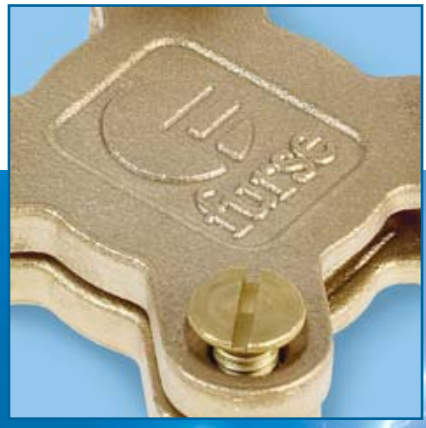
furse



Earthing & Lightning Protection Product Catalogue

Thomas&Betts

furse

Furse is a world leader in the design, manufacture and supply of earthing and lightning protection systems. Combining over 100 years' technical expertise with an enviable reputation for innovation, quality and service, Furse is uniquely placed to provide a 'Total Solution' to all your earthing, lightning and transient overvoltage protection needs.

Since 1998, the Furse brand has been included in the product portfolio of the Thomas & Betts Corporation. Thomas & Betts was founded in New York in 1898. The corporate headquarters now reside in Memphis, Tennessee with the company being listed on the New York stock exchange. Thomas & Betts has now over 100 years of experience of successfully supplying quality products to the market by using innovative design and manufacturing techniques. A truly global player having a presence in Europe, North & Central America, Australia and the Far & Middle East. Worldwide 13,000 employees are dedicated to ensuring that Thomas & Betts is fast, flexible and customer focused.

Whilst one of our core markets remains in electrical products, Thomas & Betts also has leading brands along with significant market share in emergency lighting and fire detection, steel structures, communications, electronic systems protection, earthing and lightning protection. In recent years, Thomas & Betts has developed a formidable safety products division. This division serves as a key knowledge platform, focusing on continued product innovation and delivery of competitive solutions to our customers. Furse, being one of the leading brands within this division, benefits from economies of scale in product development and production, facilitating the further efficient development of earthing, lightning protection and electronic surge protection systems.

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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.

Throughout the decades of vast technological change, Furse has adapted and expanded accordingly, providing world leading structural lightning protection, earthing and transient overvoltage protection. With offices and strong distribution networks throughout the Far East, Furse is uniquely placed to provide total lightning protection solutions.

Furthermore, by working on projects in over 120 countries, many as prestigious as the Petronas Towers in Kuala Lumpur, and Disneyland Hong Kong, Furse has developed the experience and expertise that will ensure we continue to lead the field throughout the 21st century.

Thomas & Betts

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

As one of the world's leading manufacturers of electrical and electronic components, Thomas & Betts is renowned for their interconnection and cable management products.

With many of its well known brands available worldwide, and its continued focus on product development and innovation, Thomas & Betts remains the assured choice for competitive solutions within the Far East market.

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 marketplace, to accredited engineers that can design lightning protection and earth electrode systems to the relevant British Standard (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).

Commitment to quality

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.

The support you need

At Furse we believe in sharing our knowledge with you, so you can make a properly informed decision – whether it's on the phone, through a presentation, or with our comprehensive technical literature.

Whatever your query, technical support is readily available either from our teams of engineers, or from our offices throughout the Far East and further afield, all supported by an international network of distributors.

Additionally, to help you identify what protection you do (and don't) need, in many countries, free of charge site surveys are available.

The best products, the best guidance... for total lightning protection

Furse offers the very best in terms of product development, service and support for all parties involved in lightning, earthing and transient overvoltage protection.

Our services and products cover the entire scope of lightning protection, from air terminals and conductors for structural protection, earth rods, plates, bonds and clamps etc, together with exothermic welding for effective earthing, through to enhanced surge protection devices for equipotential bonding and for protecting essential electronic systems within structures.

In short, Furse offers the Total Solution to lightning protection.

We provide a comprehensive range of product literature to support our customers with product selection or technical information as required when preparing lightning protection systems. Details of our range of publications is provided below. Contact your local office today for further information and to request your copy.

Earthing & Lightning Protection Product Catalogue

Our full range of copper and aluminium lightning protection products, essential for protecting external structures, including:

- Air terminals, bases and clamps
- Conductors
- Earthing materials, rods, fixings, clamps, earth bars and inspection pits
- Earth resistance testing equipment, compression tools and connectors

Electronic Systems Protection Product Catalogue

Our full range of Surge Protection Devices (SPDs), essential for protecting against transient overvoltages caused by lightning and electrical switching events, including:

- Service entrance and equipotential bonding SPDs
- Protectors for mains power supplies
- Protectors for data communication and signal lines
- Protectors for telephone lines and computer networks

FurseWELD Exothermic Welding Product Catalogue

Comprehensive information on the FurseWELD exothermic welding system – our fast, easy and portable way of creating high quality, fault tolerant joints without any external power or heat source. Covering both FurseWELD and SureSHOT methods for forming permanent electrical connections.

What our customers say about us

At Furse, we are fully committed to providing the best value solutions to our customers' earthing, lightning and transient overvoltage protection needs. Below is a sample of our customers' comments regarding our service.

"We know we can rely on the quality of Furse products and are ensured of excellent technical support whenever required. They have an extensive range to cover our requirements as an installer of Lightning Protection, Earthing and Surge Protection, that is why they are our #1 supplier"

Colin C Clinkard, Director, BEST Services, Britain

"Furse lightning protection units have been used on Vodafone base stations for over 10 years. These units have proved to be very reliable and complement the technical support and after sales service Vodafone have received from Furse."

Stephen Williams, Senior Engineer
Vodafone, Newbury, Britain

"Jointing Technologies stock and distribute Furse products as we believe that they are the right manufacturer to provide a range of products to suit the ever-changing earthing & lightning protection marketplace. We have worked closely with Furse for over 12 years now on many contracts including Heathrow T5, Channel Tunnel rail link, London Underground upgrade etc. Regular communication with their sales engineers ensures not only stock products are available when and where required but also customized products are available if needed to keep our projects running on time and within budget."

Nigel Ridgway, Operations Manager, Jointing Technologies, Britain

"I hadn't been involved with transient protection before, but every time I contacted Furse there was an engineer on hand. He was knowledgeable, helpful and friendly and gave good quality customer service."

Richard Mynott, Property Services Engineer
Castrol, Reading, Britain

"We are very satisfied with the performance of Furse ESP protectors, as are our customers. Previously we had used other products, but these didn't give as effective protection as Furse ESP. Although it increases the overall cost of the system, it is a justifiable expense. Because of the confidence we have in Furse we recommend use of Furse ESP to our customers."

Peter Chin Hon Ming, Sales Manager
Lucent Technologies, Kuala Lumpur, Malaysia

"As electrical consultants we have for many years realised the importance of protecting electronic equipment from lightning. It is one of the first things we specify and we specify Furse ESP for the quality of the product and the technical support we receive."

K L Ng, Director
Jentrik, Malaysia

Graha Energi Building, Jakarta

The Graha Energi building is a new office development sited at the junction of Jakarta's premier commercial district, Sudirman Central. Within its 43 storeys, the Graha Energy building provides high quality office suites, restaurants and parking to Jakarta's national and international business community.

Lightning protection may seem a small part of such a considerable development, however it remains a vital, integral component. A lightning protection scheme is essential to protect the structure, the personnel working within and the high technology electronic systems used for everyday commerce from harm.

Furse was appointed to provide both structural lightning protection and FurseWELD exothermic welding solutions to the Graha Energi development.

Burj Dubai

Already the world's tallest building and still under construction, the Burj Dubai will represent a formidable achievement as part of the development of downtown Dubai. On completion, this prestigious structure will provide hotels, residential suites, offices and leisure facilities for many Dubai residents.

Protection of tall structures is an exacting science, considering the need not only to protect the top but also the sides of the building from lightning damage. Innovative architecture presents many challenges in lightning protection scheme design.

Furse has substantial experience of providing protection for tall structures, having provided lightning protection schemes for many developments in the Middle and Far East, including the Burj Al Arab 7 star hotel in Dubai and Petronas Towers in Malaysia.

Singapore Mass Rapid Transit System – Circle Line

Currently under construction, the Circle Line is the latest development as part of Singapore's Mass Rapid Transit (MRT) system which forms the backbone of the city's railway system, serving more than a quarter of Singapore's population with a network spanning the entire city-state.

Scheduled for completion in 2011 the Circle Line will consist of 29 stations, connecting with all other lines within the network at numerous stations, thus offering to Singapore's residents a viable and improving alternative to road transport.

With the protection of passengers and vital electronic systems paramount, Furse has been commissioned to provide the essential lightning protection system for this project. Furse has many years experience working on rail specific projects, with products tailored for this market.

Why is lightning protection so important?

Lightning is one of nature's most powerful and destructive phenomena. Lightning discharges contain awesome amounts of electrical energy and even though each strike may last only a short duration, typically 200 microseconds, it is a very real cause of damage and destruction.

The effects of a direct strike are obvious and immediately apparent – fires, structural damage, disruption to services, personal injury and even death. However, the secondary effects of lightning – the short duration, high voltage spikes called transient overvoltages - can, and do, cause equally catastrophic, if less visually obvious, damage to electronic systems within structures.

Lightning can have a significant impact on an organisation. From risk of serious injury to personnel through to loss of critical services such as mains power, and significant damage to servers, PCs or electrical machinery, lightning is clearly a major threat. In the worst case scenario an organisation might go out of business as a result of lightning damage.

Reliable lightning protection needs to be applied to counter these threats. Furthermore, any lightning protection scheme must encompass both structural lightning protection and transient overvoltage protection, since structural lightning protection alone cannot and will not protect the electronic systems within a building from transient overvoltage damage.

At Furse, we are fully aware that all these risks need to be considered and protected against when developing a lightning protection scheme. With over 100 years of experience, our support and expertise has assisted thousands of businesses, both large and small, to achieve effective protection against lightning.

Fires from lightning strikes can cause major damage to structures

Furse has extensive experience of designing and supplying lightning protection systems for tall structures, including Petronas Towers, Malaysia and many new developments in the Far East

The Furse approach to external lightning protection

A structural lightning protection system is designed to protect the fabric of a structure and the lives of the people inside by channelling the lightning strike in a safe and controlled manner to the earth termination network. Using the Faraday Cage principle of lightning protection, as advocated by the majority of national and international standards, Furse offers a range of air terminals, bases and clamps for the air termination network and an extensive range of down conductors and fixings. Furse only supply high quality materials and fixings, since it only takes a single sub-standard component to compromise the performance of a structural lightning protection – or earthing – system.

The importance of a high quality earth termination network

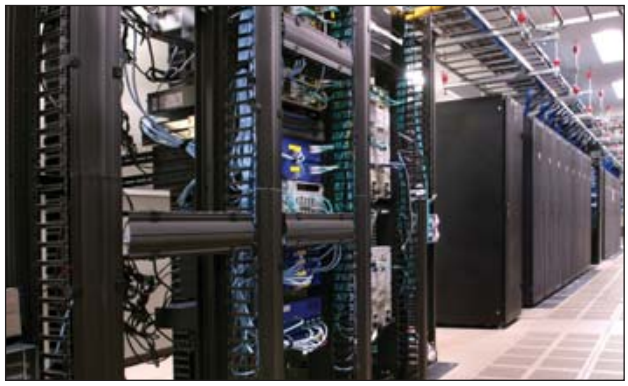
The earth termination network is the means through which the current is dissipated to the general mass of earth. Furse offers all the materials and fittings necessary for an effective earthing system, including earth rods and plates, clamps and inspection pits.

Furse also manufactures and supplies the FurseWELD exothermic welding system; a fast, easy and portable way of creating high quality, fault tolerant joints without any external power or heat source.

Please contact Furse for more information about earthing & lightning protection or FurseWELD products, or to request our catalogues.

The importance of high quality internal lightning (electronic systems) protection

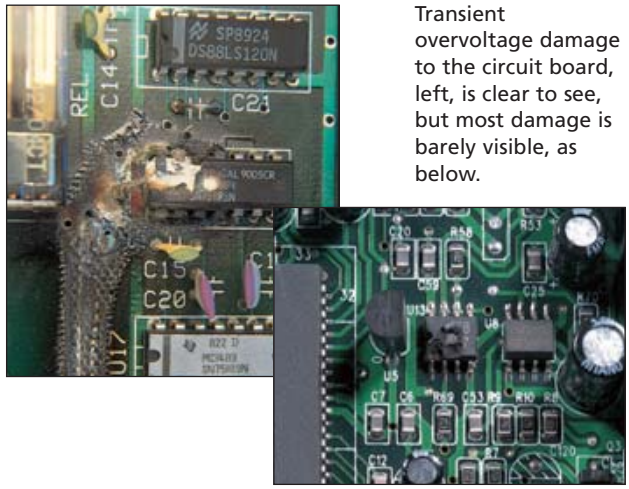
Electronic systems have become central to virtually every aspect of our lives from PCs and building management systems in the office to automated petrol pumps and bar code scanners at the supermarket. The ever-changing pace of technological development, and especially the headlong quest for miniaturisation, has created the scenario where increasingly lightning sensitive systems are placed at the core of our society. Both the threat of damage to vital electronic systems, and the seriousness of the consequences of that damage, are more real than ever before.



Most modern electronic systems are at risk:

- computers
- data communication networks
- building management systems
- PABX telephone exchanges
- CCTV equipment
- fire and burglar alarms
- telecom base stations
- uninterruptible power supplies (UPSs)
- programmable logic controllers (PLCs)
- plant sensors
- telemetry and data acquisition equipment.

Loss of these systems would cripple industrial, commercial and governmental organisations alike.



Transient overvoltage damage to the circuit board, left, is clear to see, but most damage is barely visible, as below.

The main risk to internal systems is through transient overvoltages – large, very brief and potentially destructive increases in voltage within the electrical system.

Transient overvoltages can be caused by:

- the secondary effects of lightning strikes (either between clouds or to ground) from a kilometre or more, away
- the electrical switching of large inductive loads (such as motors, transformers and electrical drives), or capacitive loads (such as power factor correction)

Devastating effects

Although they last only thousandths or millionths of a second, transient overvoltages can devastate modern electronic systems:

- disrupting system operations, through data loss, data and software corruption and unexplained crashes
- degrading equipment components and circuitry, shortening equipment lifetime and increasing failures
- destroying components, circuit boards and I/O cards
- causing costly and unnecessary system downtime

Protection benefits

Effective transient overvoltage protection can prevent:

- lost or destroyed data
- equipment damage
- repair work – especially costly for remote or unmanned installations
- the high cost of extended stoppages – sales lost to competitors, lost production, deterioration or spoilage of work in progress
- loss of essential services – fire alarm, security systems, building management systems
- health and safety hazards caused by plant instability, after loss of control
- fire risks and electric shock hazards

Please contact Furse for more information about Electronic Systems Protection products or services, or to request our catalogue.

Technical design service

Since 1893 Furse has built up an enviable reputation for innovation and quality to become a world leader in the provision of earthing and lightning protection systems. Combining over 100 years technical knowledge with our work as active contributors to National and International Standards, Furse is uniquely placed to provide sound practical advice on any aspect of your lightning protection needs.

At Furse, our aim is simple – to save you time and money in the specification, design, planning and procurement of structural lightning protection, transient overvoltage and earthing systems. From straightforward advice on product selection through to complete risk assessment, scheme design and consultancy, Furse is geared to delivering a best-value solution to all our customers.

Furse technical design

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. To counter this, we offer a range of professional services to our customers, including:

- Structural lightning and transient overvoltage protection system design
- Earthing design
- Supply of comprehensive drawings
- Soil resistivity survey
- Full earth modelling analysis
- Earth resistance measuring
- Bespoke in-house and hosted training and seminars

Using the latest computer aided design and draughting software our engineers can produce detailed or budgetary earth electrode and lightning protection system designs, in compliance with any given standard and whatever the complexity of system required.

Where necessary, we can also provide for the installation of earthing and lightning protection systems via our partnerships with specialist installers.

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, e.g. BS EN 62305, NFPA 780, IEC 62305
- A dimensioned roof plan
- External elevations
- Construction details, e.g. steelwork, reinforced concrete, roofing materials, etc
- A single line diagram indicating voltage and current for each electrical system, e.g. power, data, telephones, fire alarms, CCTV
- Details of essential equipment, e.g. network servers, PLC controllers

Power earthing systems

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

- Design standard, e.g. BS 7430, BS 7354, Ansi IEEE Std 80, EATS 41-24 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

There are a number of recognised national and international standards governing the provision of earthing systems. Our design experience and technical knowledge allow us to provide designs to any relevant standard, including BS 7430, IEEE Std 80 and EATS 41-24. Given the complexity of many of these standards, using the Furse design service avoids any confusion or misinterpretation that could lead to budget overruns or project delays.

Proper site surveys and analysis complement fully our in-house service. Through collation of all relevant information from site, including soil resistivity measurements and earthing analysis, our engineers can produce bespoke earthing designs complete with drawings, calculations and a detailed report, along with a structural lightning protection system if required.

Soil resistivity surveys

Inadequate or erroneous soil resistivity readings are likely to result in a flawed design. Furse site surveys take multiple accurate soil resistivity readings at various depths across the proposed site to form the basis of the whole earthing design.

Full earthing analysis

Full earthing analysis determines the step and touch voltages, earth potential rise and hot/cold site classification of the site generated by the initial design.

Earth resistance measurement

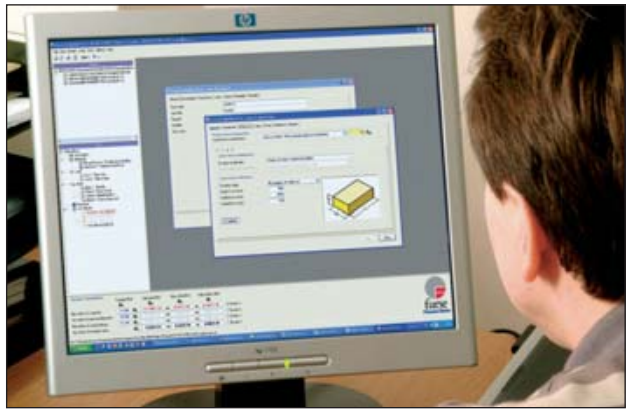
Earth resistance measurement is essential to ensure that the installation meets the anticipated criteria laid out in the initial design. Furse has the technical experience to ensure that the measurements accurately reflect the true resistance of the earthing system.

Automated risk assessment

The new Standard for lightning protection, BS EN/IEC 62305, promotes risk assessment as central and critical to determining the level of lightning protection system required. This complex risk assessment incorporates trial & error calculations which could take hours to process by hand – not the most profitable use of a consultant's time!

To assist, Furse technical team provides a risk assessment service using our proprietary risk evaluation software to process the complex calculations required by BS EN/IEC 62305-2.

Please contact Furse for more details about how automated risk assessment can help you plan your lightning protection systems.



Training and seminars

Not only do our engineers offer technical design services, but also training courses are available to ensure you or your team can acquire a greater understanding of the nature, problems and solutions to earthing and lightning protection requirements.

Courses can be tailored to individual needs and are held at the Furse offices or other convenient locations. Contact Furse for further details.

The benefits of coming to Furse

There are many benefits of coming to Furse for earthing, lightning protection and electronic systems protection designs, including:

- Specialist advice from a fully qualified technical team, which focuses solely on lightning protection issues and concerns
- Designs that comply with all relevant standards – national and international
- Our responsibility for providing a design that is safe
- Experience and the software to provide an 'optimum' design – one that doesn't use more earthing material than is necessary – saving you money
- Manufacturing experience & expertise – utilising our knowledge of the products available to provide a tailored design that can be installed using the most appropriate and up-to-date products

Furse, the Total Solution to lightning protection

This catalogue focuses on Earthing & Lightning Protection, an integral part of the comprehensive range of products and services available through the Furse Total Solution to lightning protection.

The Furse Total Solution is the industry-leading approach to lightning protection, encompassing structural, earthing and transient overvoltage protection. This approach is fully reinforced by the new standard, BS EN/IEC 62305, which emphasizes that structural lightning protection can no longer be considered in isolation to transient overvoltage protection.

Our Total Solution offers all the relevant components for effective lightning protection, from air terminals and down conductors to protect structures, through to Surge Protection Devices to protect the vital electronic systems within. By providing the highest quality products, supported by practical advice and technical expertise, Furse remains the assured choice to ensure your business is fully protected against lightning strikes and transient overvoltage damage.

Contact Furse today to discuss how our full range of products and services can help protect your business from lightning risk.

Lightning protection

BS EN 50164 Standard

Lightning protection component performance

For over 100 years, Furse has been leading the field in the design and manufacture of innovative, high quality lightning protection and earthing components. In keeping with this commitment to quality, all our products are thoroughly and independently tested to ensure they can withstand constant exposure to the environment as required by a Lightning Protection System and continue to dissipate lightning current safely and harmlessly to earth over the long term.

Recently introduced CENELEC (European) standards have redefined the process by which lightning protection components are judged fit for purpose. Whereas the previous standard focused on the use of specific materials to ensure compliance, now, with the introduction of the BS EN 50164 series of standards, performance and testing are the key criteria.

Furse components have been rigorously tested to ensure compliance with BS EN 50164. Our connection components comply with BS EN 50164-1, our conductors and earth electrodes BS EN 50164-2.

By choosing lightning protection components complying with the BS EN 50164 series, the designer ensures he or she is using the best products on the market and is in compliance with BS EN/IEC 62305.

The BS EN 50164 Series

Currently, three standards within the BS EN 50164 series have been published. These are:

- BS EN 50164-1:2000 Lightning protection components (LPC) Part 1: Requirement for connection components
- BS EN 50164-2:2002 Lightning protection components (LPC) Part 2: Requirements for conductors and earth electrodes
- BS EN 50164-3:2006 Lightning protection components (LPC) Part 3: Requirements for isolating spark gaps (ISG)

Several other parts of BS EN 50164 remain in the process of being compiled by the relevant working group in CENELEC. These are:

- BS EN 50164-4 Lightning protection components (LPC) Part 4: Requirements for conductor fasteners
- BS EN 50164-5 Lightning protection components (LPC) Part 5: Requirements for earth electrode inspection housings and earth electrode seals
- BS EN 50164-6 Lightning protection components (LPC) Part 6: Requirements for lightning strike counters
- BS EN 50164-7 Lightning protection components (LPC) Part 7: Requirements for earth enhancing compounds

Parts 4 to 7 are in draft format and only when they are mature enough for voting by the National Committees will it be decided whether they will be approved and ultimately published.

All Furse connection components have successfully passed the BS EN 50164-1:2000 test procedures

Independent testing

In order to gain compliance with BS EN 50164, manufacturers must subject their components to thorough testing and performance measurement.

Furse product tests are undertaken by an independent laboratory. The Research Development and Certification Centre – High Voltage and High Current Testing Laboratory – is a RvA Certified test laboratory.

Tests are carried out on three specimens of the component. The conductors and specimens are prepared and assembled in accordance with the manufacturer's instructions, e.g. to recommended tightening torques. Afterwards, the components undergo environmental preconditioning and are subjected to simulated lightning discharges to assess their capacity to cope with onerous conditions.

Passing the test

Each part of BS EN 50164 defines its own criteria for satisfactory performance of components. All three components tested must satisfy the conditions set out by BS EN 50164 for the testing to be deemed successful.

A full test report with certification is produced by the independent laboratory for all components satisfying the test criteria.

Environmental ageing chamber for ammonia atmosphere ageing

Furse component testing

Look out for this symbol within the catalogue for details of the relevant testing standards which Furse conductors, structural lightning protection and earthing components have passed.

Conductors

The first choice faced by the designer of a structural lightning protection system is the type of conductor system to be used.

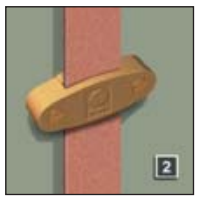
Choose the material required, i.e. copper or aluminium.

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

Conductor network

The conductor network is the means of intercepting/carrying the current of a lightning strike safely to the earth termination network. Use the guidelines of BS EN/IEC 62305-1 & 3 for the correct placement of conductors.

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, e.g. brick, stone, plastic and metal.

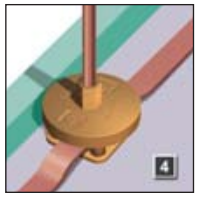
Air termination network

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. The mesh size is now determined by the chosen Lightning Protection Level (see table 5, page 86).

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.

Interconnection components

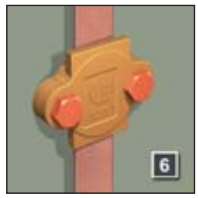
NEW Crossover clamp specially designed for use where conductors cross as part of a roof network.

Down conductor network

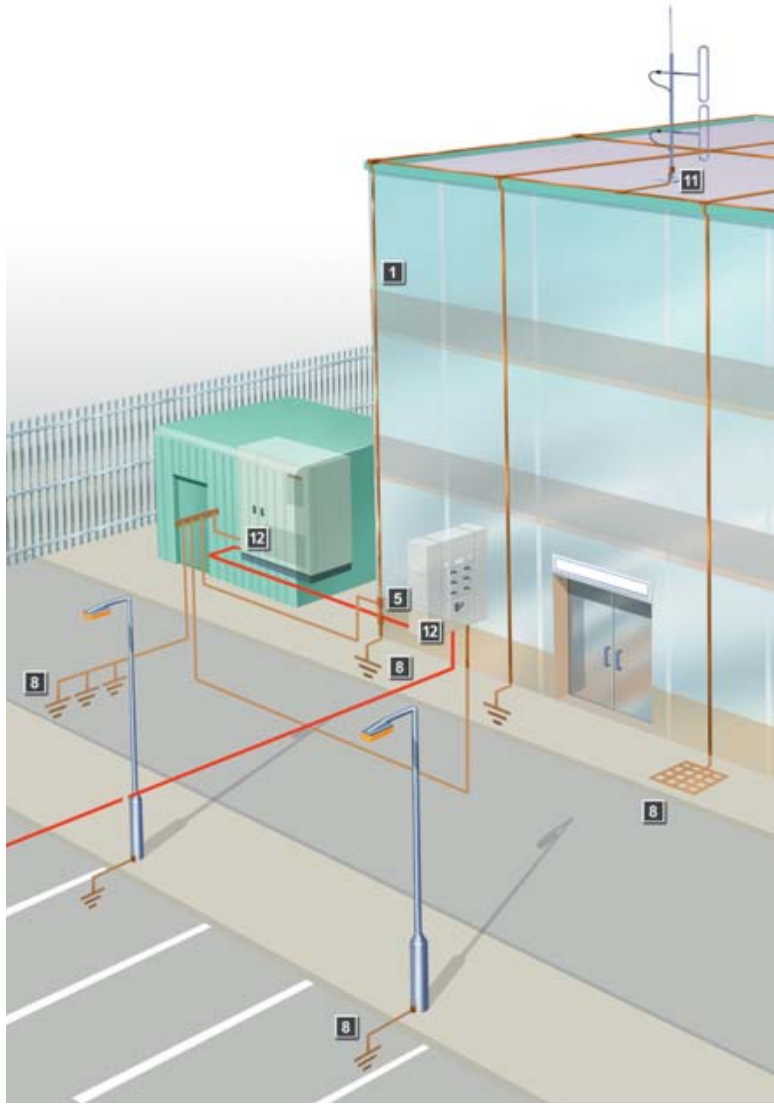
Conductor jointing clamps

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

Test clamps



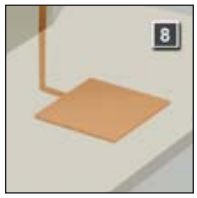
In order to allow periodic disconnection and testing of the earth termination network, select a test clamp to be placed within the run of each down conductor.



Earth termination network

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

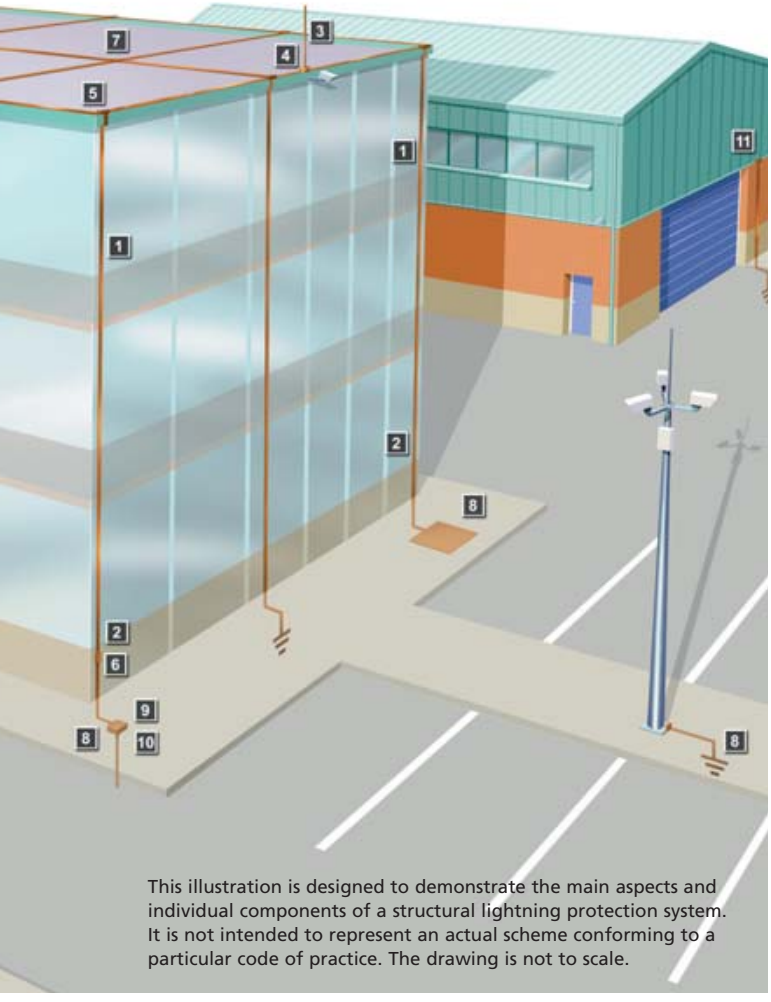
Earth electrodes



Choose an earth electrode to suit the system design i.e. Type A, Type B or foundation electrode. Electrodes can be constructed individually from earth rods, earth plates, flat tape, stranded cable or any combination of these.

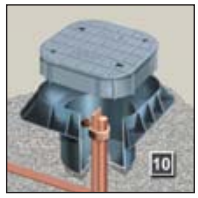
Earth rod clamps

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.



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.

Earth inspection pits



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

Equipotential 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, e.g. 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, i.e. a flat column face, a circular rainwater pipe or a ribbed reinforcing bar.

Lightning current or Equipotential bonding SPDs

Designed to prevent dangerous sparking caused by flashover, lightning current or equipotential bonding SPDs *must* be fitted to all lines entering or leaving the structure.

Product selector

(1)	Conductors	p41–48
(2)	Conductor fixings	p21–26, 30–32, 36–37
(3)	Air terminals	p17–19, 29, 35
(4)	Air rod bases	p17–19, 29, 35
(5)	Conductor jointing clamps	p26–27, 33–34, 37–38
(6)	Test clamps	p26–27, 34, 37
(7)	Crossover conductor clamp	p26
(8)	Earth electrodes	p52–55
(9)	Earth rod clamps	p57–59
(10)	Earth inspection pits	p56
(11)	Bonds	p59–64
(12)	Lightning current or Equipotential bonding SPDs	Refer to ESP Catalogue

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, e.g. 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 conductors 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.

The following pages (17 – 28) detail the products required to install a 'Flat tape' lightning protection system. Additionally, accessories can be found on pages 39 – 40.

Details of the flat tape conductors can be found in the Conductors section on pages 43 – 46.

Air rod

Rod length	Rod diameter	Thread diameter	Material	Weight each	Part No.	
500mm	15mm	16mm	Copper	0.73kg	RA215	
1000mm	15mm	16mm	Copper	1.51kg	RA225	
1500mm	15mm	16mm	Copper	2.35kg	RA230	NEW
2000mm	15mm	16mm	Copper	3.00kg	RA240	
3000mm	15mm	16mm	Copper	4.70kg	RA250	NEW
500mm	15mm	16mm	Aluminium	0.29kg	RA015	
1000mm	15mm	16mm	Aluminium	0.53kg	RA025	
1500mm	15mm	16mm	Aluminium	0.80kg	RA030	NEW
2000mm	15mm	16mm	Aluminium	1.06kg	RA040	
3000mm	15mm	16mm	Aluminium	1.60kg	RA050	NEW

Manufactured from high conductivity hard drawn copper or aluminium, with rolled threads. Supplied complete with locknut.

"Field Trials 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.

Note: during high winds and extreme weather conditions air rods over 1000mm long can be subjected to fatigue mechanisms. It is therefore recommended that additional supports are considered before installation.

BS EN 50164-2

Multiple point

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

Manufactured from high conductivity hard drawn copper, suitable for use with copper air rods only.

Air rod base

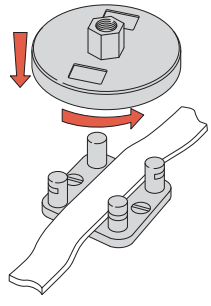
Rod diameter	Thread diameter	Maximum conductor width	Material	Weight each	Part No.	
15mm	16mm	25mm	Copper	0.43kg	SD105-H	NEW
15mm	16mm	25mm	Aluminium	0.14kg	SD003-H	NEW

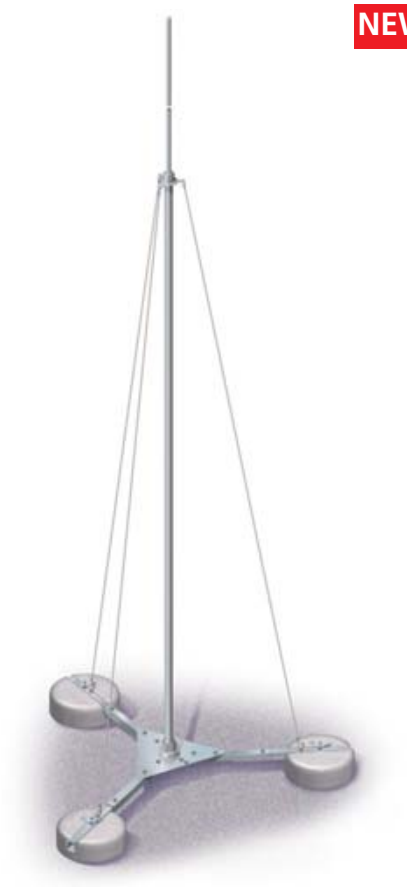
Manufactured from high quality copper and aluminium alloys. Simple to install, providing an effective connection between air rod and air termination tape.

BS EN 50164-1 Class H

Fix using countersunk wood screws (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**). See page 39 for Accessories.

Pat. pending





NEW Free-standing extendable air rod

Description	Height	Part No.
Extendable tripod base and air rod	4.5m	TP100
Extendable tripod base and air rod	6.5m	TP200
Extendable tripod base and air rod	8.5m	TP300

Manufactured from galvanized steel box section. Includes air rod and concrete blocks to create a free-standing, height adjustable air terminal. Provides an effective connection between air rod and air termination tape.

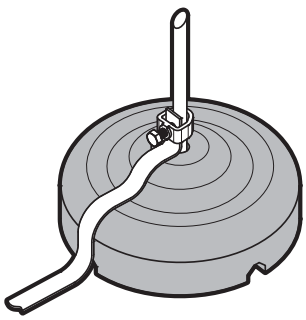
NEW Free-standing concrete air rod base

Description	Diameter	Weight each	Part No.
Concrete block	280mm	10kg	BC100
Concrete block	400mm	17kg	BC200

Use in conjunction with standard air rods to create a free-standing air terminal on roofs where conventional fixings are not possible e.g. single ply or bitumen felt.

Accessories

Description	Thread diameter	Weight each	Part No.
Polyethylene tray for concrete blocks	M16	0.05kg	PD100

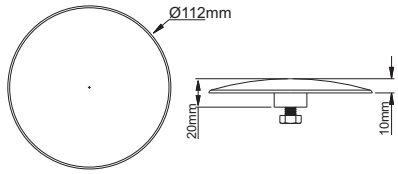


NEW Insulated distance holders

Description	Length	Weight each	Part No.
Glass fibre insulated rod	3m	0.70kg	IR100
16mm dia. air rod holder	–	0.20kg	IR200
Fixing plate	–	0.50kg	IR300
Glass fibre insulated rod attachment to cylindrical objects	1m	1.00kg	IR400

Strike pad

Conductor material	Weight each	Part No.
Copper	0.41kg	PL010
Aluminium	0.13kg	PL005
Copper stem for use with PL010	0.07kg	SM010

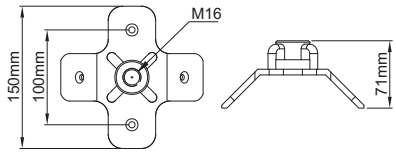


Manufactured from high quality copper and aluminium alloys. Designed to provide an exposed attractive point on conductor systems hidden/embedded in the building's fabric e.g. below the tiles of a pitched roof.

Supplied with setscrew for attachment of lightning conductors.

Ridge saddle

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

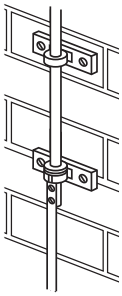


For supporting lightning conductor air rods on ridges.

BS EN 50164-1 Class H

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 15Nm

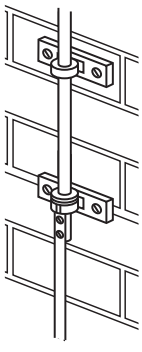


Rod brackets

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

Manufactured from high quality copper and aluminium alloys. Simple to install, providing an effective means of mounting an air rod on a vertical surface e.g. chimney stack. Use in conjunction with a rod to tape coupling.

Fix using roundhead wood screws 1½" x no. 12 or M8 and wall plugs



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

Manufactured from high quality copper and aluminium alloys. Provides an effective connection between air rod and air termination tape. Use in conjunction with rod brackets.

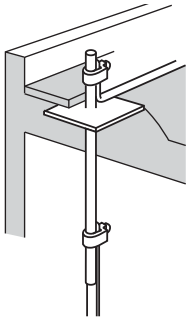
BS EN 50164-1 Class H

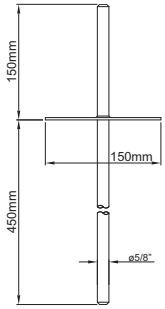
Tightening torque 7Nm

Puddle flange

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

Permits lightning conductors to pass through flat roofs without damaging the waterproof nature of the roof.





DC tape clip

Use with bare copper

Conductor size	Weight each	Part No.
20 x 3mm	0.06kg	CP205
25 x 4mm	0.07kg	CP216
30 x 5mm	0.10kg	CP227
38 x 5mm	0.12kg	CP245
40 x 4mm	0.14kg	CP241
50 x 4mm	0.15kg	CP256

Made from high quality copper alloys.

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

Made from high quality copper alloys.

Use with lead covered copper

Conductor size	Weight each	Part No.
25 x 3mm	0.20kg	CP305

Made from high quality copper alloys.

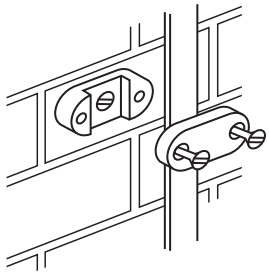
Use with bare aluminium

Conductor size	Weight each	Part No.
20 x 3mm	0.02kg	CP105

Use with PVC covered aluminium

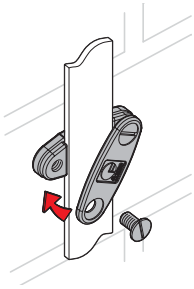
Conductor size	Weight each	Part No.
25 x 3mm	0.04kg	CP115
50 x 6mm	0.06kg	CP130

Made from high quality aluminium alloys.



Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Pat. Pending



NEW Swing lid DC tape clip

Use with bare copper

Conductor size	Weight each	Part No.
25 x 3mm	0.07kg	CP210-H
25 x 6mm	0.08kg	CP220-H

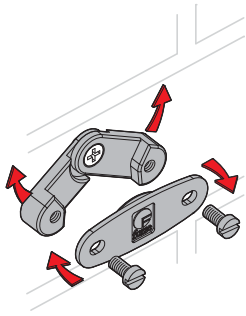
Use with bare aluminium

Conductor size	Weight each	Part No.
25 x 3mm	0.03kg	CP110-H
25 x 6mm	0.04kg	CP120-H

DC tape clips manufactured from high quality copper and aluminium alloys for excellent corrosion resistance and high pull off loads.

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Pat. Pending

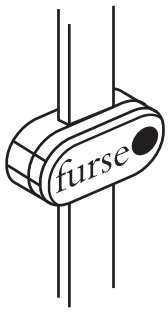


NEW Adjustable DC tape clip

Conductor size	Weight each	Part No.
31 x 3mm and 31 x 6mm – use with bare copper	0.10kg	CP230-H
38 x 3mm, 38 x 6mm and 40 x 6mm – use with bare copper	0.12kg	CP240-H
50 x 3mm and 50 x 6mm – use with bare copper	0.16kg	CP260-H
50 x 6mm – use with bare aluminium	0.05kg	CP125-H

DC tape clips manufactured from high quality copper and aluminium alloys for excellent corrosion resistance and high pull off loads.

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.



Non-metallic DC tape clip

Use with bare tape

Conductor size	Colour	Weight each	Part No.
20 x 3mm	Brown	0.01kg	CP005
20 x 3mm	Grey	0.01kg	CP010
25 x 3mm	Brown	0.01kg	CP015
25 x 3mm	Grey	0.01kg	CP020
38 x 5mm	Brown	0.01kg	CP060*
50 x 6mm	Brown	0.02kg	CP065*

Use with PVC covered tape

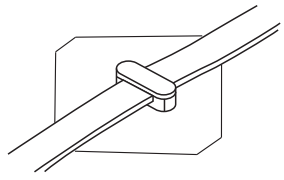
Conductor size	Colour	Weight each	Part No.
25 x 3mm	Brown	0.01kg	CP025
25 x 3mm	Black	0.01kg	CP030
25 x 3mm	Green	0.01kg	CP035
25 x 3mm	Grey	0.01kg	CP040
25 x 3mm	Stone	0.01kg	CP045
25 x 3mm	White	0.01kg	CP050

Manufactured from 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.

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

* Not as illustrated.

Bitumen felt roof clip



Use with bare tape

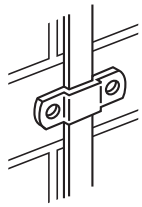
Conductor size	Colour	Weight each	Part No.
25 x 3mm	Brown	0.09kg	FP015
25 x 3mm	Grey	0.09kg	FP020

Use on bitumen felf roofing only

Use with PVC covered tape

Conductor size	Colour	Weight each	Part No.
25 x 3mm	Brown	0.09kg	FP025
25 x 3mm	Black	0.09kg	FP030
25 x 3mm	Green	0.09kg	FP035
25 x 3mm	Grey	0.09kg	FP040
25 x 3mm	Stone	0.09kg	FP045
25 x 3mm	White	0.09kg	FP050

Tape clip



Use with bare copper

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

Use with PVC covered tape

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

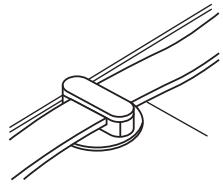
Use with bare aluminium

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

Manufactured from pure copper or aluminium, these simple pressed clips are available in a range of sizes to suit bare and PVC covered copper and aluminium tapes.

Fix using roundhead wood screws 1½" No. 10 or M6 (Part no. **SW305** or **SW405** and wall plugs (Part no. **PS305**) – see Accessories page 39.

Glue down DC tape clip



Use with bare tape

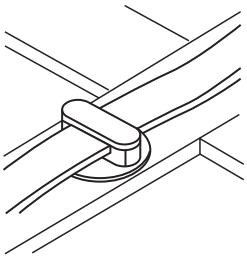
Conductor size	Colour	Weight each	Part No.
25 x 3mm	Brown	0.03kg	GD015
25 x 3mm	Grey	0.03kg	GD020

Use on clay roof tiles. Supplied in a box of 50 complete with adhesive.

Additional glue gun is required.

Use with PVC covered tape

Conductor size	Colour	Weight each	Part No.
25 x 3mm	Brown	0.03kg	GD025
25 x 3mm	Black	0.03kg	GD030
25 x 3mm	Grey	0.03kg	GD040
25 x 3mm	Stone	0.03kg	GD045
25 x 3mm	White	0.03kg	GD050



Adhesive DC tape clip

Use with bare tape

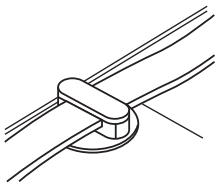
Conductor size	Colour	Weight each	Part No.
25 x 3mm	Brown	0.03kg	CA015
25 x 3mm	Grey	0.03kg	CA020

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

Designed to secure conductors to surfaces that cannot be penetrated by a screw. Ideal for aluminium, spangled galvanized steel, colour coated steel, glass, perspex, enamel and stainless steel etc. Manufactured from high grade plastic, UV stabilised against degradation by sunlight and non-brittle to prevent cold weather damage.

Use on surfaces other than PVC roofing.



Weldable DC tape clip

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

Use with PVC covered tape

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

Provides a secure means of fixing conductors to single ply PVC roof membranes. Manufactured from high grade PVC, UV stabilised against degradation by sunlight and non-brittle to prevent cold weather damage.

For dressing tool, see page 40.

Clips are available for Polypropylene, Polyethylene and other roof membranes. Please contact Furse for advice.

Universal welding solvent, Cleaning solution and Surface primer

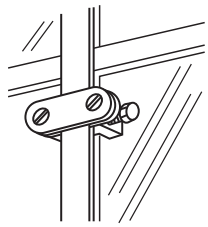
Description	Weight each	Part No.
Universal welding solvent 500ml spray applicator (sufficient for application of approx 200 clips). Use with Furse weldable clips only.	0.57kg	CW905
Cleaning solution (Acetone) 500ml spray applicator. For cleaning lacquered roofing membranes.	0.62kg	CW999
Surface primer 250ml spray applicator (sufficient for application of approx 500 clips). Use with Furse adhesive clips only.	0.24kg	CA900

Solvent and surface primer cannot be supplied outside the UK.
For overseas projects, please contact Furse for advice.

CoSHH Datasheets available on request.

Glazing bar holdfast

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



Manufactured from high quality copper and aluminium alloys. Simple to install, providing secure anchorage to thin metallic sections that cannot be drilled e.g. window mullions, angle iron etc. Once fixed any metallic or non-metallic conductor clip can be attached with the screw provided.

Conductor clip sold separately.

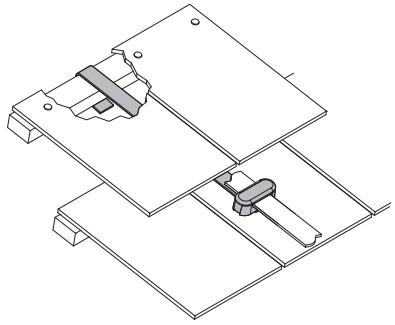
Slate holdfast

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

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



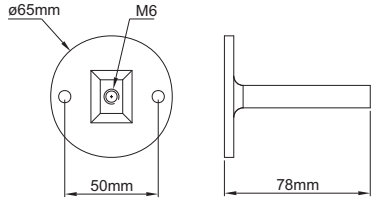
Designed to allow tape conductors to be fixed to tiled roofs without compromising the waterproofing nature of the roof. The 500mm tail fits neatly between overlapping tiles and is wrapped around/fixed to the tile lathe for secure fitting.

Back plate holdfast stem

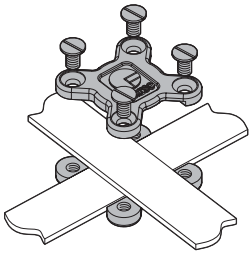
Conductor material	Weight each	Part No.
Copper	0.30kg	HF320
Aluminium	0.10kg	HF325-FU

Supplied with M6 fixing screw to secure appropriate conductor clip.

Fix using roundhead wood screws 1½" No. 10 or M6 (Part no. **SW305** or **SW405**) and wall plugs (Part no. **PS305**) – see Accessories page 39.



Reg. Design



Square tape clamp

	Conductor size	Material	Weight each	Part No.
NEW	25 x 3mm	Copper	0.12kg	CT105-H
NEW	25 x 6mm	Copper	0.30kg	CT110-H
NEW	50 x 6mm	Copper	0.60kg	CT115-H
NEW	25 x 3mm	Aluminium	0.06kg	CT005-H

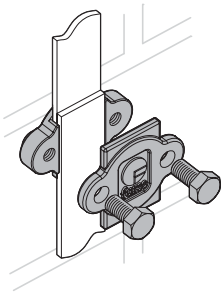
Manufactured from high quality copper and aluminium alloys. Simple to install, providing an effective low resistance connection between overlapping tapes to allow cross, tee, through and right angle joints to be formed.

BS EN 50164-1 Class H

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 5Nm

Reg. Design



Oblong test or junction clamp

	Conductor size	Material	Weight each	Part No.
NEW	26 x 8mm	Copper	0.29kg	CN105-H
	26 x 8mm	Aluminium	0.12kg	CN005*

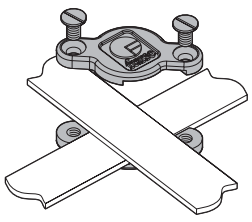
Manufactured from high quality copper and aluminium alloys. Simple to install, providing an effective low resistance connection between overlapping tapes. The clamped connection is easily made/remade to allow for periodic testing.

* Not as illustrated

BS EN 50164-1 Class H

Tightening torque CN005 15Nm; CN105-H 13Nm

Reg. Design



NEW Crossover clamp

Conductor size	Material	Weight each	Part No.
25 x 3mm	Copper	0.09kg	CX105-H
25 x 3mm	Aluminium	0.03kg	CX005-H

For forming cross joints in tape.

BS EN 50164-1 Class H

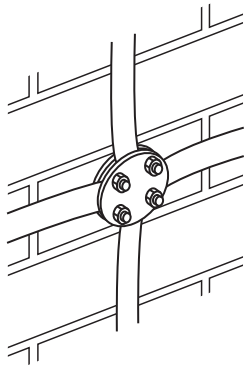
Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 5Nm

Plate type test clamp

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

Manufactured from a high quality copper alloy. Simple to install, providing an effective low resistance connection between overlapping tapes. The clamped connection is easily made/remade to allow for periodic testing. Enables cross, tee, through and right angle joints to be formed.



BS EN 50164-1 Class H

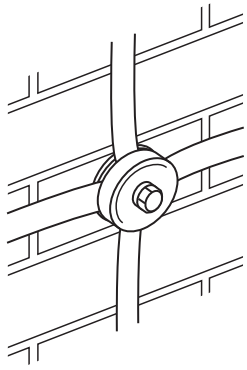
Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 15Nm

Screwdown test clamp

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

Manufactured from a high quality copper alloy. Simple to install, providing an effective low resistance connection between overlapping tapes. The clamped connection is easily made/remade to allow for periodic testing. Enables cross, tee, through and right angle joints to be formed.



BS EN 50164-1 Class H

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 20Nm

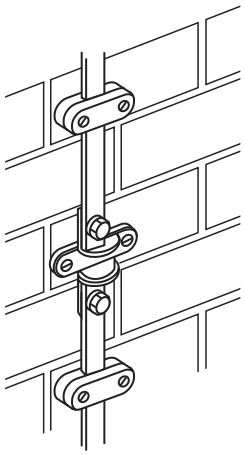
Expansion braid bond

Type	Material	Length	Cross-sectional area	Weight each	Part No.
Single length	Aluminium	200mm	50mm²	0.07kg	BN001
Single length	Copper	200mm	50mm²	0.17kg	BN101
Cross-over	Aluminium	300mm	50mm²	0.23kg	BN002
Cross-over	Copper	300mm	50mm²	0.53kg	BN102

Designed to remove the risk of damage or distortion to long conductor runs caused by thermal expansion and contraction.

CN910

CN925



Bimetallic connector

Conductor size	Weight each	Part No.
25 x 3mm aluminium tape to 25 x 3mm copper tape	0.19kg	CN910
8mm diameter aluminium conductor to 25 x 3mm copper	0.19kg	CN920
25 x 3mm aluminium tape to 25 x 3mm copper tape	0.20kg	CN925

Manufactured from a friction welded joint between high conductivity copper and aluminium to provide the ideal means of interconnecting copper and aluminium conductors whilst avoiding bimetallic corrosion.

BS EN 50164-1 Class H

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 12Nm

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.

CoSHH Datasheet available on request.

The following pages (29 – 34) detail the products required to install a 'Solid circular' lightning protection system. Additionally, accessories can be found on pages 39 – 40.

Details of the solid circular conductors can be found in the Conductors section on page 47.

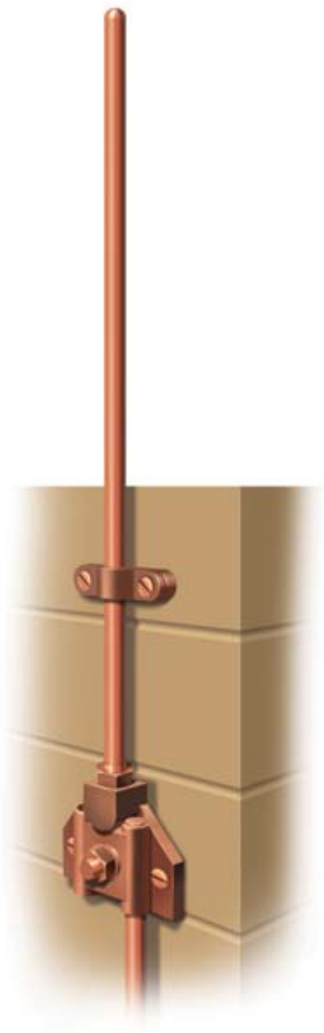
Air rod

Rod length	Rod diameter	Thread diameter	Material	Weight each	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

Manufactured from high conductivity hard drawn copper or aluminium, with rolled threads. Supplied complete with locknut.

"Field Trials 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.

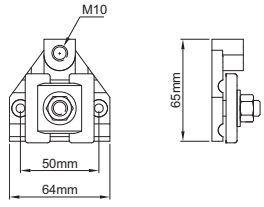


BS EN 50164-2

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

Manufactured from high quality copper and aluminium alloys. Simple to install, providing an effective connection between an air rod and the solid circular air termination conductor in either the horizontal or vertical plane.



BS EN 50164-1 Class H

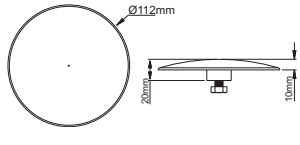
Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

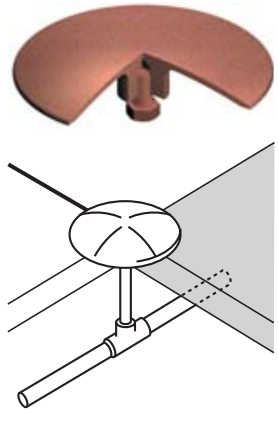
Tightening torque 15Nm

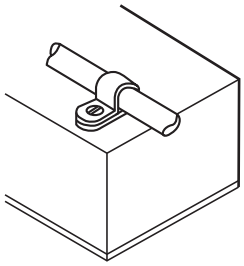
Strike pad

Conductor material	Weight each	Part No.
Copper	0.41kg	PL010
Aluminium	0.13kg	PL005
Copper stem for use with PL010	0.07kg	SM010

Manufactured from high quality copper and aluminium alloys. Designed to provide an exposed attractive point on conductor systems hidden/embedded in the building's fabric e.g. below the concrete slabs or ballast of a flat roof.







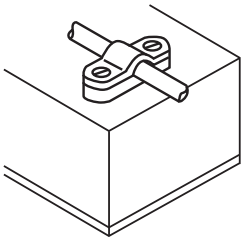
One hole cable clip

Conductor diameter	Conductor material	Weight each	Part No.
8mm	Copper	0.01kg	CP905
8mm	Aluminium	0.01kg	CP925
10mm*	Copper	0.01kg	CP915
10mm*	Aluminium	0.01kg	CP935

Manufactured from pure copper or aluminium, these simple pressed clips are available to suit bare and PVC covered copper and aluminium solid circular conductor.

* PVC covered 8mm conductor.

Fix using roundhead wood screws 1½" No. 10 or M6 (Part no. **SW305** or **SW405**) and wall plugs (Part no. **PS305**) – see Accessories page 39.



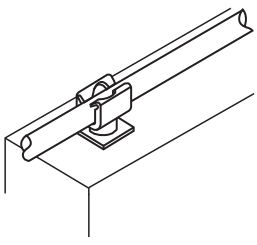
Heavy duty cast cable saddle

Conductor diameter	Conductor material	Weight each	Part No.
8mm	Copper	0.09kg	CP805
8mm	Aluminium	0.03kg	CP806
10mm*	Copper	0.10kg	CP815
10mm*	Aluminium	0.04kg	CP816

Manufactured from high quality copper and aluminium alloys for excellent corrosion resistance and high pull off loads.

* For use with PVC covered 8mm conductor or for supporting air terminals when used in conjunction with wall mounted air rod bases. Can also be used with glazing bar holdfast and back plate holdfast stem (see page 25.)

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.



Push-in plastic cable clip

		Colour range				
Conductor diameter	Weight each	Black	Grey	Stone	White	Brown
8mm	0.01kg	-	CP872	-	-	CP887
10mm*	0.01kg	CP861	CP871	CP876	CP881	CP886

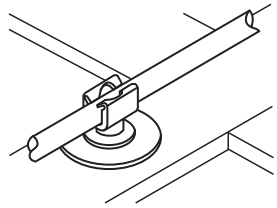
Manufactured from high grade Polypropylene, UV stabilised against degradation by sunlight and non-brittle to prevent cold weather damage. Available in five colours to match bare and PVC covered copper and aluminium solid circular conductors.

* PVC covered 8mm conductor.

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Adhesive push-in clip

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



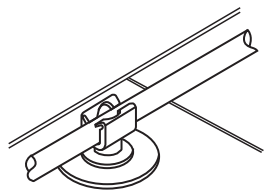
Designed as a means of securing conductors to surfaces that cannot be penetrated by a screw. Ideal for aluminium, spangled galvanized steel, colour coated steel, glass, perspex, enamel and stainless steel. Manufactured from high grade plastic, UV stabilised against degradation by sunlight and non-brittle to prevent cold weather damage.

Use on surfaces other than PVC roofing.

* PVC covered 8mm conductor.

Weldable push-in clip

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



Provides a secure means of fixing conductors to single ply PVC roof membranes. Manufactured from high grade PVC, UV stabilised against degradation by sunlight and non-brittle to prevent cold weather damage.

Clips are available for Polypropylene, Polyethylene and other roof membranes. Please contact Furse for advice.

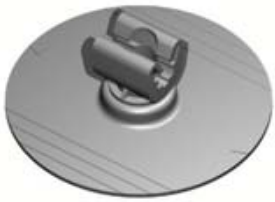
* PVC covered 8mm conductor.

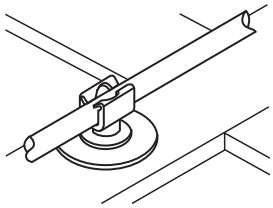
Universal welding solvent, Cleaning solution and Surface primer

Description	Weight each	Part No.
Universal welding solvent 500ml spray applicator (sufficient for application of approx 200 clips). Use with Furse weldable clips only.	0.57kg	CW905
Cleaning solution (Acetone) 500ml spray applicator. For cleaning lacquered roofing membranes.	0.62kg	CW999
Surface primer 250ml spray applicator (sufficient for application of approx 500 clips). Use with Furse adhesive clips only.	0.24kg	CA900

Solvent and surface primer cannot be supplied outside the UK.
For overseas projects, please contact Furse for advice.

CoSHH Datasheets available on request.



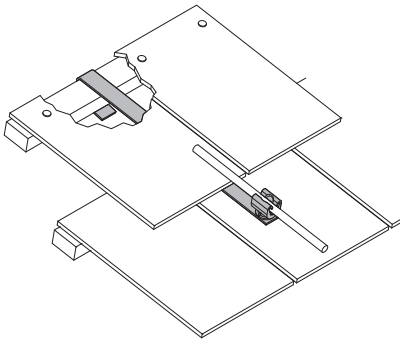


Glue down push-in clip

Conductor diameter	Colour	Weight each	Part No.
8mm	Grey	0.03kg	GD872
8mm	Brown	0.03kg	GD887
10mm	Black	0.03kg	GD861
10mm	Grey	0.03kg	GD871
10mm	Stone	0.03kg	GD876
10mm	White	0.03kg	GD881
10mm	Brown	0.03kg	GD886

Use on clay roof tiles. Supplied in a box of 50 complete with adhesive.

Additional glue gun is required.



Non metallic slate holdfast

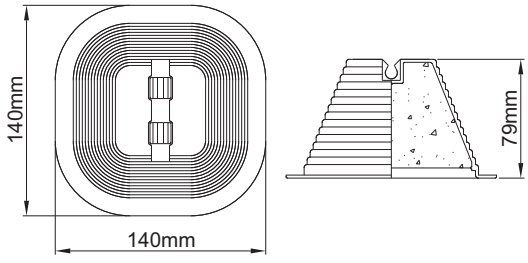
Conductor diameter	Colour	Weight each	Part No.
8mm	Brown	0.03kg	HF176
8mm	Grey	0.03kg	HF191

Designed to allow circular conductors to be fixed to tiled roofs without compromising the waterproofing nature of the roof. The 500mm tail fits neatly between overlapping tiles and is wrapped around/fixed to the tile lathe for secure fitting.

Pyramid holdfast

Conductor diameter	Weight each	Part No.
8mm	0.97kg	HF975

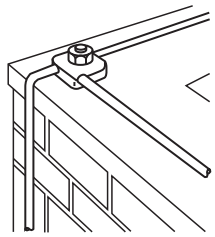
Designed to secure bare, 8mm diameter, circular conductors to flat roofs. Supplied filled with concrete the conductor is held in place by the weight of the holdfast. The lip around the base of the product permits the holdfast to be built into bitumen type roofs.



Square clamp

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

Designed to provide low resistance cross joints in solid circular conductor networks. Manufactured from high quality copper and aluminium alloys for excellent corrosion resistance.



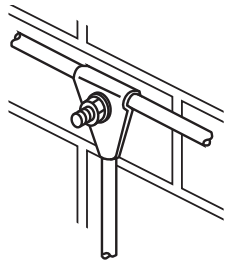
BS EN 50164-1 Class H

Tightening torque 12Nm

Tee clamp

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

Designed to provide low resistance tee joints in solid circular conductor networks. Manufactured from high quality copper and aluminium alloys for excellent corrosion resistance.



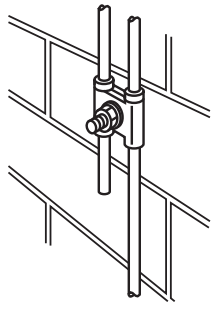
BS EN 50164-1 Class H

Tightening torque 12Nm

Jointing clamp

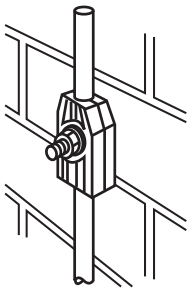
Conductor diameter	Conductor material	Weight each	Part No.
8mm	Copper	0.17kg	CS405
8mm	Aluminium	0.08kg	CS410

Designed to provide low resistance parallel joints in solid circular conductor networks. Manufactured from high quality copper and aluminium alloys for excellent corrosion resistance.



BS EN 50164-1 Class H

Tightening torque 12Nm



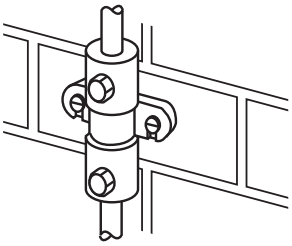
Test clamp

Conductor diameter	Conductor size	Conductor material	Weight each	Part No.
8mm	25 x 3mm	Copper	0.20kg	CN305
8mm	25 x 3mm	Aluminium	0.09kg	CN310

Designed to provide low resistance tee joints in solid circular conductor networks. These multi-purpose clamps can produce circular to circular or circular to tape connection in both through and tee configurations. Manufactured from high quality copper and aluminium alloys for excellent corrosion resistance.

BS EN 50164-1 Class H

Tightening torque 12Nm



Bimetallic connector

Conductor size	Weight each	Part No.
8mm diameter aluminium conductor to 8mm diameter copper conductor	0.25kg	CN915
8mm diameter aluminium conductor to 25mm x 3mm copper tape	0.19kg	CN920

Manufactured from a friction welded joint between high conductivity copper and aluminium to provide the ideal means of interconnecting copper and aluminium conductors whilst avoiding bimetallic corrosion.

BS EN 50164-1 Class H

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 12Nm

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.

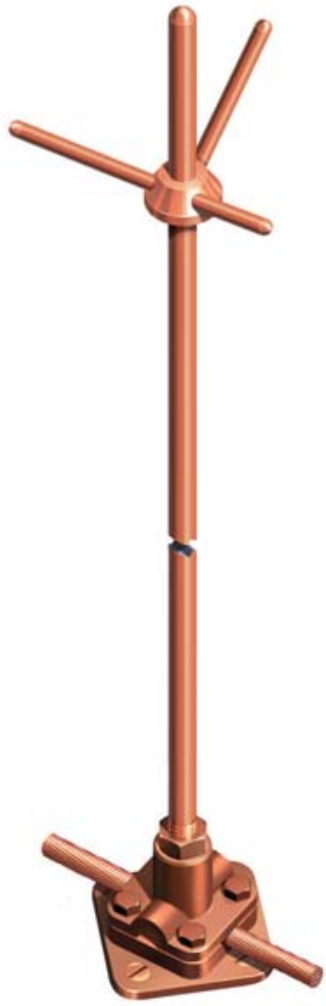
CoSHH Datasheet available on request.

The following pages (35 – 38) detail the products required to install a 'cable and wire' lightning protection system. Additionally, accessories can be found on pages 39 – 40.

Details of the cable and wire conductors can be found in the Conductors section on page 48.

Air rod

Rod length	Rod diameter	Thread diameter	Material	Weight each	Part No.	
500mm	15mm	16mm	Copper	0.73kg	RA215	
1000mm	15mm	16mm	Copper	1.51kg	RA225	
1500mm	15mm	16mm	Copper	2.35kg	RA230	NEW
2000mm	15mm	16mm	Copper	3.00kg	RA240	
3000mm	15mm	16mm	Copper	4.70kg	RA250	NEW



Manufactured from high conductivity hard drawn copper, with rolled threads. Supplied complete with locknut.

"Field Trials 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.

Note: during high winds and extreme weather conditions air rods over 1000mm long can be subjected to fatigue mechanisms. It is therefore recommended that additional supports are considered before installation.

BS EN 50164-2

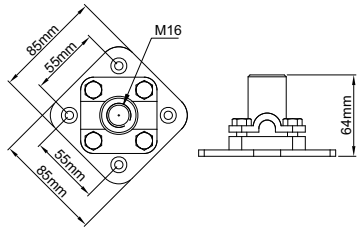
Multiple point

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

Manufactured from high conductivity hard drawn copper, suitable for use with copper air rods only.

Flat saddle

Conductor size	Rod diameter	Thread diameter	Conductor material	Weight each	Part No.
50mm²	15mm	16mm	Copper	1.03kg	SD155
70mm²	15mm	16mm	Copper	0.95kg	SD160
95mm²	15mm	16mm	Copper	0.95kg	SD165

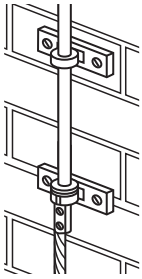


Manufactured from a high quality copper alloy. Simple to install, providing an effective connection between air rod and stranded air termination conductors.

BS EN 50164-1 Class H

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 12Nm

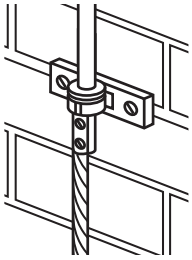


Rod brackets

Rod diameter	Rod material	Weight each	Part No.
15mm	Copper	0.90kg	BR105

Manufactured from high quality copper alloy. Simple to install, providing an effective means of mounting an air rod on a vertical surface e.g. a chimney stack. Use in conjunction with the rod to cable coupling.

Fix using roundhead wood screws 1½" No. 12 or M8



Rod to cable coupling

Rod diameter	Thread diameter	Conductor size	Conductor material	Weight each	Part No.
15mm	16mm	50 – 70mm²	Copper	0.25kg	CG705
15mm	16mm	95mm²	Copper	0.25kg	CG710

Manufactured from high quality copper alloy. Provides an effective connection between air rod and stranded air termination conductor. Use in conjunction with rod brackets.

BS EN 50164-1 Class H

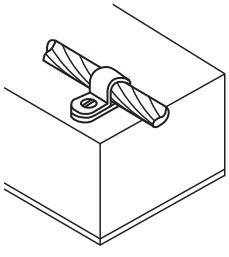
Tightening torque 6Nm

One hole cable clip

Conductor size	Conductor material	Weight each	Part No.
50mm²	Copper	0.01kg	CP910
70mm²	Copper	0.01kg	CP915
95mm²	Copper	0.01kg	CP920

Manufactured from pure copper, these simple pressed clips are available to suit a range of stranded copper conductors.

Fix using roundhead wood screws 1½" No. 10 or M6 (Part no. **SW305**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

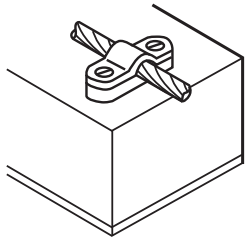


Heavy duty cast cable saddle

Conductor size	Conductor material	Weight each	Part No.
50mm²	Copper	0.10kg	CP810
70mm²	Copper	0.10kg	CP815
95mm²	Copper	0.10kg	CP835

Manufactured from high quality copper alloy. Simple to install, providing an effective fixing for stranded copper cables.

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005**) and wall plugs (Part no. **PS305**) – see Accessories page 39.



Test clamp

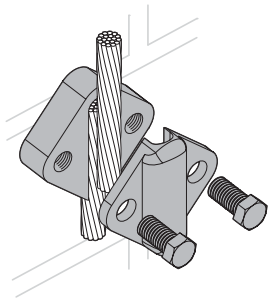
Conductor size	Conductor material	Weight each	Part No.
50mm²	Copper	0.39kg	CR855
70mm²	Copper	0.40kg	CR860
95mm²	Copper	0.40kg	CR865

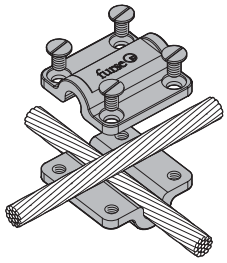
Manufactured from high quality copper alloy. Simple to install, providing an effective low resistance overlap connection between stranded copper cables.

BS EN 50164-1 Class H

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 12Nm





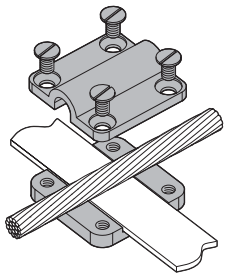
Square conductor clamp

Conductor size	Conductor material	Weight each	Part No.
50mm²	Copper	0.32kg	CR810
70mm²	Copper	0.29kg	CR815
95mm²	Copper	0.25kg	CR820

Manufactured from high quality copper alloy. Simple to install, providing an effective low resistance connection between overlapping stranded conductors allowing cross, tee, through and right angle joints to be formed.

BS EN 50164-1 Class H

Tightening torque 6Nm



NEW Cable to tape square clamp

Conductor size	Conductor material	Weight each	Part No.
25 x 3mm to 70mm²	Copper	0.30kg	CT130

Manufactured from high quality copper alloy. Simple to install, providing an effective low resistance connection between conductor tape and stranded copper conductor.

BS EN 50164-1 Class H

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 5Nm

Countersunk wood screws

	Size	Weight per 100	Part No.
Zinc plated steel	1½" x No.10	0.50kg	SW105
Zinc plated steel	1½" x No.12	0.60kg	SW110
Brass	1½" x No.10	0.50kg	SW005
Brass	1½" x No.12	0.60kg	SW010

Round head wood screws

	Size	Weight per 100	Part No.
Zinc plated steel	1½" x No.10	0.50kg	SW405
Brass	1½" x No.10	0.50kg	SW305

Plastic wall plugs

	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

	Weight per 100	Part No.
50mm long	0.70kg	NA005

Countersunk set screws

	Size	Weight per 100	Part No.
Brass	M6 x 30mm	0.60kg	SS160

Round head rivets

	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

	Size	Weight per 100	Part No.
Phosphor bronze	M10 x 25mm	2.85kg	SS635
Phosphor bronze	M10 x 35mm	3.40kg	SS640
Phosphor bronze	M12 x 25mm	4.50kg	SS650
Phosphor bronze	M12 x 35mm	5.00kg	SS655
Brass	M8 x 16mm	1.75kg	SS165
Brass	M10 x 25mm	2.50kg	SS140
Brass	M10 x 35mm	3.20kg	SS145
Brass	M12 x 25mm	3.80kg	SS150
Brass	M12 x 35mm	4.70kg	SS155

Plain washers

	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	8mm	0.15kg	WR175
Brass	10mm	0.25kg	WR167
Brass	12mm	0.50kg	WR170

Spring washers

	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

	Size	Weight per 100	Part No.
Phosphor bronze	M10	1.25kg	NU367
Phosphor bronze	M12	1.80kg	NU370
Brass	M6	0.25kg	NU165
Brass	M8	0.80kg	NU166
Brass	M10	1.15kg	NU167
Brass	M12	1.65kg	NU170

Insulating tape

Coil size	Weight each	Part No.
25mm x 33m	0.14kg	TP120-FU

Green/yellow general purpose insulating tape.

Denso tape

Coil size	Weight each	Part No.
50mm x 10m	0.76kg	TD005

A waterproof tape for wrapping underground joints.

CoSHH Datasheet available on request.

Silfos

Coil size	Thickness	Weight each	Part No.
50mm x 8m	0.12mm	0.50kg	FS005

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

CoSHH Datasheet available on request.

Flux

Material	Weight each	Part No.
Flux	0.08kg	SA115

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

Tinmans solder

Material	Weight each	Part No.
60% tin, 40% lead	0.26kg	SA105

Dressing tool

Type	Weight each	Part No.
Aluminium	0.31kg	DT100

For use with adhesive or weldable DC tape clips. See page 24.

Conductors

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, i.e. 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

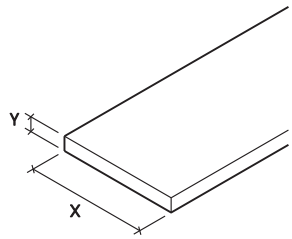
Copper conductor ratings

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

Bare copper tape



Conductor size (X x Y)	Weight per metre	Standard coil size	Part No.	Conductor size (X x Y)	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	50m*	TC020	38 x 6mm	2.02kg	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	1.42kg	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

* 20 x 3mm also available in 100m coil size (TC020/100)
25 x 3mm also available in 50m coil size (TC030/50).

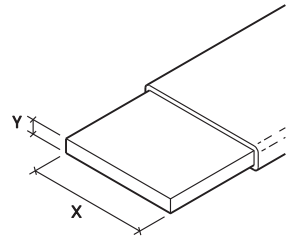
High conductivity copper tape to BS EN 13601 (formerly BS 1432).

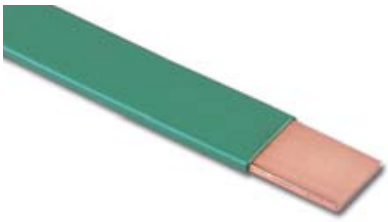
PVC covered copper tape

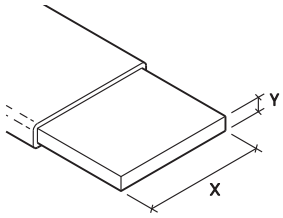
			Colour range					
Conductor size (X x Y)	Weight per metre	Standard coil size	Black 18B29	Green *	Grey 00A07	Stone 08B23	White 10B15	Brown 06C39
12.5 x 1.5mm	0.21kg	100m	TC100	-	-	-	-	-
25 x 3mm	0.77kg	25m	TC105-FU	TC110	TC115-FU	TC120-FU	TC125-FU	TC130
25 x 3mm	0.77kg	50m	TC105/50	TC110/50	TC115/50	TC120/50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

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.

High conductivity copper tape to BS EN 13601 (formerly BS 1432).
PVC colours to BS 5252. * Green to BS 6746C.





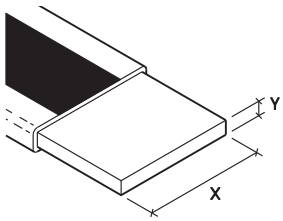


LSOH covered copper tape

Conductor size (X x Y)	Colour	Weight per metre	Standard coil size	Part No.
25 x 3mm	Green	0.77kg	25m*	TC910
25 x 6mm	Green	1.53kg	40m	TC940
50 x 6mm	Green	2.95kg	20m	TC980

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

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

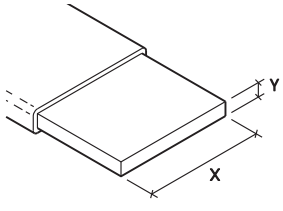


Green & yellow PVC insulated copper tape

Conductor size (X x Y)	Weight per metre	Standard coil size	Part No.
25 x 3mm	0.79kg	25m*	TC111-FU

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

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



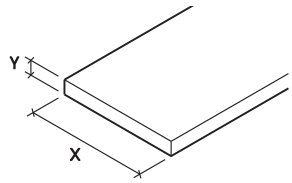
Lead covered copper tape

Conductor size (X x Y)	Weight per metre	Standard coil size	Part No.
25 x 3mm	2.56kg	25m	TC330

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

Tinned copper tape

Conductor size (X x Y)	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

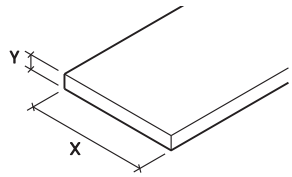


High conductivity copper tape to BS EN 13601 (formerly BS 1432).

Hard drawn copper tape

Bare hard drawn bar

Conductor size (X x Y)	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 (X x Y)	Weight per metre	Part No.
50 x 6mm	2.67kg	BA231*

Random lengths of 4 metres except * supplied in random lengths of 3 metres.

Hard drawn high conductivity copper bar to BS EN 12163.

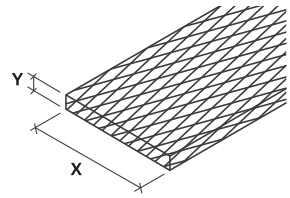
Flexible copper braid

Bare braid

Overall nominal size (X x Y)	Size	Weight per metre	Part No.
12 x 1mm	6mm²	0.055kg	BD020
15 x 1.5mm	10mm²	0.096kg	BD025
19 x 2.5mm	16mm²	0.16kg	BD026
32 x 6mm	70mm²	0.63kg	BD027
25 x 3.5mm	35mm²	0.34kg	BD030

Tinned braid

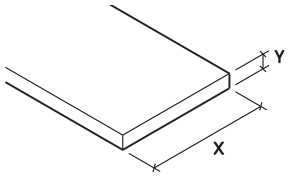
Overall nominal size (X x Y)	Size	Weight per metre	Part No.
25 x 3.5mm	35mm²	0.34kg	BD035



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

Suitable for earth bonding. Also supplied as standard pre-cut and drilled bonds (see page 62).

High conductivity copper wire to BS 4109-C101.



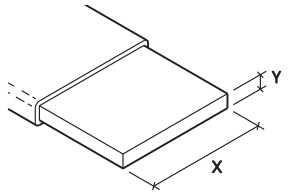
Bare aluminium tape

Conductor size (X x Y)	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	TA030
30 x 3mm	0.25kg	50m	TA042
25 x 6mm	0.42kg	50m	TA040
40 x 6mm	0.67kg	50m	TA068
50 x 6mm	0.85kg	50m	TA080

Aluminium tape to BS 2898-1350.

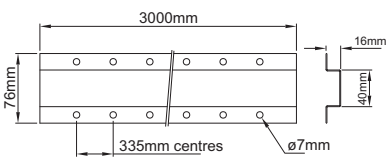
PVC covered aluminium tape

Conductor size (X x Y)	Weight per metre	Standard coil size	Colour range: Black 18B29	Green *	Grey 00A07	Stone 08B23	White 10B15	Brown 06C39
12.5 x 1.5mm	0.09kg	50m	TA100	-	-	-	-	-
20 x 3mm	0.25kg	50m	TA104	-	-	-	-	-
25 x 3mm	0.30kg	50m	TA105	TA110	TA115	TA120	TA125	TA130



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.

Aluminium tape to BS 2898-1350.
PVC colours to BS 5252. * Green to BS 6746C.



Anti-vandal down conductor guard

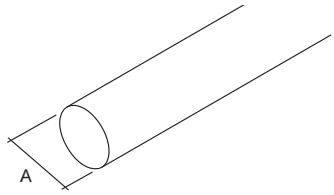
Length	Weight each	Part No.
3000mm	2.90kg	AV005

Fix using round head wood screws (Part no. **SW405**) and wall plugs (Part no. **PS305**) – see Accessories, page 39.

Suitable for use with 25 x 3mm tape.

Bare solid circular

Conductor material	Diameter (A)	Cross-sectional area	Weight per metre	Standard coil size	Part No.
Copper	8mm	50.27mm²	0.44kg	50m	CD035
Aluminium	8mm	50.27mm²	0.12kg	50m	CD080

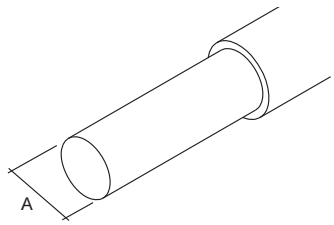


Copper conductor to BS EN 13601 (formerly BS 1433).
Aluminium conductor to BS 2898-1350.

PVC covered solid circular

Conductor material	Diameter (A)	Cross-sectional area	Weight per metre	Standard coil size	Colour range: Black 18B29	Grey 00A07	Stone 08B23	White 10B15	Brown 06C39
Copper	8mm	50.27mm²	0.49kg	50m	CD036	CD038	CD039	CD040	CD041
Aluminium	8mm	50.27mm²	0.18kg	50m	CD081	CD083	CD084	CD085	CD086

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.



Copper conductor to BS EN 13601 (formerly BS 1433).
Aluminium conductor to BS 2898-1350.
PVC colours to BS 5252.

Bare 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.
6mm²	7/1.04	0.05kg	CB006	120mm²	37/2.03	1.09kg	CB120
16mm²	7/1.70	0.15kg	CB016	150mm²	37/2.25	1.33kg	CB150-FU
25mm²	7/2.14	0.23kg	CB025	185mm²	37/2.52	1.67kg	CB185
35mm²	7/2.52	0.32kg	CB035	240mm²	61/2.25	2.20kg	CB240
50mm²	19/1.78	0.43kg	CB050-FU	300mm²	61/2.52	2.76kg	CB300-FU
70mm²	19/2.14	0.62kg	CB070	400mm²	61/2.85	3.53kg	CB400-FU
95mm²	19/2.52	0.86kg	CB095				

Soft drawn stranded copper cable to BS EN 60228

Cross-sectional area	Stranding No./mm Ø	Weight per metre	Part No.
70mm²	7/3.55	0.64kg	CB071

Hard drawn stranded copper cable to BS 7884

Green & 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.
16mm²	7/1.70	0.19kg	CC016	120mm²	37/2.03	1.16kg	CC120-FU
25mm²	7/2.14	0.29kg	CC025	150mm²	37/2.25	1.54kg	CC150-FU
35mm²	7/2.52	0.41kg	CC035	185mm²	37/2.52	2.01kg	CC185
50mm²	19/1.78	0.53kg	CC050	240mm²	61/2.25	2.49kg	CC240
70mm²	19/2.14	0.73kg	CC070	300mm²	61/2.52	3.05kg	CC300
95mm²	19/2.52	1.00kg	CC095	400mm²	61/2.85	3.90kg	CC400-FU

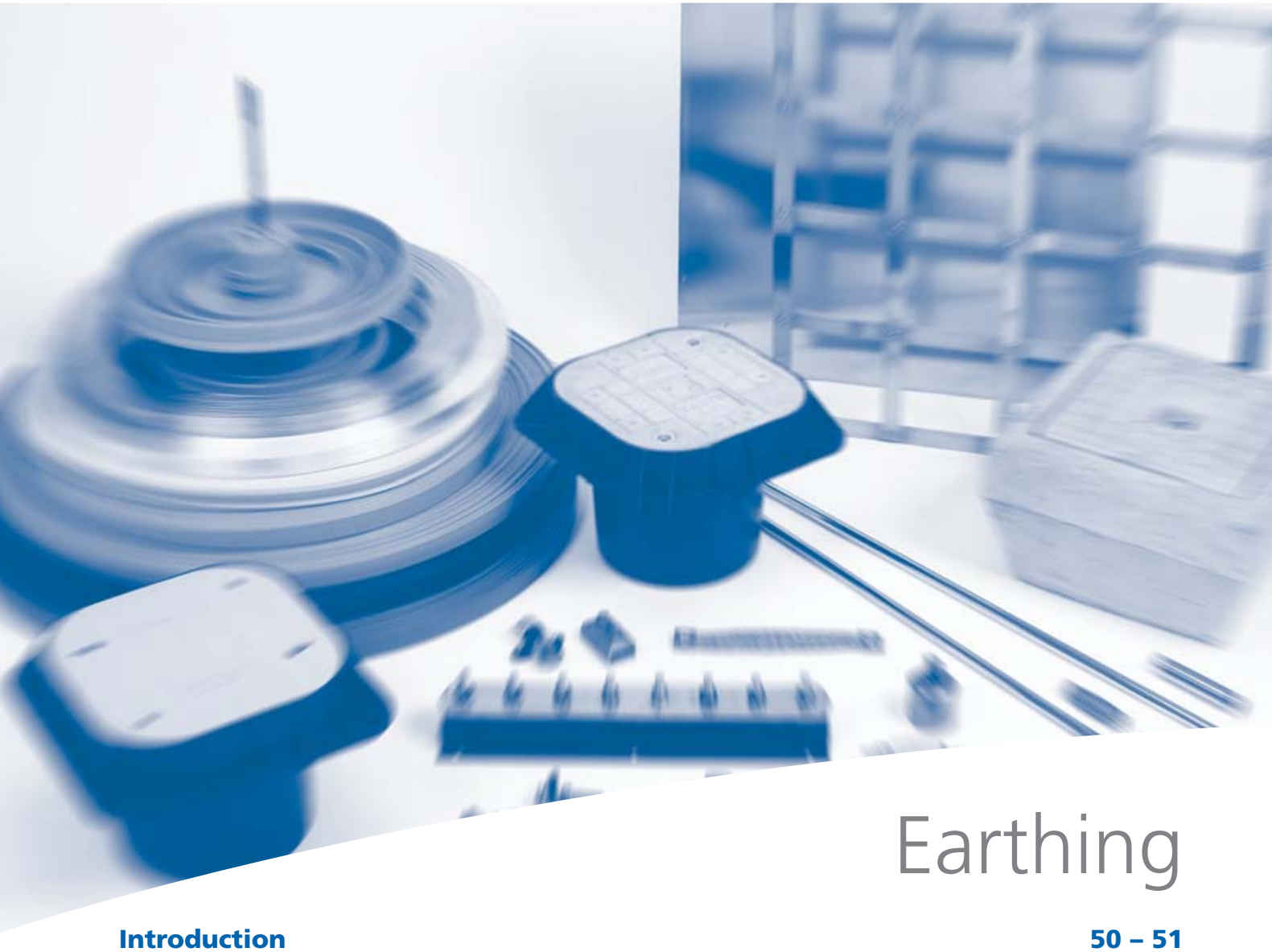
PVC covered soft drawn stranded copper cable to BS 6004.
PVC colours to BS 6746C.

Bimetallic cable

AWG	Cross-sectional area	Nominal diameter	Stranding No./AWG	Weight per metre	Part No.
1/0	50mm²	9.96mm	3/5	0.41kg	BC001
1	40mm²	8.86mm	3/6	0.33kg	BC002
2	35mm²	7.9mm	3/7	0.26kg	BC003
3	25mm²	7.04mm	3/8	0.21kg	BC004
4	20mm²	6.27mm	3/9	0.16kg	BC005
5	16mm²	5.59mm	3/10	0.13kg	BC006
6	10mm²	4.42mm	3/12	0.08kg	BC007
300	150mm²	15.6mm	7/4	1.22kg	BC008
4/0	120mm²	13.9mm	7/5	0.97kg	BC009
3/0	95mm²	12.3mm	7/6	0.77kg	BC010
2/0	70mm²	11mm	7/7	0.61kg	BC011
1/0	50mm²	9.78mm	7/8	0.48kg	BC012
1	40mm²	8.71mm	7/9	0.38kg	BC013
2	35mm²	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

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 are 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

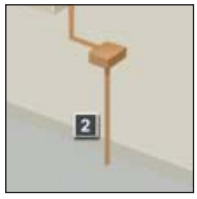
Furse offer three types of conductor: Flat tape, solid circular and stranded cable.

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.

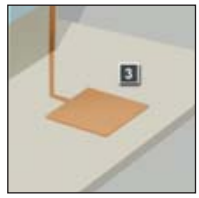
It is important that earthing conductors should be correctly sized for their application, as they may be required to carry a considerable current for several seconds. Specific data regarding conductor ratings can be found on page 42.

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
e.g. HV switching positions.

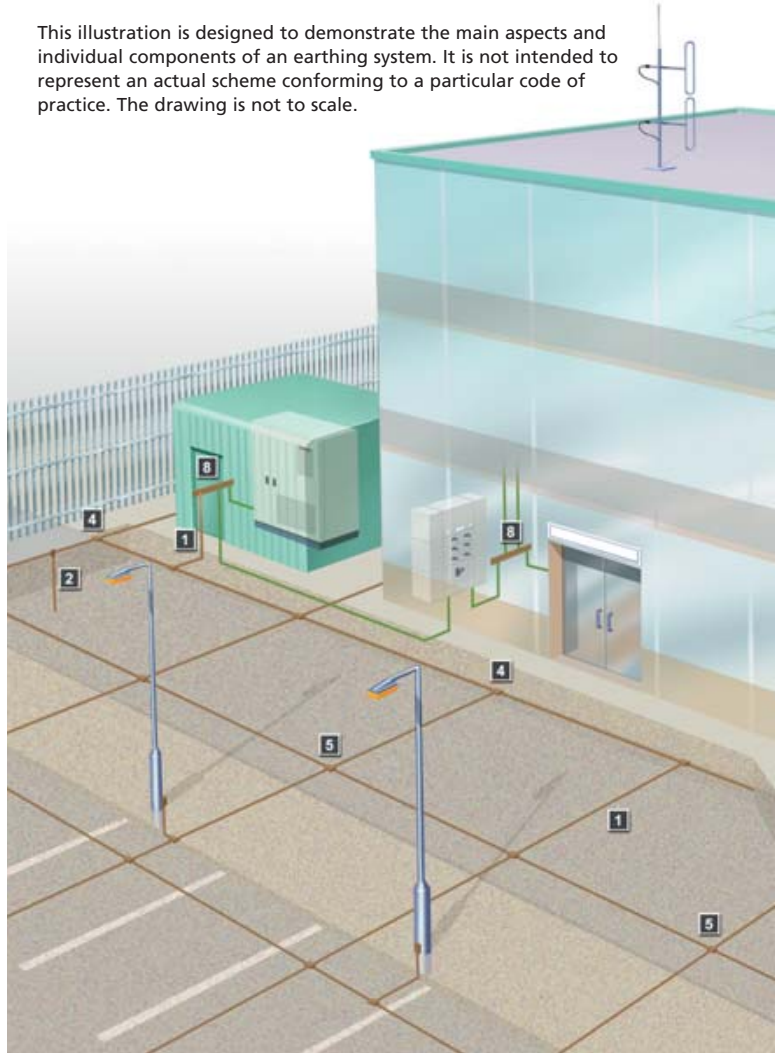
Connectors and terminations

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.

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.



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.

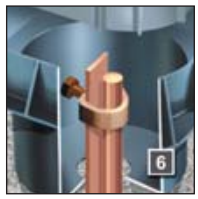
Compression connectors

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.

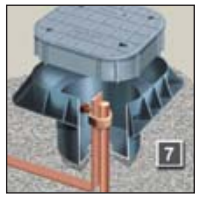
Mechanical clamps

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.

Earth electrode backfills

Earth electrode backfills are to be used in areas where required resistance levels are difficult to achieve. These products effectively act to increase the electrodes surface area thus lowering its resistance to earth.

Product selector

Earth electrode materials

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

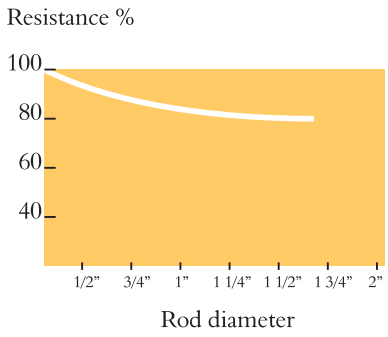
Furse can supply all three types, but the copperbonded steel cored rod is by far the most popular, due to its combination of strength, corrosion resistance, and comparatively low cost.

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 per cent by doubling the diameter of the rod (which means increasing the weight and the cost of the rod by approximately 400 per cent!)

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.



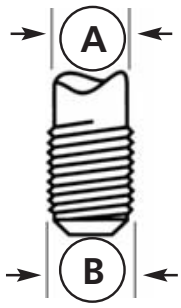
Effect of electrode diameter on resistance

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).



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.

Copper thickness minimum 250 microns.

Threaded copperbond earth rod

Nominal diameter	Length	Thread diameter 'B'	Shank diameter 'A'	Weight each	Part No.
½"	1200mm	9/16"	12.7mm	1.18kg	RB105
½"	1500mm	9/16"	12.7mm	1.55kg	RB110
½"	1800mm	9/16"	12.7mm	1.76kg	RB115
½"	2400mm	9/16"	12.7mm	2.36kg	RB125
⅝"	1200mm	⅝"	14.2mm	1.53kg	RB205-FU
⅝"	1500mm	⅝"	14.2mm	1.88kg	RB210
⅝"	1800mm	⅝"	14.2mm	2.29kg	RB215
⅝"	2100mm	⅝"	14.2mm	2.51kg	RB220-FU
⅝"	2400mm	⅝"	14.2mm	3.00kg	RB225
⅝"	3000mm	⅝"	14.2mm	3.79kg	RB235
¾"	1200mm	¾"	17.2mm	2.19kg	RB305
¾"	1500mm	¾"	17.2mm	2.73kg	RB310
¾"	1800mm	¾"	17.2mm	3.27kg	RB315
¾"	2100mm	¾"	17.2mm	3.83kg	RB320-FU
¾"	2400mm	¾"	17.2mm	4.35kg	RB325
¾"	3000mm	¾"	17.2mm	5.44kg	RB335

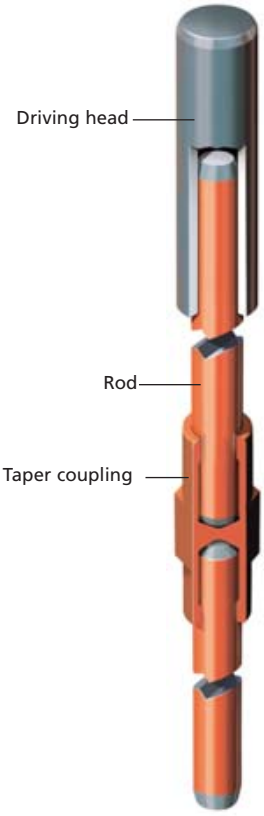
Copper thickness minimum 250 microns.

Earth rods to BS EN 50164-2, BS 7430, UL467
Fittings to BS EN 50164-1

Fittings

Type	Weight each	Part No.
½" Coupling	0.09kg	CG170
⅝" Coupling	0.08kg	CG270
¾" Coupling	0.13kg	CG370
½" Driving stud	0.05kg	ST100
⅝" Driving stud	0.08kg	ST200
¾" Driving stud	0.12kg	ST300

Earth rods



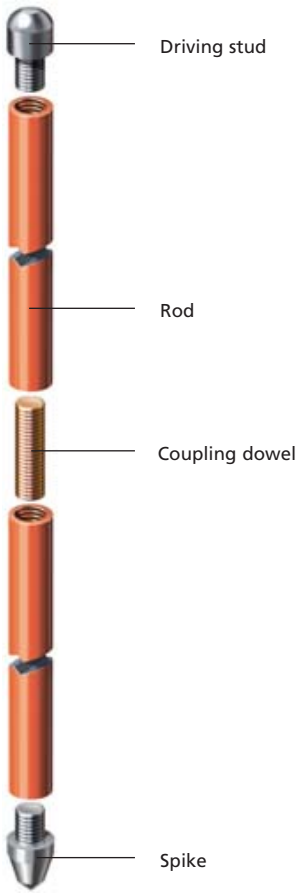
Unthreaded copperbond rod

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

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

Earth rods to BS EN 50164-2, BS 7430, UL467



BS EN 50164-2, BS 7430

Solid copper and stainless steel 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

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

Earth plate – solid copper

Size	Total surface area	Weight each	Part No.
600 x 600 x 1.5mm	0.72m²	5.00kg	PE005
900 x 900 x 1.5mm	1.63m²	11.21kg	PE015
600 x 600 x 3mm	0.73m²	9.74kg	PE010
900 x 900 x 3mm	1.63m²	21.74kg	PE020

BS EN 12163

Earth plate – lattice copper

Size	Total surface area	Weight each	Part No.
600 x 600 x 3mm	0.31m²	3.98kg	PE110
900 x 900 x 3mm	0.65m²	7.20kg	PE120

BS EN 13601 (formerly BS 1432)

Earth rod seal

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*

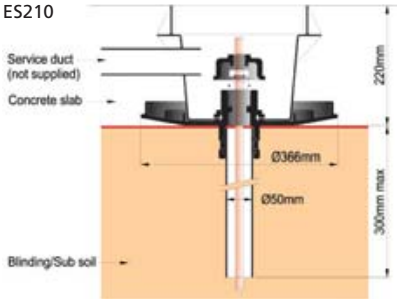
* For use with ⅜" UNC rods only.

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

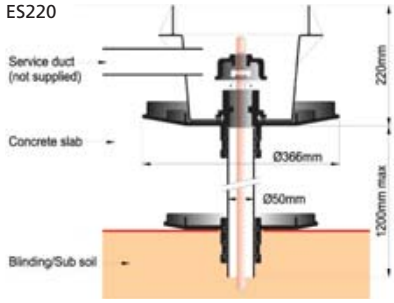
The unique design allows the seal to be effective across a broad range of rod diameters from a nominal ½" to ¾" rod, by the use of various compression rings and seal kits.

For use with **PT205** – lightweight inspection pit.

ES210

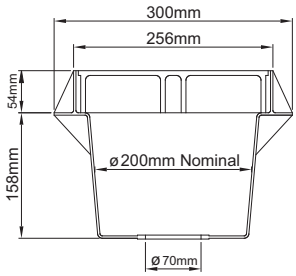


ES220



A separate datasheet is available should you require further information.

Earth inspection pits



Lightweight inspection pit

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

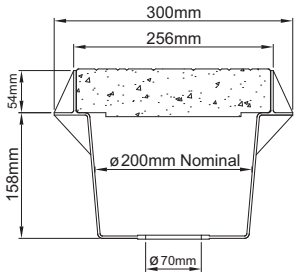
Accessories

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

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.



Lightweight inspection pit with concrete lid

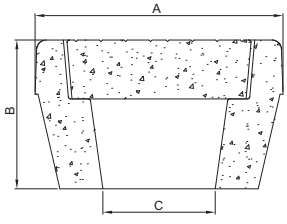
Description	Weight each	Part No.
Lightweight inspection pit with concrete lid	7.50kg	PT110

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

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).



Concrete inspection pit

Description	A B C Dimensions	Weight each	Part No.
Concrete inspection pit	320mm x 192mm x 146mm	30kg	PT005
NEW Lightweight concrete inspection pit	285mm x 140mm x 130mm	19kg	PT050

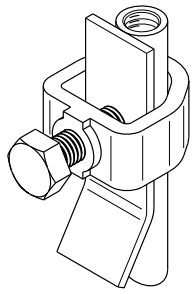
Accessories

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.

Rod to tape clamp (type A)



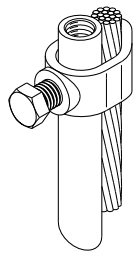
Nominal rod diameter		Max. conductor	Weight each	Part No.
½"	12.7mm	26 x 12mm	0.15kg	CR105
⅝"	16mm	26 x 12mm	0.15kg	CR105
¾"	20mm	26 x 10mm	0.15kg	CR105
⅝"	16mm	30 x 2mm	0.16kg	CR108
¾"	20mm	30 x 2mm	0.16kg	CR108
⅝"	16mm	40 x 12mm	0.24kg	CR110
⅝"	16mm	51 x 8mm	0.30kg	CR115
¾"	20mm	51 x 12mm	0.30kg	CR125
½"	12.7mm	26 x 20mm	0.23kg	CR130
⅝"	16mm	26 x 18mm	0.23kg	CR130
¾"	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**.

BS EN 50164-1
Class H, BS 7430

Tightening torque 15Nm

Rod to cable clamp (type G)



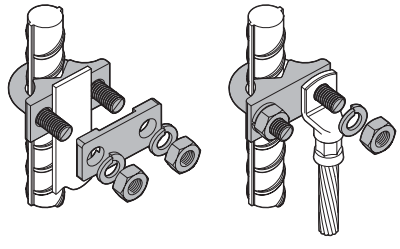
Nominal rod diameter		Max. conductor	Weight each	Part No.
⅜"	9.5mm	6 – 35mm²	0.03kg	CR505
½"	12.5mm	16 – 50mm²	0.05kg	CR510-FU*
⅝"	16mm	16 – 70mm²	0.06kg	CR515*
¾"	20mm	35 – 95mm²	0.06kg	CR520*
1"	25mm	70 – 120mm²	0.14kg	CR525

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

BS EN 50164-1
Class H, BS 7430

Tightening torque 12Nm

'U' bolt rod clamp (type E)



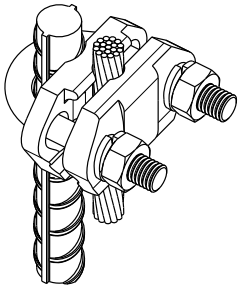
Nominal rod diameter	Hole centres	Tape width	Weight each	Part No.
⅝"	37mm	-	0.20kg	CR305
¾"	37mm	-	0.20kg	CR310
1"	37mm	-	0.20kg	CR315
⅝"	37mm	25mm	0.26kg	CR320*
1½"	54mm	-	0.37kg	CR325
2"	64mm	-	0.44kg	CR330

'U' Bolt threaded M10.

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

BS 7430

Earth rod clamps



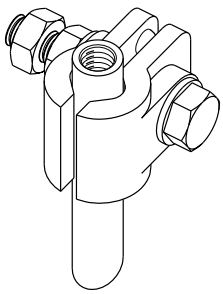
Rod to cable clamp (type GUV)

Nominal rod diameter		Conductor range	Weight each	Part No.
⅝"	16mm	16 – 95mm²	0.39kg	CR700*
¾"	20mm	16 – 70mm²	0.39kg	CR700*
⅝"	16mm	70 – 185mm²	0.39kg	CR705
¾"	20mm	70 – 150mm²	0.39kg	CR705
⅝"	16mm	150 – 300mm²	0.62kg	CR730
¾"	20mm	150 – 300mm²	0.62kg	CR730

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

BS EN 50164-1 Class H, BS 7430

Tightening torque 12Nm



Rod to cable lug clamp (type B)

Nominal rod diameter		Rod type	Bolt size	Weight each	Part No.
⅜"	9.5mm	Copperbond	M8	0.09kg	CR205
⅝"	16mm	Copperbond	M10	0.30kg	CR215
⅝"	15mm	Solid copper	M10	0.30kg	CR220
¾"	20mm	Copperbond	M10	0.30kg	CR225
¾"	20mm	Solid copper	M10	0.30kg	CR230

BS 7430

Tower earth clamp

Conductor range	Channel thickness	Bolt size	Conductor material	Weight each	Part No.
16 – 70mm²	10mm	M10	Copper	0.13kg	BN125*
70 – 120mm²	10mm	M12	Copper	0.22kg	BN130
25 – 50mm²	10mm	M10	Copper	0.08kg	BN300-FU*
25 – 50mm²	10mm	M10	Aluminium	0.05kg	BN305*
120 – 185mm²	10mm	M12	Copper	0.30kg	BN320
185 – 240mm²	10mm	M12	Copper	0.40kg	BN325

For bonding copper cable or wire to steel structures.

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

BS EN 50164-1 Class H, BS 7430

Tightening torque 12Nm

Square tape clamp NEW

Conductor size	Material	Weight each	Part No.
25 x 3mm	Copper	0.12kg	CT105-H
25 x 6mm	Copper	0.30kg	CT110-H
50 x 6mm	Copper	0.60kg	CT115-H

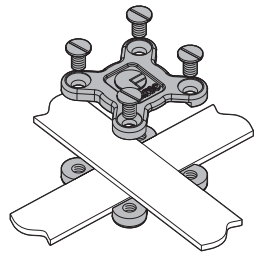
Reg. design

Manufactured from high quality copper and aluminium alloys. Simple to install, providing an effective low resistance connection between overlapping tapes to allow cross, tee, through and right angle joints to be formed.

BS EN 50164-1 Class H, BS 7430

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

Tightening torque 5Nm



DC tape clip

Use with bare copper

Conductor size	Weight each	Part No.
20 x 3mm	0.06kg	CP205
25 x 4mm	0.07kg	CP216
30 x 5mm	0.10kg	CP227
38 x 5mm	0.12kg	CP245
40 x 4mm	0.14kg	CP241
50 x 4mm	0.15kg	CP256

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

Pat. Pending

Use with lead covered copper

Conductor size	Weight each	Part No.
25 x 3mm	0.20kg	CP305

Swing lid DC tape clip – Use with bare copper

Conductor size	Weight each	Part No.	
25 x 3mm	0.07kg	CP210-H	NEW
25 x 6mm	0.08kg	CP220-H	NEW

DC tape clips manufactured from high quality copper and aluminium alloys for excellent corrosion resistance and high pull off loads.

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.

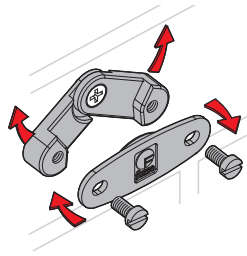
Adjustable DC tape clip NEW

Use with bare copper

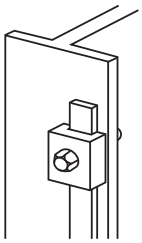
Conductor size	Weight each	Part No.
31 x 3mm and 31 x 6mm – use with bare copper	0.10kg	CP230-H
38 x 3mm, 38 x 6mm and 40 x 6mm – use with bare copper	0.12kg	CP240-H
50 x 3mm and 50 x 6mm – use with bare copper	0.16kg	CP260-H

Pat. Pending

DC tape clips manufactured from high quality copper and aluminium alloys for excellent corrosion resistance and high pull off loads.



Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 39.



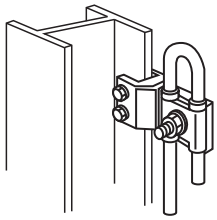
‘B’ bond

Maximum tape width	Bolt size	Conductor material	Weight each	Part No.
26mm	M10	Copper	0.12kg	BN105
26mm	M10	Aluminium	0.06kg	BN005
31mm	M10	Copper	0.15kg	BN113

For bonding tape to steel structures.

BS EN 50164-1 Class H, BS 7430

Tightening torque 17Nm



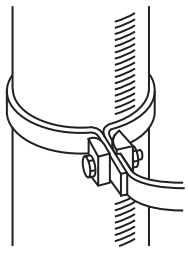
Metalwork bond

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.

BS EN 50164-1 Class H, BS 7430

Tightening torque – M8 bolt: 10Nm, M10 bolt: 12Nm



RWP bond

Maximum tape width	Bolt size	Conductor material	Weight each	Part No.
26mm	M10	Copper	0.12kg	BN115
26mm	M10	Aluminium	0.07kg	BN010

For bonding tape to rainwater pipes, handrails etc.

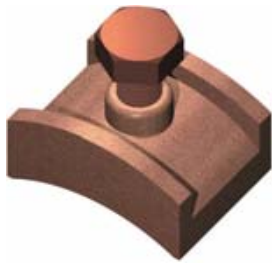
BS 7430

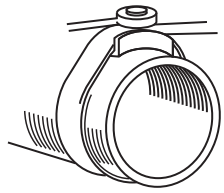
Watermain bond

Maximum tape width	Conductor material	Weight each	Part No.
26mm	Copper	0.26kg	BN120

For bonding tape to large diameter pipes.

BS 7430





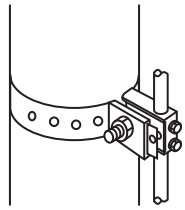
Pipe bond

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.

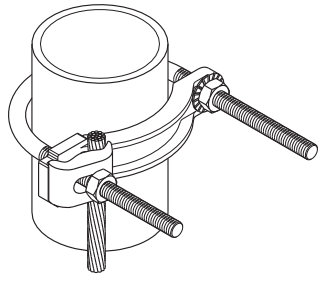
BS EN 50164-1 Class H, BS 7430

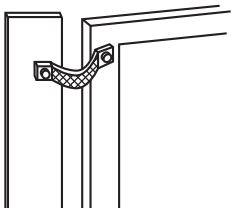
Tightening torque – M6 bolt: 6Nm, M10 bolt: 12Nm



Pipe clamp

Pipe diameter		Conductor range	Weight each	Part No.
½" – 1"	13 – 25mm	25 – 95mm²	0.3kg	3902
1¼" – 2"	32 – 50mm	25 – 95mm²	0.4kg	3903
2½" – 3½"	65 – 90mm	25 – 95mm²	0.5kg	3904
4" – 5"	100 – 125mm	25 – 95mm²	0.6kg	3905-TB
6"	150mm	25 – 95mm²	0.8kg	3906-TB
8"	200mm	25 – 95mm²	1.0kg	3907
10"	250mm	25 – 95mm²	1.1kg	3908
12"	300mm	25 – 95mm²	1.5kg	3909-TB



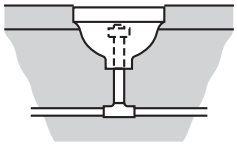


Flexible copper braid bond

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 35mm^2. Other materials, lengths and sections available as special items.

BS 7430

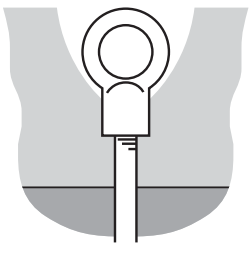


Static earth receptacle

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.

BS 7430



Eyebolt

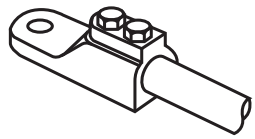
Nominal copperbond rod diameter	Weight each	Part No.
5/8"	0.52kg	BT150
3/4"	0.52kg	BT160

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

BS 7430

Straight setscrew type cable socket

Conductor diameter	Palm hole diameter	Conductor material	Weight each	Part No.
8mm	12mm	Copper	0.11kg	SX450
8mm	12mm	Aluminium	0.05kg	SX455



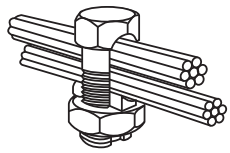
For bonding copper and aluminium conductors to steel work.

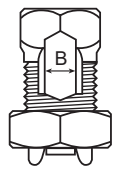
BS EN 50164-1 Class H

Tightening torque 3Nm

Type H – High strength splitbolt connector

Conductor range				Dimension	Weight	Part No.
Main		Tap				
Min	Max	Min	Max	B	each	
4mm²	10mm²	2.5mm²	10mm²	4.1mm	0.02kg	8H-FU
10mm²	16mm²	2.5mm²	16mm²	5.5mm	0.03kg	4H-FU
16mm²	25mm²	4mm²	25mm²	6.9mm	0.04kg	2H-FU
25mm²	35mm²	4mm²	35mm²	8.4mm	0.06kg	1H-FU
35mm²	50mm²	4mm²	50mm²	9.7mm	0.09kg	10H-FU
35mm²	70mm²	4mm²	70mm²	11.2mm	0.14kg	20H-FU
50mm²	95mm²	4mm²	95mm²	13.6mm	0.17kg	30H-FU
50mm²	120mm²	6mm²	120mm²	14.7mm	0.18kg	40H-FU
95mm²	185mm²	6mm²	185mm²	18.2mm	0.35kg	350M-FU



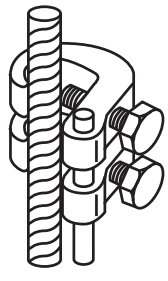


For copper to copper connections. No special tools required.

BS 7430

Rebar clamp

Conductor diameter	Rebar diameter	Conductor material	Weight each	Part No.
8mm	8 –18mm	Copper	0.32kg	BN150
8mm	18 – 38mm	Copper	0.75kg	BN155

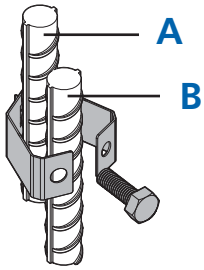


For bonding to reinforcing bars, steam pipes, handrails etc.

BS 7430

Rebar connecting clips

Pat. Pending



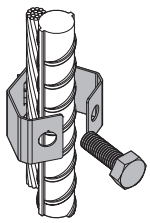
NEW Rebar to rebar connecting clip

Maximum rebar diameter (A)	Maximum rebar diameter (B)	Weight each	Part No.
8mm	12mm	0.05kg	RR812
16mm	16mm	0.05kg	RR1616
20mm	20mm	0.06kg	RR2121
25mm	25mm	0.07kg	RR2626
32mm	32mm	0.07kg	RR3232
40mm	40mm	0.08kg	RR3838

Manufactured from high quality stainless steel for excellent corrosion resistance. Simple to install, providing a secure connection between internal reinforcing bars.

BS EN 50164-1 Class H

Pat. Pending



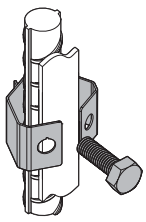
NEW Rebar to cable connecting clip

Rebar diameter	Conductor size	Weight each	Part No.
12mm	50mm² or 8mm dia.	0.05kg	RC812-0850
16mm	8mm dia., 50 – 70 – 95mm²	0.06kg	RC16-087095
20mm	8mm dia., 50 – 70 – 95mm²	0.07kg	RC20-087095
25mm	8mm dia., 50 – 70 – 95mm²	0.07kg	RC25-087095
32mm	8mm dia., 50 – 70 – 95mm²	0.07kg	RC32-087095
40mm	8mm dia., 50 – 70 – 95mm²	0.08kg	RC40-087095

Manufactured from high quality stainless steel for excellent corrosion resistance. Simple to install, providing a secure connection between internal reinforcing bars and conductor.

BS EN 50164-1 Class H

Pat. Pending



NEW Rebar to tape connecting clip

Rebar diameter	Conductor size	Weight each	Part No.
25mm	25 x 3mm	0.07kg	RC25-087095

Manufactured from high quality stainless steel for excellent corrosion resistance. Simple to install, providing a secure connection between internal reinforcing bars and flat tape conductor.

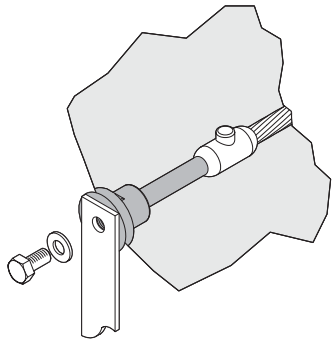
BS EN 50164-1 Class H

Single hole earth point

Hole size	Length	Weight each	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).

BS 7430

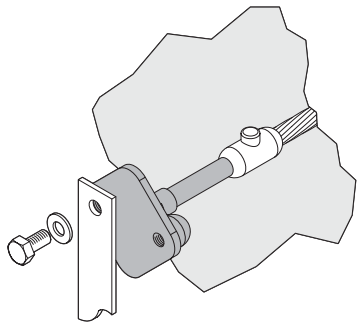


Two hole earth point

Hole size	Length	Weight each	Part No.
M8 x 12mm	80mm	0.44kg	PC115-FU
Supplied c/w front plate for connection of 25mm x 3mm copper tape or 70mm² 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

BS EN 50164-1 Class H, BS 7430

Tightening torque 8Nm

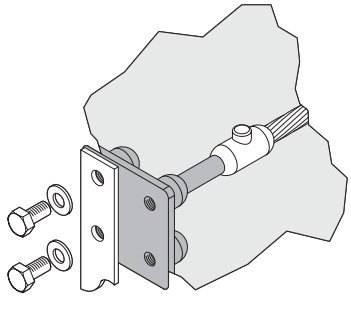


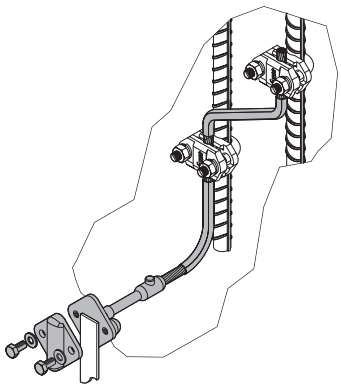
Four hole earth point

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

Stem diameter = 10.7mm (70mm²).

BS 7430





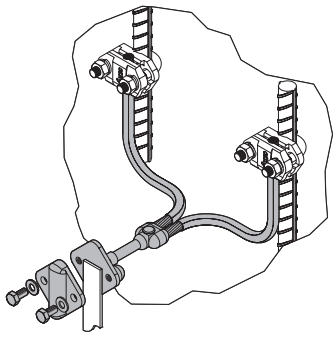
Earth point with pre-welded tail

Description	Weight each	Part No.
As PC100-FU with prewelded 500mm long tail of 70mm² PVC insulated earth cable	0.56kg	PC105
As PC101 with prewelded 500mm long tail of 70mm² PVC insulated earth cable	0.56kg	PC106
As PC102 with prewelded 500mm long tail of 70mm² PVC insulated earth cable	0.56kg	PC107
As PC103 with prewelded 500mm long tail of 70mm² PVC insulated earth cable	0.56kg	PC108
As PC110 with prewelded 500mm long tail of 70mm² PVC insulated earth cable	1.14kg	PC111
As PC115-FU with prewelded 500mm long tail of 70mm² PVC insulated earth cable	0.84kg	PC116
As PC120 with prewelded 500mm long tail of 70mm² PVC insulated earth cable	0.84kg	PC121
As PC125 with prewelded 500mm long tail of 70mm² PVC insulated earth cable	0.84kg	PC126-FU

For earth points PC100-FU etc. please refer to page 65.

BS EN 50164-1 Class H, BS 7430

Tightening torque 8Nm



NEW Earth point with double pre-welded tail

Description	Weight each	Part No.
As PC110 but with 2 x 500mm prewelded long tail of 70mm² PVC insulated earth cable	1.23kg	PC216
As PC115-FU but with 2 x 500mm prewelded long tail of 70mm² PVC insulated earth cable	1.26kg	PC211
As PC120 but with 2 x 500mm prewelded long tail of 70mm² PVC insulated earth cable	1.26kg	PC221

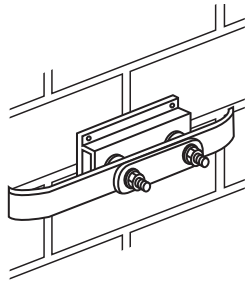
For earth points PC110 etc. please refer to page 65.

BS EN 50164-1 Class H, BS 7430

Tightening torque 8Nm

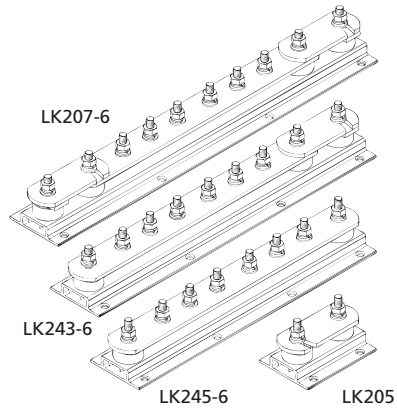
Earth bar

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 bar 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 bar 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

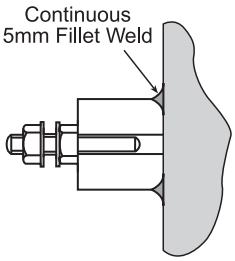
Description	Length	Width	Height	Weight each	Part No.
Swan-neck link	400mm	50mm	36mm	0.42kg	LK004
Disconnecting link	125mm	90mm	90mm	0.59kg	LK205

All the above products consist of 50 x 6mm copper bar with M10 termination screws.

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

Fix using countersunk wood screws 1½" No. 12 (Part no. **SW110**) and wall plugs (Part no. **PS310**) – see Accessories page 39.

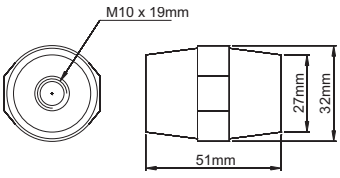
Earth boss/insulators



Earth boss

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

Made of mild steel to BS 970 230M07 (ENIA) with phosphor bronze stud and nuts. For welding to steel vessels/tanks/structures. Wrap connections with Denso tape (see page 40).



Insulator

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

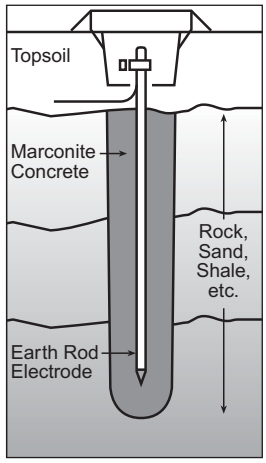
Marconite® conductive aggregate

Description	Sack Weight	Part No.	
Marconite	25kg	CM025	
Marconite (pre mixed with cement)	25kg	CM025-PM	NEW

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.

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.

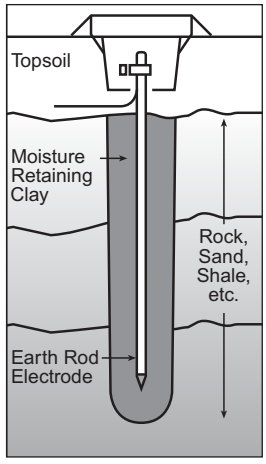
CoSHH Datasheet available on request.

Bentonite moisture retaining clay

Description	Sack Weight	Part No.	
Bentonite powder	25kg	CM015	
Bentonite granules	25kg	CM015-PM	NEW

Used as an earth-electrode backfill to reduce soil resistivity by retaining moisture. The clay is a sodium activated 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).

CoSHH Datasheet available on request.



Earth rod hammer

Description	Weight each	Part No.
Atlas Copco Cobra TT petrol driven hammer	24kg	HM005
Earth rod adapter (Suitable for ⅝" and ¾" 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.

DET10C Earth resistance tester

Description	Weight each	Part No.
Clamp-on earth resistance tester	0.75kg	DET10C

The DET10C measures earth/ground resistance and current flow by the clamp-on method, with capability for taking ground resistance readings from 0.025Ω to 1550Ω and for measuring ground leakage current from 0.2mA to 35A. With its extra large jaws (35mm) and its light weight the DET10C is the ideal entry level testing solution.

DET3TC Earth resistance tester

Description	Weight each	Part No.
Digital earth resistance tester	1.0kg	DET3TC

The DET3TC is a three-terminal digital model that includes Attached Rod Technique (ART) capability. The DET3TC is capable of measuring ground resistance from 0.01Ω to 2000Ω and earth voltages up to 100V.

With the optional clamp, it will read ground current from 0.5mA to 19.9A. This unit is supplied complete with carrying case, test leads and probes.

DET4TD2 Earth resistance tester

Description	Weight each	Part No.
Digital earth resistance tester	1.0kg	DET4TD2

The DET4TD2 is capable of 2 pole, 3 pole or 4 pole testing and is designed to measure ground resistance from 0.01Ω to 20,000Ω. The instrument also includes a voltmeter to measure ground voltages up to 100V.

This unit is supplied complete with test leads, stakes, batteries and calibration certificate.

DET2/2 Earth resistance tester

Description	Weight each	Part No.
Digital earth resistance tester	5.0kg	DET2/2

The DET2/2 is a four-terminal digital model designed to operate in the most difficult (and electrically noisy) of test environments and for use on large, critical ground systems. This model has an extra digit of resolution (to 0.001) on readings and includes an interference filter, test current control and, most importantly, adjustable test current frequency (105-160Hz). As a four-terminal unit, the DET2/2 can also be used to make earth resistivity measurements.

Static earthing kits

Medium duty stainless steel earthing clamp

Description	Jaw opening	Cable length (max.)	Weight each	Part No.
Medium duty earthing clamp	15mm	3m	0.56kg	SK010

Clamp Certification Ex II 1 GD T6

Medium duty stainless earthing clamp for earthing buckets, small drums, containers and plant equipment etc. Clamp features twin tungsten carbide teeth for effective penetration of paint and contamination.

Supplied complete with chemically resistant Cen-Stat 3m Spiral Cable and 10mm ring terminal.

Heavy duty stainless steel earthing clamp

Description	Jaw opening	Cable length (max.)	Weight each	Part No.
Heavy duty earthing clamp	35mm	5m	1.09kg	SK020

Clamp Certification Ex II 1 GD T6 FM Approved

Heavy duty stainless earthing clamp for earthing 205 litre drums, IBCs, production vessels and road tankers etc. Clamp features twin tungsten carbide teeth for effective penetration of paint and contamination.

Supplied complete with chemically resistant Cen-Stat 5m Spiral Cable and 10mm ring terminal.

Medium duty stainless steel earthing clamp & reel

Description	Jaw opening	Cable length (max.)	Weight each	Part No.
Medium duty earthing clamp & reel	15mm	6.1m	3kg	SK030

Clamp Certification Ex II 1 GD T6 Reel Certification Ex II 1 GD T6

Medium duty stainless earthing clamp for earthing buckets, small drums, containers and plant equipment etc. Clamp features twin tungsten carbide teeth for effective penetration of paint and contamination.

Supplied complete with 6.1m retracting cable reel.

Heavy duty stainless steel earthing clamp & reel

Description	Jaw opening	Cable length (max.)	Weight each	Part No.
Heavy duty earthing clamp & reel	35mm	15.2m	6kg	SK040

Clamp Certification Ex II 1 GD T6 FM Approved
Reel Certification Ex II 1 GD T6

Heavy duty stainless earthing clamp for earthing 205 litre drums, IBC's, production vessels and road tankers. Clamp features twin tungsten carbide teeth for effective penetration of paint and contamination.

Supplied complete with 15.2m retracting cable reel.

Hydraulic crimping tool

Description	Weight each	Part No.
Hand operated 13 ton tool with carrying case	8kg	HT010

(Dies are not included)

Self-contained hydraulic crimping tool used for jointing and terminating copper, aluminium and ACSR conductors.

- Crimping force 130kN
- Two stage 'rapid-ram' advance mechanism for fast installation
- Short fibreglass handle for combined work spaces
- Accepts most U-Type dies of equivalent tonnage
- 180 degree head rotation
- Includes carrying case
- See page 75 for die details

(Dies are not included)

Hydraulic crimping head and pump

Description	Weight each	Part No.
15 ton hydraulic tool with carrying case	5.5kg	HT020
Foot operated hydraulic pump with carrying case	16.5kg	HT030

Self-contained hydraulic crimping tool used for jointing and terminating copper, aluminium and ACSR conductors.

- Crimping force 230kN, maximum operating pressure 700 bar
- Hydraulic head complete with quick automatic coupler for connection to pump
- Accepts most U-Type dies of equivalent tonnage
- Pump supplied with 3m long high pressure flexible hose
- Each supplied with carrying case
- See page 75 for die details

(Dies are not included)

Battery powered hydraulic crimping tool

Description	Weight each	Part No.
Battery powered, open head 14 ton tool	10.6kg	HT040

This self-contained, compact, cordless hydraulic tool makes crimping easy with its lightweight single handed design.

- Crimping force 130kN
- Two stage 'rapid-ram' advance mechanism for fast installation
- Accepts most U-Type dies of equivalent tonnage
- 180 degree head rotation
- See page 75 for die details

The tool is supplied with:

- Basic tool complete with battery
- Shoulder strap
- Spare battery (14.4V 3.0Ah)
- Battery charger
- Carrying case suitable for storing up to 14 sets of dies

(Dies are not included)

Battery powered hydraulic cutting tool

Description	Weight each	Part No.
Battery powered 6 ton cutting tool	6.5kg	HT050

This self-contained, compact, cordless hydraulic tool makes cutting copper, aluminium, ACSR and steel earth rods easy with its lightweight single handed design.

- Two stage 'rapid-ram' advance mechanism for fast installation
- Maximum cutting diameter of 25mm
- Blades manufactured from high strength special steel, heat treated to ensure a long service life
- 180 degree head rotation

The tool is supplied with:

- Basic tool complete with battery
- Battery wrist strap and shoulder strap
- Spare battery (14.4V 3.0Ah)
- Battery charger
- Carrying case suitable for storing tool and accessories

Die to suit tool type HT010 and HT040

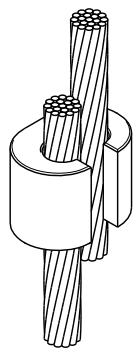
Main conductor	Conductor range	Weight each	Part No.
10mm²	1.5 – 10mm²	0.26kg	HD100
16mm²	1.5 – 16mm²	0.26kg	HD200
16 – 25mm²	1.5 – 10mm²	0.26kg	HD200
25mm²	16 – 25mm²	0.26kg	HD200
35mm²	1.5 – 16mm²	0.28kg	HD300
35mm²	25 – 35mm²	0.28kg	HD300
70mm²	1.5 – 25mm²	0.28kg	HD300
50mm²	4 – 25mm²	0.27kg	HD400
50mm²	35 – 50mm²	0.27kg	HD400
50 – 70mm²	4 – 35mm²	0.27kg	HD400
50 – 70mm²	35 – 70mm²	0.27kg	HD400
95mm²	4 – 35mm²	0.27kg	HD500
95mm²	35 – 70mm²	0.27kg	HD500
95mm²	70 – 95mm²	0.27kg	HD500
120mm²	25 – 120mm²	0.27kg	HD600
150mm²	25 – 120mm²	0.27kg	HD600
150mm²	70 – 150mm²	0.27kg	HD600
185mm²	16 – 95mm²	0.27kg	HD600

Die to suit tool type HT020 and pump HT030

Main conductor	Conductor range	Weight each	Part No.
120 – 185mm²	120 – 185mm²	0.22kg	HD700
150 – 240mm²	95 – 120mm²	0.22kg	HD700

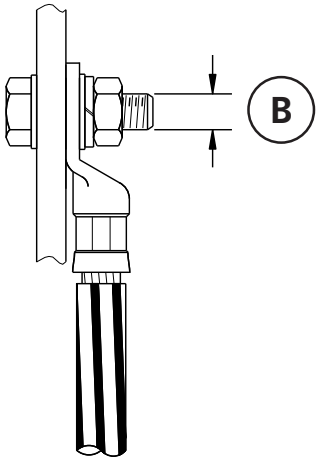
Manufactured from high quality stainless steel.

"C" Shape connectors



Main conductor	Conductor range	Box quantity	Weight each	Part No.
10mm²	1.5 – 10mm²	100	0.01kg	CN1010
16mm²	1.5 – 16mm²	100	0.02kg	CN1616
16 – 25mm²	1.5 – 10mm²	50	0.02kg	CN2510
25mm²	16 – 25mm²	50	0.02kg	CN2525
35mm²	1.5 – 16mm²	25	0.04kg	CN3516
35mm²	25 – 35mm²	25	0.04kg	CN3535
50mm²	4 – 25mm²	25	0.09kg	CN5025
50mm²	35 – 50mm²	25	0.09kg	CN5050
70mm²	1.5 – 25mm²	25	0.04kg	CN7025
50 – 70mm²	4 – 35mm²	25	0.10kg	CN7035
50 – 70mm²	35 – 70mm²	25	0.09kg	CN7070
95mm²	4 – 35mm²	25	0.15kg	CN9535
95mm²	35 – 70mm²	25	0.15kg	CN9570
95mm²	70 – 95mm²	25	0.14kg	CN9595
120mm²	25 – 120mm²	25	0.17kg	CN120120
150mm²	25 – 120mm²	25	0.16kg	CN150120
150mm²	70 - 150mm²	25	0.12kg	CN150150
185mm²	16 – 95mm²	25	0.13kg	CN18595
120 – 185mm²	120 – 185mm²	15	0.23kg	CN185185
150 – 240mm²	95 – 120mm²	15	0.24kg	CN240120

Manufactured from pure copper. All sizes also available in tinned, please contact our sales office to discuss specific requirements.



Terminals

Conductor size	Screw size (B)	Weight each	Part No.
16mm²	6mm	0.01kg	FCT166
16mm²	8mm	0.01kg	FCT168
16mm²	10mm	0.01kg	FCT1610
16mm²	12mm	0.01kg	FCT1612
25mm²	6mm	0.01kg	FCT256
25mm²	8mm	0.01kg	FCT258
25mm²	10mm	0.01kg	FCT2510
25mm²	12mm	0.01kg	FCT2512
35mm²	6mm	0.01kg	FCT356
35mm²	8mm	0.01kg	FCT358
35mm²	10mm	0.01kg	FCT3510
35mm²	12mm	0.01kg	FCT3512
50mm²	6mm	0.02kg	FCT506
50mm²	8mm	0.02kg	FCT508
50mm²	10mm	0.02kg	FCT5010
50mm²	12mm	0.02kg	FCT5012
70mm²	8mm	0.04kg	FCT708
70mm²	10mm	0.04kg	FCT7010
70mm²	12mm	0.04kg	FCT7012
70mm²	14mm	0.04kg	FCT7014
70mm²	16mm	0.04kg	FCT7016
95mm²	8mm	0.06kg	FCT958
95mm²	10mm	0.06kg	FCT9510
95mm²	12mm	0.06kg	FCT9512
95mm²	14mm	0.06kg	FCT9514
95mm²	16mm	0.06kg	FCT9516
120mm²	10mm	0.06kg	FCT12010
120mm²	12mm	0.06kg	FCT12012
120mm²	14mm	0.06kg	FCT12014
120mm²	16mm	0.06kg	FCT12016
150mm²	10mm	0.09kg	FCT15010
150mm²	12mm	0.09kg	FCT15012
150mm²	14mm	0.09kg	FCT15014
150mm²	16mm	0.09kg	FCT15016
185mm²	12mm	0.11kg	FCT18512
185mm²	14mm	0.11kg	FCT18514
185mm²	16mm	0.11kg	FCT18516
240mm²	12mm	0.14kg	FCT24012
240mm²	14mm	0.14kg	FCT24014
240mm²	16mm	0.14kg	FCT24016
300mm²	12mm	0.17kg	FCT30012
300mm²	14mm	0.17kg	FCT30014
300mm²	16mm	0.17kg	FCT30016
400mm²	12mm	0.21kg	FCT40012
400mm²	14mm	0.21kg	FCT40014
400mm²	16mm	0.21kg	FCT40016

Use with tool HT010, see page 73.

Introduction to BS EN/IEC 62305

A new standard in lightning protection

BS 6651:1999 Protection of structures against lightning has been the cornerstone for guidance on design and installation of lightning protection since 1985. In September 2006, however, a new standard for lightning protection, BS EN 62305, was introduced. For a finite period, both BS 6651 and the new BS EN 62305 standard have run in parallel, but, as of August 2008, BS 6651 has been withdrawn and BS EN 62305 is now the only recognised standard. BS EN/IEC 62305 has become the relevant, comparable standard applicable to the Far East market.

This new standard reflects increased scientific understanding of lightning and its effects over the last twenty years, and takes stock of the growing impact of technology and electronic systems on our daily activities. More complex and exacting than its 118 page predecessor, the 475-page BS EN 62305 is structured as a series with four parts (as per the IEC 62305 version), starting at general principles, then risk management, through to damage to the structure and damage to electronic systems therein.

Key to the new standard is that all considerations for lightning protection are driven by a comprehensive and complex risk assessment and that this assessment not only takes into account the structure to be protected, but also the services to which the structure is connected.

In essence, structural lightning protection can no longer be considered in isolation, protection against transient overvoltages or electrical surges are integral to the new standard.

Structure of BS EN/IEC 62305

The BS EN/IEC 62305 series consists of four parts, all of which need to be taken into consideration. These four parts are outlined below:

Part 1: General principles

BS EN/IEC 62305-1 (part 1) is an introduction to the other parts of the standard and essentially describes how to design a Lightning Protection System (LPS) in accordance with the accompanying parts of the standard.

Part 2: Risk management

BS EN/IEC 62305-2 (part 2) risk management approach, does not concentrate so much on the purely physical damage to a structure caused by a lightning discharge, but more on the risk of loss of human life, loss of service to the public, loss of cultural heritage and economic loss.

Part 3: Physical damage to structures and life hazard

BS EN/IEC 62305-3 (part 3) relates directly to the major part of BS 6651. It differs from BS 6651 in as much that this new part has four Classes or protection levels of Lightning Protection System (LPS), as opposed to the basic two (ordinary and high-risk) levels in BS 6651.

Part 4: Electrical and electronic systems within structures

BS EN/IEC 62305-4 (part 4) covers the protection of electrical and electronic systems housed within structures. This part essentially embodies what Annex C in BS 6651 conveyed, but with a new zonal approach referred to as Lightning Protection Zones (LPZs). It provides information for the design, installation, maintenance and testing of a Lightning Electromagnetic Impulse (LEMP) protection system for electrical/electronic systems within a structure.

The following table gives a broad outline as to the key variances between the previous standard, BS 6651, and the new standard BS EN/IEC 62305.

BS 6651 standard	BS EN/IEC 62305 standard
Document structure	
118 page document, including 9 pages devoted to risk assessment	475 page document, separated into 4 parts, including 153 pages devoted to risk assessment (BS EN 62305-2)
Focus on Protection of Structures against Lightning	Broader focus on Protection against Lightning including the structure and services connected to the structure
Specific tables relating to choice and dimension of Lightning Protection System components and conductors	Specific tables relating to sizes and types of conductor and earth electrodes. Lightning Protection System components – specifically related to BS EN 50164 testing regimes
Annex B – guidance on application of BS 6651	BS EN/IEC 62305-3 Annex E – extensive guidance given on application of installation techniques complete with illustrations
Annex C – general advice (recommendation) for protection of electronic equipment with separate risk assessment	BS EN/IEC 62305-4 is devoted entirely to protection of electrical and electronic systems within the structure (integral part of standard) and is implemented through single separate risk assessment (BS EN/IEC 62305-2)
Definition of risk	
Risk (of death/injury) level set at 1 in 100,000 (1×10^{-5}) based on comparable exposures (smoking, traffic accidents, drowning etc)	3 primary risk levels defined (BS EN 62305): R_1 loss of human life 1 in 100,000 (1×10^{-5}) R_2* loss of service to the public 1 in 10,000 (1×10^{-4}) R_3* loss of cultural heritage 1 in 10,000 (1×10^{-4}) *R_2 and R_3 are 1 in 1000 (1×10^{-3}) within IEC 62305-2
Protection measures	
Mesh arrangement is promoted as the commonly used means of air termination network	Mesh arrangement, protective angle method, catenary system, extensive use of air finials, all form part of or all of air termination network
2 levels of Lightning Protection mesh design: (20m x 10m; 10m x 5m)	4 sizes of mesh defined according to structural class of Lightning Protection System: Class I 5m x 5m Class II 10m x 10m Class III 15m x 15m Class IV 20m x 20m
2 levels of down conductor spacing: 20m & 10m	4 levels of down conductor spacing dependent on structural class of Lightning Protection System: Class I 10m Class II 10m Class III 15m Class IV 20m
Use of bonds promoted to minimise side flashing	Extensive sections/explanations provided on equipotential bonding
10 ohm overall earthing requirement, achieved by 10 x number of down conductors	10 ohms overall earthing requirement achieved either by Type A arrangement (rods) or Type B arrangement (ring conductor)
Requirement to bond all metallic services, (gas, water, electricity etc) to main earth terminal along with external down conductor	Requirement to bond all metallic services to main equipotential bonding bar. 'Live' electrical conductors (e.g. power, data, telecoms) bonded via Surge Protection Devices (SPDs)
Rolling sphere concept on structures over 20m tall: 20m sphere used on highly flammable contents/ electronic equipment within building 60m sphere all other buildings	4 sizes of rolling sphere concept defined according to structural class of Lightning Protection System: Class I 20m Class II 30m Class III 45m Class IV 60m

BS EN/IEC 62305-1 General principles

This opening part of the BS EN/IEC 62305 suite of standards serves as an introduction to the further parts of the standard. It classifies the sources and types of damage to be evaluated and introduces the risks or types of loss to be anticipated as a result of lightning activity.

Furthermore, It defines the relationships between damage and loss that form the basis for the risk assessment calculations in part 2 of the standard.

Lightning current parameters are defined. These are used as the basis for the selection and implementation of the appropriate protection measures detailed in parts 3 and 4 of the standard.

Part 1 of the standard also introduces new concepts for consideration when preparing a lightning protection scheme, such as Lightning Protection Zones (LPZs) and separation distance.

Damage and loss

BS EN/IEC 62305 identifies four main sources of damage:

S1 **Flashes to the structure**

S2 **Flashes near to the structure**

S3 **Flashes to a service**

S4 **Flashes near to a service**

Each source of damage may result in one or more of three types of damage:

D1 **Injury of living beings due to step and touch voltages**

D2 **Physical damage (fire, explosion, mechanical destruction, chemical release) due to lightning current effects including sparking**

D3 **Failure of internal systems due to Lightning Electromagnetic Impulse (LEMP)**

The following types of loss may result from damage due to lightning;

L1 **Loss of human life**

L2 **Loss of service to the public**

L3 **Loss of cultural heritage**

L4 **Loss of economic value**

The relationships of all of the above parameters are summarised in Table 1.

Figure 1 on page 81 depicts the types of damage and loss resulting from lightning.

For a more detailed explanation of the general principles forming part 1 of the BS EN 62305 standard, please refer to our full reference guide `A Guide to BS EN 62305.' Although focused on the BS EN standard, this guide may provide supporting information of interest to consultants and scheme designers in the Far East. Please see page 93 for more details about this guide.

Point of strike	Source of damage	Type of damage	Type of loss
Structure	S1	D1 D2 D3	L1, L4** L1, L2, L3, L4 L1*, L2, L4
Near a structure	S2	D3	L1*, L2, L4
Service connected to the structure	S3	D1 D2 D3	L1, L4** L1, L2, L3, L4 L1*, L2, L4
Near a service	S4	D3	L1*, L2, L4

* Only for structures with risk of explosion and for hospitals or other structures where failures of internal systems immediately endangers human life.
** Only for properties where animals may be lost.

Table 1: Damage and loss in a structure according to different points of lightning strike (BS EN/IEC 62305-1 Table 3)

Scheme design criteria

The ideal lightning protection for a structure and its connected services would be to enclose the structure within an earthed and perfectly conducting metallic shield (box), and in addition provide adequate bonding of any connected services at the entrance point into the shield.

This in essence would prevent the penetration of the lightning current and the induced electromagnetic field into the structure.

However, in practice it is not possible or indeed cost effective to go to such lengths.

This standard thus sets out a defined set of lightning current parameters where protection measures, adopted in accordance with its recommendations, will reduce any damage and consequential loss as a result of a lightning strike. This reduction in damage and consequential loss is valid provided the lightning strike parameters fall within defined limits, established as Lightning Protection Levels (LPL).

Lightning Protection Levels (LPL)

Four protection levels have been determined based on parameters obtained from previously published technical papers. Each level has a fixed set of maximum and minimum lightning current parameters. These parameters are shown in Table 2.

The maximum values have been used in the design of products such as lightning protection components and Surge Protection Devices.

The minimum values of lightning current have been used to derive the rolling sphere radius for each level.

LPL	I	II	III	IV
Maximum current (kA)	200	150	100	100
Minimum current (kA)	3	5	10	16

Table 2: Lightning current for each LPL based on 10/350µs waveform

For a more detailed explanation of Lightning Protection Levels and maximum/minimum current parameters please see page 16 of our Guide to BS EN 62305.

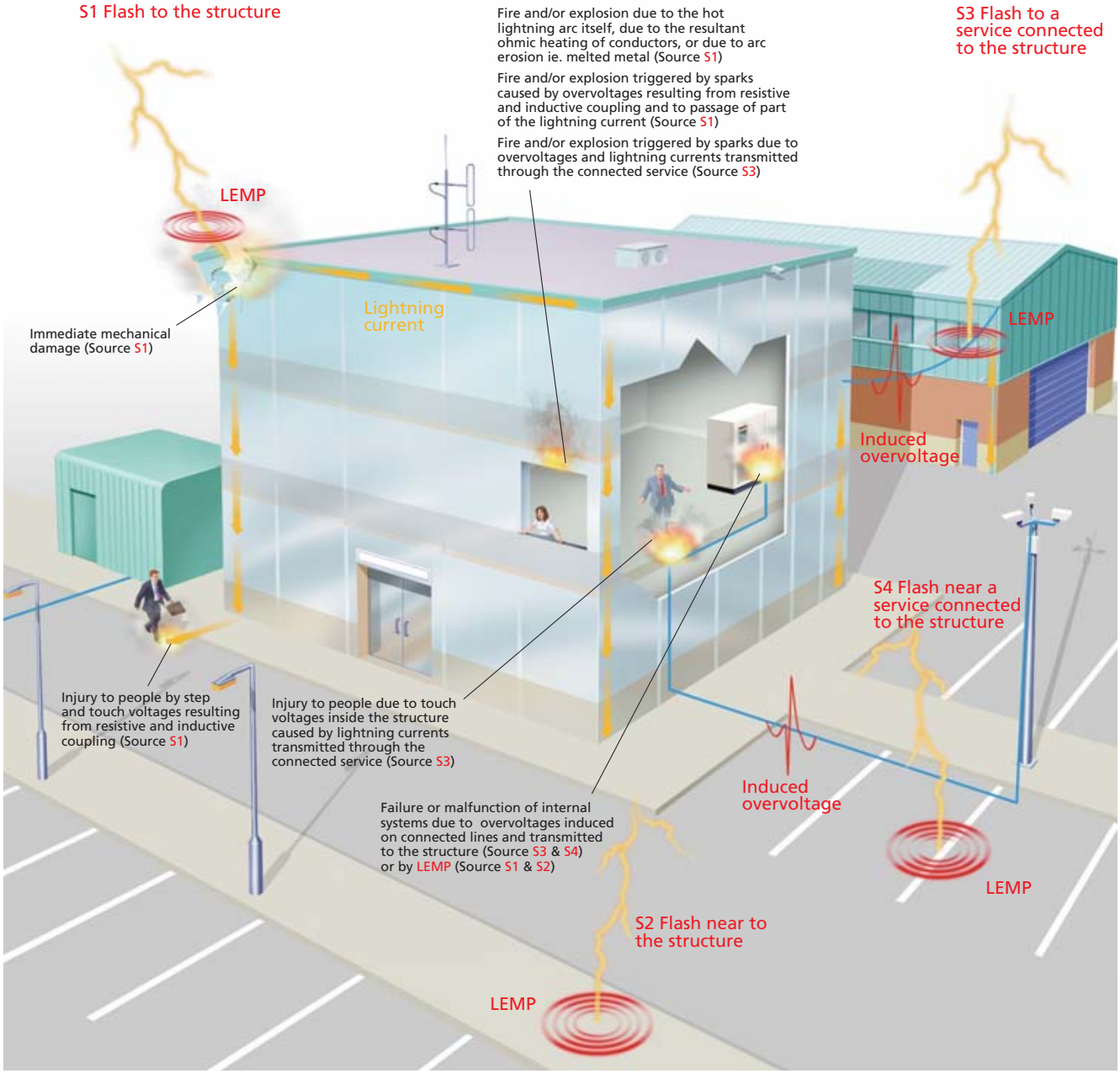


Figure 1: The types of damage and loss resulting from a lightning strike on or near a structure

Lightning Protection Zones (LPZ)

New to BS EN/IEC 62305, the concept of Lightning Protection Zones (LPZ) has been introduced particularly to assist in determining the protection measures required to establish a Lightning Electromagnetic Impulse (LEMP) Protection Measures System (LPMS) within a structure.

The general principle is that the equipment requiring protection should be located in a Lightning Protection Zone whose electromagnetic characteristics are compatible with the equipment stress withstand or immunity capability.

The concept caters for external zones, with risk of direct lightning stroke (LPZ 0_A), or risk of partial lightning current occurring (LPZ 0_B), and levels of protection within internal zones (LPZ 1 & LPZ 2.)

In general the higher the number of the zone (LPZ 2; LPZ 3 etc) the lower the electromagnetic effects expected. Typically, any sensitive electronic equipment should be located in higher numbered LPZs and be protected by its relevant LPMS measures.

Figure 2 highlights the LPZ concept as applied to the structure and to an LEMP Protection Measures System (LPMS). The concept is expanded upon in BS EN/IEC 62305-3 and BS EN/IEC 62305-4.

Selection of the most suitable LEMP protection measures is made using the risk assessment in accordance with BS EN/IEC 62305-2.

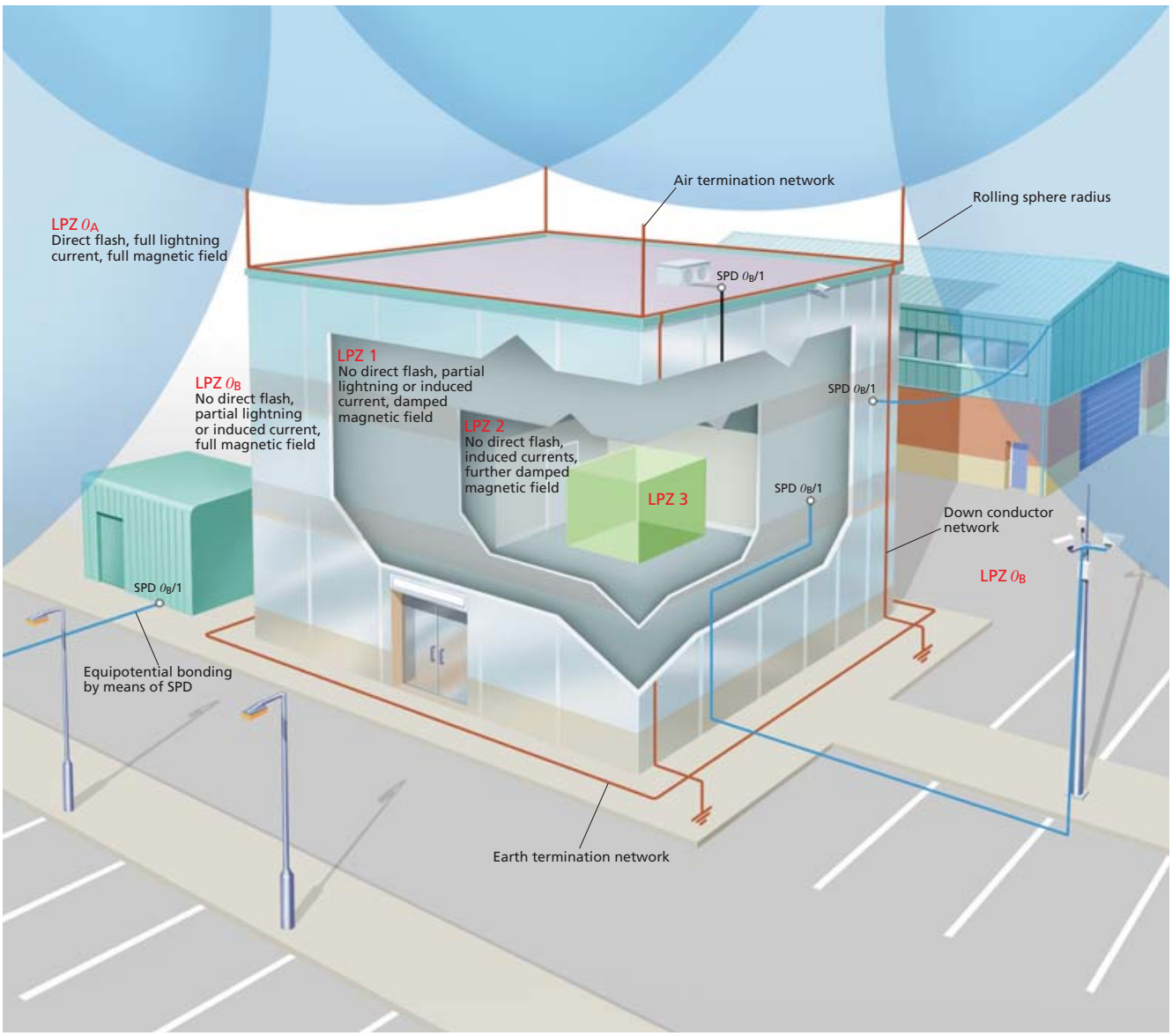


Figure 2: The LPZ concept

BS EN/IEC 62305-2 Risk management

BS EN/IEC 62305-2 is key to the correct implementation of BS EN/IEC 62305-3 and BS EN/IEC 62305-4. The assessment and management of risk is now significantly more in depth and extensive than the approach of BS 6651.

BS EN/IEC 62305-2 specifically deals with making a risk assessment, the results of which define the level of Lightning Protection System (LPS) required. While BS 6651 devoted 9 pages (including figures) to the subject of risk assessment, BS EN/IEC 62305-2 currently contains some 153 pages.

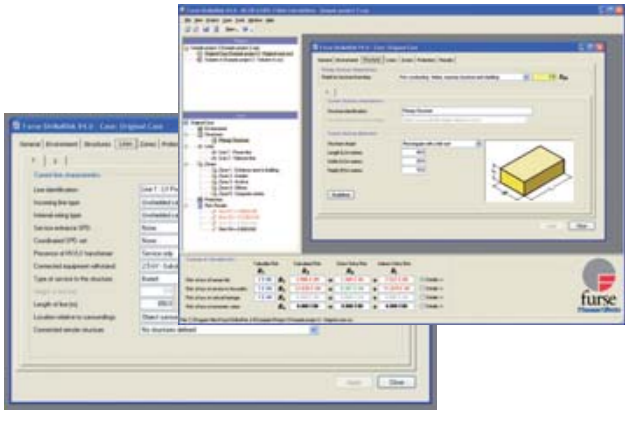
The first stage of the risk assessment is to identify which of the four types of loss (as identified in BS EN/IEC 62305-1) the structure and its contents can incur. The ultimate aim of the risk assessment is to quantify and if necessary reduce the relevant primary risks i.e.:

- R_1 **risk of loss of human life**
- R_2 **risk of loss of service to the public**
- R_3 **risk of loss of cultural heritage**
- R_4 **risk of loss of economic value**

For each of the first three primary risks, a tolerable risk (R_T) is set. This data can be sourced in Table 7 of IEC 62305-2 or Table NK.1 of the National Annex of BS EN 62305-2.

Each primary risk (R_n) is determined through a long series of calculations as defined within the standard. If the actual risk (R_n) is less than or equal to the tolerable risk (R_T), then no protection measures are needed. If the actual risk (R_n) is greater than its corresponding tolerable risk (R_T), then protection measures must be instigated. The above process is repeated (using new values that relate to the chosen protection measures) until R_n is less than or equal to its corresponding R_T.

It is this iterative process as shown in Figure 3 that decides the choice or indeed Lightning Protection Level (LPL) of Lightning Protection System (LPS) and Lightning Electro-magnetic Impulse (LEMP) Protection Measures System (LPMS).



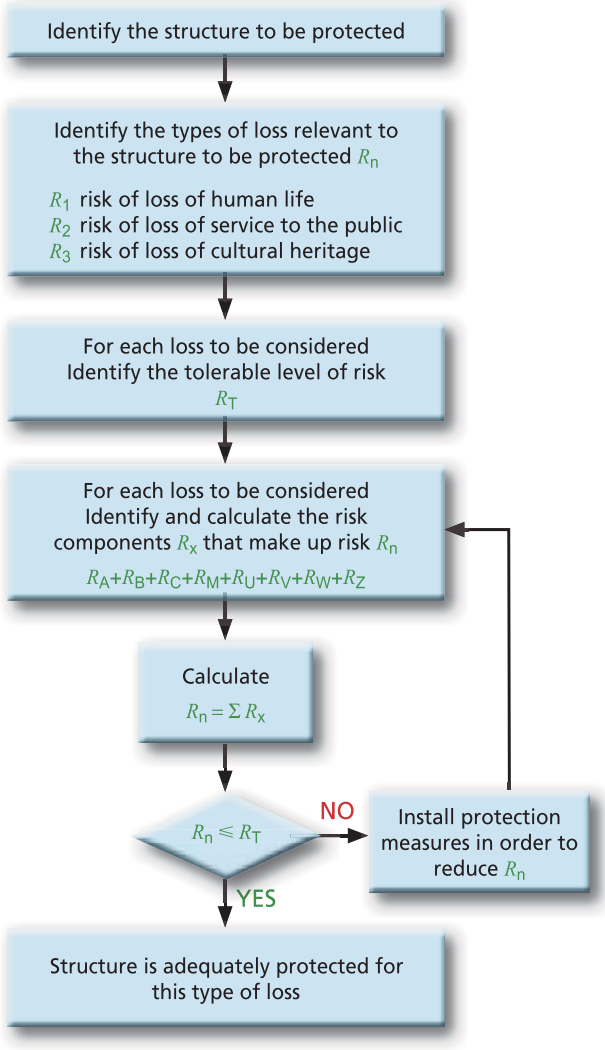


Figure 3: Procedure for deciding the need for protection (BS EN/IEC 62305-1 Figure 1)

StrikeRisk v5.0 risk management software

An invaluable tool for those involved in undertaking the complex risk assessment calculations required by BS EN 62305-2, StrikeRisk v5.0 facilitates the assessment of risk of loss due to lightning strikes and transient overvoltages caused by lightning.

Quick & easy to use, with full reporting capability, StrikeRisk v5.0 automates risk assessment calculations and delivers results in minutes, rather than the hours or days it would take to do the same calculations by hand.

Contact Furse for more details about StrikeRisk v5.0.

BS EN/IEC 62305-3 Physical damage to structures and life hazard

This part of the suite of standards deals with protection measures in and around a structure and as such relates directly to the major part of BS 6651.

The main body of this part of the standard gives guidance on the design of an external Lightning Protection System (LPS), internal LPS and maintenance and inspection programmes.

Lightning Protection System (LPS)

BS EN/IEC 62305-1 has defined four Lightning Protection Levels (LPLs) based on probable minimum and maximum lightning currents. These LPLs equate directly to classes of Lightning Protection System (LPS).

The correlation between the four levels of LPL and LPS is identified in Table 3. In essence, the greater the Lightning Protection Level, the higher class of Lightning Protection System is required.

LPL	Class of LPS
I	I
II	II
III	III
IV	IV

Table 3: Relation between Lightning Protection Level (LPL) and Class of LPS (BS EN/IEC 62305-3 Table 1)

The class of LPS to be installed is governed by the result of the risk assessment calculation highlighted in BS EN/IEC 62305-2.

External LPS design considerations

The lightning protection designer must initially consider the thermal and explosive effects caused at the point of a lightning strike and the consequences to the structure under consideration. Depending upon the consequences the designer may choose either of the following types of external LPS:

- Isolated
- Non-isolated

An Isolated LPS is typically chosen when the structure is constructed of combustible materials or presents a risk of explosion.

Conversely a non-isolated system may be fitted where no such danger exists.

An external LPS consists of:

- Air termination system
- Down conductor system
- Earth termination system

These individual elements of an LPS should be connected together using appropriate lightning protection components (LPC) complying (in the case of BS EN 62305) with BS EN 50164 series. This will ensure that in the event of a lightning current discharge to the structure, the correct design and choice of components will minimize any potential damage.

Air termination system

The role of an air termination system is to capture the lightning discharge current and dissipate it harmlessly to earth via the down conductor and earth termination system. Therefore it is vitally important to use a correctly designed air termination system.

BS EN/IEC 62305-3 advocates the following, in any combination, for the design of the air termination:

- Air rods (or finials) whether they are free standing masts or linked with conductors to form a mesh on the roof
- Catenary (or suspended) conductors, whether they are supported by free standing masts or linked with conductors to form a mesh on the roof
- Meshed conductor network that may lie in direct contact with the roof or be suspended above it (in the event that it is of paramount importance that the roof is not exposed to a direct lightning discharge)

The standard makes it quite clear that all types of air termination systems that are used shall meet the positioning requirements laid down in the body of the standard. It highlights that the air termination components should be installed on corners, exposed points and edges of the structure.

The three basic methods recommended for determining the position of the air termination systems are:

- The rolling sphere method
- The protective angle method
- The mesh method

These methods are detailed over the following pages.

The rolling sphere method

The Rolling Sphere method is a simple means of identifying areas of a structure that need protection, taking into account the possibility of side strikes to the structure. The basic concept of applying the rolling sphere to a structure is illustrated in Figure 4.

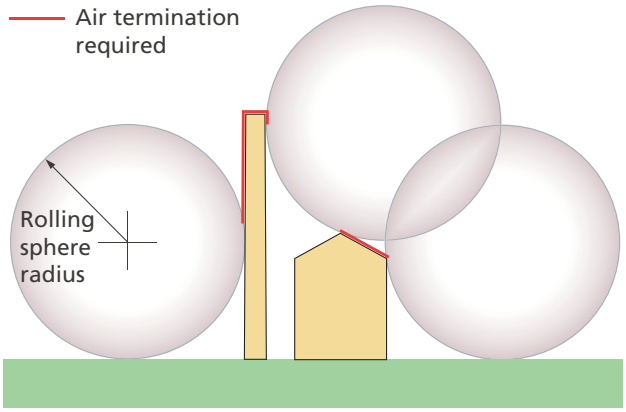


Figure 4: Application of the rolling sphere method

The rolling sphere method was used in BS 6651, the only difference being that in BS EN/IEC 62305 there are different radii of the rolling sphere that correspond to the relevant class of LPS (see Table 4).

Class of LPS	Rolling sphere radius (m)
I	20
II	30
III	45
IV	60

Table 4: Maximum values of rolling sphere radius corresponding to the Class of LPS

This method is suitable for defining zones of protection for all types of structures, particularly those of complex geometry.

The protective angle method

The protective angle method is a mathematical simplification of the rolling sphere method. The protective angle (a) is the angle created between the tip (A) of the vertical rod and a line projected down to the surface on which the rod sits (see Figure 5).

The protective angle afforded by an air rod is clearly a three dimensional concept whereby the rod is assigned a cone of protection by sweeping the line AC at the angle of protection a full 360° around the air rod.

The protective angle differs with varying height of the air rod and class of LPS. The protective angle afforded by an air rod is determined from Table 2 of BS EN/IEC 62305-3 (see Figure 6).

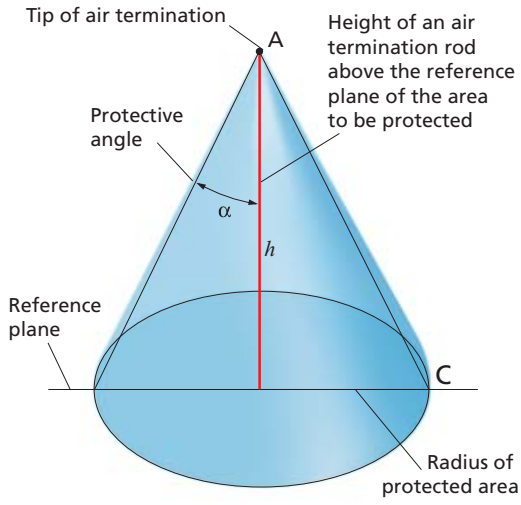
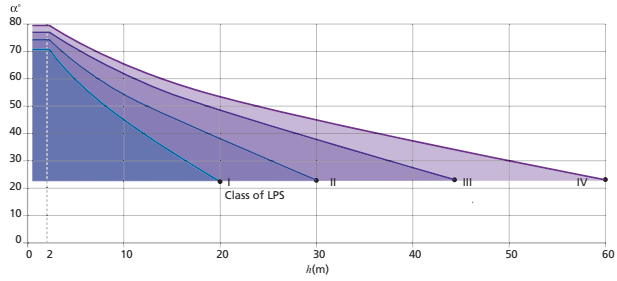


Figure 5: The protective angle method for a single air rod

Varying the protection angle is a change to the simple 45° zone of protection afforded in most cases in BS 6651. Furthermore the new standard uses the height of the air termination system above the reference plane, whether that be ground or roof level (See Figure 7).



Note 1 Not applicable beyond the values marked with •
Only rolling sphere and mesh methods apply in these cases
Note 2 *h* is the height of air-termination above the reference plane of the area to be protected
Note 3 The angle will not change for values of *h* below 2m

Figure 6: Determination of the protective angle (BS EN/IEC 62305-3 Table 2)

The protective angle method is suitable for simple shaped buildings. However this method is only valid up to a height equal to the rolling sphere radius of the appropriate LPL.

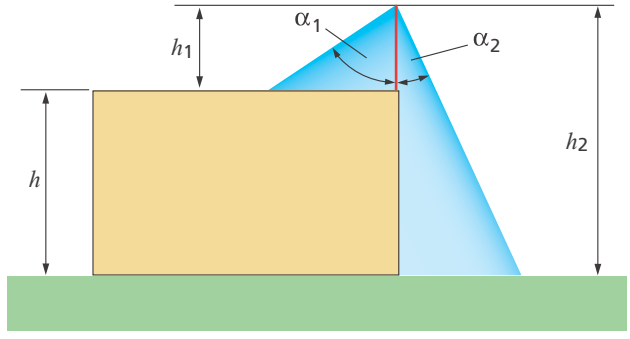


Figure 7: Effect of the height of the reference plane on the protection angle

The mesh method

This is the method that was most commonly used under the recommendations of BS 6651. Again, for the new standard four different air termination mesh sizes are defined and correspond to the relevant class of LPS (see Table 5).

Class of LPS	Mesh size (m)
I	5 x 5
II	10 x 10
III	15 x 15
IV	20 x 20

Table 5: Maximum values of mesh size corresponding to the Class of LPS

This method is suitable where plain surfaces require protection if the following conditions are met:

- Air termination conductors must be positioned at roof edges, on roof overhangs and on the ridges of roof with a pitch in excess of 1 in 10 (5.7°)
- No metal installation protrudes above the air termination system.

Modern research on lightning inflicted damage has shown that the edges and corners of roofs are most susceptible to damage.

So on all structures particularly with flat roofs, perimeter conductors should be installed as close to the outer edges of the roof as is practicable.

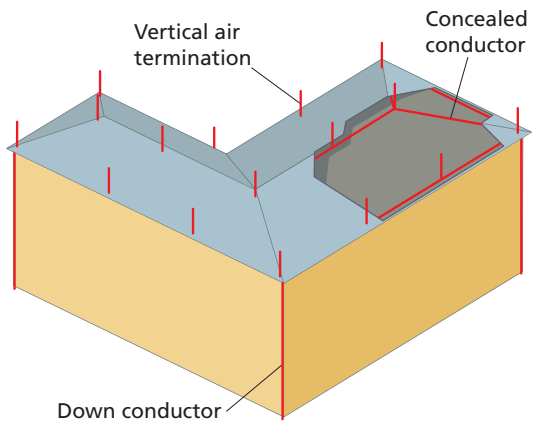


Figure 8: Concealed air termination network

As in BS 6651, this standard permits the use of conductors (whether they be fortuitous metalwork or dedicated LP conductors) under the roof. Vertical air rods (finials) or strike plates should be mounted above the roof and connected to the conductor system beneath. The air rods should be spaced not more than 10m apart and if strike plates are used as an alternative, these should be strategically placed over the roof area not more than 5m apart.

Non-conventional air termination systems

A lot of technical (and commercial) debate has raged over the years regarding the validity of the claims made by the proponents of such systems. This topic was discussed extensively within the technical working groups that compiled BS EN/IEC 62305. The outcome was to remain with the information housed within this standard.

Typically, Annex A (normative) which discusses the positioning of the air rods (finials) states unequivocally that the volume or zone of protection afforded by the air termination system (e.g. air rod) shall be determined only by the real physical dimension of the air termination system. Typically if the air rod is 5m tall then the only claim for the zone of protection afforded by this air rod would be based on 5m and the relevant class of LPS and not any enhanced dimension claimed by some non-conventional air rods.

There is no other standard being contemplated to run in parallel with this standard BS EN/IEC 62305.

Natural components

When metallic roofs are being considered as a natural air termination arrangement, then BS 6651 gave guidance on the minimum thickness and type of material under consideration. BS EN/IEC 62305-3 gives similar guidance as well as additional information if the roof has to be considered puncture proof from a lightning discharge (see Table 6).

Class of LPS	Material	Thickness(1) t (mm)	Thickness(2) t' (mm)
I to IV	Lead	-	2.0
	Steel (stainless, galvanized)	4	0.5
	Copper	5	0.5
	Aluminium	7	0.65
	Zinc	-	0.7

(1) Thickness t prevents puncture, hot spot or ignition.
(2) Thickness t' only for metal sheets if it is not important to prevent puncture, hot spot or ignition problems.

Table 6: Minimum thickness of metal sheets or metal pipes in air termination systems (BS EN/IEC 62305-3 Table 3)

Down conductors

Down conductors should within the bounds of practical constraints take the most direct route from the air termination system to the earth termination system. The greater the number of down conductors the better the lightning current is shared between them. This is enhanced further by equipotential bonding to the conductive parts of the structure.

Lateral connections sometimes referred to as coronal bands or ring conductors provided either by fortuitous metalwork or external conductors at regular intervals is also encouraged. The down conductor/ring conductor spacing should correspond with the relevant class of LPS (see Table 7).

Class of LPS	Typical distances (m)
I	10
II	10
III	15
IV	20

Table 7: Typical values of the distance between down conductors and between ring conductors according to the Class of LPS (BS EN/IEC 62305-3 Table 4)

There should always be a minimum of two down conductors distributed around the perimeter of the structure. Down conductors should wherever possible be installed at each exposed corner of the structure as research has shown these to carry the major part of the lightning current.

Natural components

BS EN/IEC 62305, like BS 6651, encourages the use of fortuitous metal parts on or within the structure to be incorporated into the LPS.

Where BS 6651 encouraged an electrical continuity when using reinforcing bars located in concrete structures, so too does BS EN/IEC 62305-3. Additionally, it states that reinforcing bars are welded, clamped with suitable connection components or overlapped a minimum of 20 times the rebar diameter. This is to ensure that those reinforcing bars likely to carry lightning currents have secure connections from one length to the next.

When internal reinforcing bars are required to be connected to external down conductors or earthing network either of the arrangements shown in Figure 9 is suitable. If the connection from the bonding conductor to the rebar is to be encased in concrete then the standard recommends that two clamps are used, one connected to one length of rebar and the other to a different length of rebar. The joints should then be encased by a moisture inhibiting compound such as Denso tape.

If the reinforcing bars (or structural steel frames) are to be used as down conductors then electrical continuity should be ascertained from the air termination system to the earthing system. For new

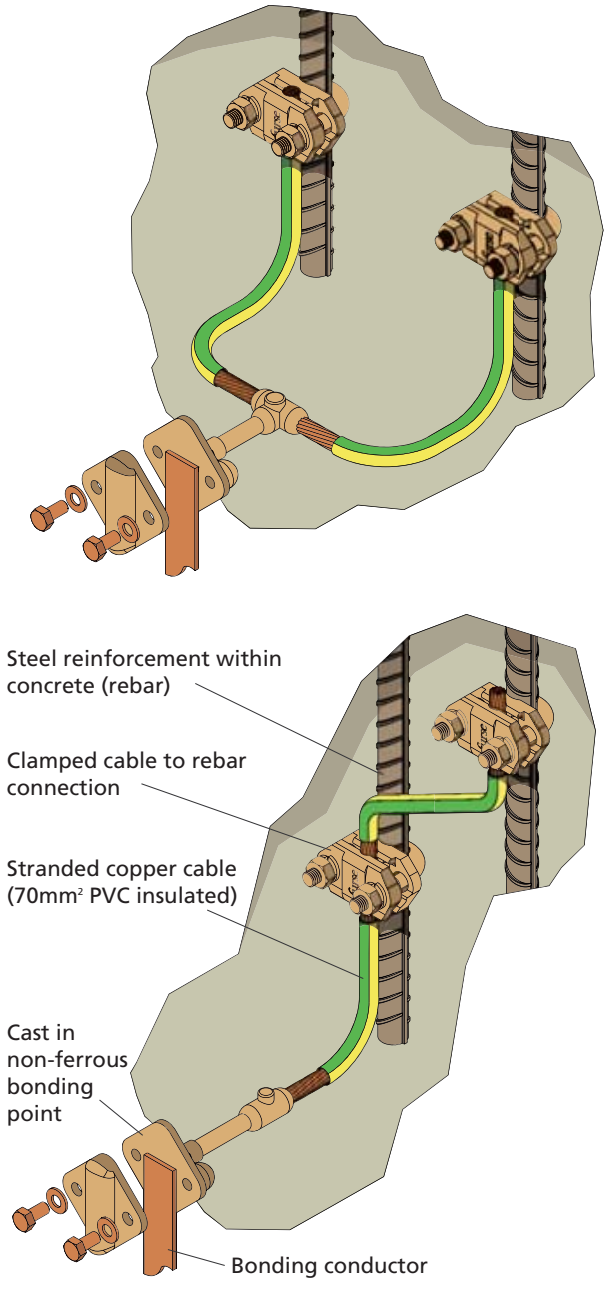


Figure 9: Typical methods of bonding to steel reinforcement within concrete

build structures this can be decided at the early construction stage by using dedicated reinforcing bars or alternatively to run a dedicated copper conductor from the top of the structure to the foundation prior to the pouring of the concrete. This dedicated copper conductor should be bonded to the adjoining/adjacent reinforcing bars periodically.

If there is doubt as to the route and continuity of the reinforcing bars within existing structures then an external down conductor system should be installed. These should ideally be bonded into the reinforcing network of the structures at the top and bottom of the structure.

Earth termination system

The earth termination system is vital for the dispersion of lightning current safely and effectively into the ground.

In line with BS 6651, the new standard recommends a single integrated earth termination system for a structure, combining lightning protection, power and telecommunication systems. The agreement of the operating authority or owner of the relevant systems should be obtained prior to any bonding taking place.

A good earth connection should possess the following characteristics:

- Low electrical resistance between the electrode and the earth. The lower the earth electrode resistance the more likely the lightning current will choose to flow down that path in preference to any other, allowing the current to be conducted safely to and dissipated in the earth
- Good corrosion resistance. The choice of material for the earth electrode and its connections is of vital importance. It will be buried in soil for many years so has to be totally dependable

The standard advocates a low earthing resistance requirement and points out that it can be achieved with an overall earth termination system of 10 ohms or less.

Three basic earth electrode arrangements are used.

- Type A arrangement
- Type B arrangement
- Foundation earth electrodes

Type A arrangement

This consists of horizontal or vertical earth electrodes, connected to each down conductor fixed on the outside of the structure. This is in essence the earthing system used in BS 6651, where each down conductor has an earth electrode (rod) connected to it.

Type B arrangement

This arrangement is essentially a ring earth electrode that is sited around the periphery of the structure and is in contact with the surrounding soil for a minimum 80% of its total length (i.e. 20% of its overall length may be housed in say the basement of the structure and not in direct contact with the earth).

Foundation earth electrodes

This is essentially a type B earthing arrangement. It comprises conductors that are installed in the concrete foundation of the structure. If any additional lengths of electrodes are required they need to meet the same criteria as those for type B arrangement. Foundation earth electrodes can be used to augment the steel reinforcing foundation mesh.

A sample of Furse high quality earthing components.

Separation (isolation) distance of the external LPS

A separation distance (i.e. the electrical insulation) between the external LPS and the structural metal parts is essentially required. This will minimise any chance of partial lightning current being introduced internally in the structure. This can be achieved by placing lightning conductors sufficiently far away from any conductive parts that have routes leading into the structure. So, if the lightning discharge strikes the lightning conductor, it cannot `bridge the gap' and flash over to the adjacent metalwork.

BS EN/IEC 62305 recommends a single integrated earth termination system for a structure, combining lightning protection, power and telecommunication systems.

Internal LPS design considerations

The fundamental role of the internal LPS is to ensure the avoidance of dangerous sparking occurring within the structure to be protected. This could be due, following a lightning discharge, to lightning current flowing in the external LPS or indeed other conductive parts of the structure and attempting to flash or spark over to internal metallic installations.

Carrying out appropriate equipotential bonding measures or ensuring there is a sufficient electrical insulation distance between the metallic parts can avoid dangerous sparking between different metallic parts.

Lightning equipotential bonding

Equipotential bonding is simply the electrical interconnection of all appropriate metallic installations/parts, such that in the event of lightning currents flowing, no metallic part is at a different voltage potential with respect to one another. If the metallic parts are essentially at the same potential then the risk of sparking or flash over is nullified.

This electrical interconnection can be achieved by natural/fortuitous bonding or by using specific bonding conductors that are sized according to Tables 8 and 9 of BS EN/IEC 62305-3.

Bonding can also be accomplished by the use of surge protection devices (SPDs) where the direct connection with bonding conductors is not suitable.

Figure 10 (which is based on BS EN/IEC 62305-3 fig E.45) shows a typical example of an equipotential bonding arrangement. The gas, water and central heating system are all bonded directly to the equipotential bonding bar located inside but close to an outer wall near ground level. The power cable is bonded via a suitable SPD, upstream from the electric meter, to the equipotential bonding bar. This bonding bar should be located close to the main distribution board (MDB) and also closely connected to the earth termination system with short length conductors. In larger or extended structures several bonding bars may be required but they should all be interconnected with each other.

The screen of any antenna cable along with any shielded power supply to electronic appliances being routed into the structure should also be bonded at the equipotential bar.

Further guidance relating to equipotential bonding, meshed interconnection earthing systems and SPD selection can be found in the Furse guidebook.

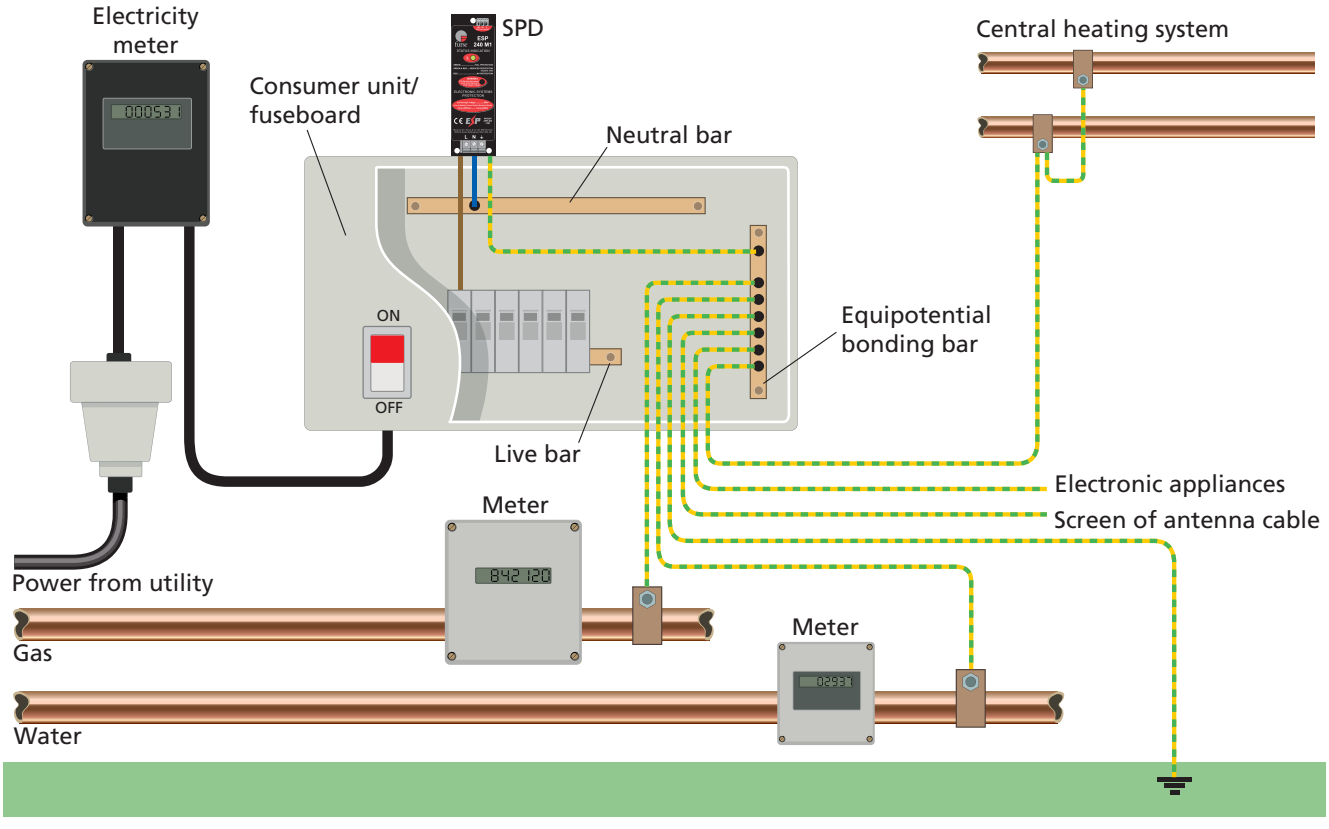


Figure 10: Example of main equipotential bonding

BS EN/IEC 62305-4 Electrical and electronic systems within structures

Electronic systems now pervade almost every aspect of our lives, from the work environment, through filling the car with petrol and even shopping at the local supermarket. As a society, we are now heavily reliant on the continuous and efficient running of such systems. The use of computers, electronic process controls and telecommunications has exploded during the last two decades. Not only are there more systems in existence, the physical size of the electronics involved has reduced considerably (smaller size means less energy required to damage circuits).

BS EN/IEC 62305 accepts that we now live in the electronic age, making LEMP (Lightning Electromagnetic Impulse) protection for electronic and electrical systems integral to the standard through part 4. LEMP is the term given to the overall electromagnetic effects of lightning, including conducted surges (transient overvoltages and currents) and radiated electromagnetic field effects.

LEMP damage is so prevalent such that it is identified as one of the specific types (D3) to be protected against and that LEMP damage can occur from ALL strike points to the structure or connected services – direct or indirect – for further reference to the types of damage caused by lightning see table 1 on page 80. This extended approach also takes into account the danger of fire or explosion associated with services connected to the structure, e.g. power, telecoms and other metallic lines.

Lightning is not the only threat...

Transient overvoltages caused by electrical switching events are very common and can be a source of considerable interference. Current flowing through a conductor creates a magnetic field in which energy is stored. When the current is interrupted or switched off, the energy in the magnetic field is suddenly released. In an attempt to dissipate itself it becomes a high voltage transient.

Motors create switching events

The more stored energy, the larger the resulting transient. Higher currents and longer lengths of conductor both contribute to more energy stored and also released!

This is why inductive loads such as motors, transformers and electrical drives are all common causes of switching transients.

Significance of BS EN/IEC 62305-4

Previously transient overvoltage or surge protection was included as an advisory annex in the BS 6651 standard, with a separate risk assessment. As a result protection was often fitted after equipment damage was suffered, often through obligation to insurance companies. However, the new BS EN/IEC 62305 standard's single risk assessment dictates whether structural and/or LEMP protection is required hence structural lightning protection cannot now be considered in isolation from transient overvoltage protection - known as Surge Protective Devices (SPDs) within this new standard. This in itself is a significant deviation from that of BS 6651.

Indeed, as per BS EN/IEC 62305-3, an LPS system can no longer be fitted without lightning current or equipotential bonding SPDs to incoming metallic services that have "live cores" – such as power and telecoms cables – which cannot be directly bonded to earth. Such SPDs are required to protect against the risk of loss of human life by preventing dangerous sparking that could present fire or electric shock hazards.

Lightning current or equipotential bonding SPDs are also used on overhead service lines feeding the structure that are at risk from a direct strike. However, the use of these SPDs alone "provides no effective protection against failure of sensitive electrical or electronic systems", to quote BS EN/IEC 62305 part 4, which is specifically dedicated to the protection of electrical and electronic systems within structures.

Lightning current SPDs form one part of a coordinated set of SPDs that include overvoltage SPDs – which are needed in total to effectively protect sensitive electrical and electronic systems from both lightning and switching transients.

Lightning Protection Zones (LPZs)

Whilst BS 6651 recognised a concept of zoning in Annex C (Location Categories A, B and C), BS EN/IEC 62305-4 defines the concept of Lightning Protection Zones (LPZs). Figure 11 illustrates the basic LPZ concept defined by protection measures against LEMP as detailed within part 4.

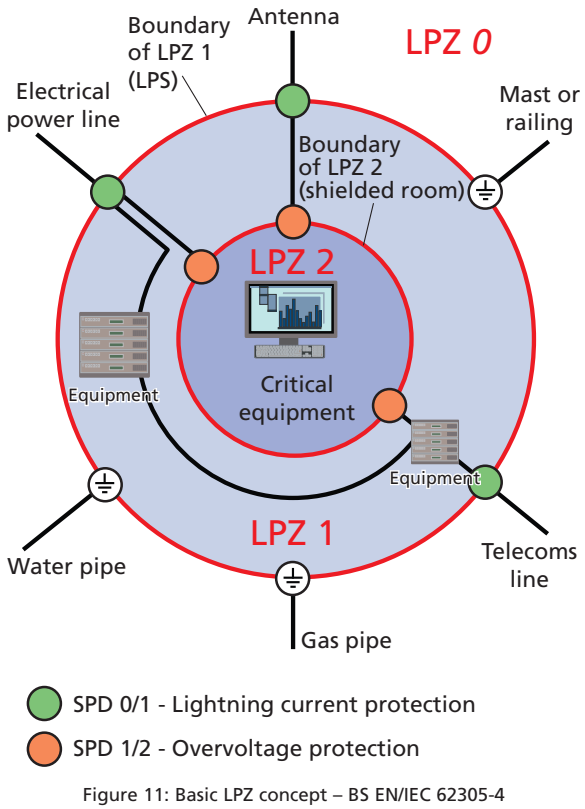


Figure 11: Basic LPZ concept – BS EN/IEC 62305-4

Within a structure a series of LPZs are created to have, or identified as already having, successively less exposure to the effects of lightning. Successive zones use a combination of bonding, shielding and coordinated SPDs to achieve a significant reduction in LEMP severity, from conducted surge currents and, transient overvoltages, as well as radiated magnetic field effects. Designers coordinate these levels so that the more sensitive equipment is sited in the more protected zones.

The LPZs can be split into two categories – 2 external zones (LPZ 0_A, LPZ 0_B) and usually 2 internal zones (LPZ 1, 2) although further zones can be introduced for a further reduction of the electromagnetic field and lightning current if required.

External zones

LPZ 0_A is the area subject to direct lightning strokes and therefore may have to carry up to the full lightning current. This is typically the roof area of a structure. The full electromagnetic field occurs here.

LPZ 0_B is the area not subject to direct lightning strokes and is typically the sidewalls of a structure. However the full electromagnetic field still occurs here and conducted partial lightning currents and switching surges can occur here.

Internal zones

LPZ 1 is the internal area that is subject to partial lightning currents. The conducted lightning currents and/or switching surges are reduced compared with the external zones LPZ 0_A, LPZ 0_B. This is typically the area where services enter the structure or where the main power switchboard is located.

LPZ 2 is an internal area that is further located inside the structure where the remnants of lightning impulse currents and/or switching surges are reduced compared with LPZ 1. This is typically a screened room or, for mains power, at the sub-distribution board area.

Protection levels within a zone must be coordinated with the immunity characteristics of the equipment to be protected, i.e., the more sensitive the equipment, the more protected the zone required. The existing fabric and layout of a building may make readily apparent zones, or LPZ techniques may have to be applied to create the required zones.

Protection with LEMP Protection Measures System (LPMS)

Some areas of a structure, such as a screened room, are naturally better protected from lightning than others and it is possible to extend the more protected zones by careful design of the LPS, earth bonding of metallic services such as water and gas, and cabling techniques. However it is the correct installation of coordinated Surge Protection Devices (SPDs) that protect equipment from damage as well as ensuring continuity of its operation – critical for eliminating downtime. These measures in total are referred to as a LEMP Protection Measures System (LPMS).

When applying bonding, shielding and SPDs, technical excellence must be balanced with economic necessity. For new builds, bonding and screening measures can be integrally designed to form part of the complete LPMS. However, for an existing structure, retrofitting a set of coordinated SPDs is likely to be the easiest and most cost-effective solution.

Coordinated SPDs

BS EN/IEC 62305-4 emphasises the use of coordinated SPDs for the protection of equipment within their environment. This simply means a series of SPDs whose locations and LEMP handling attributes are coordinated in such a way as to protect the equipment in their environment by reducing the LEMP effects to a safe level. So there may be a heavy duty lightning current SPD at the service entrance to handle the majority of the surge energy (partial lightning current from an LPS and/or overhead lines) with the respective transient overvoltage controlled to safe levels by coordinated plus downstream overvoltage SPDs to protect terminal equipment including potential damage by switching sources, e.g. large inductive motors. Appropriate SPDs should be fitted wherever services cross from one LPZ to another.

Coordinated SPDs have to effectively operate together as a cascaded system to protect equipment in their environment. For example the lightning current SPD at the service entrance should handle the majority of surge energy, sufficiently relieving the downstream overvoltage SPDs to control the overvoltage. Poor coordination could mean that the overvoltage SPDs are subject to too much surge energy putting both itself and potentially equipment at risk from damage.

Furthermore, voltage protection levels or let-through voltages of installed SPDs must be coordinated with the insulating withstand voltage of the parts of the installation and the immunity withstand voltage of electronic equipment.

Appropriate SPDs should be fitted wherever services cross from one LPZ to another

Enhanced SPDs

Whilst outright damage to equipment is not desirable, the need to minimize downtime as a result of loss of operation or malfunction of equipment can also be critical. This is particularly important for industries that serve the public, be they hospitals, financial institutions, manufacturing plants or commercial businesses, where the inability to provide their service due to the loss of operation of equipment would result in significant health and safety and/or financial consequences.

Standard SPDs may only protect against common mode surges (between live conductors and earth), providing effective protection against outright damage but not against downtime due to system disruption.

BS EN 62305 therefore considers the use of enhanced SPDs (SPD*) that further reduce the risk of damage and malfunction to critical equipment where continuous operation is required. Installers will therefore need to be much more aware of the application and installation requirements of SPDs than perhaps they may have been previously.

Superior or enhanced SPDs provide lower (better) let-through voltage protection against surges in both common mode and differential mode (between live conductors) and therefore also provide additional protection over bonding and shielding measures. Such enhanced SPDs can even offer up to mains Type 1+2+3 or data/telecom Test Cat D+C+B protection within one unit. As terminal equipment, e.g. computers, tends to be more vulnerable to differential mode surges, this additional protection can be a vital consideration.

Furthermore, the capacity to protect against common and differential mode surges permits equipment to remain in continued operation during surge activity – offering considerable benefit to commercial, industrial and public service organisations alike.

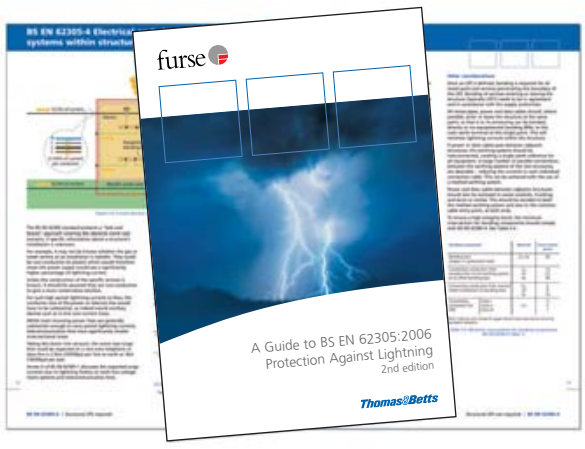
Furse only offer enhanced SPDs with industry leading low let-through voltage, as they are the best choice to achieve cost-effective, maintenance-free repeated protection in addition to preventing costly system downtime. Low let-through voltage protection in all common and differential modes means fewer units are required to provide protection, which saves on unit and installation costs, as well as installation time.

Furse only offer enhanced SPDs with industry leading low let-through voltage

Conclusion

Lightning poses a clear threat to a structure but a growing threat to the systems within the structure due to the increased use and reliance of electrical and electronic equipment. The new BS EN/IEC 62305 series of standards clearly acknowledge this. Structural lightning protection can no longer be in isolation from transient overvoltage or surge protection of equipment. The use of enhanced SPDs provides a practical cost-effective means of protection allowing continuous operation of critical systems during LEMP activity.

A Guide to BS EN 62305:2006 Protection Against Lightning



Further to this summary on BS EN/IEC 62305, we have available a comprehensive guide to the new BS EN 62305:2006 Standard for those interested in learning more about the new developments governing lightning protection design and installation. This A4 Guide helps to explain in clear and concise terms the requirements of BS EN 62305:2006. Following the 4 sections of the Standard (Part 1 – General principles; Part 2 – Risk management; Part 3 – Physical damage to structures and life hazard; and Part 4 – Electrical and electronic systems within structures) the Guide provides the information necessary to enable the reader to identify all risks and calculate the required level of protection in accordance with BS EN 62305:2006.

Although focused on the BS EN standard, this guide may provide supporting information of interest to consultants and scheme designers in the Far East.

To request your free of charge copy – contact us directly at any of the addresses given on the back cover or visit **www.furse.com**

Application index/Part number index

Application index

Part number index

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In addition to credit accounts, we can also accept payments by VISA and Master Card.

Website

Visit www.furse.com today for the latest Furse news, information and worldwide distributor contact details. Our site also contains searchable technical details for structural lightning protection, earthing materials, transient overvoltage protectors and FurseWELD products. Full product details can be downloaded in PDF format.

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As industry leader, Furse is ideally placed to provide the latest, most relevant information and support regarding changes to the standards or regulations involving lightning protection.

Furse offers seminars to assist our customers to appreciate important changes to lightning protection standards, the impact these changes have on ongoing business and planning, and how to manage these changes for better implementation of lightning protection systems.

Seminars can be held centrally at key geographical locations, or at customer offices if preferred. Contact Furse for further details.

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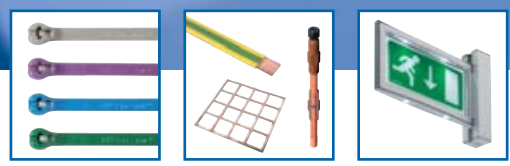

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