216	55	3.00	PPIT-K

Paving can be laid up to the lid edge without an unsightly concrete filler surround. Installation instructions are printed on the side. Will withstand 6000kg load when installed correctly.

Lockable lid, using a screwdriver or special key to release the locking mechanism.

Material: Polypropylene (body)
GRP (lid)

Standard: BS:EN 62561-5:2011



Earth Bars (for Plastic Inspection Pit)

Kingsmill **Inspection Pit Earth Bars** are used to facilitate testing of the earth electrode or earthing system.

The **Inspection Pit Earth Bar** can be fitted width ways in slots provided in the base of the **Plastic Inspection Pit** (three slots per pit).

DESCRIPTION	OVERALL SIZE (mm) L x W x T	HOLE SIZE (mm)	WEIGHT (kg)	PART NO.
5 hole Earth Bar	203 x 25 x 6	11	0.24	PBAR5PPK
7 hole Earth Bar	203 x 25 x 6	11	0.22	PBAR7PPK

Material: Copper

Standard: BS:EN 13601



Light Duty Plastic Inspection Pit



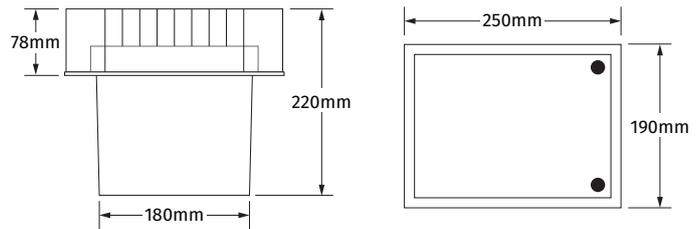
Kingsmill **Light Duty Plastic Inspection Pits** are suitable for load rating to 500kg and is suitable for most types of Earthing and Lightning Protection installations.

The **Light Duty Plastic Inspection Pit** protects the **Earth Rod** connection and makes it available for inspection. The pit can have an **Earth Bar** fitted width ways in slots provided for multiple connections.

DESCRIPTION	WEIGHT (kg)	PART NO.
Light Duty Plastic Inspection Pit	1.28	PPIT-G

Material: Polypropylene

Standard: BS:EN 62561-5:2011



Earth Bars (for Light Duty Plastic Inspection Pit)



Kingsmill **Inspection Pit Earth Bars** are used to facilitate testing of the earth electrode or earthing system.

The **Earth Bar** can be fitted width ways in a slot (one) provided. The **Earth Bar** allows for multiple conductor connections.

DESCRIPTION	OVERALL SIZE (mm) L x W x T	HOLE SIZE (mm)	WEIGHT (kg)	PART NO.
5 hole Pit Bar	200 x 25 x 6	11	0.24	PBAR5/PP
7 hole Pit Bar	200 x 25 x 6	11	0.23	PBAR7/PP

Material: Copper

Standard: BS:EN 13601



Single Flange Earth Rod Seals

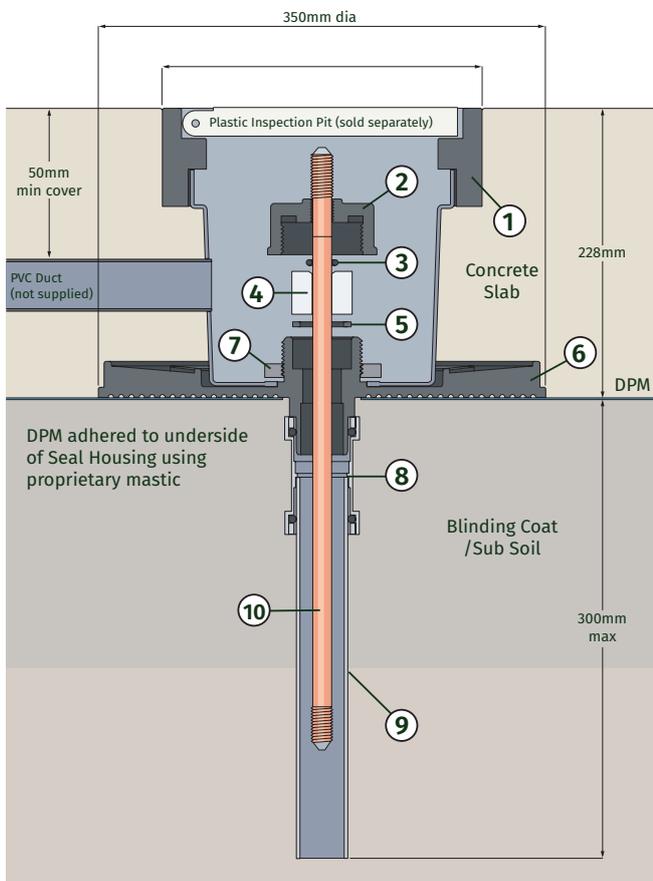
A waterproof earth electrode **Single Flange Seal** for use in constructions where internal earths are specified.

Unique design allows the seals to be used with a broad range of rod diameters. Use with PPIT-G **Plastic Inspection Pit** (page EAR:26).

ROD DIA. (in : mm)	ROD TYPE	LENGTH (mm)	WEIGHT (kg)	PART NO.
5/8" UNC	Copperbond	300	1.92	KES-58
3/4" UNC	Copperbond	300	1.92	KES-34
15mm	Solid Copper/Stainless Steel	300	1.92	KES-15
16mm	Solid Copper/Stainless Steel	300	1.92	KES-16
20mm	Solid Copper/Stainless Steel	300	1.92	KES-20

Material: High Density Plastic

Standard: BS:EN 62561-5:2011 and an extended 5 day test following BS:EN 62561-5 test conditions.



Benefits:

Additional Earth Rods can be driven at a later date, with no additional parts or causing damage to the Earth Rod Seal.



Kingsmill **Single Flange Earth Rod Seals** have been designed for use in concrete slabs with a nominal thickness of 300mm. They will withstand a pressure up to 80psi (5.5 bar) and have been tested accordingly.

- ① Plastic Inspection Pit (sold separately)
- ② Seal Cap
- ③ 'O' Ring Rod Seal
- ④ Compression Collar
- ⑤ EDPM Flat Seal Washer
- ⑥ Seal Housing
- ⑦ Inspection Pit Lock Nut
- ⑧ Seal Tube Coupler
- ⑨ Seal Tube
- ⑩ Earth Rod (sold separately)



Installation Notes:

Ingress of water from anywhere other than around the Earth Rod Seal is the responsibility of the installation contractor. The Earth Rod Seal flange and components must be free from dust/debris/grease/paint before pouring the concrete (highest quality and fully compacted to ensure sealing).

Performance depends on the integrity of the surrounding concrete. The main concrete slab must not be shuttered out and the Earth Rod Seal fitted later.

Double Flange Earth Rod Seal



Kingsmill **Double Flange Earth Rod Seals** have been designed for use in concrete slabs with a nominal thickness of 300mm. They will withstand a pressure up to 80psi (5.5 bar) and have been tested accordingly.

- ① Plastic Inspection Pit (Sold Separately)
- ② Seal Cap
- ③ 'O' Ring Rod Seal
- ④ Compression Collar
- ⑤ EDPM Flat Seal Washer
- ⑥ Seal Housing
- ⑦ Inspection Pit Lock Nut
- ⑧ Seal Tube Coupler
- ⑨ Seal Tube
- ⑩ Bottom Flange
- ⑪ Earth Rod (sold separately)



Installation Notes:

Ingress of water from anywhere other than around the Earth Rod Seal is the responsibility of the installation contractor. The Earth Rod Seal flange and components must be free from dust/debris/grease/paint before pouring the concrete (highest quality and fully compacted to ensure sealing).

Performance depends on the integrity of the surrounding concrete. The main concrete slab must not be shuttered out and the Earth Rod Seal fitted later.

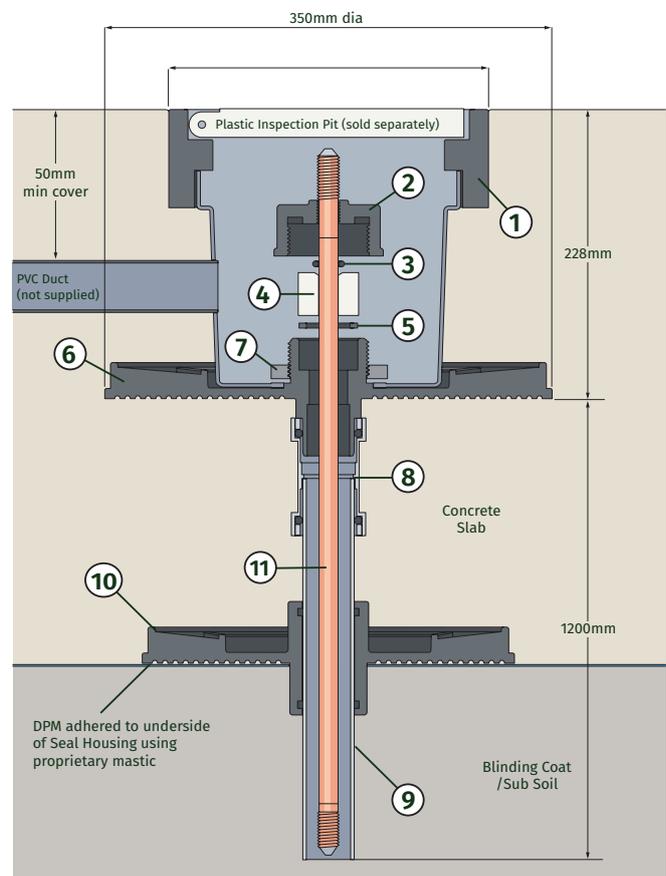
A waterproof earth electrode **Double Flange Earth Rod Seal** for use in constructions where internal earths are specified.

Unique design allows the seals to be used with a broad range of rod diameters. Use with PPIT-G **Plastic Inspection Pit** (page EAR:26).

ROD DIA. (in : mm)	ROD TYPE	LENGTH (mm)	WEIGHT (kg)	PART NO.
5/8" UNC	Copperbond	1200	2.80	KES-58-DBL
3/4" UNC	Copperbond	1200	2.80	KES-34-DBL
15mm	Solid Copper/Stainless Steel	1200	2.80	KES-15-DBL
16mm	Solid Copper/Stainless Steel	1200	2.80	KES-16-DBL
20mm	Solid Copper/Stainless Steel	1200	2.80	KES-20-DBL

Material: High Density Plastic

Standard: BS:EN 62561-5:2011 and an extended 5 day test following BS:EN 62561-5 test conditions.



Benefits:

Additional Earth Rods can be driven at a later date, with no additional parts or causing damage to the Earth Rod Seal.

Extended Seal Tubes

The **Double Flange Earth Rod Seal** is supplied with a 300mm long seal tube. Longer tube lengths are available (*see below*).

DESCRIPTION	LENGTH (mm)	WEIGHT (kg)	PART NO.
500mm seal tube	500	0.12	KES-TUBE-500
1200mm seal tube	1200	0.28	KES-TUBE-1200
2000mm seal tube	2000	0.47	KES-TUBE-2000
3000mm seal tube	3000	0.70	KES-TUBE-3000

Rod To Tape Clamps (A Type)

Rod To Tape Type 'A' Clamps are designed to join various sizes of conductor tape to the earth electrode.

The clamps have a high resistance to corrosion and are mechanically strong to ensure a lasting connection.

ROD DIAMETER (in : mm)	MAX CONDUCTOR SIZE (mm)	BOLT SIZE (mm)	BOLT MATERIAL	WEIGHT (kg)	PART NO.
5/8 : 16 - 3/4 : 20	29 x 16 - 29 x 13	M10	Stainless steel	0.10	CLA2530
5/8 : 16 - 3/4 : 20	29 x 16 - 29 x 13	M10	Stainless steel	0.23	CLA2510
5/8 : 16 - 3/4 : 20	29 x 16 - 29 x 13	M10	Stainless steel	0.21	CLA4012
5/8 : 16 - 3/4 : 20	29 x 16 - 29 x 13	M10	Stainless steel	0.21	CLA5060
5/8 : 16 - 3/4 : 20	29 x 16 - 29 x 13	M10	Phosphor bronze	0.10	CLA2530/PB
5/8 : 16 - 3/4 : 20	29 x 16 - 29 x 13	M10	Phosphor bronze	0.23	CLA2510/PB
5/8 : 16 - 3/4 : 20	29 x 16 - 29 x 13	M10	Phosphor bronze	0.21	CLA4012/PB
5/8 : 16 - 3/4 : 20	29 x 16 - 29 x 13	M10	Phosphor bronze	0.21	CLA5060/PB

Material: High Strength Copper Alloy (body), Stainless Steel or Phosphor Bronze (bolt)

Standard: BS:EN 62561-1 Class H, BS 7430

Tightening torque: 15Nm



Rod To Tape Clamps (U Bolt Single Plate Type)

Rod To Tape Type 'U' Bolt Single Plate Clamps are designed to join various sizes of conductor tape to the earth electrode.

The clamps have a high resistance to corrosion and are mechanically strong to ensure a lasting connection.

ROD DIAMETER (in : mm)	HOLE CENTRES (mm)	WEIGHT (kg)	PART NO.
5/8 : 16	37	0.21	CLUB16
3/4 : 20	37	0.21	CLUB20
1 : 25	37	0.22	CLUB25
1 1/4 : 30	43	0.22	CLUB30
2 : 50	64	0.36	CLUB50

Material: High Strength Copper Alloy (body), 99.9% HD Copper ('U' bolt)

Standard: BS:EN 62561-1 Class H, BS 7430

Tightening torque: 12Nm



Rod To Tape Clamps (U Bolt Double Plate Type)



Rod To Tape Type Clamps (U Bolt Double Plate Type) join 25 x 3 conductor tape to the earth electrode/rebar without the need to drill the tape.

The clamps have a high resistance to corrosion and are mechanically strong to ensure a lasting connection.

ROD DIAMETER (in : mm)	TAPE WIDTH (mm)	WEIGHT (kg)	PART NO.
5/8 : 16	25	0.26	CLUB16-2
3/4 : 20	25	0.27	CLUB20-2
1 : 25	25	0.28	CLUB25-2
2 : 50	25	0.40	CLUB50-2

Material: High Strength Copper Alloy (body)
99.9% HD copper ('U' bolt material)

Standard: BS 7430

Tightening torque: 12Nm

Rod To Cable Clamps (JAB Type)



Rod To Cable Clamps (JAB Type) are used to join various sizes of cable to the earth electrode.

The clamps have a high resistance to corrosion and are mechanically strong to ensure a lasting connection.

ROD DIAMETER (in : mm)	CONDUCTOR RANGE (mm ²)	BOLT MATERIAL	BOLT SIZE (mm)	WEIGHT (kg)	PART NO.
5/8" : 16mm	16 - 70	Stainless steel	M10	0.07	CLJA16
3/4" : 20mm	35 - 95	Stainless steel	M10	0.09	CLJA20
5/8" : 16mm	16 - 70	Phosphor bronze	M10	0.07	CLJA16/PB
3/4" : 20mm	35 - 95	Phosphor bronze	M10	0.09	CLJA20/PB

Material: High Strength Copper Alloy (body)
Stainless steel/phosphor bronze (bolt - see table)

Standard: BS:EN 62561-1 class H, BS 7430

Tightening torque: 12Nm

Rod To Strand Clamp



The **Rod To Strand Clamp** connects **Earth Rods** to stranded conductor.

ROD DIAMETER (in : mm)	CONDUCTOR RANGE (mm ²)	WEIGHT (kg)	PART NO.
5/8" : 16mm	35 - 70	0.38	CGUV16S

Material: Bronze (body), 99.9% HD Copper ('U' bolt)

Rod to Cable Clamps (GUV Type)

Rod to Cable Clamps (GUV Type) are designed to join various sizes of cable to earth electrodes/rebars etc. They have a high resistance to corrosion and are mechanically strong to ensure a lasting connection.

ROD DIAMETER (in : mm)	CONDUCTOR RANGE (mm ²)	WEIGHT (kg)	PART NO.
5/8 : 16 - 3/4 : 20	16 - 70	0.39	CGUV16
5/8 : 16 - 3/4 : 20	70 - 185	0.35	CGUV70
5/8 : 16 - 3/4 : 20	150 - 300	0.52	CGUV150

Material: High Tensile Copper Alloy (body)
99.9% HD Copper ('U' bolt)

Standard: BS:EN 62561-1, Class H

Tightening torque: 12Nm



CGUV16 & CGUV70



CGUV150

Rod To Cable Clamps (Keyhole Type)

Rod To Cable Clamps (Keyhole Type) are designed to join various sizes of compression lugs to the earth electrode. They have a high resistance to corrosion and are mechanically strong to ensure a lasting connection.

For use with copperbond rods

ROD DIAMETER	BOLT MATERIAL	BOLT SIZE	WEIGHT (kg)	PART NO.
9.5mm	Stainless steel	M08	0.09	CLUG10
5/8" UNC	Stainless steel	M10	0.22	CLUG16
3/4" UNC	Stainless steel	M10	0.20	CLUG20
9.5mm	Phosphor bronze	M08	0.09	CLUG10/PB
5/8" UNC	Phosphor bronze	M10	0.22	CLUG16/PB
3/4" UNC	Phosphor bronze	M10	0.20	CLUG20/PB

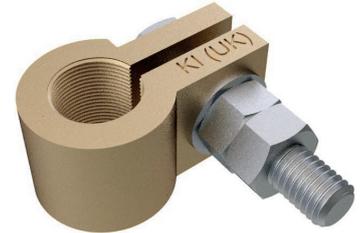
For use with solid copper rods

ROD DIAMETER (mm)	BOLT MATERIAL	BOLT SIZE	WEIGHT (kg)	PART NO.
15	Stainless steel	M10	0.21	CLUG15S
16	Stainless steel	M10	0.28	CLUG16S
20	Stainless steel	M10	0.18	CLUG20S
15	Phosphor bronze	M10	0.21	CLUG15S/PB
16	Phosphor bronze	M10	0.28	CLUG16S/PB
20	Phosphor bronze	M10	0.18	CLUG20S/PB

Material: High Tensile Copper Alloy (body)
Stainless Steel or Phosphor Bronze (bolt - see above)

Standard: BS:EN 62561-1 Class H, BS7430

Tightening torque: 12Nm



Tinmans Solder



Tinmans solder is used to braze copper bar and tape.

DESCRIPTION	LENGTH (mm)	WEIGHT (kg)	PART NO.
Tinmans solder (1/2lb stick)	300	0.26	TINS1/2

Material: Tin (60%), Lead (40%)

Denso Tape



Denso Tape offers a weatherproof seal when wrapped around joints to stop the ingress of moisture, preventing corrosion.

COIL SIZE (mm)	MATERIAL	WEIGHT (kg)	PART NO.
50 x 10000	Synthetic fabric	0.76	DEN050

Material: Synthetic - impregnated and coated with a neutral petroleum compound

Inteltox Oxide Inhibiting Paste



Inteltox Paste assures a high conductivity joint by sealing out air and moisture for prevention of corrosion and reformation of oxide film.

Recommended for use on aluminium to copper connections, bare conductors or bus bar.

DESCRIPTION	SIZE (kg)	PART NO.
Inteltox anti-oxide compound	0.25	INTELTR0X250

Supplied in a squeeze bottle with a resealable plastic cap.

Silfos



Silfos allows copper to be brazed in air without the use of flux.

SIZE (W x L) (mm)	MATERIAL	WEIGHT (kg)	PART NO.
50 x 8000	Silver, phosphorus and copper alloy	0.425	SF050