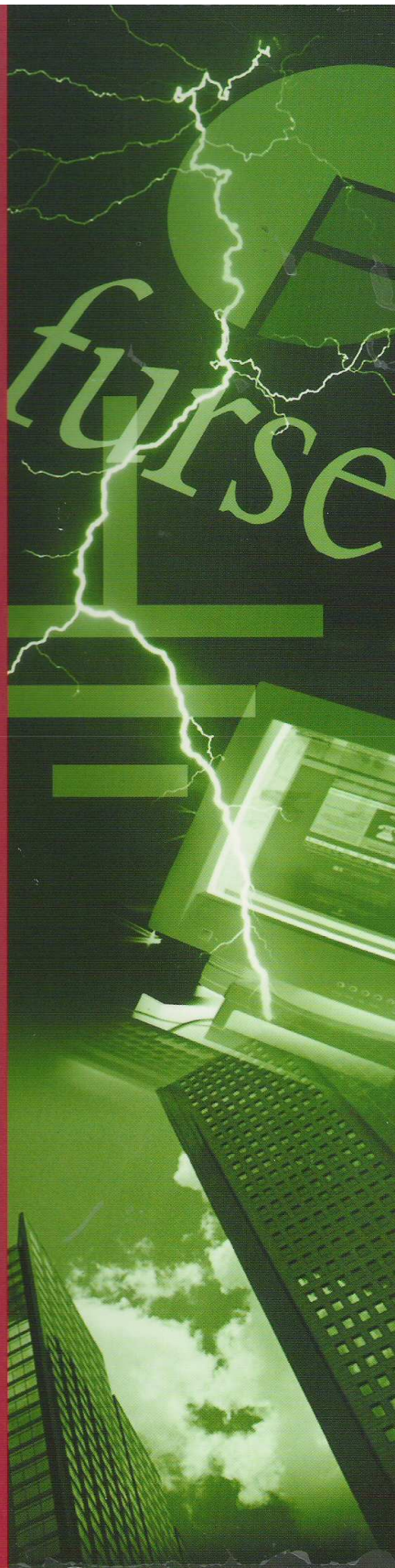


EARTHING & LIGHTNING PROTECTION



EARTHING &
LIGHTNING
PROTECTION

Structural Lightning
Protection

Conductors

Earthing materials

Compression
Connectors

Thomas & Betts

Thomas & Betts

Since 1998, Furze has been a member of the Thomas & Betts family. Home to many well-known brands and with over 100 years experience, Thomas & Betts provide a truly world-class level of quality, service and support. Thomas & Betts' Electrical Division provides the following key products:

Cable Ties and Fasteners

From the pioneers of the 'Ty-Rap®' - a huge range of cable ties, including:

- ◆ Ty-Rap® premium two piece ties with stainless steel locking barb
- ◆ Ty-Fast® high quality, one-piece all-plastic ties
- ◆ Ty-Met™ self-locking stainless steel ties
- ◆ Ty-Grip™ Hook & Loop releasable ties.

Termination Systems

A wide range of termination systems for a variety of applications, including:

- ◆ Shield-Kon® crimp connectors for an easy and reliable earth termination of shielded cables
- ◆ Sta-Kon® insulated and non-insulated crimp terminals splices and disconnects
- ◆ Dragon Tooth® insulation piercing crimp connectors to splice, tap and terminate magnet wires
- ◆ Color-Keyed® compression copper tube lugs for power, bonding and grounding.

Heatshrink

Shrink-Kon® multi-purpose heatshrink for use in insulation, protection, identification and strain relief:

- ◆ Manufactured from cross-linked polyolefin
- ◆ Available in a variety of shrink ratios
- ◆ Up to 14 nominal widths to deal with a large variety of applications.

Conduit and Fittings

A range of flexible conduit and fittings to provide excellent protection of electrical cables against external aggressions (mechanical shocks and vibrations, liquids, chemicals, oils, dust, heat):

- ◆ The Shureseal™ range of flexible, metallic and non-metallic conduits and fittings (up to IP67), available in 7 specific grades to cover the most demanding applications
- ◆ The Shureflex™ system of ultra-flexible conduit in galvanised steel, offers an economic solution in industrial and commercial applications where a high level of flexibility and good mechanical resistance are required.

In addition, Thomas & Betts is also proud to present the following brands:



The E-Klips range of spring steel fasteners offers a quick, easy and reliable method of fixing services to steelwork without the need for bracket making, drilling holes or the use of nuts and bolts. They can be installed using a minimum of tools - usually only a hammer, screwdriver or pair of pliers.



Emergi-Lite is an established name for self-contained emergency luminaires and analogue addressable and conventional fire detection products. Emergi-Lite products, like the infra-red emergency lighting testing system, have been installed in such prestigious buildings as the Savoy Hotel and the Palace of Westminster in London.



Existalite provide emergency lighting solutions to the lighting industry. They have built a reputation for providing high quality products, including inverter ballasts and conversion packs for a wide range of lamps. Also produced is low location emergency exit lighting for marine, rail and land based applications.



With over 50 years experience, Kaufel are experts in emergency lighting. They provide a complete range of self-contained luminaires, central sources and slave luminaires as well as a complementary range of fire alarms.



Since its formation over 75 years ago as a battery manufacturer, KAUFEL (formerly known as NIFE for many decades), has become a leading manufacturer of power supply systems and emergency lighting units. Every power system is designed specifically to meet each customer's unique requirements.



With over 50 years experience, Van Lien produce a wide range of quality emergency lighting products. These include: Luminaires for centralised and decentralised systems; Conversion units; Mobile emergency lighting and Central power and test systems.

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With over 100 years experience, Furse is the name you can rely on

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Q06054

Company background

A world of experience



Since 1893, when William Joseph Furse bought a small steeplejacking company, Furse has been proud of our commitment to innovation and quality.

Through the intervening period of massive commercial and technological change, Furse has continued to expand and grow, becoming a world leader in structural lightning protection, earthing and transient overvoltage protection.



By working on projects in over 120 countries, many as prestigious as Canary Wharf in London and the Petronas Towers in Kuala Lumpur, Furse has developed the experience and expertise that will continue to lead the field into the 21st century.

Expertise and know how

At Furse, our wealth of knowledge in structural lightning protection, earthing and transient overvoltage protection gives our engineers the ability to offer leading edge product development and unparalleled technical support.

From dedicated teams of design engineers developing new products to meet the ever-changing demands of the market place, to accredited engineers that can design lightning protection and earth electrode systems to BS or any other recognised national or international standard, Furse technical expertise is focused on the customer.

Our expertise has also been confirmed by our continuing contributions to British, European and international standards for lightning and transient overvoltage protection (BSI, CENELEC and IEC) and earthing (BSI).



The support you need



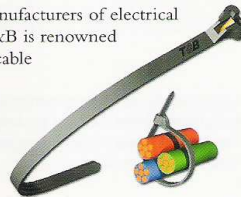
For us, our ISO 9001 Registration is only the start of our commitment to quality. A commitment that applies equally to all areas of Furse – from design and development to manufacturing and customer services.

At Furse we believe in sharing our knowledge with you, so you can make a properly informed decision. Whatever your query, technical support is readily available from engineers at our UK and overseas offices, supported by our international network of distributors.

Thomas & Betts

Since 1998, Furse has been part of the Thomas & Betts Corporation, who, like ourselves, has over 100 years of electrical engineering experience.

One of the world's leading manufacturers of electrical and electronic components, T&B is renowned for their interconnection and cable management products.



Thomas & Betts

Lightning protection

Introduction

Technical guide to structural lightning protection design considerations **4-7**

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Solid circular system

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Cable and wire system

Air terminals and fixings, conductor fixings, bonds and clamps **27-30**

Accessories

Fixings, insulating tape, Denso tape, Silfos, Flux and Tinmans solder **31-32**

Lightning protection

Structural lightning protection design considerations

BS 6651 (Protection of structures against lightning) clearly advises strict adherence to the provision of a conventional Lightning Protection System (LPS) – to the total exclusion of any other device or system for which claims of enhanced protection are made.

Principle components of a conventional structural lightning protection system, in accordance with BS 6651 are:

- ◆ Air termination network
- ◆ Down conductors
- ◆ Earth termination network
- ◆ Bonding (to prevent side flashing).

Air termination network

On high risk structures such as explosive factories, no part of the roof should be more than 2.5m from an air termination conductor. This is generally achieved by applying a 5m x 10m mesh to the roof.

However, for most structures, a mesh of 10m x 20m is considered sufficient, giving a maximum distance from any part of the roof to the nearest conductor of 5m.

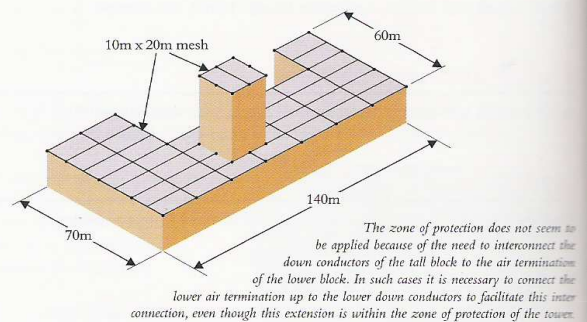


Figure 1 – Air terminations for tall conducting structures

The 'Zone of Protection' offered by an air termination network is considered to be 45° for heights up to 20m. Above this height, the zone of protection is determined by the 'Rolling Sphere Method'.

This involves rolling an imaginary sphere of 60m radius over a structure. The areas touched by the sphere are deemed to require protection. On tall structures, this can obviously include the sides of the building.

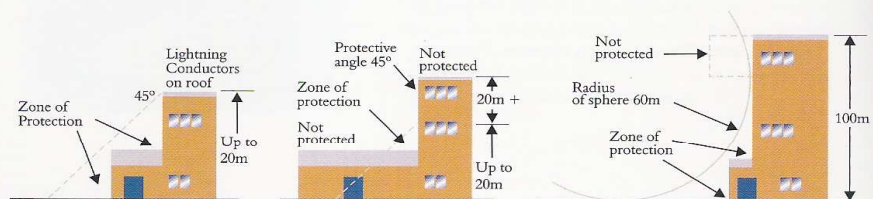


Figure 2 – Zones of protection

Lightning protection

Down conductors

Down conductor positioning and distancing is often dictated by architectural constraints. There should be one down conductor for every 20m or part thereof of the building perimeter at roof or ground level (whichever is greater). These should be evenly spaced and distances apart of more than 20m avoided if possible.

If the building is above 20m in height or of an abnormal risk this distance should be reduced to 10m.

They should be routed as directly as possible from the air termination network to the earth termination network to avoid risks of side flashing. Re-entrant loops are also to be avoided. BS 6651 recommends that the length of conductor forming the loop should not exceed eight times the width of its open side.

BS 6651 allows the use of 'natural conductors' such as rebars and structural steelwork, provided that they are electrically continuous and adequately earthed.

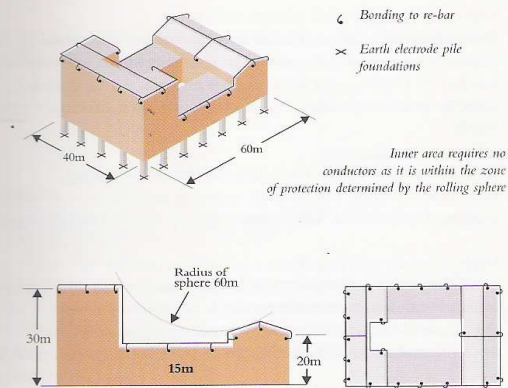


Figure 3 - Lightning Protection Scheme to BS 6651 using the reinforced concrete within the structure for down conductors

Earth termination networks

Each down conductor must have a separate earth termination. Moreover provision should be made in each down conductor, for disconnection from the earth for testing purposes. This is achieved with a test clamp (see Figure 4).

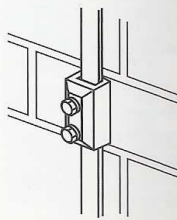


Figure 4 - Oblong test or junction clamp

BS 6651 stipulates that the resistance to earth of the lightning protection system measured at any point, should not exceed 10 ohms.

With the test clamp disconnected, the resistance of each individual earth should be no more than ten times the number of down conductors in the complete system. eg for a system with 15 down conductors, the individual earth readings should be no more than $10 \times 15 = 150$ ohms.

Several types of earth electrode are permissible, but by far the most commonly used are deep driven earth rods. BS 6651 states that the combined earth rod length of a system should be no less than 9m whilst each individual earth rod should be no less than 1.5m in length.

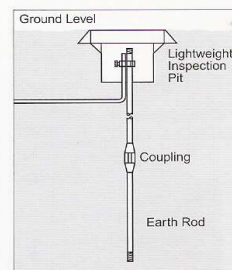


Figure 5 - Deep driven earth electrode

Lightning protection

Parallel earth rod electrodes

Where ground conditions make deep driving of earth rods impossible, a matrix arrangement of rods coupled to one another by conductors can be used. If possible, the earth rods must be spaced at a distance at least equal to their driven depth.

If earth rods cannot be driven in a parallel line a "Crows Foot" configuration can be used, ensuring that the spacing/depth ratio is still maintained.

High resistivity soil conditions can be overcome by backfilling earth rods with a suitable medium such as Marconite conductive concrete which effectively increases the diameter of the earth rod and hence its surface area, thus lowering resistance to earth. (For more information see page 59.)

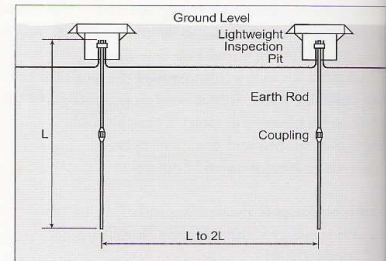


Figure 6 - Spacing of parallel earth rod electrode

Bonding

All metal work, including water pipes, gas pipes, handrails, air conditioning units, metal cladding, metal roofs etc, in the vicinity of the LPS must be bonded to it, to avoid the danger of side flashing.

For the same reason, the LPS earth should be bonded to the main electrical earth, as well as any other earthing system present in the structure.

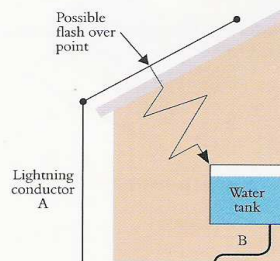
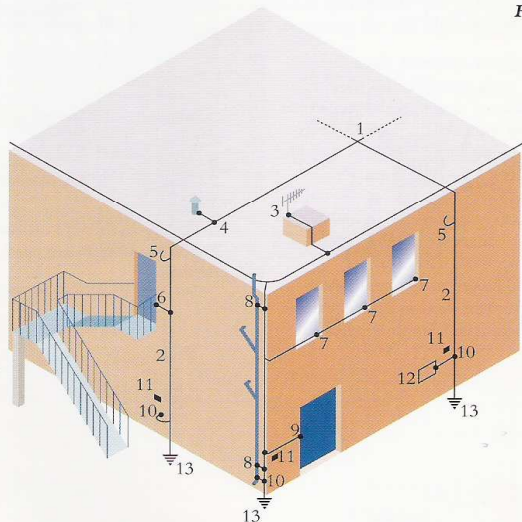


Figure 7 - Example of side flashing

If the lightning protection system on a structure is hit by lightning, then the current flowing through the system and the resistance/impedance offered by the conductor path will determine the magnitude of the potential difference seen by the lightning conductors with respect to true earth. The lightning conductors can, instantaneously, have a potential magnitude of megavolts (1,000,000V) with respect to true earth.

Typically, at instant of discharge:
potential difference at A = 1,500,000V
potential difference at B = 0V

Figure 8 - Bonding to prevent side flashing



1. Air termination
2. Down conductor
3. Bond to aerial
4. Bond to vent
5. Bond to re-bar
6. Bond to metal staircase
7. Bond to metal window frame
8. Bond to vent pipe
9. Bond to steel door/frame
10. Test clamp
11. Indicating plate
12. Main earthing terminal of electrical installation
13. Earth termination point

Lightning protection

Corrosion

BS 6651 contains tables of materials suitable for use in Lightning Protection System (LPS) components. Adherence to these requirements is vital to avoid corrosion problems.

The correct choice of material and installation design should ensure a life span of 30 years for the earth electrode system.

Inspection, testing, records and maintenance

The code adequately details the requirement for inspecting an LPS, the testing required and the detailed records that should be maintained.

Observance of clauses 32 to 34 of the code will highlight any maintenance of the system required. Of particular importance is the regular detailed examination of the complete LPS for any evidence of corrosion. If this check is not carried out then vital components within the LPS, which may have suffered from corrosion and which could exhibit a high resistance could be missed. This will have a detrimental effect on the whole system making it an unattractive high impedance path for the lightning current to follow.

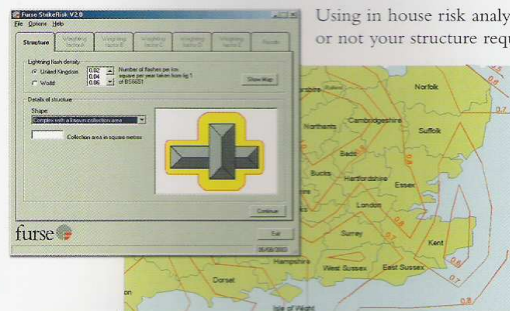
To minimise this problem, along with regular inspections, the selection of the correct materials should be made in accordance with the recommendations of BS 6651.

The need for protection

Before proceeding to design a lightning protection system, first carefully consider if the structure actually needs protection.

In many cases, it is obvious that some form of protection is required. High risk structures eg explosives factories, oil refineries, etc, will require the highest possible class of lightning protection to be provided. In many cases the need for protection is not so evident. BS 6651 provides a simple mathematical overall risk factor analysis for assessing whether a structure needs protection.

The standard suggests an acceptable lightning strike risk factor is 10^{-5} (1 in 100,000) per year. Therefore, having applied the mathematical analysis to a particular set of parameters, the scheme designer will achieve a numerical solution. If the risk factor is less than 10^{-5} (1 in 100,000), for example 10^{-6} (1 in 1,000,000) then in the absence of other over-riding considerations, protection is deemed unnecessary. If however, the risk factor is greater than 10^{-5} for example 10^{-4} (1 in 10,000) then protection would be recommended.



Using in house risk analysis software, Furse can quickly determine whether or not your structure requires protection.

StrikeRisk (illustrated, left) is an application developed by our own engineers to enable you to quickly and accurately identify if your building requires structural lightning protection in accordance with BS 6651.

StrikeRisk can be downloaded from www.furse.com.

How to apply structural lightning protection

Conductors

The first choice faced by the designer of a structural lightning protection system is the type of conductor system to be used. Choose the material required, ie copper or aluminium.

Choose the type of conductor required, ie tape, solid circular or stranded.

Down conductor network



The down conductor system is the means of carrying the current of a lightning strike safely to the earth termination network.

Fixings



Select the correct system of fixings for each part of the conductor system. Fixings are available for a wide range of modern construction materials, eg brick, stone, plastic and metal.

Air termination network

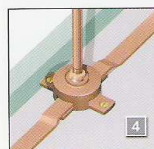
The air termination network is the point of connection for a lightning strike. It typically consists of a meshed conductor arrangement covering the roof of the structure.

Air terminals



Use air terminals in the form of vertical air rods for the protection of prominent roof top features or equipment. Use strike pads to connect and thus expose concealed conductors.

Air rod bases



Choose the correct air rod base. This will ensure that the vertical air rods are both solidly fixed to the fabric of the structure and have a low resistance connection to the conductor network.

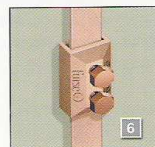
Air termination network

Conductor jointing clamps

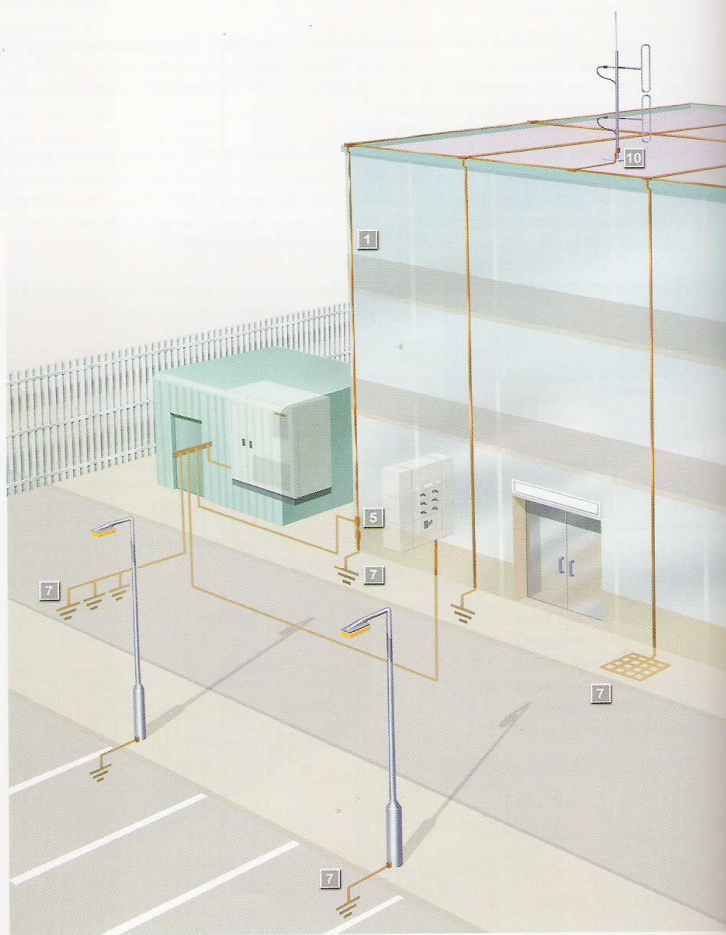


Select a component for the interconnection of multiple conductors or for changes of direction. Jointing clamps will ensure a low resistance, corrosion resistant connection.

Test clamps



In order to allow periodic disconnection and testing of the earth termination network, select a test clamp to be placed within the run of each down conductor.

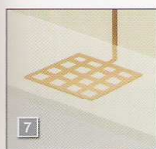


How to apply structural lightning protection

Earth termination network

The means of dissipating the current to the general mass of earth.

Earth electrodes



Choose an earth electrode to suit the ground conditions in the locality of the structure. Electrodes are available in the form of rods and plates (lattice or solid).



Earth termination network

Earth rod clamps



Select a high copper content alloy earth rod clamp for the connection of the earthing conductor to the earth rod. In this below ground application, the clamp must ensure a good electrical contact and resist corrosion throughout the lifetime of the installation.

Earth inspection pits

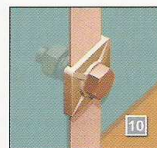


Select an earth inspection pit to protect the earth electrode connections. High strength pits are available in plastic and concrete.

Bonding

Bonding is the most commonly employed method of avoiding the damaging effects of side flashing. All continuous metalwork should be considered for bonding. All metallic services, eg cable armouring, gas, water or steam piping, entering the building should also be bonded as directly as possible to the earth termination network.

Bonds to metalwork



Select the correct type of metalwork bond for the application, ie a flat column face, a circular rainwater pipe or a ribbed reinforcing bar.

Product selector

(1)	Conductors	p33-40
(2)	Conductor fixings	p14-17, 20-22, 29
(3)	Air terminals	p11-12, 19, 27
(4)	Air rod bases	p11-12, 19, 27
(5)	Conductor jointing clamps	p17-18, 23-24, 30
(6)	Test clamps	p17-18, 24, 30
(7)	Earth electrodes	p46-49
(8)	Earth rod clamps	p51-52
(9)	Earth inspection pits	p50
(10)	Bonds	p25-26, 53-55

This illustration is designed to demonstrate the main aspects and individual components of a structural lightning protection system. It is not intended to represent an actual scheme conforming to a particular code of practice. The drawing is not to scale.

Lightning protection

Introduction to flat tape, solid circular and cable & wire systems

When designing a structural lightning protection system using the Faraday Cage principle, it is possible to use one or more of a variety of available conductor systems; namely flat tape, solid circular or cable/wire. The decision about which type to use is often based more on country-specific historical preferences or aesthetic considerations than the superiority of one type over another.

Furse provides high quality conductors, plus the appropriate fittings, for all three systems.

Flat tape system

Furse manufacture and supply flat tape conductors in copper or aluminium. The flat tape system is easy to install, with no need to straighten the tape for a neat finish. Furse typically provides tape in coils for cost effective transportation and easier handling.

Flat tape conductors can be installed bare or with a PVC covering. Six standard colours are available, with others on request, to enable the tape to blend with modern building fabrics.

Tinned copper tape is available for applications that require additional protection measures.

Copper braid is also available for use where flexibility is necessary, eg on moving installations like gates or doors.

In addition, Furse manufacture and supply a complete range of fittings for flat tape conductors, from tape clips and clamps, to bimetallic connectors.



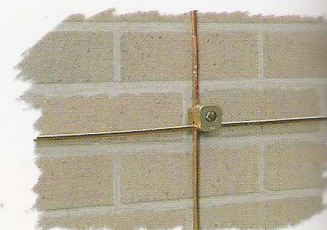
Solid circular system

Solid circular conductor can be used in applications where aesthetic considerations are important. The 8mm diameter solid circular range is less conspicuous than the flat tape system, and lends itself much better to being concealed.

Available in copper or aluminium, solid circular conductors can also have PVC coverings, again to make them less conspicuous.

A coil of circular conductor can be quickly installed, being easy to bend in any plane, and only needing a straightening tool to give a very neat finish.

Furse also manufacture a comprehensive range of clamps, bonds and fixings to ease installation in whatever situation.

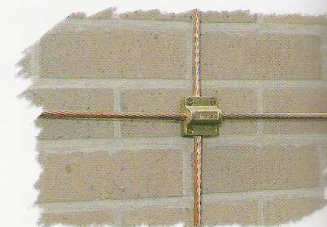


Cable and wire system

The Furse range of stranded conductors is available only in copper, and complies with the US standard NFPA 780.

The stranded conductor is available bare or PVC insulated.

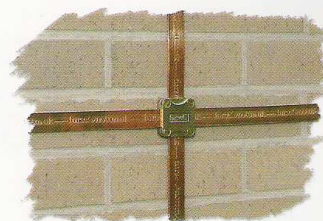
Furse also provide a practical range of fixings for use with stranded conductors.



Flat tape system

The following pages (11-18) detail the products required to install a 'Flat tape' lightning protection system. Additionally, accessories can be found on pages 31-32.

Details of the flat tape conductors can be found in the Conductors section on pages 33-40.



Air terminals and fixings

Rod length	Rod diameter	Thread diameter	Material	Weight per rod	Part no.
500mm	15mm	16mm	Copper	0.73kg	RA215
1000mm	15mm	16mm	Copper	1.51kg	RA225
2000mm	15mm	16mm	Copper	3.00kg	RA240
500mm	15mm	16mm	Aluminium	0.29kg	RA015
1000mm	15mm	16mm	Aluminium	0.53kg	RA025
2000mm	15mm	16mm	Aluminium	1.06kg	RA040

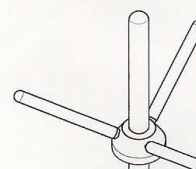
Supplied with locknut.

"Field trial tests in the United States, carried out over many years research have confirmed that blunt air rods are struck by lightning in preference to taper pointed air rods."

"Lightning rod improvement studies" by C B Moore, W Rison, J Mathis, G Aulich. Journal of Applied Meteorology, May 2000.



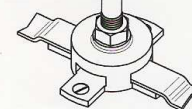
Air rod



Multiple point

Rod diameter	Material	Weight each	Part no.
15mm	Copper	0.27kg	RA600

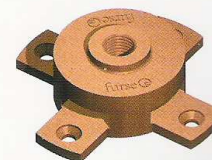
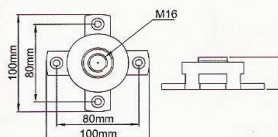
Suitable only for use with copper air terminals.



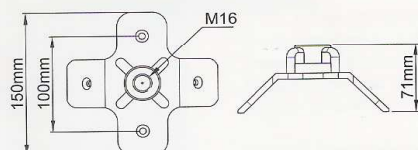
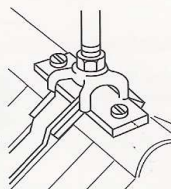
Air rod base

Rod diameter	Thread diameter	Maximum conductor width	Material	Weight each	Part no.
15mm	16mm	25mm	Copper	0.47kg	SD105
15mm	16mm	25mm	Aluminium	0.15kg	SD003

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.



Ridge saddle

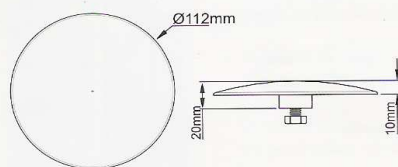
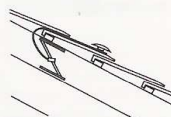


Air terminals and fixings

Rod diameter	Thread diameter	Maximum conductor width	Material	Weight each	Part no.
15mm	16mm	31mm	Copper	1.07kg	SD115

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug. For supporting lightning conductor air rods on ridges.

Strike pad



Description	Material	Weight each	Part no.
Strike pad	Copper	0.41kg	PL010
Strike pad	Aluminium	0.13kg	PL005

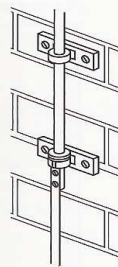
Description	Weight each	Part no.
Copper stem for use with PL010	0.07kg	SM010

This product is supplied with a set screw to enable the lightning conductors to be attached to the strike pad.

Air terminals and fixings

Rod diameter	Rod material	Weight each	Part no.
15mm	Copper	0.90kg	BR105
15mm	Aluminium	0.28kg	BR005

Recommended fixing - round head woodscrew 1 5/8" x no.16 and wall plug.



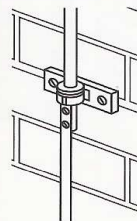
Rod brackets



Rod to tape coupling

Rod diameter	Thread diameter	Rod material	Weight each	Part no.
15mm	16mm	Copper	0.23kg	CG600
15mm	16mm	Aluminium	0.08kg	CG500

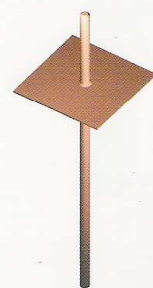
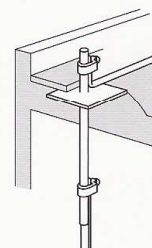
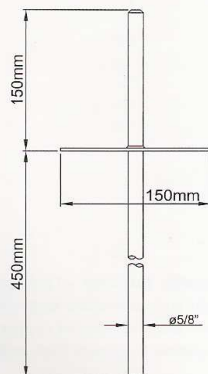
Used in conjunction with rod brackets above.



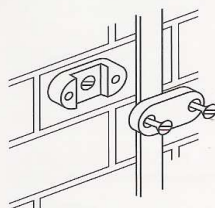
Puddle flange

Material	Weight each	Part no.
Copper	1.54kg	PF105
Aluminium	0.50kg	PF005

For taking lightning conductors through roofs etc.



DC tape clip



Conductor fixings

For use with bare copper

Conductor size	Weight each	Part no.
20 x 3mm	0.06kg	CP205
25 x 3mm	0.07kg	CP210
25 x 4mm	0.07kg	CP216
25 x 6mm	0.08kg	CP220
31 x 3mm	0.09kg	CP230
31 x 6mm	0.10kg	CP235
38 x 3mm	0.12kg	CP240
38 x 5mm	0.12kg	CP245
38 x 6mm	0.14kg	CP250-FU
40 x 4mm	0.14kg	CP241
40 x 6mm	0.15kg	CP251
50 x 3mm	0.15kg	CP255
50 x 4mm	0.15kg	CP256
50 x 6mm	0.16kg	CP260

For use with PVC covered copper

Conductor size	Weight each	Part no.
25 x 3mm	0.10kg	CP215
25 x 6mm	0.13kg	CP225
50 x 6mm	0.26kg	CP265

For use with lead covered copper

Conductor size	Weight each	Part no.
25 x 3mm	0.02kg	CP305

For use with bare aluminium

Conductor size	Weight each	Part no.
20 x 3mm	0.02kg	CP105
25 x 3mm	0.03kg	CP110
25 x 6mm	0.04kg	CP120
50 x 6mm	0.05kg	CP125

For use with PVC covered aluminium

Conductor size	Weight each	Part no.
25 x 3mm	0.04kg	CP115
50 x 6mm	0.06kg	CP130

Made from high quality copper and aluminium alloys

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.

Non-metallic DC tape clip



For use with bare tape

Conductor size	Colour	Weight each	Part no.
20 x 3mm	Brown	0.01kg	CP002
20 x 3mm	Grey	0.01kg	CP001
25 x 3mm	Brown	0.01kg	CP011
25 x 3mm	Grey	0.01kg	CP012
38 x 5mm	Brown	0.01kg	CP060
50 x 6mm	Brown	0.02kg	CP065

For use with PVC covered tape

Conductor size	Colour	Weight each	Part no.
25 x 3mm	Brown	0.01kg	CP021
25 x 3mm	Black	0.01kg	CP031
25 x 3mm	Green	0.01kg	CP033
25 x 3mm	Grey	0.01kg	CP041
25 x 3mm	Stone	0.01kg	CP044
25 x 3mm	White	0.01kg	CP051

Non-metallic DC clip - High grade polypropylene, UV stabilised against degradation by sunlight and non-brittle to prevent cold weather damage. Available in six colours to match bare and pvc covered copper and aluminium tapes. This unique design provides easy installation and resists high pull off loads.

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.

* Not as illustrated.

Conductor fixings

For use with bare copper

Conductor size	Weight each	Part no.
20 x 3mm	0.02kg	CP510
25 x 3mm	0.02kg	CP515

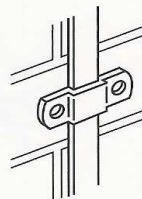
For use with bare aluminium

Conductor size	Weight each	Part no.
20 x 3mm	0.01kg	CP405
25 x 3mm	0.05kg	CP410

For use with PVC covered tape

Conductor size	Weight each	Part no.
25 x 3mm	0.02kg	CP517

Recommended fixing – round head woodscrew 1 1/2" x no.10 and wall plug.



Tape clip

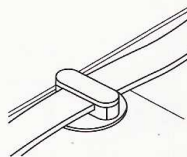


Weldable DC tape clip

For use with PVC roofing only

For use with bare tape

Conductor size	Colour	Weight each	Part no.
25 x 3mm	Brown	0.03kg	CW015
25 x 3mm	Grey	0.03kg	CW020



For use with PVC covered tape

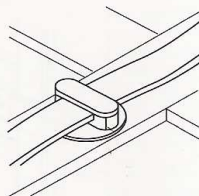
Conductor size	Colour	Weight each	Part no.
25 x 3mm	Brown	0.03kg	CW025
25 x 3mm	Grey	0.03kg	CW040
25 x 3mm	Black	0.03kg	CW030
25 x 3mm	Stone	0.03kg	CW045
25 x 3mm	White	0.03kg	CW050

Cleaning solution

Description	Weight each	Part no.
Cleaning solution (Acetone)	0.62kg	CW999
For cleaning lacquered roofing membranes. 500ml spray applicator.		



Adhesive DC tape clip



Conductor fixings

For use on surfaces other than PVC roofing
For use with bare tape

Conductor size	Colour	Weight each	Part no.
25 x 3mm	Brown	0.03kg	CA015
25 x 3mm	Grey	0.03kg	CA020

For use with PVC covered tape

Conductor size	Colour	Weight each	Part no.
25 x 3mm	Brown	0.03kg	CA025
25 x 3mm	Black	0.03kg	CA030
25 x 3mm	Grey	0.03kg	CA040
25 x 3mm	Stone	0.03kg	CA045
25 x 3mm	White	0.03kg	CA050

Surface primer

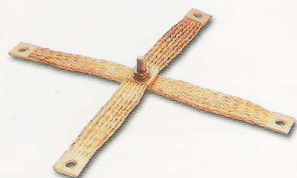


Accessories for adhesive clips

Description	Weight each	Part no.
Surface primer 250ml spray applicator (sufficient for the application of approximately 500 clips).	0.24kg	CA900

Note: Furse strongly recommend the use of the primer when installing the Furse adhesive clip.

Expansion braid bonds and dressing tool



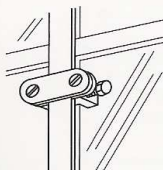
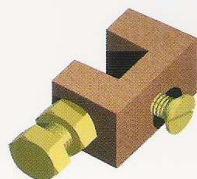
Special flexible expansion braid bonds

Type	Material	Length	Cross-sectional area	Weight each	Part no.
Single length	Aluminium	200mm	50mm ²	0.07kg	BN000
Single length	Copper	200mm	50mm ²	0.17kg	BN100
Cross-over	Aluminium	300mm	50mm ²	0.23kg	BN002
Cross-over	Copper	300mm	50mm ²	0.53kg	BN102

Dressing tool

Description	Weight each	Part no.
Aluminium tool for dressing conductor	0.31kg	DT100

Glazing bar holdfast



Conductor material	Maximum glazing bar width	Weight each	Part no.
Copper	12mm	0.11kg	HF705
Aluminium	12mm	0.05kg	HF710

Block supplied complete with fixing screw. Enables DC clips etc, to be secured to steel frames, girders, window frames, etc.
Conductor clip sold separately.

Conductor fixings

Slate holdfast

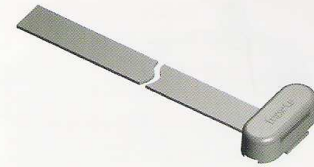
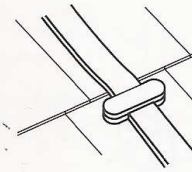
For use with bare tape

Conductor size	DC Clip colour	Weight each	Part no.
25 x 3mm	Brown	0.06kg	HF015
25 x 3mm	Grey	0.06kg	HF020

For use with PVC covered tape

Conductor size	DC Clip colour	Weight each	Part no.
25 x 3mm	Brown	0.06kg	HF025
25 x 3mm	Black	0.06kg	HF030
25 x 3mm	Grey	0.06kg	HF040
25 x 3mm	Stone	0.06kg	HF045

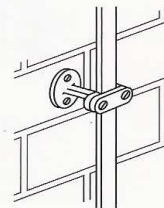
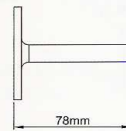
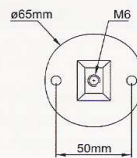
Tail length 500mm.



Back plate holdfast stem

Material	Stem height	Weight each	Part no.
Copper	78mm	0.30kg	HF320
Aluminium	78mm	0.10kg	HF325-FU

Recommended fixing - round head woodscrew 1 1/2" x no.10 and wall plug.
For use with the appropriate DC clip etc.
Supplied with M6 fixing screw.

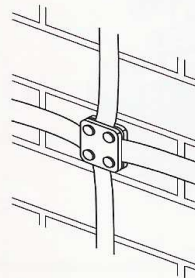


Test and junction clamps

Square tape clamp

Conductor size	Material	Weight each	Part no.
25 x 3mm	Copper	0.23kg	CT105-FU
25 x 6mm	Copper	0.42kg	CT110
31 x 3mm	Copper	0.30kg	CT113-FU
50 x 6mm	Copper	0.98kg	CT115
25 x 3mm	Aluminium	0.07kg	CT005

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.
For forming straight through, cross or tee joints in tape.



Oblong test or junction clamp

Maximum conductor size	Material	Weight each	Part no.
26 x 8mm	Copper	0.29kg	CN105
26 x 8mm	Aluminium	0.12kg	CN005

For straight through tape joints.

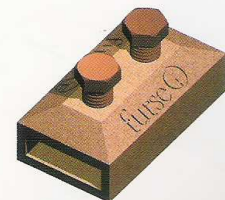
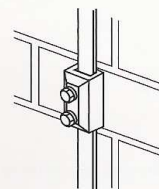
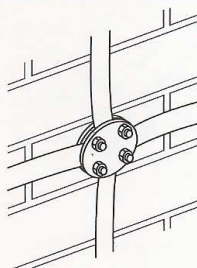
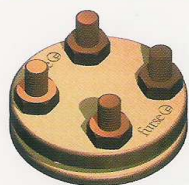


Plate type test clamp

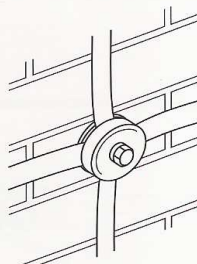


Test and junction clamps

Maximum conductor size	Conductor material	Weight each	Part no.
26 x 12mm	Copper	0.62kg	CT405

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.

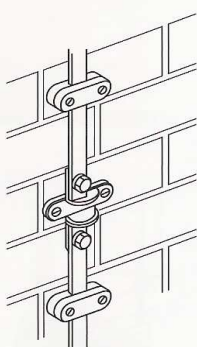
Screwdown test clamp



Maximum conductor size	Conductor material	Weight each	Part no.
26 x 8mm	Copper	0.84kg	CT305

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.

Bimetallic connector



Conductor size	Weight each	Part no.
25 x 3mm aluminium tape to 25 x 3mm copper tape	0.19kg	CN901
8mm diameter aluminium conductor to 25 x 3mm copper tape	0.19kg	CN902

For joining aluminium to copper.

Particularly useful where an aluminium lightning protection system needs to be earthed using copper.

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.

Oxide inhibiting compound



Description	Weight each	Part no.
Plastic 8oz bottle	0.23kg	CM005

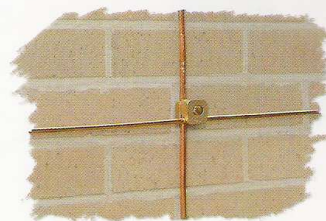
For all the items in this range we recommend the use of oxide inhibitor when aluminium fittings are installed.

Oxide inhibitor is a non-water soluble, natural-petroleum based polymer grease that seals electrical connections from oxygen and moisture.

Solid circular system

The following pages (19-26) detail the products required to install a 'Solid circular' lightning protection system. Additionally, accessories can be found on pages 31-32.

Details of the solid circular conductors can be found in the Conductors section on pages 33-40.



Air terminals and fixings

Air rod

Rod length	Rod diameter	Thread diameter	Material	Weight per rod	Part no.
500mm	10mm	10mm	Copper	0.33kg	RA400-FU
1000mm	10mm	10mm	Copper	0.65kg	RA402
500mm	10mm	10mm	Aluminium	0.11kg	RA080
1000mm	10mm	10mm	Aluminium	0.22kg	RA085

Supplied with locknut.

"Field trial tests in the United States, carried out over many years research have confirmed that blunt air rods are struck by lightning in preference to taper pointed air rods."

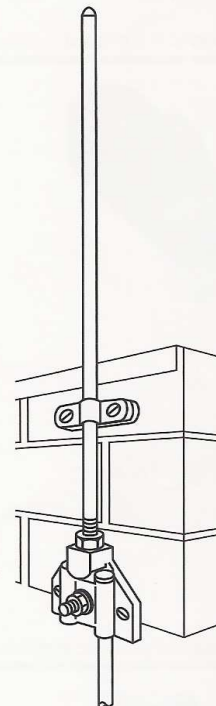
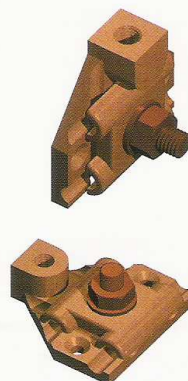
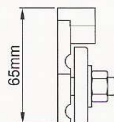
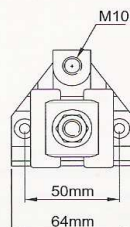
"Lightning rod improvement studies" by C B Moore, W Rison, J Mathis, G Aulich.
Journal of Applied Meteorology, May 2000.



Air rod base

Conductor diameter	Thread diameter	Conductor material	Weight each	Vertically mounted	Horizontally mounted
8mm	10mm	Copper	0.30kg	SD307	SD305
8mm	10mm	Aluminium	0.11kg	SD007	SD005

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.



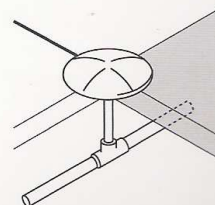
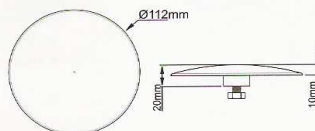
Strike pad

Conductor material	Weight each	Part no.
Copper	0.41kg	PL010
Aluminium	0.13kg	PL005

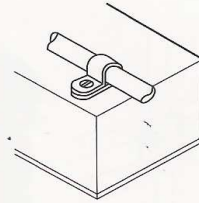
Accessories

Description	Weight each	Part no.
Copper stem for use with PL010	0.07kg	SM010

The strike pad PL010 can be used in lightning protection schemes in multi-storey car parks, using the stem SM010 connected to the re-bar cage or buried earth conductor.



One hole cable clip

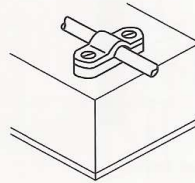


Conductor fixings

Conductor diameter	Conductor material	Weight each	Part no.
8mm	Copper	0.01kg	CP800
8mm	Aluminium	0.01kg	CP801
10mm*	Copper	0.01kg	CP802
10mm*	Aluminium	0.01kg	CP803

Recommended fixing - round head woodscrew 1 1/2" x no.10 and wall plug.
* PVC covered 8mm conductor.

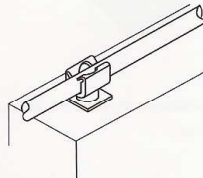
Heavy duty cast cable saddle



Conductor diameter	Conductor material	Weight each	Part no.
8mm	Copper	0.09kg	CP804
8mm	Aluminium	0.03kg	CP805
10mm*	Copper	0.10kg	CP806
10mm*	Aluminium	0.04kg	CP807

* For use with PVC covered 8mm conductor or for supporting air terminals when used in conjunction with wall mounted air rod base. Can also be used with Glazing bar holdfast and Back plate holdfast stem (see pages 16-17).
Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.

Push-in plastic cable clip



Conductor diameter	Weight each	Black	Grey	Stone	White	Brown
8mm	0.01kg	-	CP872	-	-	CP873
10mm*	0.01kg	CP861	CP871	CP876	CP881	CP882

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.
* PVC covered 8mm conductor.

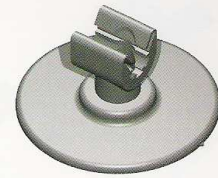
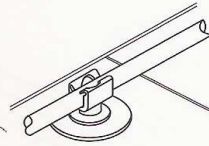
Conductor fixings

Weldable push-in clip

For use with PVC roofing only

Conductor diameter	Colour	Weight each	Part no.
8mm	Grey	0.03kg	CW872
8mm	Brown	0.03kg	CW887
10mm*	Grey	0.03kg	CW871
10mm*	Brown	0.03kg	CW886

* PVC covered 8mm conductor.



Cleaning solution

Description	Weight each	Part no.
Cleaning solution (Acetone) 500ml spray applicator. For cleaning lacquered roofing membranes.	0.62kg	CW999

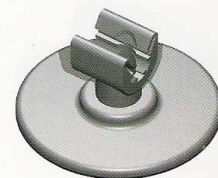
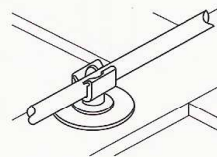


Adhesive push-in clip

For use on surfaces other than PVC roofing

Conductor diameter	Weight each	Colour range				
		Black	Grey	Stone	White	Brown
8mm	0.02kg	-	CA872	-	-	CA887
10mm*	0.02kg	CA861	CA871	CA876	CA881	CA886

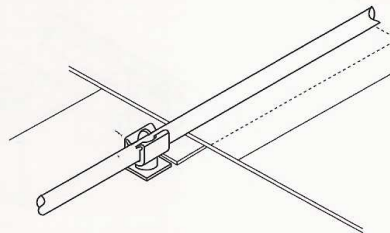
* PVC covered 8mm conductor.



Description	Weight each	Part no.
Surface primer 250ml spray applicator (sufficient for the application of approximately 500 clips).	0.24kg	CA900

Note: Furse strongly recommend use of the primer when installing Furse adhesive clips.

Non metallic slate holdfast



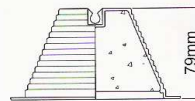
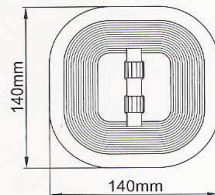
Conductor fixings

Conductor diameter	Colour	Weight each	Part no.
8mm	Brown	0.03kg	HF176
8mm	Grey	0.03kg	HF191

Variations of tail length, clip size and clip colour can be made to order as special items.

Standard tail length 500mm.

Pyramid holdfast



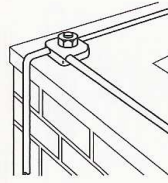
Type	Weight each	Part no.
Filled	0.97kg	HF975

Supplied filled with concrete, they can be used to hold conductors on flat surfaces. The lip around the base allows them to be built into bitumen type roofs, etc. Suitable for 8mm diameter bare conductor.

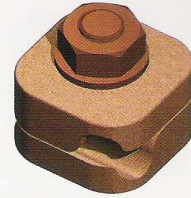
Test and junction clamps

Conductor diameter	Conductor material	Weight each	Part no.
8mm	Copper	0.17kg	CS605
8mm	Aluminium	0.07kg	CS610

For forming cross or tee joints.

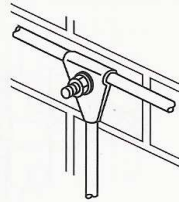


Square clamp

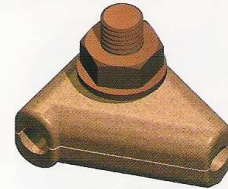


Conductor diameter	Conductor material	Weight each	Part no.
8mm	Copper	0.17kg	CS505
8mm	Aluminium	0.07kg	CS510

For forming tee joints.

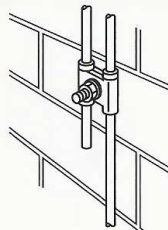


Tee clamp

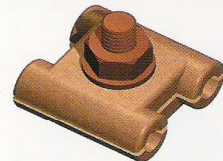


Conductor diameter	Conductor material	Weight each	Part no.
8mm	Copper	0.17kg	CS405
8mm	Aluminium	0.08kg	CS410

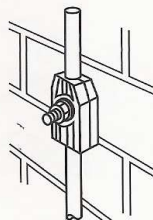
For forming straight through joints.



Jointing clamp



Test clamp



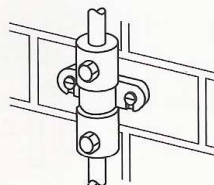
Test and junction clamps

Conductor diameter	Conductor material	Weight each	Part no.
8mm	Copper	0.20kg	CN30
8mm	Aluminium	0.09kg	CN31

For forming straight through joints or for disconnection and test purposes.

Also available for connecting 8mm diameter conductor to 25 x 3mm conductor.

Bimetallic connector



Conductor diameter	Weight each	Part no.
8mm diameter aluminium conductor to 8mm diameter copper conductor	0.25kg	CN32
8mm diameter aluminium conductor to 25mm x 3mm copper tape	0.19kg	CN33

For joining aluminium and copper circular conductors. Particularly useful where an aluminium lightning protection system needs to be earthed using copper.

Oxide inhibiting compound



Description	Weight each	Part no.
Plastic 8oz bottle	0.23kg	CM10

For all the items in this range we recommend the use of oxide inhibitor when aluminium fittings are installed.

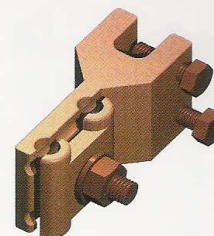
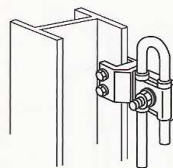
Oxide inhibitor is a non-water soluble, natural-petroleum based polymer grease that seals electrical connections from oxygen and moisture.

Bonds and clamps

Metalwork bond

Conductor diameter	Conductor material	Weight each	Part no.
8mm	Copper	0.37kg	CS350
8mm	Aluminium	0.17kg	CS355

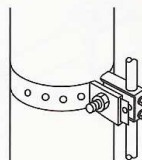
For connecting to all types of metal structures up to 13mm thickness.



Pipe bond

Conductor diameter	Pipe diameter	Conductor material	Weight each	Part no.
8mm	50-200mm	Copper	0.46kg	BN175
8mm	50-200mm	Aluminium	0.25kg	BN176

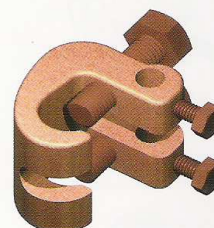
For bonding to ducts and large diameter pipeworks.



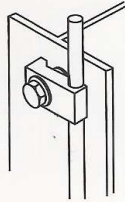
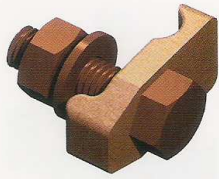
Re-bar clamp

Conductor diameter	Pipe diameter	Conductor material	Weight each	Part no.
8mm	8-18mm	Copper	0.32kg	BN150
8mm	18-38mm	Copper	0.75kg	BN155

For bonding to reinforcing bars, steam pipes, handrails etc.



Tower earth clamp

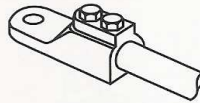


Bonds and clamps

Conductor diameter	Channel thickness	Bolt size	Conductor material	Weight each	Part no.
8mm	10mm	M10	Copper	0.08kg	BNG3004
8mm	10mm	M10	Aluminium	0.05kg	BNG3005

For bonding copper and aluminium conductors to steel work.

Straight setscrew type cable socket

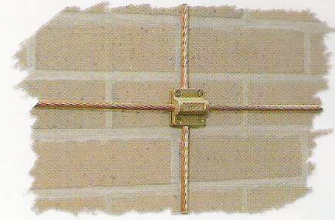


Conductor diameter	Palm hole diameter	Conductor material	Weight each	Part no.
8mm	12mm	Copper	0.11kg	SB3004
8mm	12mm	Aluminium	0.05kg	SB3005

Cable and wire system

The following pages (27-30) detail the products required to install a 'Cable and wire' lightning protection system. Additionally, accessories can be found on pages 31-32.

Details of the cable and wire conductors can be found in the Conductors section on pages 33-40.



Air terminals and fixings

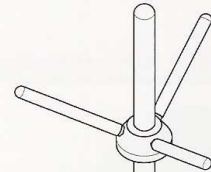
Air rod

Rod length	Rod diameter	Thread diameter	Material	Weight per rod	Part no.
500mm	15mm	16mm	Copper	0.73kg	RA215
1000mm	15mm	16mm	Copper	1.51kg	RA225
2000mm	15mm	16mm	Copper	3.00kg	RA240

Supplied with locknut.

"Field trial tests in the United States, carried out over many years research have confirmed that blunt air rods are struck by lightning in preference to taper pointed air rods."

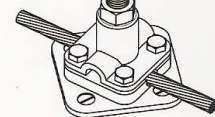
"Lightning rod improvement studies" by C B Moore, W Rison, J Mathis, G Aulich. Journal of Applied Meteorology, May 2000.



Multiple point

Rod diameter	Material	Weight each	Part no.
15mm	Copper	0.27kg	RA600

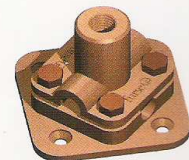
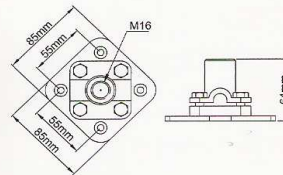
Suitable only for use with copper air terminals.



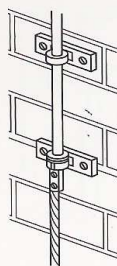
Flat saddle

Conductor size	Rod diameter	Thread diameter	Conductor material	Weight each	Part no.
50mm	15mm	16mm	Copper	1.03kg	SD155
70mm	15mm	16mm	Copper	0.95kg	SD160
95mm	15mm	16mm	Copper	0.95kg	SD165

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.



Rod brackets

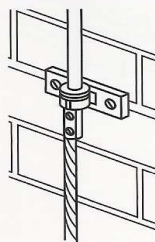


Air terminals and fixings

Rod diameter	Rod material	Weight each	Part no.
15mm	Copper	0.90kg	BR105
15mm	Aluminium	0.28kg	BR005

For wall mounted air terminals.
Recommended fixing - round head
woodscrew 1 5/8" x no.16 and wall plug.

Rod to cable coupling



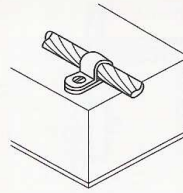
Rod diameter	Thread diameter	Conductor size	Conductor material	Weight each	Part no.
15mm	16mm	50 - 70mm ²	Copper	0.25kg	CG705
15mm	16mm	95mm ²	Copper	0.25kg	CG710

Used in conjunction with rod brackets above.

Conductor fixings

Conductor size	Conductor material	Weight each	Part no.
50mm ²	Copper	0.01kg	CP910
70mm ²	Copper	0.01kg	CP915
95mm ²	Copper	0.01kg	CP920

Recommended fixing - round head woodscrew 1 1/2" x no.10 and wall plug.

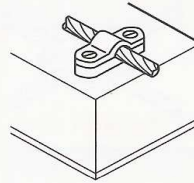


One hole cable clip



Conductor size	Conductor material	Weight each	Part no.
50mm ²	Copper	0.10kg	CP810
70mm ²	Copper	0.10kg	CP815
95mm ²	Copper	0.10kg	CP835

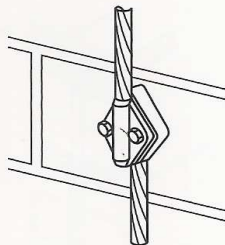
Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.



Heavy duty cast cable saddle



Test clamp



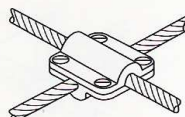
Test and junction clamps

Conductor size	Conductor material	Weight each	Part no.
50mm ²	Copper	0.39kg	CR855
70mm ²	Copper	0.40kg	CR860
95mm ²	Copper	0.40kg	CR865

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.

For forming end to end joints.

Square conductor clamp

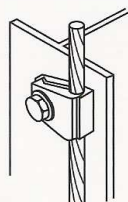
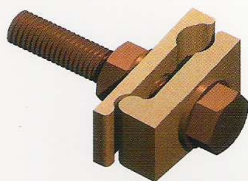


Conductor size	Conductor material	Weight each	Part no.
50mm ²	Copper	0.32kg	CR810
70mm ²	Copper	0.29kg	CR815
95mm ²	Copper	0.25kg	CR820

Recommended fixing - countersunk woodscrew 1 1/2" x no.10 and wall plug.

For forming straight through cross or tee joints in cable.

Tower earth clamp



Bonds and clamps

Conductor size min	Conductor size max	Channel thickness	Bolt size	Conductor material	Weight each	Part no.
16mm ²	70mm ²	10mm	M10	Copper	0.13kg	BN125
70mm ²	120mm ²	10mm	M12	Copper	0.22kg	BN130

For bonding copper cable to steel structures.

Accessories

Fixings

Countersunk wood screws

Type	Size	Weight per 100	Part no.
Zinc plated steel	1.5" x no.10	0.50kg	SW105
Zinc plated steel	1.5" x no.12	0.60kg	SW110
Brass	1.5" x no.10	0.50kg	SW005
Brass	1.5" x no.12	0.60kg	SW010



Round head wood screws

Type	Size	Weight per 100	Part no.
Zinc plated steel	1.5" x no.10	0.50kg	SW405
Brass	1.5" x no.10	0.50kg	SW305



Plastic wall plugs

Type	Size	Weight per 100	Part no.
Red	No.10	0.06kg	PS305
Brown	No.12	0.06kg	PS310



Masonry drills

Size	Weight each	Part no.
No.10	0.02kg	DL005
No.12	0.02kg	DL010



Round head copper nails

Length	Weight per 100	Part no.
50mm	0.70kg	NA005



Countersunk set screws

Type	Size	Weight per 100	Part no.
Brass	6 x 30mm	0.60kg	SS160



Round head rivets

Type	Size	Weight per 100	Part no.
Aluminium	5 x 12mm	0.12kg	RV005
Aluminium	5 x 20mm	0.15kg	RV010
Copper	5 x 12mm	0.35kg	RV105
Copper	5 x 20mm	0.45kg	RV110



Hexagon head set screws

Type	Size	Weight per 100	Part no.
Phosphor bronze	10 x 25mm	2.85kg	SS635
Phosphor bronze	10 x 35mm	3.40kg	SS640
Phosphor bronze	12 x 25mm	4.50kg	SS650
Phosphor bronze	12 x 35mm	5.00kg	SS655
Brass	10 x 25mm	2.50kg	SS140
Brass	10 x 35mm	3.20kg	SS145
Brass	12 x 25mm	3.80kg	SS150
Brass	12 x 35mm	4.70kg	SS155



Plain washers

Type	Size	Weight per 100	Part no.
Phosphor bronze	6mm	0.05kg	WR365
Phosphor bronze	10mm	0.25kg	WR367
Phosphor bronze	12mm	0.50kg	WR370
Brass	6mm	0.05kg	WR165
Brass	10mm	0.25kg	WR167
Brass	12mm	0.50kg	WR170



Spring washers

Type	Size	Weight per 100	Part no.
Phosphor bronze	6mm	0.04kg	WS365
Phosphor bronze	10mm	0.20kg	WS367
Phosphor bronze	12mm	0.20kg	WS370



Hexagon nuts

Type	Size	Weight per 100	Part no.
Phosphor bronze	10mm	1.25kg	NU367
Phosphor bronze	12mm	1.80kg	NU370
Brass	6mm	0.25kg	NU165
Brass	10mm	1.15kg	NU167
Brass	12mm	1.65kg	NU170



Insulating tape



Accessories

Coil size	Weight	Part no.
25mm x 33m	0.14kg	TP120-FUR

Green/yellow general purpose insulating tape.

Denso tape



Coil size	Weight	Part no.
50mm x 10m	0.76kg	TD065

A waterproof tape for wrapping underground joints.

Silfos



Coil size	Thickness	Weight	Part no.
50mm x 8m	0.12mm	0.50kg	FS085

An alloy of silver, phosphorous and copper. Is used to braze copper in air without the use of Flux.

Flux



Material	Weight	Part no.
Flux	0.08kg	SAME

Use with tinmans solder for general purpose soldering of copper products.

Tinmans solder



Material	Weight	Part no.
60% tin, 40% lead	0.26kg	SAME

Conductors

Introduction

Conductor colour chart and conductor ratings table	34
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Flat tape

Bare, PVC, LSOH, lead covered and tinned copper tape, hard drawn copper bar, flexible copper braid, and bare and PVC covered aluminium tape	35-38
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Solid circular

Bare and PVC covered copper and aluminium	39
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Stranded

Bare and PVC covered copper and bimetallic cable	40
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Conductors

By far the largest and most important component of any earthing or structural lightning protection system is the actual conductor.

Furse offer a comprehensive range of copper and aluminium conductors in each of the main world standard formats, ie flat tape, solid circular and stranded.

Conductor colour chart

The choice of a lightning protection conductor is usually governed by its aesthetic impact on the structure to be protected. For many people the term lightning conductor conjures up an image of a bright green strip running down the spire of a church. This would clearly be unacceptable to the owner/architect of a modern structure.

In order to reduce the impact of an external system Furse offer a range of UV stabilised PVC covered tapes and solid circular conductors in colours chosen to match common building materials.

Black	18B29*	
Green	BS 6746C	
Grey	00A07*	
Stone	08B23*	
White	10B15*	
Brown	06C39*	

* PVC colours to BS 5252

Copper conductor ratings

For below ground earthing applications Furse produce a large range of bare copper, tape and stranded conductors thus offering the designer of the system the correctly rated conductor without the need to oversize.

The following conductor ratings are based upon the recommendations of BS 7430 with an initial conductor temperature of 30°C and a maximum temperature of 250°C.

Conductor size	C.S.A. (mm ²)	kA for 1 sec	kA for 3 sec	Conductor size	C.S.A. (mm ²)	kA for 1 sec	kA for 3 sec
12.5 x 1.5mm	18.75	3.3	1.9	31 x 6mm	186	32.7	18.9
12.5 x 3mm	37.5	6.6	3.8	38 x 3mm	114	20.1	11.6
20 x 1.5mm	30	5.3	3.0	38 x 5mm	190	33.4	19.3
20 x 3mm	60	10.6	6.1	38 x 6mm	228	40.1	23.2
25 x 1.5mm	37.5	6.6	3.8	40 x 3mm	120	21.1	12.2
25 x 3mm	75	13.2	7.6	40 x 4mm	160	28.2	16.3
25 x 4mm	100	17.6	10.2	40 x 5mm	200	35.2	20.3
25 x 6mm	150	26.4	15.2	40 x 6mm	240	42.2	24.4
30 x 2mm	60	10.6	6.1	40 x 6.3mm	252	44.4	25.6
30 x 3mm	90	15.8	9.1	50 x 3mm	150	26.4	15.2
30 x 4mm	120	21.1	12.2	50 x 4mm	200	35.2	20.3
30 x 5mm	150	26.4	15.2	50 x 5mm	250	44.0	25.4
31 x 3mm	93	16.4	9.5	50 x 6mm	300	52.8	30.5
31.5 x 4mm	126	22.2	12.8	50 x 6.3mm	315	55.4	32.0

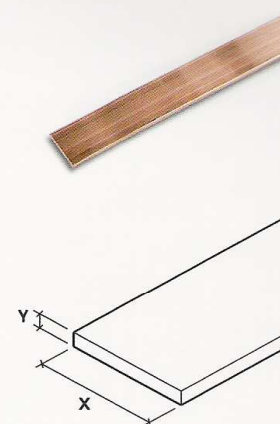
Conductors

Bare copper tape

Conductor size (XxY)	Weight per metre	Standard coil size	Part no.	Conductor size (XxY)	Weight per metre	Standard coil size	Part no.
12.5 x 1.5mm	0.17kg	100m	TC005	31 x 6mm	1.65kg	30m	TC050
12.5 x 3mm	0.33kg	100m	TC010	38 x 3mm	1.01kg	50m	TC055
20 x 1.5mm	0.27kg	100m	TC015	38 x 5mm	1.69kg	30m	TC060-FU
20 x 3mm	0.53kg	100m	TC020	38 x 6mm	1.45kg	25m	TC065
25 x 1.5mm	0.33kg	100m	TC025	40 x 3mm	1.06kg	40m	TC067
25 x 3mm	0.67kg	25m*	TC030	40 x 4mm	2.03kg	30m	TC066
25 x 4mm	0.89kg	50m	TC035	40 x 5mm	1.78kg	25m	TC071
25 x 6mm	1.33kg	40m	TC040	40 x 6mm	2.16kg	25m	TC068
30 x 2mm	0.53kg	50m	TC039	40 x 6.3mm	2.24kg	25m	TC069
30 x 3mm	0.80kg	50m	TC042	50 x 3mm	1.33kg	40m	TC070
30 x 4mm	1.07kg	40m	TC044	50 x 4mm	1.78kg	30m	TC075
30 x 5mm	1.33kg	40m	TC043	50 x 5mm	2.22kg	20m	TC078
31 x 3mm	0.83kg	50m	TC045	50 x 6mm	2.68kg	20m	TC080
31.5 x 4mm	1.13kg	40m	TC048	50 x 6.3mm	2.80kg	20m	TC082

High conductivity copper tape to BS EN 13601 (formerly BS 1432).

*25 x 3mm also available in 50m coil size (TC030/50).

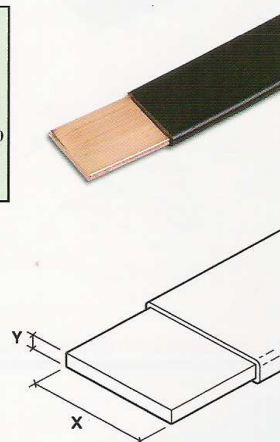


PVC covered copper tape

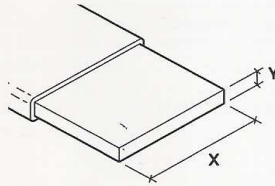
Conductor size (XxY)	Weight per metre	Standard coil size	Colour range					
			Black 18B29	Green *	Grey 00A07	Stone 08B23	White 10B15	Brown 06C39
12.5 x 1.5mm	0.21kg	100m	TC100	-	-	-	-	-
25 x 3mm	0.77kg	25m	TC105-FU	TC110	TC115-FU	TC120-FU	TC125-FU	TC130
25 x 3mm	0.77kg	50m	TC105/50	TC110/50	TC115/50	TC120/50	TC125/50	TC130/50
25 x 6mm	1.53kg	40m	-	TC140-FU	-	-	-	-
50 x 6mm	2.95kg	20m	-	TC145	-	-	-	-

High conductivity copper tape to BS EN 13601 (formerly BS 1432).

PVC colours to BS 5252. *Green to BS 6746C. Other colours are available to order. Contact Furse for details. Furse takes every precaution to ensure the UV stability of its PVC coverings, but as with all plastics, colour variation will occur over time.



LSOH covered copper tape

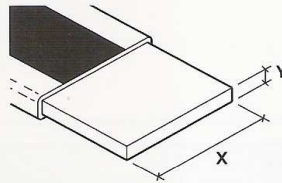


Conductor size (XxY)	Colour	Weight per metre	Standard coil size	Part no
25 x 3mm	Green	0.77kg	25m*	TC111-25
25 x 6mm	Green	1.53kg	40m	TC111-25
50 x 6mm	Green	2.95kg	20m	TC111-50

High conductivity copper tape to BS EN 13601 (formerly BS 1432). PVC colours to BS 6746C.

*25 x 3mm also available in 50m coil size (TC910/50).

Green & yellow PVC insulated copper tape

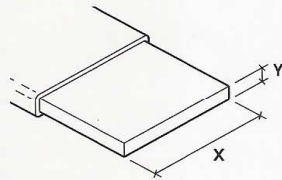
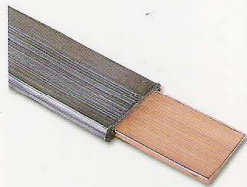


Conductor size (XxY)	Weight per metre	Standard coil size	Part no
25 x 3mm	0.79kg	25m*	TC111-25

High conductivity copper tape to BS EN 13601 (formerly BS 1432). PVC colours to BS 6746C.

*Also available in 50m coil size (TC111/50).

Lead covered copper tape



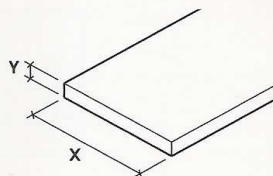
Conductor size (XxY)	Weight per metre	Standard coil size	Part no
25 x 3mm	2.56kg	50m	TC111-25

High conductivity copper tape to BS EN 13601 (formerly BS 1432).

Conductors

Tinned copper tape

Conductor size (XxY)	Weight per metre	Standard coil size	Part no.
12.5 x 1.5mm	0.17kg	100m	TC225-FU
25 x 3mm	0.67kg	50m	TC230
30 x 2mm	0.53kg	50m	TC239
25 x 6mm	1.33kg	40m	TC240
31 x 3mm	0.83kg	50m	TC245
38 x 5mm	1.69kg	30m	TC260
50 x 6mm	2.68kg	20m	TC280



High conductivity copper tape to BS EN 13601 (formerly BS 1432).

Hard drawn copper bar

Bare hard drawn bar

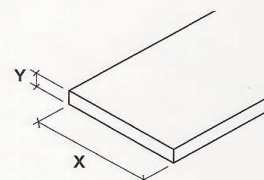
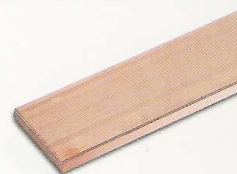
Conductor size (XxY)	Weight per metre	Part no.
25 x 3mm	0.67kg	BA205*
25 x 6mm	1.33kg	BA210
38 x 6mm	2.03kg	BA225
50 x 6mm	2.67kg	BA230*
50 x 10mm	4.45kg	BA235
75 x 6mm	4.00kg	BA240
100 x 6mm	5.38kg	BA250-FU

Tinned hard drawn bar

Conductor size (XxY)	Weight per metre	Part no.
50 x 6mm	2.67kg	BA231*

Standard lengths of 4 metres except
*supplied in maximum lengths of 3 metres.

Hard drawn high conductivity copper bar to BS 2874-C101/C103.



Flexible copper braid

Bare braid

Overall nominal size (XxY)	Size	Weight per metre	Part no.
12 x 1mm	6mm ²	0.055kg	BD020
15 x 1.5mm	10mm ²	0.096kg	BD025
19 x 2.5mm	16mm ²	0.16kg	BD026
32 x 6mm	70mm ²	0.63kg	BD027
25 x 3.5mm	35mm ²	0.34kg	BD030

Suitable for earth bonding.
Also supplied as standard pre-cut and drilled bonds (see page 54).

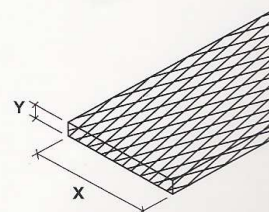
High conductivity copper wire to BS 4109-C101.



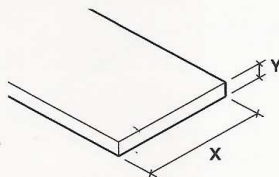
Tinned braid

Overall nominal size (XxY)	Size	Weight per metre	Part no.
25 x 3.5mm	35mm ²	0.34kg	BD035

Other sizes and types of braid can be made to order.
Please telephone for details.



Bare aluminium tape

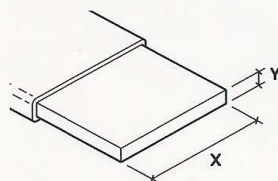
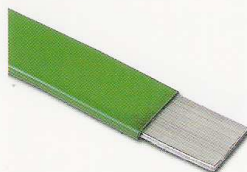


Conductors

Conductor size (XxY)	Weight per metre	Standard coil size	Part no.
12.5 x 1.5mm	0.05kg	50m	TA005
20 x 3mm	0.17kg	50m	TA020
25 x 3mm	0.21kg	50m	TA025
30 x 3mm	0.25kg	50m	TA030
25 x 6mm	0.42kg	50m	TA040
40 x 6mm	0.67kg	50m	TA060
50 x 6mm	0.85kg	50m	TA080

Aluminium tape to BS 2898-1350.

PVC covered aluminium tape

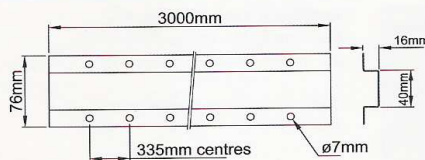


Conductor size (XxY)	Weight per metre	Standard coil size	Colour range				
			Black 18B29	Green *	Grey 00A07	Stone 08B23	White 10B15
12.5 x 1.5mm	0.09kg	50m	TA100	-	-	-	-
20 x 3mm	0.25kg	50m	TA104	-	-	-	-
25 x 3mm	0.30kg	50m	TA105	TA110	TA115	TA120	TA125

Aluminium tape to BS 2898-1350.

PVC colours to BS 5252. *Green to BS 6746C. Other colours are available to order. Contact Furse for details. Furse takes every precaution to ensure the UV stability of its PVC coverings, but as with all plastics, colour variation will occur over time.

Anti-vandal down conductor guard



Length	Weight each	Part no.
3000mm	2.90kg	AV005

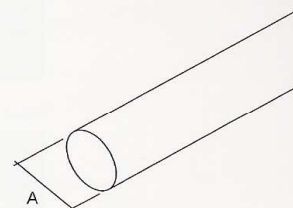
Recommended fixing - round head woodscrew 1 1/2" x no.10 and wall plug.

Suitable for use with 25 x 3mm tape

Conductors

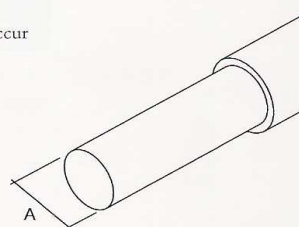
Bare solid circular

Conductor material	Diameter (A)	Cross-sectional area	Weight per metre	Standard coil size	Part no.
Copper	8mm	50.27mm ²	0.44kg	50m	CD035
to BS EN 13601 (formerly BS 1433)					
Aluminium	8mm	50.27mm ²	0.12kg	50m	CD080
to BS 2898-1350					



PVC covered solid circular

Conductor material	Diameter (A)	Cross-sectional area	Weight per metre	Standard coil size	Colour range				
					Black	Grey	Stone	White	Brown
Copper	8mm	50.27mm ²	0.49kg	50m	18B29	00A07	08B23	10B15	06C39
to BS EN 13601 (formerly BS 1433)						CD036	CD038	CD039	CD040
Aluminium	8mm	50.27mm ²	0.18kg	50m	CD081	CD083	CD084	CD085	CD086
to BS 2898-1350									



PVC colours to BS 5252. Other colours are available to order. Contact Furse for details. Furse takes every precaution to ensure the UV stability of its PVC coverings, but as with all plastics, colour variation will occur over time.

Bare stranded copper cable



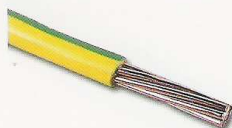
Soft drawn stranded copper cable to BS 6360

Cross-sectional area	Stranding no./mm Ø	Weight per metre	Part no.	Cross-sectional area	Stranding no./mm Ø	Weight per metre	Part no.
6mm ²	7/1.04	0.05kg	CB006	120mm ²	37/2.03	1.09kg	CB120
16mm ²	7/1.70	0.15kg	CB016	150mm ²	37/2.25	1.33kg	CB150-FU
25mm ²	7/2.14	0.23kg	CB025	185mm ²	37/2.52	1.67kg	CB185
35mm ²	7/2.52	0.32kg	CB035	240mm ²	61/2.25	2.20kg	CB240
50mm ²	19/1.78	0.43kg	CB050-FU	300mm ²	61/2.52	2.76kg	CB300-FU
70mm ²	19/2.14	0.62kg	CB070	400mm ²	61/2.85	3.53kg	CB400-FU
95mm ²	19/2.52	0.86kg	CB095				

Hard drawn stranded copper cable to BS 7884

Cross-sectional area	Stranding no./mm Ø	Weight per metre	Part no.
70mm ²	7/3.55	0.64kg	CB071

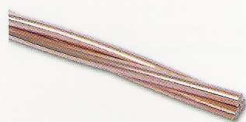
Green and yellow PVC insulated stranded copper cable



Cross-sectional area	Stranding no./mm Ø	Weight per metre	Part no.	Cross-sectional area	Stranding no./mm Ø	Weight per metre	Part no.
16mm ²	7/1.70	0.19kg	CC016	120mm ²	37/2.03	1.16kg	CC120-FU
25mm ²	7/2.14	0.29kg	CC025	150mm ²	37/2.25	1.54kg	CC150-FU
35mm ²	7/2.52	0.41kg	CC035	185mm ²	37/2.52	2.01kg	CC185
50mm ²	19/1.78	0.53kg	CC050	240mm ²	61/2.25	2.49kg	CC240
70mm ²	19/2.14	0.73kg	CC070	300mm ²	61/2.52	3.05kg	CC300
95mm ²	19/2.52	1.00kg	CC095	400mm ²	61/2.85	3.90kg	CC400-FU

PVC covered soft drawn stranded copper cable to BS 6004. PVC colours to BS 6746C.

Bimetallic cable



AWG	Cross-sectional area	Nominal diameter	Stranding no. wires/AWG	Weight per metre	Part no.
1/0	50mm ²	9.96mm	3/5	0.41kg	BC005
1	40mm ²	8.86mm	3/6	0.33kg	BC002
2	35mm ²	7.9mm	3/7	0.26kg	BC003
3	25mm ²	7.04mm	3/8	0.21kg	BC004
4	20mm ²	6.27mm	3/9	0.16kg	BC005
5	16mm ²	5.59mm	3/10	0.13kg	BC006
6	10mm ²	4.42mm	3/12	0.08kg	BC007
300	150mm ²	15.6mm	7/4	1.22kg	BC008
4/0	120mm ²	13.9mm	7/5	0.97kg	BC009
3/0	95mm ²	12.3mm	7/6	0.77kg	BC010
2/0	70mm ²	11mm	7/7	0.61kg	BC011
1/0	50mm ²	9.78mm	7/8	0.48kg	BC012
1	40mm ²	8.71mm	7/9	0.38kg	BC013
2	35mm ²	7.77mm	7/10	0.30kg	BC014

Copper/steel cable to ASTM B228.

40% conductivity supplied as standard. Other sizes also available. Contact Furse for details.

Earthing

Introduction

How to apply earthing equipment	42-43
Earthing design considerations	44-45

Earth rods

Copperbond, solid copper and stainless steel	46-48
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Earthing accessories

Earth plates and seals, Inspection pits, Earth rod clamps, Bonds and clamps, Earth points and bosses, Earth bars and disconnecting links, Soil conditioning agents, Rod hammer, Hammer rig, Earth resistance testers and Split bolt connectors	49-61
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Static earthing kits

A range of static earth leads and discharge reels	62
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Compression connectors

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How to apply earthing equipment

An effective earthing system is a fundamental requirement of any modern structure or system for operational and/or safety reasons. Without such a system, the safety of a structure, the equipment contained within it and its occupants is compromised.

Earthing systems typically fall into (but are not limited to) one of the following categories:

- Power generation, transmission and distribution
- Lightning protection
- Control of undesirable static electricity
- Telecommunications.

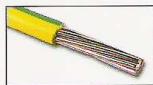
The following schematic illustrates the key elements of an effective earthing system.

Conductors and Earth rods

As with lightning protection, the first choice faced by the designer of an earthing system is the type of conductor to be used. The correct choice of conductor is extremely important, whether it be a simple below ground electrode or a complex computer room signal reference grid.

Conductors

Furse offer three types of conductor: Flat tape, Solid circular and Stranded cable.

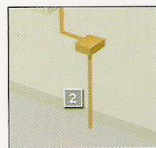


A range of conductor materials are available. Above ground, copper, aluminium and steel may be used. Below ground, copper is the most common choice due to its high resistance to corrosion.

It is important that earthing conductors should be correctly sized for their application, as they may be required to carry a considerable current for several seconds. Specific data regarding conductor ratings can be found on page 34.

Earth rods and plates

In addition to the conductors outlined above, earth rods and plates or any combination thereof can be used to achieve an effective earth depending on the site conditions.



Earth rods take advantage of lower resistivity soils at greater depths than normal excavation will allow.



Earth plates are used to attain an effective earth in shallow soils with underlying rocks or in locations with large amounts of buried services. They can also provide protection at potentially dangerous places eg HV switching positions.

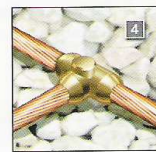
Connectors and terminations

An effective earthing system relies on joints and connections to have good electrical conductivity with high mechanical strength. Poorly chosen or badly installed joints and connectors can compromise the safe operation of an earthing system.

Furse offer a range of connectors and termination methods to suit a wide range of applications.

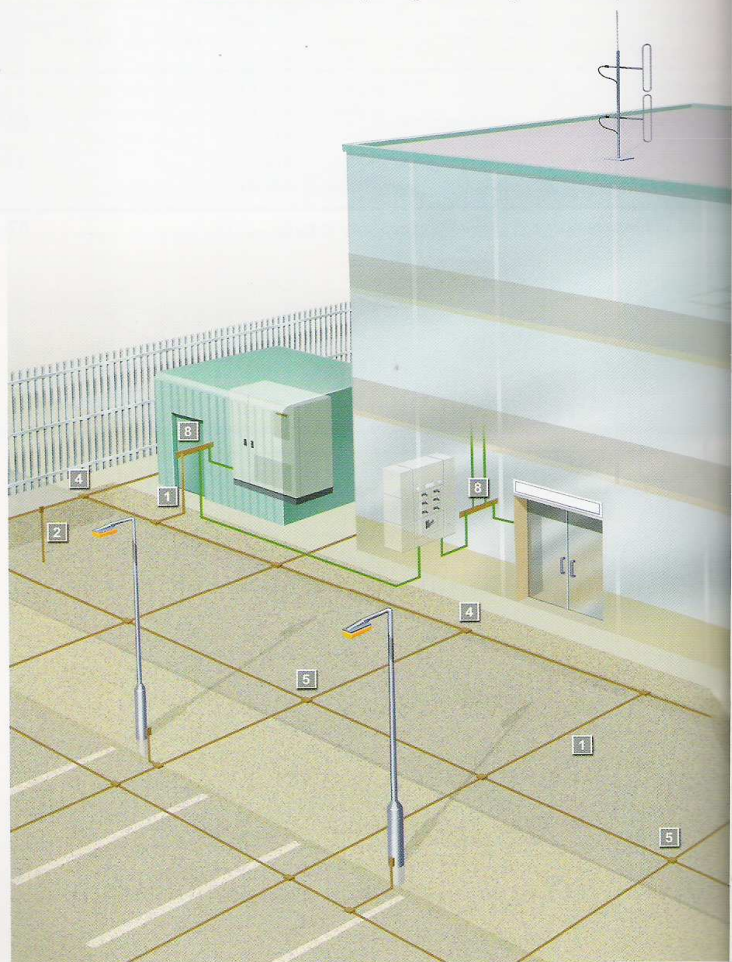
FurseWELD exothermic welding

A simple, self-contained method of forming high quality electrical connections which requires no external power or heat source. Connections are made using the high temperature reaction of powdered copper oxide and aluminium.



FurseWELD connections allow conductors to carry higher currents than other types of connections. They will never loosen, are highly conductive and have excellent corrosion resistance.

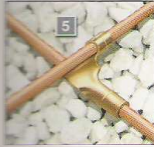
(See separate catalogue for details)



How to apply earthing equipment

Compression connectors

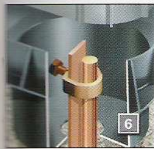
For applications where exothermic welding is not appropriate for creating permanent connections, compression connectors may be used.



Compression connectors produce very robust joints which can be buried in the ground or in concrete.

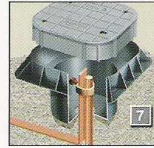
Mechanical clamps

Where permanent connections are not appropriate, mechanical clamps offer the ideal solution. These are typically used on smaller scale installations where periodic disconnection for testing is required.



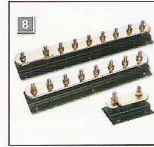
All Furse mechanical clamps are manufactured from high copper content alloy. They have high mechanical strength, excellent corrosion resistance and conductivity.

Earth inspection pits



Regular inspection and testing of the earthing system is essential. Inspection pits allow easy access to earth electrodes and conductors to facilitate this procedure.

Earth bars



Earth bars are an efficient and convenient way of providing a common earth point. Integral disconnecting links mean the earth bars can be isolated for testing purposes.

Soil conditioning agents



Soil conditioning agents are to be used in areas where required resistivity levels are difficult to achieve. When used as a backfill for earth electrodes, soil conditioning agents effectively act to increase the electrodes surface area thus lowering its resistance to earth.



Product selector

(1)	Conductors	p35-40
(2)	Earth rods	p47-48
(3)	Earth plates	p49
(4)	FurseWELD exothermic welding (See separate catalogue for details)	
(5)	Compression connectors	p64-68
(6)	Mechanical clamps	p51-57
(7)	Earth inspection pits	p50
(8)	Earth bars	p58

This illustration is designed to demonstrate the main aspects and individual components of an earthing system. It is not intended to represent an actual scheme conforming to a particular code of practice. The drawing is not to scale.

Earthing

Earthing design considerations

A correctly designed and installed earthing system will safeguard both lives and equipment.

A good earth connection should have:

- ◆ Low electrical resistance to earth
- ◆ Good corrosion resistance
- ◆ Ability to carry the required current repeatedly
- ◆ A reliable life of at least 30 years

The crucial factors that determine the resistance to earth of an electrode are:

- ◆ Soil resistivity
- ◆ Electrode dimensions
- ◆ Area available

Soil resistivity

Physical composition

Different soil compositions give different average resistivities.

Soil type	Typical resistivity Ohm-m
Marshy ground	2 – 2.7
Loam and clay	4 – 150
Chalk	60 – 400
Sand	90 – 8,000
Peat	200 upwards
Sandy gravel	300 – 500
Rock	1,000 upward

Table 1 – Effect of soil type on resistivity

Moisture

Increased moisture content of the ground can rapidly decrease its resistivity.

It is especially important to consider moisture content in areas of high seasonal variation in rainfall.

Wherever possible the earth electrode should be installed deep enough to reach the “water table” or “permanent moisture level”.

Moisture content % by weight	Resistivity Ohm-m Top soil	Resistivity Ohm-m Sandy loam
0	$1,000 \times 10^4$	$1,000 \times 10^4$
2.5	2,500	1,500
5	1,650	430
10	530	185
15	310	105
20	120	63
30	64	42

Table 2 – Effect of moisture on resistivity

Chemical composition

Certain minerals and salts can affect soil resistivity. Their levels can vary with time due to rainfall or flowing water.

Note that although the addition of salts can lower soil resistivity, they are not recommended due to corrosion and leaching. (See section on soil conditioning on page 59.)

Added salt (% by weight of moisture)	Resistivity Ohm-m
0	107
0.1	18
1	4.6
5	1.9
10	1.3
20	1.0

Table 3 – Effect of salt on resistivity for sandy loam, 15.2% moisture

Earthing

Temperature

When the ground becomes frozen, its resistivity rises dramatically. An earth that may be effective during temperate weather may become ineffective in winter.

Please note that, if your soil temperature decreases from +20°C to -5°C, the resistivity increases more than ten times.

Temperature °C	Temperature °F	Resistivity Ohm-m
20	68	72
10	50	99
0	32(water)	138
0	32(ice)	300
-5	23	790
-15	14	3300

Table 4 - Effect of temperature on resistivity for sandy loam, 15.2% moisture

Electrode dimensions

The most important dimension to consider when designing an earth electrode is its length. The greater the length of an electrode the lower the density of the current in soil in the immediate vicinity of that electrode.

For this reason a rod or strip type electrode will have a much lower resistance to earth than a plate type electrode of the same surface area.

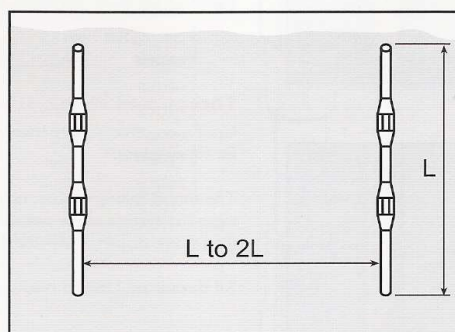
By reaching permanent moisture and frost free soil levels, low resistance should be achieved. Often these levels are some metres below the surface and the most economical way of reaching them is by extensible deep driven earth rod electrodes.

Furse recommend the use of deep driven earth rod electrodes wherever conditions allow.

Where rocks lie just below the surface and deep driving is not possible, parallel driven shorter rods, plates, mats or buried conductors, or a combination of these can be used. However, these should still be buried as deep as possible to avoid seasonal variations, damage from agricultural machinery etc.

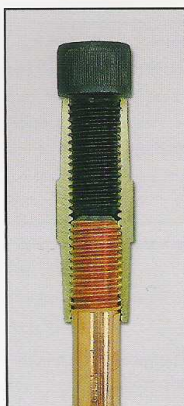
Area available

Often a single earth rod, strip or plate will not achieve the desired resistance alone. If a number of electrodes can be installed in parallel the combined resistance is then practically proportional to the reciprocal of the number employed. This is true so long as each electrode is situated outside the resistance area of any other. For rod electrodes this separation distance is considered to be equal to the driven depth. When an earth electrode must be composed of multiple parallel electrodes the area available for earthing becomes of major importance.



Parallel rods

Earth rods



Earth electrode materials

Quality earth rods are commonly made from either solid copper, stainless steel or copperbonded steel.

Furse can supply all three types, but the copperbonded steel cored rod is by far the most popular, due to its combination of strength, corrosion resistance, and comparatively low cost.

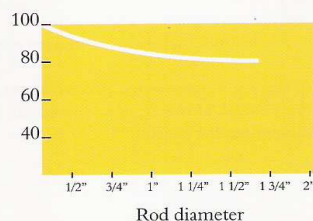
Solid copper and stainless steel rods offer a very high level of corrosion resistance at the expense of lower strength and higher cost.

Diameter of rod

One common misconception is that the diameter of the rod has a drastic effect on lowering earth resistance. This is not true! As the graph shows, you only lower the resistance value by 9.5% by doubling the diameter of the rod (which means increasing the weight and the cost of the rod by approximately 400%!).

Thus the rationale is: Use the most economical rod that soil conditions will allow you to drive. This is one of the ways to ensure that you don't waste money on over-dimensioned rods.

Resistance %



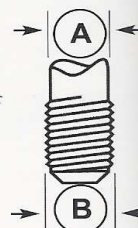
Effect of electrode diameter on resistance.

Thread and shank diameters

Confusion often arises between thread and shank diameters for threaded rods.

The thread rolling process, used by quality rod manufacturers, raises the surface of the rod so that thread diameter (B) is greater than shank diameter (A) (see drawing).

All threads are Unified National Coarse (UNC-2A).



Earth rods

Copperbond rod

Diameter	Length	Weight each	Part no.
9.0mm	1200mm	0.62kg	RB005
12.7mm	1200mm	1.18kg	RB103
12.7mm	1500mm	1.55kg	RB107
12.7mm	1800mm	1.76kg	RB116
12.7mm	2400mm	2.36kg	RB126
14.2mm	1200mm	1.53kg	RB203
14.2mm	1500mm	1.88kg	RB213
14.2mm	1800mm	2.29kg	RB216
14.2mm	2000mm	2.51kg	RB217
14.2mm	2100mm	2.68kg	RB223
14.2mm	2400mm	3.00kg	RB226
14.2mm	3000mm	3.79kg	RB236
17.2mm	1200mm	2.19kg	RB306
17.2mm	1500mm	2.73kg	RB313
17.2mm	1800mm	3.27kg	RB316
17.2mm	2000mm	3.64kg	RB317
17.2mm	2100mm	3.83kg	RB323
17.2mm	2400mm	4.35kg	RB326
17.2mm	3000mm	5.44kg	RB336

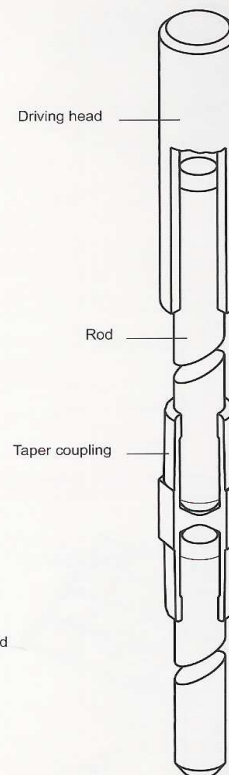
Unthreaded copperbond earth rods

Furse copperbond earth rods probably offer to the installer the best and most economical earth rods available. They are made by molecularly bonding 99.9% pure electrolytic copper onto a low carbon steel core. **Furse rods are not of the sheathed type.** They are highly resistant to corrosion, and because the steel used has a very high tensile strength, they can be driven by power hammers to great depths.

The counter-bored couplings are made from high copper content alloy, **commercial brass is not used.** This again ensures excellent corrosion resistance and high strength.

Fittings

Type	Weight each	Part no.
12.7mm Coupling	0.09kg	CG177
14.2mm Coupling	0.08kg	CG277
17.2mm Coupling	0.13kg	CG377
12.7mm Driving head	0.25kg	ST107
14.2mm Driving head	0.22kg	ST207
17.2mm Driving head	0.27kg	ST307



BS 7430, BS 6651, UL467

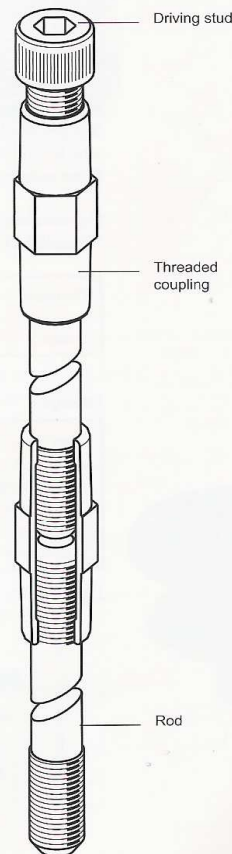
Threaded copperbond earth rods

Nominal diameter	Length	Thread diameter 'B'	Shank diameter 'A'	Weight each	Part no.
1/2"	1200mm	9/16"	12.7mm	1.18kg	RB105
1/2"	1500mm	9/16"	12.7mm	1.55kg	RB110
1/2"	1800mm	9/16"	12.7mm	1.76kg	RB115
1/2"	2400mm	9/16"	12.7mm	2.36kg	RB125
5/8"	1200mm	5/8"	14.2mm	1.53kg	RB205-FU
5/8"	1500mm	5/8"	14.2mm	1.88kg	RB210
5/8"	1800mm	5/8"	14.2mm	2.29kg	RB215
5/8"	2100mm	5/8"	14.2mm	2.51kg	RB220-FU
5/8"	2400mm	5/8"	14.2mm	3.00kg	RB225
5/8"	3000mm	5/8"	14.2mm	3.79kg	RB235
3/4"	1200mm	3/4"	17.2mm	2.19kg	RB305
3/4"	1500mm	3/4"	17.2mm	2.73kg	RB310
3/4"	1800mm	3/4"	17.2mm	3.27kg	RB315
3/4"	2400mm	3/4"	17.2mm	4.35kg	RB325
3/4"	3000mm	3/4"	17.2mm	5.44kg	RB335

Fittings

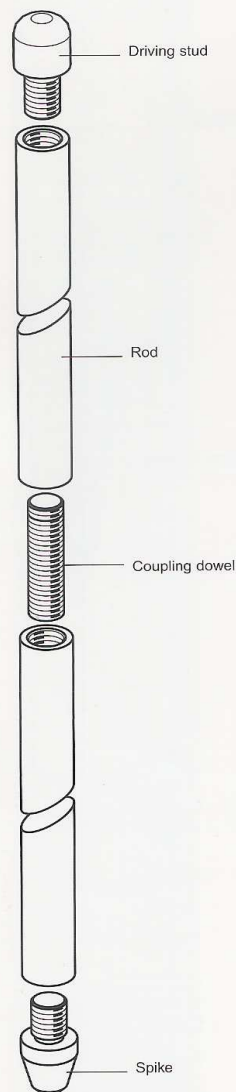
Type	Weight each	Part no.
1/2" Coupling	0.09kg	CG170
5/8" Coupling	0.08kg	CG270
3/4" Coupling	0.13kg	CG370
1/2" Driving stud	0.05kg	ST100
5/8" Driving stud	0.08kg	ST200
3/4" Driving stud	0.12kg	ST300

BS 7430, BS 6651, UL467



Solid copper and stainless steel rods

Earth rods



Solid copper rod

Furse solid copper earth rods offer greater resistance to corrosion. They are ideally used in applications where soil conditions are very aggressive, such as soils with high salt content.

Connections to the rods can be by mechanical clamps, compression or by Furse's own "Furseweld" exothermic welding system.

Diameter	Length	Weight each	Part no.
15mm	1200mm	1.88kg	RC010
20mm	1200mm	3.34kg	RC015

Fittings

Type	Weight each	Part no.
15mm Driving stud	0.02kg	ST010
20mm Driving stud	0.05kg	ST015
Coupling dowel for both sizes of above rods	0.02kg	CG013
15mm Spike	0.02kg	SP010
20mm Spike	0.04kg	SP015

BS 7430, BS 6651

Stainless steel rod

Stainless steel rods are used to overcome many of the problems caused by galvanic corrosion which can take place between dissimilar metals buried in close proximity.

Furse stainless steel earth rods are highly resistant to corrosion.

Connections to the rods can be by mechanical clamps, compression or by Furse's own "FurseWELD" exothermic welding system.

Diameter	Length	Weight each	Part no.
16mm	1200mm	1.87kg	RS005

Fittings

Type	Weight each	Part no.
15mm Driving stud	0.02kg	ST010
Stainless steel coupling dowel	0.02kg	CG005
15mm Spike	0.02kg	SP010

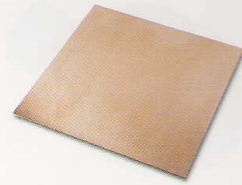
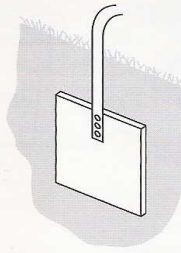
BS 7430, BS 6651

Earth plates and earth rod seals

Earth plate - solid copper

Size	Total surface area	Weight each	Part no.
600 x 600 x 1.5mm	0.72m ²	5.00kg	PE005
900 x 900 x 1.5mm	1.63m ²	11.21kg	PE015
600 x 600 x 3mm	0.73m ²	9.74kg	PE010
900 x 900 x 3mm	1.63m ²	21.74kg	PE020

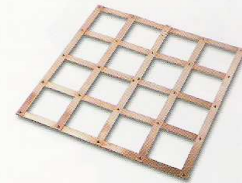
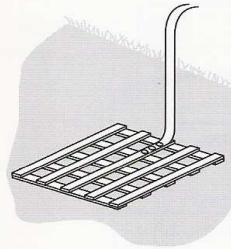
BS 2874 - C101/C103



Earth plate - lattice copper

Size	Total surface area	Weight each	Part no.
600 x 600 x 3mm	0.31m ²	3.98kg	PE110
900 x 900 x 3mm	0.65m ²	7.20kg	PE120

BS EN 13601 (formerly BS 1432)

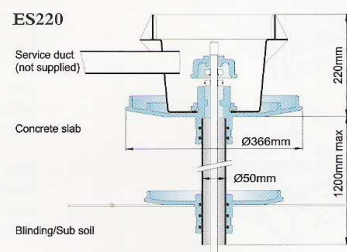
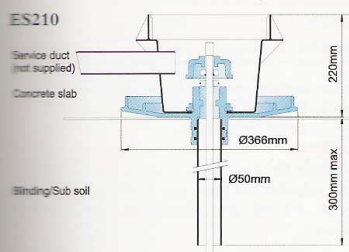


Earth rod seals

Description	Weight each	Part no.
Single-flange earth rod seal (for most applications)	2.00kg	ES210
Double-flange earth rod seal (for deep concrete slab-layers)	3.20kg	ES220

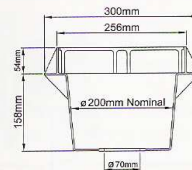
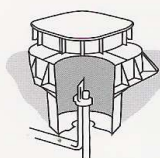
A waterproof earth electrode seal for use in constructions where internal earths are specified.

The unique design allows the seal to be effective across a broad range of rod diameters from a nominal 1/2" to 3/4" rod, by the use of various compression rings and seals. For use with PT205 - lightweight inspection pit.



A separate datasheet is available should you require further information.

Lightweight inspection pit



The lightweight inspection pit weighs only 1.8kg yet is load rated to 5,000kg. It has a lockable lid and improved working area compared to the concrete inspection pit.

An integral earth bar is available as an optional extra.

Manufactured from high-performance polymer, the lightweight pit is UV stable and chemically resistant.

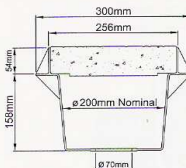
Earth inspection pits

Description	Weight each	Part no.
Lightweight inspection pit with grey lid	1.80kg	PT205
Lightweight inspection pit with black (unbranded) lid	1.80kg	PT309-FU

Accessories

Description	Weight each	Part no.
5 hole earth bar	0.40kg	PT004
6mm Allen key	0.03kg	AK005

Lightweight inspection pit with concrete lid



New to the range is a lightweight inspection pit with a concrete lid. Suitable for use in pedestrianised and light vehicular areas, the pit is load rated to 1,200kg.

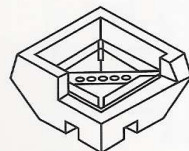
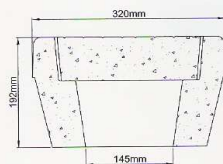
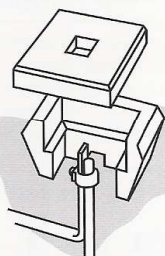
The lid can be locked in place, if required (order 2 x AS100 Allen caphead screws).

Description	Weight each	Part no.
Lightweight inspection pit with concrete lid	7.50kg	PT110

Accessories

Description	Weight each	Part no.
5 hole earth bar	0.40kg	PT004
M8 x 100mm lg mild steel 'J' bolt lifting hook	0.04kg	JH100
M8 x 60 stainless steel Allen caphead screw (2 per lid)	0.03kg	AS100

Concrete inspection pit



Description	Weight each	Part no.
Concrete inspection pit	30kg	PT005

Accessories

Description	Weight each	Part no.
5 hole earth bar	0.40kg	PT006
7 hole earth bar	0.58kg	PT007

The concrete inspection pit is load rated to 4,500kg and is suitable for most types of earthing and lightning protection installations.

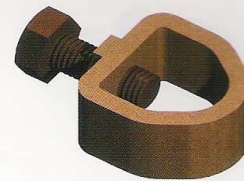
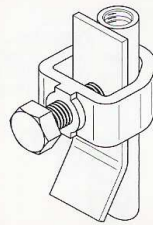
It is not suitable for use in areas where high load, small wheel vehicles are used. The Lightweight inspection pit (PT205) is recommended for this type of application.

Earth rod clamps

Nominal rod diameter	Max. conductor	Weight each	Part no.
1/2" 12.7mm	26 x 12mm	0.15kg	CR105
5/8" 16mm	26 x 12mm	0.15kg	CR105
3/4" 20mm	26 x 10mm	0.15kg	CR105
5/8" 16mm	30 x 2mm	0.16kg	CR108
3/4" 20mm	30 x 2mm	0.16kg	CR108
5/8" 16mm	40 x 12mm	0.24kg	CR110
5/8" 16mm	51 x 8mm	0.30kg	CR115
3/4" 20mm	51 x 12mm	0.30kg	CR125
1/2" 12.7mm	26 x 20mm	0.23kg	CR130
5/8" 16mm	26 x 18mm	0.23kg	CR130
3/4" 20mm	26 x 10mm	0.23kg	CR130
1" 25mm	26 x 10mm	0.23kg	CR130

Corrosion resistance, conductivity and mechanical strength are essential considerations in clamp design to ensure an earthing system remains operative for many years. All Furse earth rod clamps have high strength copper alloy bodies and screws e.g. aluminium bronze, phosphor bronze etc., **commercial brass is not used.**

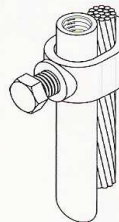
Rod to tape clamp (type A)



Rod to cable clamp (type G)

Nominal rod diameter	Conductor range	Weight each	Part no.
3/8" 9.5mm	6-35mm ²	0.03kg	CR505
1/2" 12.5mm	16-50mm ²	0.05kg	CR510-FU*
5/8" 16mm	16-70mm ²	0.06kg	CR515*
3/4" 20mm	35-95mm ²	0.06kg	CR520*
1" 25mm	70-120mm ²	0.14kg	CR525

* Suitable for use with 8mm Ø solid circular copper conductor.

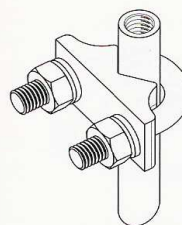


'U' bolt rod clamp (type E)

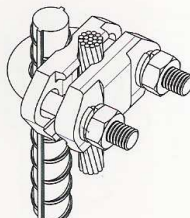
Nominal rod diameter	Hole centres	Tape width	Weight each	Part no.
5/8"	37mm	-	0.20kg	CR305
3/4"	37mm	-	0.20kg	CR310
1"	37mm	-	0.20kg	CR315
5/8"	37mm	25mm	0.26kg	CR320*
1 1/2"	54mm	-	0.37kg	CR325
2"	64mm	-	0.44kg	CR330

'U' Bolt threaded M10.

*CR320 includes additional plate to allow tape to be clamped without drilling.



Rod to cable clamp (type GUV)

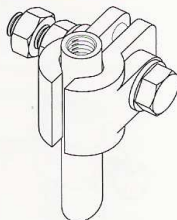


Earth rod clamps

Nominal rod diameter	Conductor range	Weight each	Part no.
5/8" 16mm	16-95mm ²	0.39kg	CR700*
3/4" 20mm	16-70mm ²	0.39kg	CR700*
5/8" 16mm	70-185mm ²	0.39kg	CR705
3/4" 20mm	70-150mm ²	0.39kg	CR705
5/8" 16mm	150-300mm ²	0.62kg	CR730
3/4" 20mm	150-300mm ²	0.62kg	CR730

* Suitable for use with 8mm Ø solid circular copper conductor.

Rod to cable lug clamp (type B)



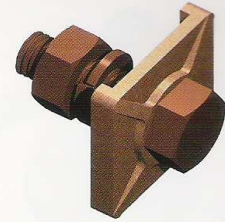
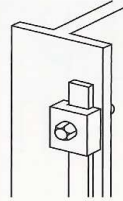
Nominal rod diameter	Rod type	Bolt size	Weight each	Part no.
3/8" 9.5mm	Copperbond	M8	0.09kg	CR205
5/8" 16mm	Copperbond	M10	0.30kg	CR215
5/8" 15mm	Solid copper	M10	0.30kg	CR220
3/4" 20mm	Copperbond	M10	0.30kg	CR225
3/4" 20mm	Solid copper	M10	0.30kg	CR230

Bonds and clamps

'B' bond

Maximum tape width	Bolt size	Conductor material	Weight each	Part no.
25mm	M10	Copper	0.12kg	BN105
25mm	M10	Aluminium	0.06kg	BN005
31mm	M10	Copper	0.15kg	BN113

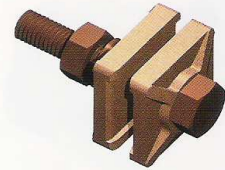
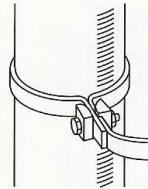
For bonding tape to steel structures.



RWP bond

Maximum tape width	Bolt size	Conductor material	Weight each	Part no.
25mm	M10	Copper	0.12kg	BN115
25mm	M10	Aluminium	0.07kg	BN010

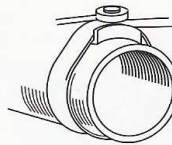
For bonding tape to rainwater pipes, handrails etc.



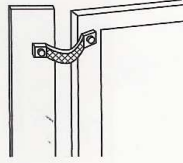
Watermain bond

Maximum tape width	Conductor material	Weight each	Part no.
25mm	Copper	0.26kg	BN120

For bonding tape to large diameter pipes.



Flexible copper braid bond

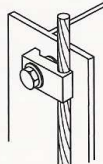
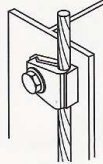
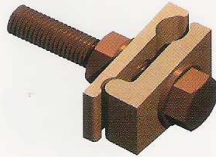


Bonds and clamps

Overall braid dimensions	Hole size	Hole centres	Weight each	Part no.
25 x 3.5mm	11mm	200mm	0.09kg	BN505
25 x 3.5mm	11mm	400mm	0.15kg	BN510

Flexible copper braid for bonding gates, doors, fences etc. Equivalent cross sectional area 35mm². Other materials, lengths and sections available as special items.

Tower earth clamps

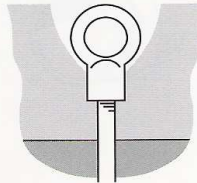


Conductor range	Channel thickness	Bolt size	Conductor material	Weight each	Part no.
16-70mm ²	10mm	M10	Copper	0.13kg	BN125*
70-120mm ²	10mm	M12	Copper	0.22kg	BN130
25-50mm ²	10mm	M10	Copper	0.08kg	BN300-FU*
25-50mm ²	10mm	M10	Aluminium	0.05kg	BN305*
120-185mm ²	10mm	M12	Copper	0.30kg	BN320
185-240mm ²	10mm	M12	Copper	0.40kg	BN325

For bonding copper cable or wire to steel structures.

* Suitable for use with 8mm Ø solid circular conductor.

Eyebolt



Nominal copperbond rod diameter	Weight each	Part no.
5/8"	0.52kg	BT150
3/4"	0.52kg	BT160

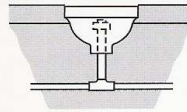
Screws direct onto a copperbond earth rod, offering an earth point for boats, trucks etc.

Bonds and clamps

Static earth receptacle

Conductor material	Weight each	Part no.
Copper	0.64kg	RX005

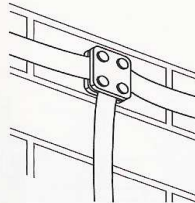
For setting into roadways or runways. Provides a static discharge point for aircraft, fuel tankers, etc.



Square tape clamp

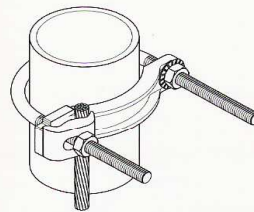
Conductor size	Conductor material	Weight each	Part no.
25 x 3mm	Copper	0.22kg	CT105-FU
25 x 6mm	Copper	0.41kg	CT110
31 x 3mm	Copper	0.35kg	CT113-FU
50 x 6mm	Copper	0.97kg	CT115

For forming straight through, cross or tee joints in tape and bar.



Pipe clamp

Pipe diameter	Conductor range	Weight each	Part no.
1/2" - 1"	13 - 25mm	25 - 95mm ²	0.03kg 3902
1 1/4" - 2"	32 - 50mm	25 - 95mm ²	0.04kg 3903
2 1/2" - 3 1/2"	65 - 90mm	25 - 95mm ²	0.08kg 3904
4" - 5"	100 - 125mm	25 - 95mm ²	0.06kg 3905-TB
6"	150mm	25 - 95mm ²	0.08kg 3906-TB
8"	200mm	25 - 95mm ²	0.10kg 3907
10"	250mm	25 - 95mm ²	0.11kg 3908
12"	300mm	25 - 95mm ²	0.15kg 3909-TB



Single hole earth points

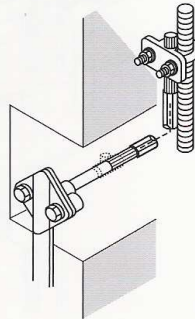
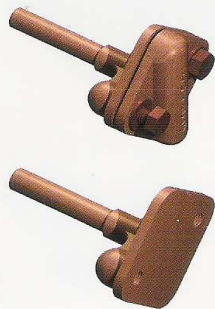


Earth points

Hole size	Length	Weight	Part no.
M8 x 15mm	80mm	0.14kg	PC100-FU
M10 x 15mm	80mm	0.14kg	PC101
M12 x 15mm	80mm	0.14kg	PC102
M16 x 15mm	80mm	0.14kg	PC103

Stem diameter = 10.7mm (70mm²).

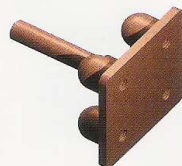
Two hole earth points



Hole Size	Length	Weight	Part no.
M8 x 12mm	80mm	0.44kg	PC115-FU
Supplied c/w front plate for connection of 25mm x 3mm copper tape or 70mm ² stranded copper cable.			
M8 x 12mm	80mm	0.44kg	PC120
Supplied c/w front plate for connection of 25mm x 3mm copper tape or 8mm diameter solid circular copper.			
M8 x 12mm	80mm	0.28kg	PC125

Stem diameter = 10.7mm (70mm²).

Four hole earth points



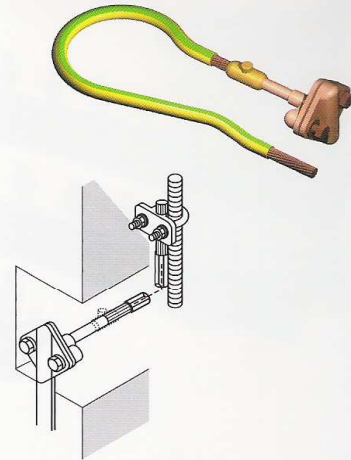
Hole size	Length	Weight	Part no.
M8 x 14mm	75mm	0.41kg	PC110

Stem diameter = 10.7mm (70mm²).

Earth points, earth boss and insulator

Earth points with pre-welded tails

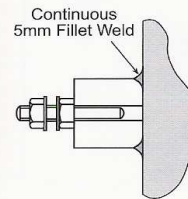
Description	Weight each	Part no.
As PC100-FU with prewelded 500mm long tail of 70mm ² PVC insulated earth cable	0.56kg	PC105
As PC101 with prewelded 500mm long tail of 70mm ² PVC insulated earth cable	0.56kg	PC106
As PC102 with prewelded 500mm long tail of 70mm ² PVC insulated earth cable	0.56kg	PC107
As PC103 with prewelded 500mm long tail of 70mm ² PVC insulated earth cable	0.56kg	PC108
As PC110 with prewelded 500mm long tail of 70mm ² PVC insulated earth cable	1.14kg	PC111
As PC115-FU with prewelded 500mm long tail of 70mm ² PVC insulated earth cable	0.84kg	PC116
As PC120 with prewelded 500mm long tail of 70mm ² PVC insulated earth cable	0.84kg	PC121
As PC125 with prewelded 500mm long tail of 70mm ² PVC insulated earth cable	0.84kg	PC126-FU



Earth boss

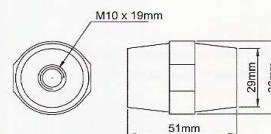
Length	Diameter	Thread size	Weight each	Part no.
50mm	50mm	M10	0.79kg	EB001

Made of mild steel to BS 970 230M07 (EN1A) with phosphor bronze stud and nuts. For welding to steel vessels/tanks/structures. Wrap connections with Denso tape (see page 32).

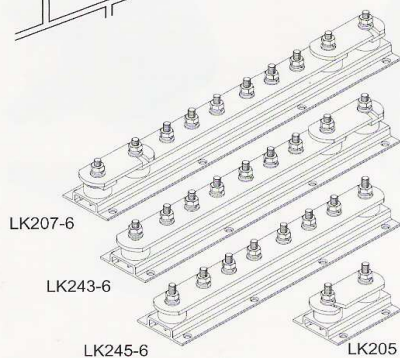
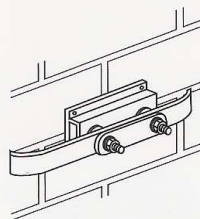
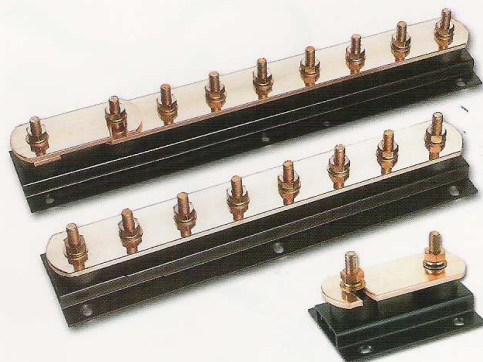


Insulator

Description	Thread size	Weight	Part no.
Insulator with 2 studs and 3 nuts	M10	0.22kg	IN005
Insulator only	M10	0.14kg	IN013



Earth bars and disconnecting links



Recommended fixing - roundhead woodscrew 1 1/2" x no.16 and wall plug. All the above products consist of 50 x 6mm copper bar.

Furse can offer a range of earth bars manufactured to your individual requirements. Contact the sales office for further information.

Earth bars and disconnecting links

Earth bars

Description	Length	Width	Height	Weight each	Part no.
6 way	400mm	90mm	90mm	1.80kg	LK245-6
8 way	500mm	90mm	90mm	2.20kg	LK245-8
10 way	650mm	90mm	90mm	2.80kg	LK245-10
12 way	750mm	90mm	90mm	3.20kg	LK245-12
14 way	850mm	90mm	90mm	3.60kg	LK245-14
16 way	950mm	90mm	90mm	4.00kg	LK245-16
18 way	1050mm	90mm	90mm	4.40kg	LK245-18
20 way	1200mm	90mm	90mm	5.00kg	LK245-20
22 way	1300mm	90mm	90mm	5.40kg	LK245-22
24 way	1400mm	90mm	90mm	5.80kg	LK245-24
26 way	1500mm	90mm	90mm	6.20kg	LK245-26
28 way	1650mm	90mm	90mm	6.90kg	LK245-28
30 way	1750mm	90mm	90mm	7.30kg	LK245-30

Earth bars with single disconnecting link

Description	Length	Width	Height	Weight each	Part no.
6 way	475mm	90mm	96mm	2.30kg	LK243-6
8 way	575mm	90mm	96mm	2.70kg	LK243-8
10 way	725mm	90mm	96mm	3.30kg	LK243-10
12 way	825mm	90mm	96mm	3.70kg	LK243-12
14 way	925mm	90mm	96mm	4.10kg	LK243-14
16 way	1025mm	90mm	96mm	4.50kg	LK243-16
18 way	1125mm	90mm	96mm	4.90kg	LK243-18
20 way	1275mm	90mm	96mm	5.50kg	LK243-20
22 way	1375mm	90mm	96mm	5.90kg	LK243-22
24 way	1475mm	90mm	96mm	6.30kg	LK243-24
26 way	1575mm	90mm	96mm	6.70kg	LK243-26
28 way	1725mm	90mm	96mm	7.40kg	LK243-28
30 way	1825mm	90mm	96mm	7.80kg	LK243-30

Earth bars with twin disconnecting links

Description	Length	Width	Height	Weight each	Part no.
6 way	550mm	90mm	96mm	2.80kg	LK207-6
8 way	650mm	90mm	96mm	3.20kg	LK207-8
10 way	800mm	90mm	96mm	3.80kg	LK207-10
12 way	900mm	90mm	96mm	4.20kg	LK207-12
14 way	1000mm	90mm	96mm	4.60kg	LK207-14
16 way	1100mm	90mm	96mm	5.00kg	LK207-16
18 way	1200mm	90mm	96mm	5.40kg	LK207-18
20 way	1350mm	90mm	96mm	6.00kg	LK207-20
22 way	1450mm	90mm	96mm	6.40kg	LK207-22
24 way	1550mm	90mm	96mm	6.80kg	LK207-24
26 way	1650mm	90mm	96mm	7.20kg	LK207-26
28 way	1800mm	90mm	96mm	7.90kg	LK207-28
30 way	1900mm	90mm	96mm	8.30kg	LK207-30

Accessories

Description	Length	Width	Height	Weight each	Part no.
Swan-neck link	400mm	50mm	36mm	0.42kg	LK004
Disconnecting link	125mm	90mm	90mm	0.59kg	LK205

Soil conditioning agents

Marconite® conductive aggregate

Sack weight	Part no.
25kg	CM025

For further information on Marconite, please contact the Furse sales office. A separate data sheet is available. Marconite is a registered trademark of Marconi Communications Ltd., and is manufactured by PMC Holdings Ltd. - Conductive Products Division.

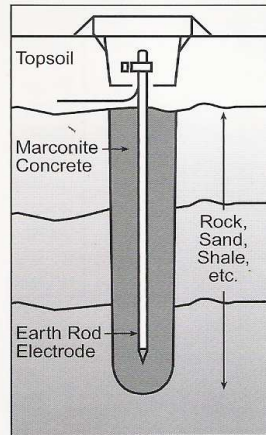
Marconite is a unique product, developed by Marconi Communications Ltd.

Certain ground conditions make it difficult to obtain a reliable earth resistance, whilst particular installations may require a very low resistance. In such cases, Marconite provides a convenient and permanent solution.

By adding Marconite in place of sand and aggregate, to cement, a conductive concrete is formed. This electrically conductive medium has many applications in the electrical/construction industry, including RF and microwave screening, static control and of course earthing, for which it was specifically developed.

When used as a backfill for earth electrodes, Marconite impregnated concrete greatly increases the electrodes surface area thus lowering its resistance to earth.

No other product can offer the same benefits as Marconite in earthing applications.

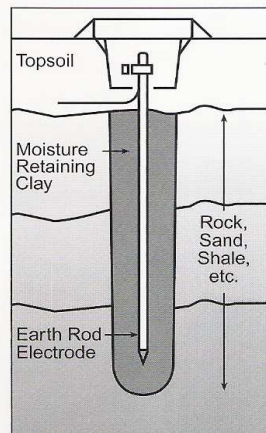


Marconite concrete used as a backfill for a conventional earth rod to achieve a lower earth electrode resistance.



Sack weight	Part no.
25kg	CM015

Used as an earth-electrode backfill to reduce soil resistivity by retaining moisture. The clay consists largely of sodium montmorillonite, which when mixed with water swells to many times its dry volume. It has the ability to hold its moisture content for a considerable period of time and to absorb moisture from the surrounding soil (e.g. from rainfall).



Moisture retaining clay



Earth rod hammer



Accessories

Description	Weight each	Part no.
Atlas Copco Cobra TT petrol driven hammer	24kg	HM005
Earth rod adapter (Suitable for 5/8" and 3/4" Earth rods)	0.7kg	HM010

For projects where hand driving is uneconomical owing to a large quantity of rods or unfavourable ground conditions, the earth rod hammer can drastically cut installation times.

Hammer rig



Description	Weight each	Part no.
Hammer rig	196.35kg	HM105

By mounting a hammer onto a rig, longer lengths of earth rods can be driven.

For projects where large quantities of rods are required cost savings can be achieved, for example, by using single 8ft rods rather than 2 x 4ft rods which would need couplers etc. Installation time is also considerably reduced.

Please specify length of rod to be driven and type of hammer to be used when ordering.

Earth resistance testers



DET 2/2



DET 3/2

A selection of earth testing instruments are available.

The DET 3/2 and the DET 2/2 digital earth testers are shown.

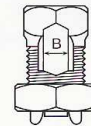
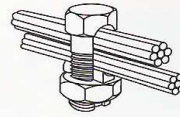
For further information on the earth resistance testers available, please contact our Technical Services department.

Accessories

Type H - High strength splitbolt connector

Conductor range				Dimension B	Weight each	Part no.
Min	Max	Min	Max			
4mm ²	10mm ²	2.5mm ²	10mm ²	4.1mm	0.02kg	8H-FU
10mm ²	16mm ²	2.5mm ²	16mm ²	5.5mm	0.03kg	4H-FU
16mm ²	25mm ²	4mm ²	25mm ²	6.9mm	0.04kg	2H-FU
25mm ²	35mm ²	4mm ²	35mm ²	8.4mm	0.06kg	1H-FU
35mm ²	50mm ²	4mm ²	50mm ²	9.7mm	0.09kg	10H-FU
35mm ²	70mm ²	4mm ²	70mm ²	11.2mm	0.14kg	20H-FU
50mm ²	95mm ²	4mm ²	95mm ²	13.6mm	0.17kg	30H-FU
50mm ²	120mm ²	6mm ²	120mm ²	14.7mm	0.18kg	40H-FU
95mm ²	185mm ²	6mm ²	185mm ²	18.2mm	0.35kg	350M-FU

For copper to copper connections. No special tools required.



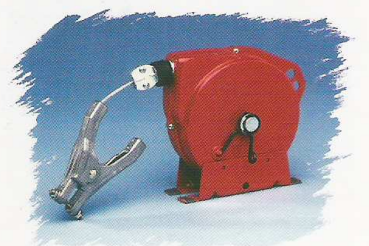
Static earth lead and plier clamp



Static earth lead and heavy duty clamp



Static discharge reel and plier clamp



Static discharge reel and heavy duty clamp



Static earthing kits

Description	Cable length (max)	Weight each	Part no.
Static earth lead and plier clamp	3 metres	0.56kg	SK010

Clamp certification II 1GD T6

A multicored high-tensile steel cable with a medium duty hard anodized diecast aluminium clamp. The cable has an orange Hytrel coating and is pre-terminated with an M10 compression ring terminal. The clamp has stainless steel contact teeth.

Description	Cable length (max)	Weight each	Part no.
Static earth lead and heavy duty clamp	5 metres	1.09kg	SK020

Clamp certification II 1GD T6

A multicored high-tensile steel cable with a heavy duty passivated carbon steel clamp. The cable has an orange Hytrel coating and is pre-terminated with an M10 compression ring terminal. The clamp has twin tungsten carbide contact teeth.

Description	Cable length (max)	Weight each	Part no.
Static discharge reel and plier clamp	6.1 metres	4kg	SK030

Clamp certification II 1GD T6. Reel certification II 2GD T6

A multicored galvanised steel cable with a medium duty hard anodized diecast aluminium clamp. The cable is housed in a self-retracting cable drum with an instant lock mechanism. The clamp has stainless steel contact teeth.

Description	Cable length (max)	Weight each	Part no.
Static discharge reel and heavy duty clamp	15.2 metres	5.9kg	SK040

Clamp certification II 1GD T6. Reel certification II 2GD T6

A multicored galvanised steel cable with a heavy duty passivated carbon steel clamp. The cable is housed in a self-retracting cable drum with an instant lock mechanism. The clamp has twin tungsten carbide contact teeth.

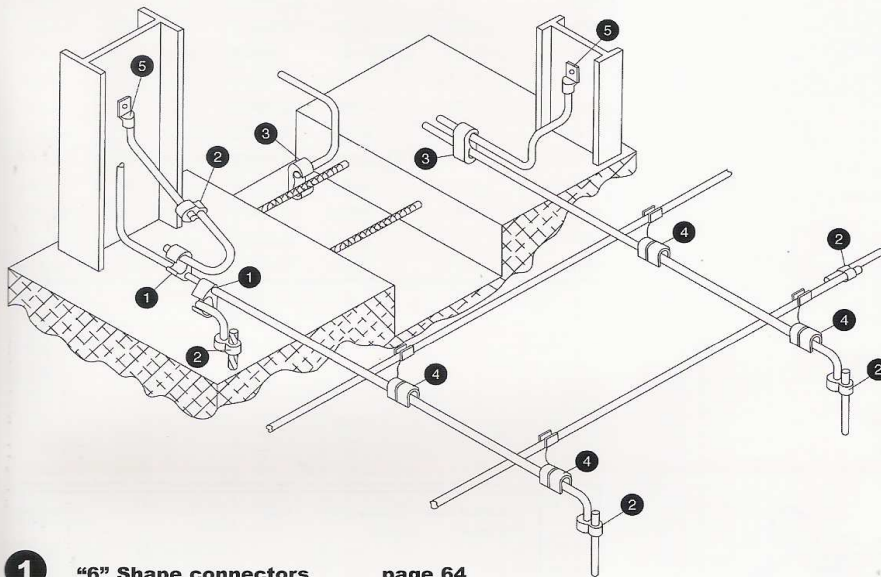
Compression connectors

Compression connectors produce very robust joints which can be buried in the ground or in concrete. They are ideal for use in situations where exothermic welding is not appropriate and periodic disconnection is not required.

A compression tool is required to make each joint - details of our manual hydraulic and battery powered tools and cutting tools can be found on pages 67-68.

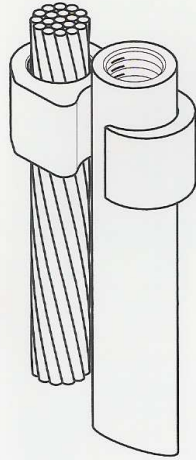


Connector selector



- | | | |
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| 2 | "8" Shape connectors | page 64 |
| 3 | "C" Shape connectors | page 65 |
| 4 | Grid connectors | page 65 |
| 5 | Terminals | page 66 |

"6" Shape connectors

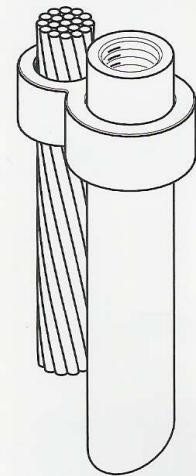


Compression connectors

Conductor	Main Rod	Conductor range	Tool	Die	Part no.
50 - 120mm ²	1/2" - 5/8"	25 - 35mm ²		15G86R	54855
50 - 120mm ²	1/2" - 5/8"	50 - 70mm ²		15G86R	54860
50 - 120mm ²	1/2" - 5/8"	95 - 120mm ²	TBM14M	15G86R	54865-CK
16 - 35mm ²	-	16 - 35mm ²	or	15501A	54875
120 - 240mm ²	5/8" - 3/4"	25 - 35mm ²	TBM15I	15G126R	54890
120 - 240mm ²	5/8" - 3/4"	95 - 120mm ²		15G121R	54895
-	5/8" - 3/4"	185 - 240mm ²		15G121R	54800
120 - 240mm ²	-	185 - 240mm ²		15G121R	54900

Can also be used to connect cable to steel reinforcing bar.

"8" Shape connectors

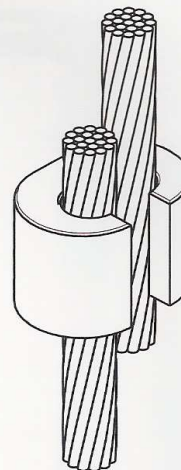


Nominal rod diameter	Conductor range	Tool	Die	Part no.
1"	150 - 240mm ²		15G121R	GR1-300500
3/4"	150 - 240mm ²		15G121R	GR34-300500
5/8"	150 - 240mm ²		15G121R	GR58-300500
1"	70 - 150mm ²		15G121R	GR1-40250
3/4"	70 - 150mm ²	TBM14M	15G121R	GR34-40250
5/8"	70 - 150mm ²	or	15G121R	GR58-40250
1/2"	70 - 150mm ²	TBM15I	15G121R	GR12-40250
1"	35 - 70mm ²		15G121R	GR1-202
3/4"	35 - 70mm ²		15G121R	GR34-202
5/8"	35 - 70mm ²		15G121R	GR58-202
1/2"	35 - 70mm ²		15G121R	GR12-202

Compression connectors

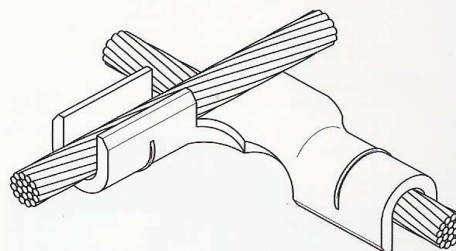
Main conductor	Conductor range	Tool	Die	Die colour code	Part no.
50mm ²	35 - 50mm ²	TBM14M	15512	Blue	54755
70mm ²	25 - 70mm ²	TBM12	TBM12D-4	Blue	54755
70mm ²	16 - 50mm ²	TBM15I	15512	Blue	54755
95mm ²	10 - 35mm ²	TBM14M	15512	Blue	54755
70mm ²	25 - 70mm ²	TBM14M	15506	Brown	54760
95mm ²	25 - 95mm ²	TBM12	TBM12D-3	Brown	54760
120mm ²	10 - 50mm ²	TBM15I	15506	Brown	54760
70mm ²	35 - 70mm ²	TBM14M	15505	Pink	54765
95mm ²	25 - 95mm ²	TBM12	TBM12D-2	Pink	54765
120mm ²	16 - 70mm ²	TBM15I	15505	Pink	54765
120mm ²	10 - 70mm ²	TBM14M	15505	Pink	54765
95mm ²	70 - 95mm ²	TBM14M	15515	Black	54770
120mm ²	35 - 120mm ²	TBM15I	15515	Black	54770
50mm ²	25 - 95mm ²	TBM12	TBM12D-2	Black	54770
185mm ²	16 - 70mm ²	TBM14M	15515	Black	54770
150mm ²	70 - 150mm ²	TBM14M	15504	Yellow	54775
185mm ²	50 - 185mm ²	TBM15I	15504	Yellow	54775
185mm ²	35 - 150mm ²	TBM12	TBM12D-1	Yellow	54775
240mm ²	16 - 120mm ²	TBM15I	15504	Yellow	54775
185mm ²	95 - 185mm ²	TBM15I	15603	White	54780
185mm ²	70 - 185mm ²	TBM15I	15603	White	54780
240mm ²	35 - 240mm ²	TBM15I	15603	White	54780

"C" Shape connectors

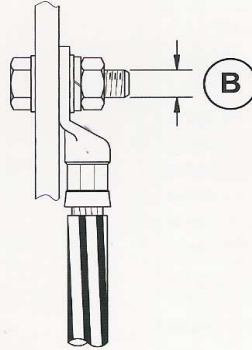


Grid connectors

Main conductor	Die	Conductor range	Die	Tool	Part no.
35mm ²	45	35mm ²	45		GG21-21
50mm ²	54	50mm ²	54		GG10-10
70mm ²	60	35mm ²	45		GG2030-21
70mm ²	60	50mm ²	54		GG2030-10
70mm ²	60	70mm ²	60		GG2030-2030
95 - 120mm ²	71	35mm ²	45	TBM14M	GG40250-21
95 - 120mm ²	71	50mm ²	54	or	GG40250-10
95 - 120mm ²	71	70mm ²	60	TBM15I	GG40250-2030
95 - 120mm ²	71	95 - 120mm ²	71		GG40250-40250
185mm ²	80H	185mm ²	80H		GG350-350
240mm ²	87	120mm ²	71		GG500-40250
240mm ²	87	240mm ²	87		GG500-500
240mm ²	87H	185mm ²	80H		GG500-350
240mm ²	87H	70mm ²	60		GG500-2030



Terminals



Compression connectors

Conductor size	Screw size (B)	Weight each	Part no.
16mm ²	6mm	0.01kg	FCT166
16mm ²	8mm	0.01kg	FCT168
16mm ²	10mm	0.01kg	FCT1610
16mm ²	12mm	0.01kg	FCT1612
25mm ²	6mm	0.01kg	FCT256
25mm ²	8mm	0.01kg	FCT258
25mm ²	10mm	0.01kg	FCT2510
25mm ²	12mm	0.01kg	FCT2512
35mm ²	6mm	0.01kg	FCT356
35mm ²	8mm	0.01kg	FCT358
35mm ²	10mm	0.01kg	FCT3510
35mm ²	12mm	0.01kg	FCT3512
50mm ²	6mm	0.02kg	FCT506
50mm ²	8mm	0.02kg	FCT508
50mm ²	10mm	0.02kg	FCT5010
50mm ²	12mm	0.02kg	FCT5012
70mm ²	8mm	0.04kg	FCT708
70mm ²	10mm	0.04kg	FCT7010
70mm ²	12mm	0.04kg	FCT7012
70mm ²	16mm	0.04kg	FCT7016
95mm ²	8mm	0.06kg	FCT958
95mm ²	10mm	0.06kg	FCT9510
95mm ²	12mm	0.06kg	FCT9512
95mm ²	14mm	0.06kg	FCT9514
95mm ²	16mm	0.06kg	FCT9516
120mm ²	10mm	0.06kg	FCT12010
120mm ²	12mm	0.06kg	FCT12012
120mm ²	14mm	0.06kg	FCT12014
120mm ²	16mm	0.06kg	FCT12016
150mm ²	10mm	0.09kg	FCT15010
150mm ²	12mm	0.09kg	FCT15012
150mm ²	14mm	0.09kg	FCT15014
150mm ²	16mm	0.09kg	FCT15016
185mm ²	12mm	0.11kg	FCT18512
185mm ²	14mm	0.11kg	FCT18514
185mm ²	16mm	0.11kg	FCT18516
240mm ²	12mm	0.14kg	FCT24012
240mm ²	14mm	0.14kg	FCT24014
240mm ²	16mm	0.14kg	FCT24016
300mm ²	12mm	0.17kg	FCT30012
300mm ²	14mm	0.17kg	FCT30014
300mm ²	16mm	0.17kg	FCT30016
400mm ²	12mm	0.21kg	FCT40012
400mm ²	14mm	0.21kg	FCT40014
400mm ²	16mm	0.21kg	FCT40016

Compression tools

JB12B, TBM14M

Self-contained hydraulic crimping tools to install copper, aluminium and ACSR conductors.

- Two-stage 'rapid-ram' advance mechanism for fast installation
- Short fibreglass handle for confined work spaces
- Accepts all U-Type dies now used for Alcoa, Burndy, Thomas & Betts and Blackburn tools of equivalent tonnage
- 180 degree head rotation
- Includes carrying case
- Contact Furse for die details

Description	Weight each	Part no.
Hand operated 12 ton tool with carrying case	5.9kg	JB12B
Hand operated 14 ton tool with carrying case	7kg	TBM14M

(Dies are not included)



TBM15I

Self-contained hydraulic crimping tools to install copper, aluminium and ACSR conductors.

- Can be used to install copper and aluminium lugs, splices, C and H taps and grid ground connectors
- Long, slim profile allows easy access into tight spaces
- Runs off existing 10,000 PSI hydraulic pumps
- Includes steel carrying case
- Contact Furse for die details

Description	Weight each	Part no.
15 ton hydraulic tool with carrying case	5.9kg	TBM15I



TBM14BSCR, TBM15BSCR



Compression tools

TBM14BSCR (Open head)

This self-contained, compact tool makes crimping easy.

- One finger trigger operation eliminates fatigue and muscle related strains
- Built-in, pre-set 10,000 psi bypass cartridge activates when the 14 ton pressure is achieved
- Includes battery charger, two NiCad batteries and carrying case
- Contact Furse for die details

TBM15BSCR (Closed head)

Self-contained, state of the art hydraulic 15 ton tool.

- Features superior hydraulics with an internally sealed oil circuit, eliminating refilling
- Solid state circuitry
- High grade forged steel head rotates 180 degrees
- High capacity battery offers 60% more compression cycles than regular batteries and can be recharged in 25 minutes or less
- Includes battery charger, two NiCad batteries and carrying case
- Contact Furse for die details

Description	Weight	Part no.
Battery powered, open head 14 ton tool	5.9kg	TBM14BSCR
Battery powered, closed head 15 ton tool	7kg	TBM15BSCR



Standard kit includes:

- 1 battery powered tool
- 1 carrying strap
- 1 carrying case
- 2 CRCTBP batteries
- 1 CRCTQC 15 minutes AC charger

(Dies are not included)

TBM58BSCT



Cutting tool

Cuts ACSR, aluminium and copper cables up to 1.5" (37mm) and earth rods to 5/8" (16mm) diameter.

- Ideal for aerial bucket work and trench operations
- One-handed operation
- Built-in bypass will activate if material is beyond the cutters capacity
- Includes battery charger, two NiCad batteries and carrying case

Description	Weight	Part no.
Battery powered 6 ton cutting tool	5.9kg	TBM58BSCT

Technical design service

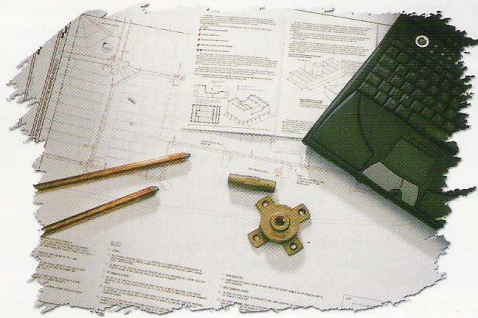
A unique service in the design of structural lightning protection, transient overvoltage and earthing systems.

As an acknowledged world leader, Furse can save you time and money in the specification, design, planning and procurement of structural lightning protection, transient overvoltage and earthing systems.

Given the complexity of National and International Earthing and Lightning Protection Standards, confusion and misinterpretation can easily lead to budget overruns and costly extra time on site.

So to avoid unnecessary material costs and prevent lengthy project delays, speak to Furse.

After all, with over one hundred years technical knowledge combined with our work as active contributors to National and International Standards, we at Furse are uniquely placed to provide sound practical advice on any aspect of Lightning Protection or Earthing.



Computer Aided Design

Through the use of modern computer aided design and draughting software, Furse can quickly produce detailed or budgetary earth electrode and lightning protection system designs, in compliance with any given standard.

Structural lightning and transient overvoltage protection

In order for Furse to design a structural and/or transient overvoltage Lightning Protection System, we need the following information:

- ◆ Design standard, eg BS 6651, NFPA 780, VDE 0185 etc
- ◆ A dimensioned roof plan
- ◆ External elevations
- ◆ Construction details, eg steelwork, reinforced concrete, roofing materials, etc
- ◆ A single line diagram indicating voltage and current for each electrical system, eg power, data, telephones, fire alarms, CCTV
- ◆ Details of essential equipment, eg network servers, PLC controllers.

Power earthing systems

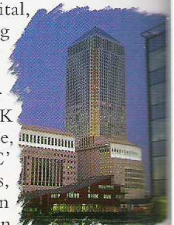
To design a power earth electrode system, we need the following information:

- ◆ Design standard, eg BS 7430, BS 7354, Ansi IEEE Std 80 etc
- ◆ A dimensioned site plan
- ◆ Overall electrical single line diagram
- ◆ Soil resistivity survey results
- ◆ Earth fault current magnitude. (Due consideration should be given to the proportion of current flowing through cable sheaths or the aerial earth wires of overhead transmission lines.)
- ◆ Earth fault current duration.



Just some of the projects where Furse Earthing and Lightning Protection systems have been installed

Abu Dhabi Exhibition Centre Al Faisaliah Centre, Riyadh Al Mazraa Substation, Syria Al Zahera Substation, Syria American University, Beirut American University, Sharjah Amiri Flight Centre, Abu Dhabi Atomic Weapons Establishment, UK Barka Substation, Oman British Library, London Burj Al Arab, Dubai Canary Wharf, London Channel Tunnel Rail Link, UK Chelsea and Westminster Hospital, UK Delimara Power Station, Malta Dubai International Airport Emirates Towers, Dubai Grand Mosque, Abu Dhabi Hammam Power Station, Algeria Hanfeng Power Station, China Heathrow Airport, UK Hospital in Slim River, Malaysia Houses of Parliament, London Institute Kesihatan Bangsar, Malaysia Johor Water Treatment Plant, Malaysia Juma Al Majid Hotel, Dubai Kapichira Hydro Station, Malawi Karachaganak Power Station, Kazakhstan Kelantan Hospital Pakar, Malaysia Kingdom Centre, Riyadh Komotini Power Station, Greece Kranji Racecourse, Singapore Light Rapid Transit, Singapore London Stock Exchange Lumut Manchong Power Station, Malaysia Manchester Airport, UK Manchester Metro Link System, UK Manchester United Training Ground, UK Manjung Power Plant, Malaysia Mass Rapid Transit, Singapore Midland Metro Line, UK Millennium Seedbank Project, UK Mimos HQ Buildings, Malaysia Mombassa Substation, Kenya Nanyang Polytechnic in Ang Mo Kio, Singapore New Nicosia General Hospital, Cyprus Newcastle International Airport, UK Oasis Leisure Centre, Cumbria Penang Water Treatment Plant, Malaysia Petronas Twin Towers, Kuala Lumpur Pfizer Pharmaceuticals, UK Planet Hollywood, Dubai Poolbeg Power Station, Eire Putrajaya Government Ministry Buildings, Malaysia Q A F Microwave Transmitting Towers, Qatar Quortaba 'B' Substation, Kuwait Reebok Stadium - Bolton Wanderers Football Club, UK Revithousa Island Project, Greece Royal Albert Hall, London Royal Courts of Justice, London Sabiya Power Station Chimney, Kuwait Salisbury Cathedral, UK Salwa 'C' Substation, Kuwait Schering Plough Pharmaceutical Plant, Singapore Senoko Gasworks, Singapore Senoko Incinerator Plant, Singapore Sharjah University Sharqia Transmission Line 132KV and Substations, Oman Singapore Post Centre in Eunos St. Lucia Expansion Project Staythorpe Substation, UK Sungai Selangor Water Works, Malaysia Suntec City Convention Centre, Singapore Telekom University Melaka, Malaysia Tuas Power Station, Singapore UIA Kuantan University, Malaysia USM Penang University, Malaysia UTM Skudai University, Malaysia Vasilikos Power Station, Cyprus Wembley Station Jubilee Line (London Underground) Windsor Castle, UK World Trade Centre, Abu Dhabi Yangcheng Power Station, China



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Tel: +65 6720 8828
Fax: +65 6720 8780
E-mail: asia_enquiry@furse.com

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- ◆ where to put transient overvoltage protectors
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**EARTHING &
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TAMCO SYSTEMS (M) SDN BHD (Company No. 84527-A)
(formerly known as Tamco Electrical & Electronics (M) Sdn Bhd)

NO. 35, PERSIARAN INDUSTRI, BANDAR SRI DAMANSARA,
52200 KUALA LUMPUR, MALAYSIA.
TEL: 03-6276 8732 FAX: 03-6272 1137

SINGAPORE

**10 Ang Mo Kio Street 65
#06-07 Techpoint
Singapore 569059**

**Tel: +65 6720 8828
Fax: +65 6720 8780**

**Web: www.furse.com
E-mail: asia_enquiry@furse.com**

JAPAN

**3F Prime Kamiyacho Building
1-11-9 Azabudai
Minato-ku
Tokyo 106-0041
Japan**

**Tel: +81 3 5549 8821
Fax: +81 3 5549 8828**

CHINA

**Room 2208, Golden Tower
No. 1 Xi Ba He South Road
Chaoyang District
Beijing 100028
China**

**Tel: +86 10 6440 2395
Fax: +86 10 6440 2440**

KOREA

**Room 2209, 22F Hanwha Building
23-5 Yoido, Youngdeungpo-Ku
Seoul 150-717
Republic of Korea**

**Tel: +82 2 761 0398
Fax: +82 2 761 0399**

MALAYSIA

**Suite C-05-03, Block C, Plaza Mont Kiara
No. 2 Jalan Kiara, Mont Kiara
50480 Kuala Lumpur
Malaysia**

**Tel: +65 6720 8828
Fax: +65 6720 8780**

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