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 an LPS 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 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.

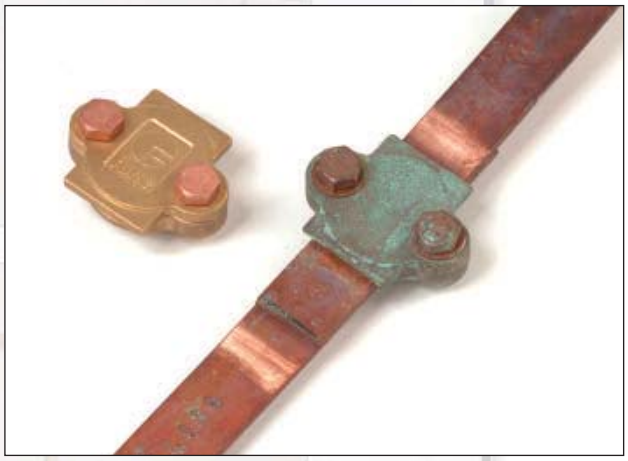
All Furse connection components have successfully passed the BS EN 50164-1:2000 test procedures

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.

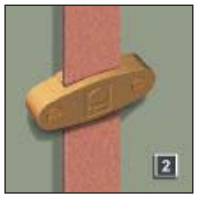
Choose the material required, i.e. copper or aluminium.

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 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.

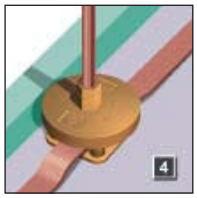
Air termination network

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 LPL (see table 5, page 24).

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

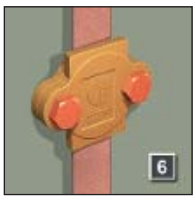
NEW Crossover clamp specially designed for use where conductors cross as part of a roof network.

Down conductor network

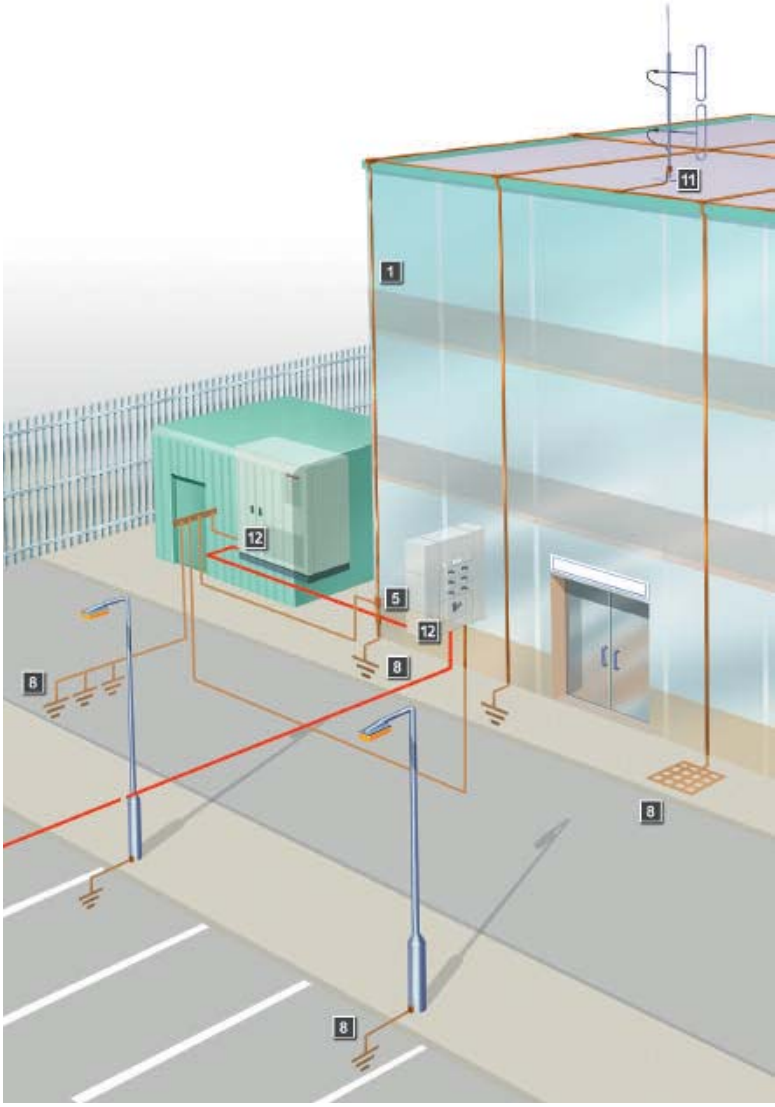
Conductor jointing clamps

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



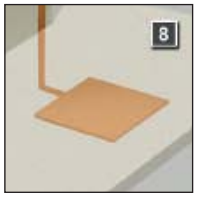
In order to allow periodic disconnection and testing of the earth termination network, select a test clamp to be placed within the run of each down conductor.



Earth termination network

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

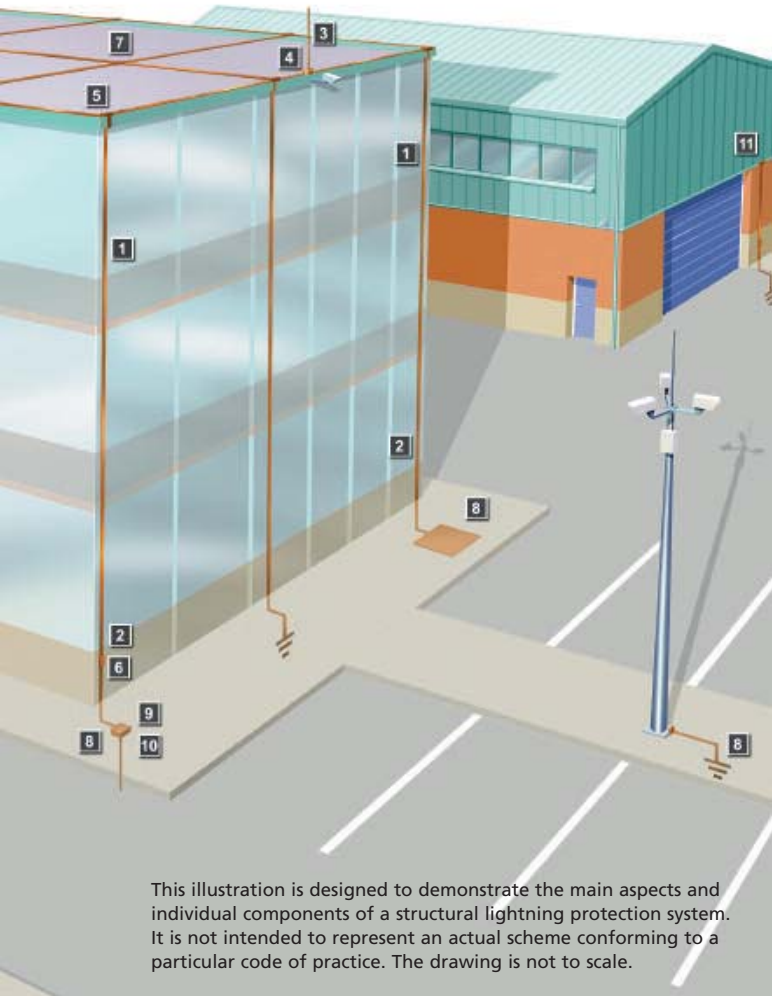
Earth electrodes



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.

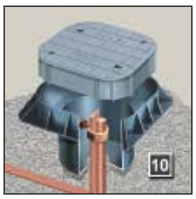
Earth rod clamps

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

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.

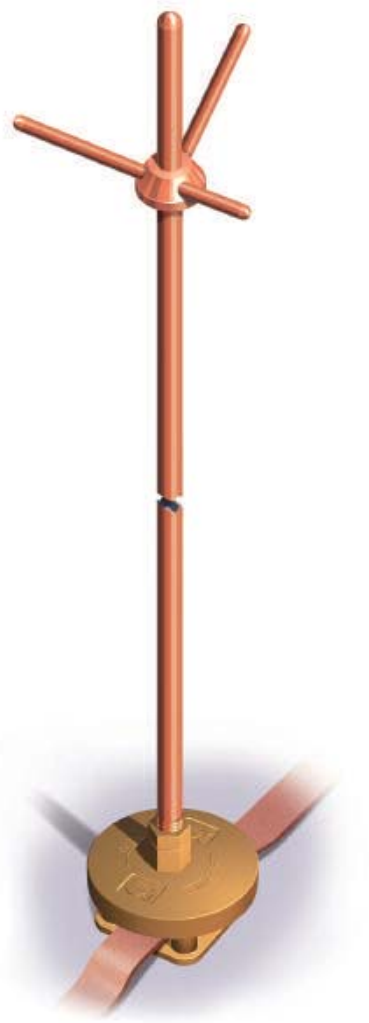
Furse also provide a practical range of fixings for use with stranded conductors.

The following pages (41 – 52) detail the products required to install a 'Flat tape' lightning protection system. Additionally, accessories can be found on pages 63 – 64.

Details of the flat tape conductors can be found in the Conductors section on pages 67 – 70.

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	3.20kg	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

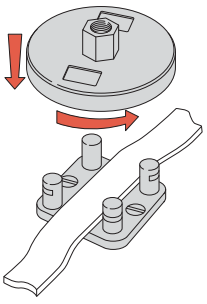
Rod diameter	Material	Weight each	Part No.
15mm	Copper	0.27kg	RA600

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

Pat. pending



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 63 for Accessories.

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.

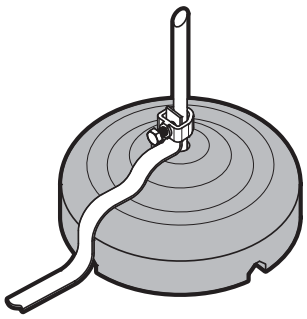
NEW Free-standing concrete air rod base

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

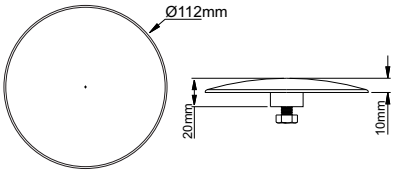


NEW Insulated distance holders

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

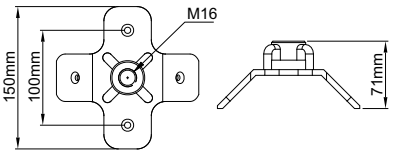


Manufactured from high quality copper and aluminium alloys. Designed to provide an exposed attractive point on conductor systems hidden/embedded in the building's fabric e.g. below the tiles of a pitched roof.

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

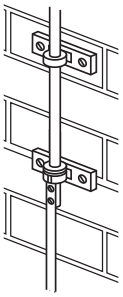


For supporting lightning conductor air rods on ridges.

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 63.

Tightening torque 15Nm

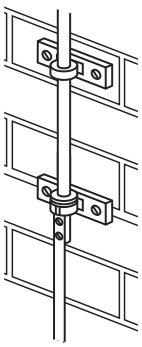


Rod brackets

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.

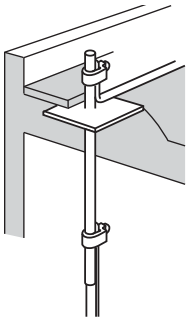
BS EN 50164-1 Class H

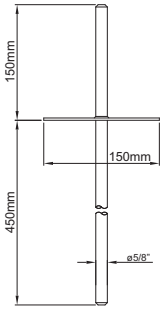
Tightening torque 7Nm

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.

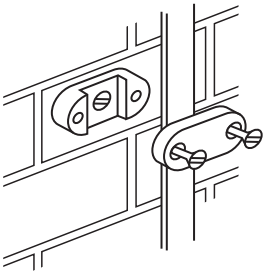
Use with bare aluminium

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

Use with PVC covered aluminium

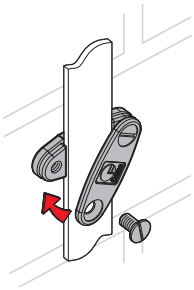
Conductor size	Weight each	Part No.
25 x 3mm	0.04kg	CP115
50 x 6mm	0.06kg	CP130

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 63.

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

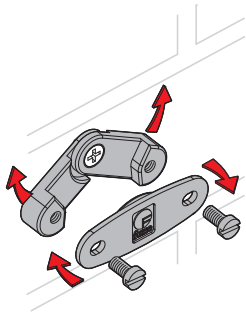
Use with bare aluminium

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 63.

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 63.

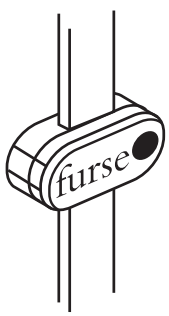
Non-metallic DC tape clip

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

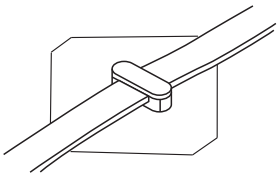


Manufactured from high grade Polypropylene, UV stabilised against degradation by sunlight and non-brittle to prevent cold weather damage. Available in six colours to match bare and PVC covered copper and aluminium tapes. This unique design provides easy installation and resists high pull off loads.

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 63.

* Not as illustrated.

Bitumen felt roof clip



Use with bare tape

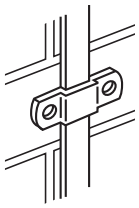
Conductor size	Colour	Weight each	Part No.
25 x 3mm	Brown	0.09kg	FP015
25 x 3mm	Grey	0.09kg	FP020

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

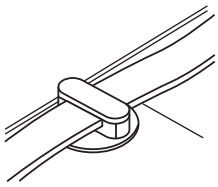
Use with bare aluminium

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 63.

Glue down DC tape clip



Use with bare tape

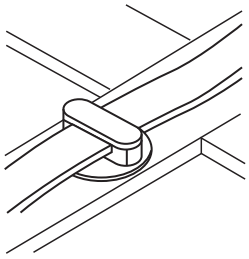
Conductor size	Colour	Weight each	Part No.
25 x 3mm	Brown	0.03kg	GD015
25 x 3mm	Grey	0.03kg	GD020

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

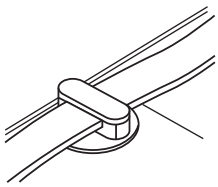
Conductor size	Colour	Weight each	Part No.
25 x 3mm	Brown	0.03kg	CA015
25 x 3mm	Grey	0.03kg	CA020

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 64.

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

Universal welding solvent, Cleaning solution and Surface primer

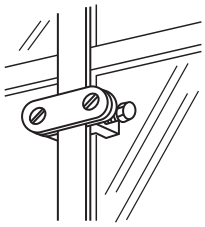
Description	Weight each	Part No.
Universal welding solvent 500ml spray applicator (sufficient for application of approx 200 clips). Use with Furse weldable clips only.	0.57kg	CW905
Cleaning solution (Acetone) 500ml spray applicator. For cleaning lacquered roofing membranes.	0.62kg	CW999
Surface primer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



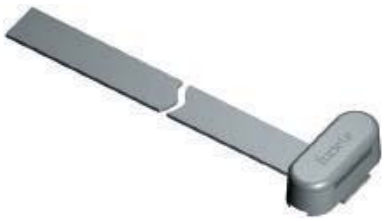
Manufactured from high quality copper and aluminium alloys. Simple to install, providing secure anchorage to thin metallic sections that cannot be drilled e.g. window mullions, angle iron etc. Once fixed any metallic or non-metallic conductor clip can be attached with the screw provided.

Conductor clip sold separately.

Slate holdfast

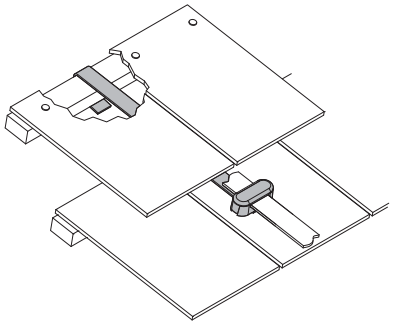
Use with bare tape

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



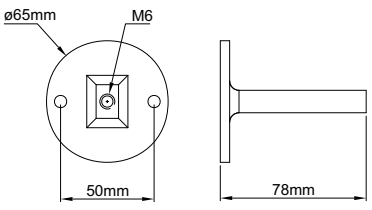
Designed to allow tape conductors to be fixed to tiled roofs without compromising the waterproofing nature of the roof. The 500mm tail fits neatly between overlapping tiles and is wrapped around/fixed to the tile lathe for secure fitting.

Back plate holdfast stem

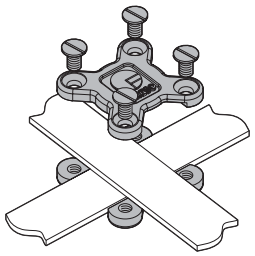
Conductor material	Weight each	Part No.
Copper	0.30kg	HF320
Aluminium	0.10kg	HF325-FU

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 63.



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

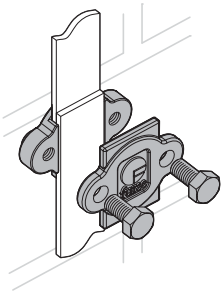
Manufactured from high quality copper and aluminium alloys. Simple to install, providing an effective low resistance connection between overlapping tapes to allow cross, tee, through and right angle joints to be formed.

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 63.

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*

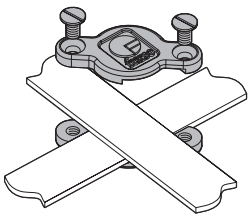
Manufactured from high quality copper and aluminium alloys. Simple to install, providing an effective low resistance connection between overlapping tapes. The clamped connection is easily made/remade to allow for periodic testing.

* 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 63.

Tightening torque 5Nm

Plate type test clamp

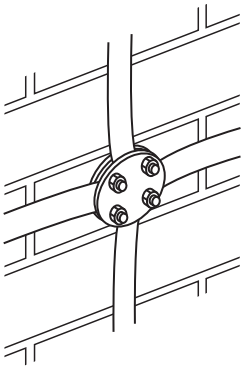
Maximum conductor size	Conductor material	Weight each	Part No.
26 x 12mm	Copper	0.62kg	CT405

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 63.

Tightening torque 15Nm



Screwdown test clamp

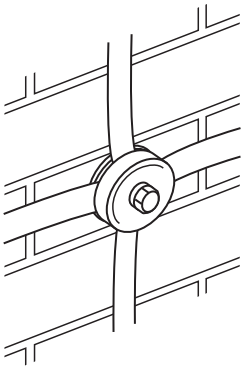
Maximum conductor size	Conductor material	Weight each	Part No.
26 x 8mm	Copper	0.84kg	CT305

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 63.

Tightening torque 20Nm



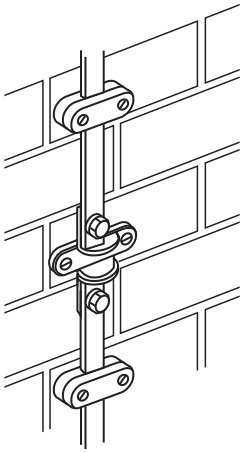
Expansion braid bond

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 63.

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 (53 – 58) detail the products required to install a 'Solid circular' lightning protection system. Additionally, accessories can be found on pages 63 – 64.

Details of the solid circular conductors can be found in the Conductors section on page 71.

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."

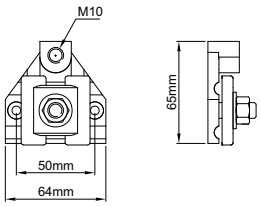
"Lightning rod improvement studies" by C B Moore, W Rison, J Mathis, G Aulich. Journal of Applied Meteorology, May 2000.

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

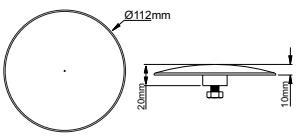
Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 63.

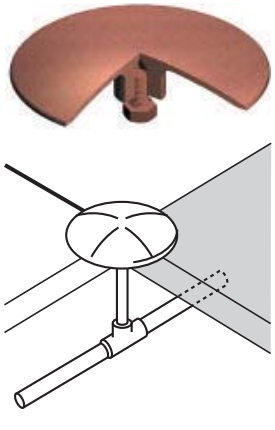
Tightening torque 15Nm

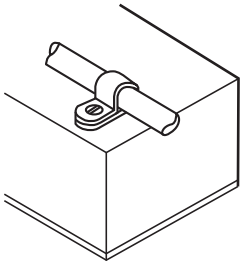
Strike pad

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.







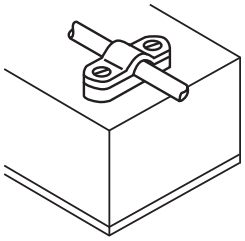
One hole cable clip

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 63.



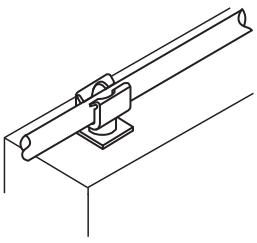
Heavy duty cast cable saddle

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 49.)

Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 63.



Push-in plastic cable clip

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

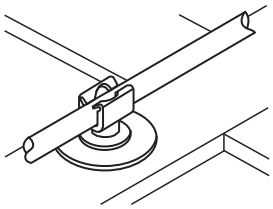
Manufactured from high grade Polypropylene, UV stabilised against degradation by sunlight and non-brittle to prevent cold weather damage. Available in five colours to match bare and PVC covered copper and aluminium solid circular conductors.

* 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 63.

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



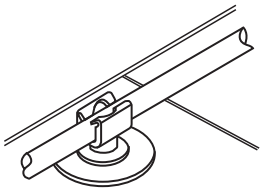
Designed as a means of securing conductors to surfaces that cannot be penetrated by a screw. Ideal for aluminium, spangled galvanized steel, colour coated steel, glass, perspex, enamel and stainless steel. Manufactured from high grade plastic, UV stabilised against degradation by sunlight and non-brittle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

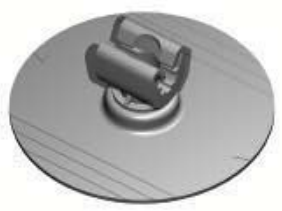
* PVC covered 8mm conductor.

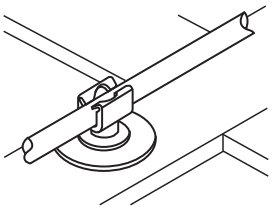
Universal welding solvent, Cleaning solution and Surface primer

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.



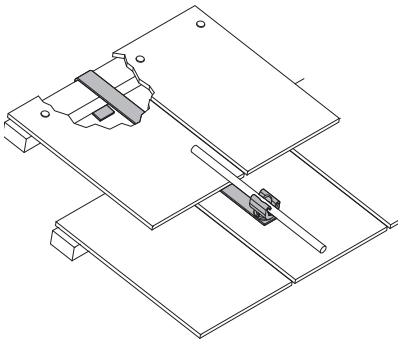


Glue down push-in clip

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

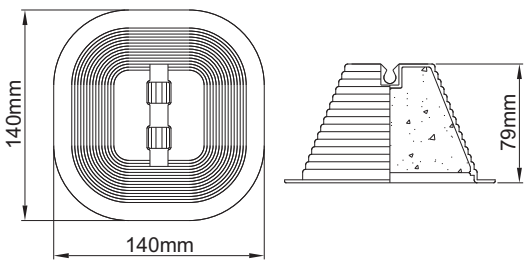
Conductor diameter	Colour	Weight each	Part No.
8mm	Brown	0.03kg	HF176
8mm	Grey	0.03kg	HF191

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

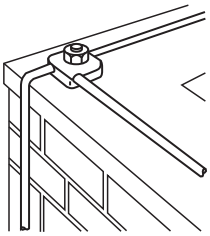
Designed to secure bare, 8mm diameter, circular conductors to flat roofs. Supplied filled with concrete the conductor is held in place by the weight of the holdfast. The lip around the base of the product permits the holdfast to be built into bitumen type roofs.



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.



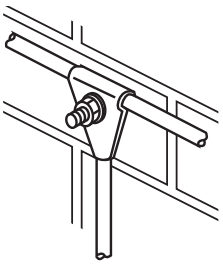
BS EN 50164-1 Class H

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.



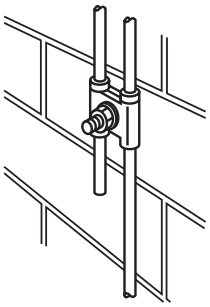
BS EN 50164-1 Class H

Tightening torque 12Nm

Jointing clamp

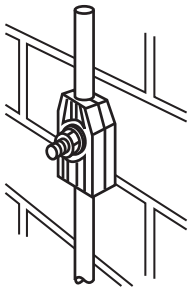
Conductor diameter	Conductor material	Weight each	Part No.
8mm	Copper	0.17kg	CS405
8mm	Aluminium	0.08kg	CS410

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



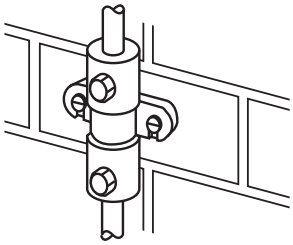
Test clamp

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 63.

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.

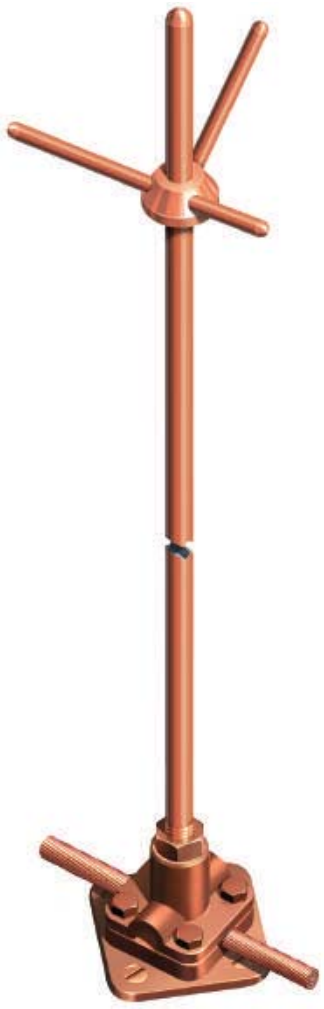
CoSHH Datasheet available on request.

The following pages (59 – 62) detail the products required to install a 'cable and wire' lightning protection system. Additionally, accessories can be found on pages 63 – 64.

Details of the cable and wire conductors can be found in the Conductors section on page 72.

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

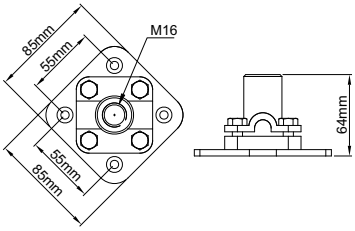
Multiple point

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.
50mm	15mm	16mm	Copper	1.03kg	SD155
70mm	15mm	16mm	Copper	0.95kg	SD160
95mm	15mm	16mm	Copper	0.95kg	SD165

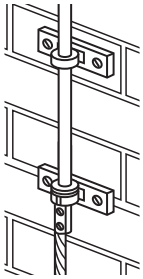


Manufactured from a high quality copper alloy. Simple to install, providing an effective connection between air rod and stranded air termination conductors.

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 63.

Tightening torque 12Nm

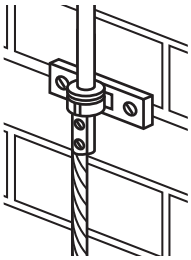


Rod brackets

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



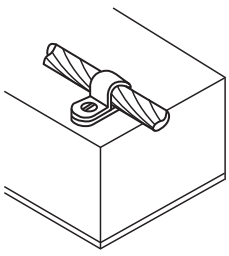
Rod to cable coupling

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.

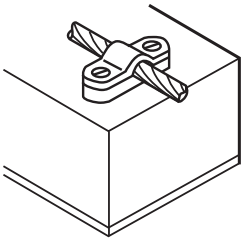
Fix using roundhead wood screws 1½" No. 10 or M6 (Part no. **SW305**) and wall plugs (Part no. **PS305**) – see Accessories page 63.

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 63.



Test clamp

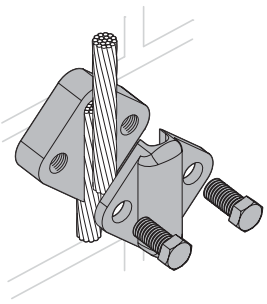
Conductor size	Conductor material	Weight each	Part No.
50mm²	Copper	0.39kg	CR855
70mm²	Copper	0.40kg	CR860
95mm²	Copper	0.40kg	CR865

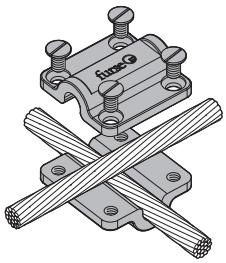
Manufactured from high quality copper alloy. Simple to install, providing an effective low resistance overlap connection between stranded copper cables.

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 63.

Tightening torque 12Nm





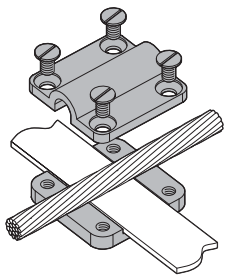
Square conductor clamp

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 63.

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

Accessories

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 48.

StrikeRisk risk assessment software v5.0

Description	Workstation licence	Network licence	Part No.
Single user copy	✓	–	SR500
Single user copy	–	✓	SR501
5 user copy	–	✓	SR505
10 user copy	–	✓	SR510
fixed user copy	–	✓	SR599

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

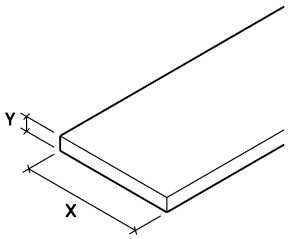
For below ground earthing applications Furse produce a large range of bare copper, tape and stranded conductors thus offering the designer of the system the correctly rated conductor without the need to oversize.

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).

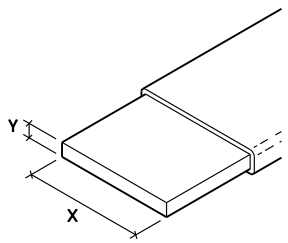
High conductivity copper tape to BS EN 13601 (formerly BS 1432).

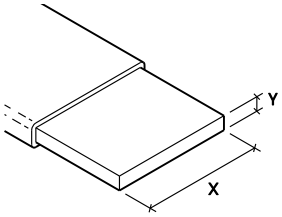
PVC covered copper tape

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	0.21kg	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.



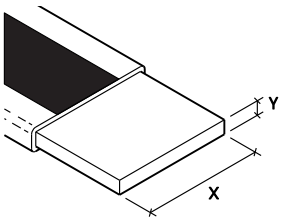


LSOH covered copper tape

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.

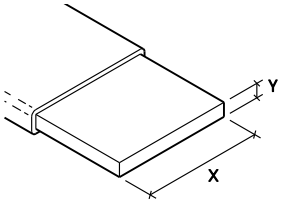


Green & yellow PVC insulated copper tape

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.



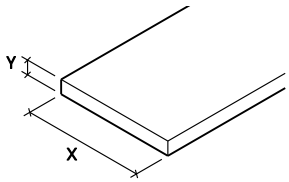
Lead covered copper tape

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

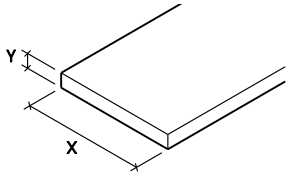


High conductivity copper tape to BS EN 13601 (formerly BS 1432).

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*

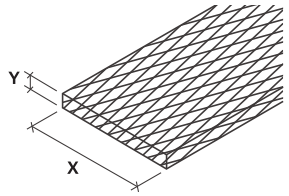
Random lengths of 4 metres except * supplied in random lengths of 3 metres.

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	6mm^2	0.055kg	BD020
15 x 1.5mm	10mm^2	0.096kg	BD025
19 x 2.5mm	16mm^2	0.16kg	BD026
32 x 6mm	70mm^2	0.63kg	BD027
25 x 3.5mm	35mm^2	0.34kg	BD030



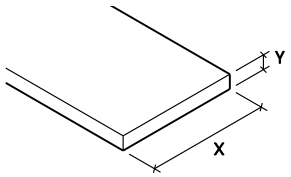
Tinned braid

Overall nominal size (X x Y)	Size	Weight per metre	Part No.
25 x 3.5mm	35mm^2	0.34kg	BD035

Suitable for earth bonding. Also supplied as standard pre-cut and drilled bonds (see page 86).

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

High conductivity copper wire to BS 4109-C101.



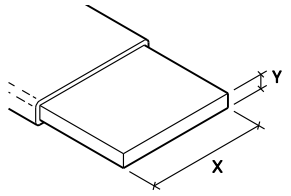
Bare aluminium tape

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.

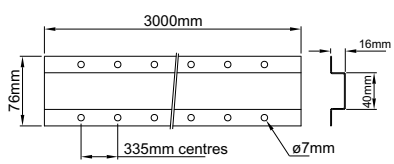
PVC covered aluminium tape

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

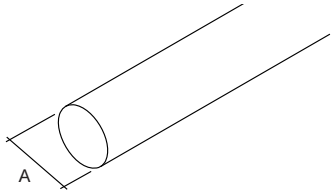
Length	Weight each	Part No.
3000mm	2.90kg	AV005

Fix using round head wood screws (Part no. **SW405**) and wall plugs (Part no. **PS305**) – see Accessories, page 63.

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

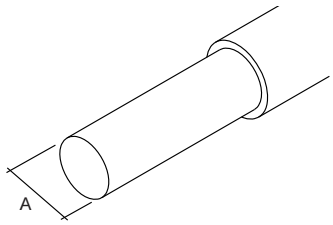


Copper conductor to BS EN 13601 (formerly BS 1433).
Aluminium conductor to BS 2898-1350.

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

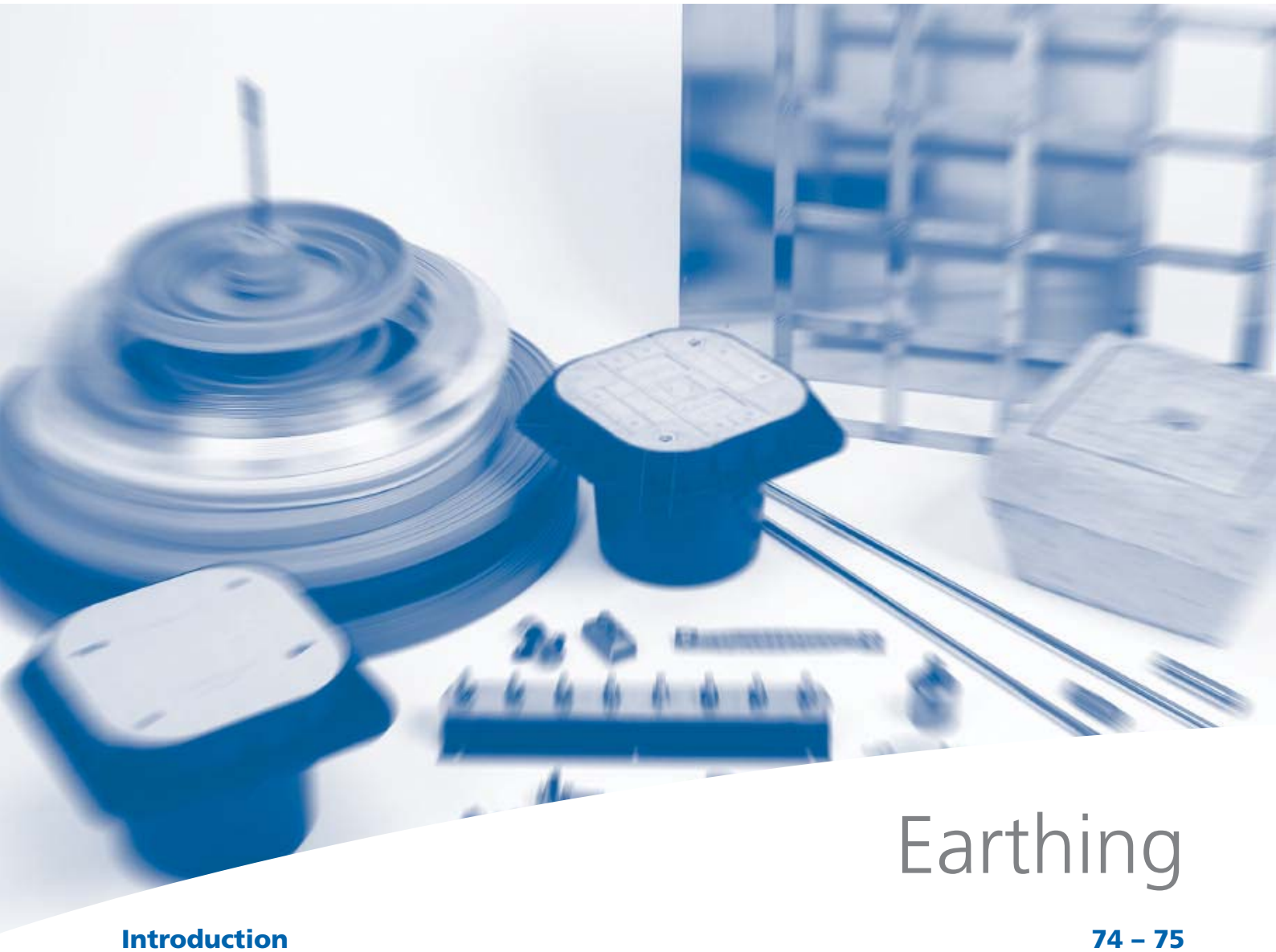
PVC covered soft drawn stranded copper cable to BS 6004.
PVC colours to BS 6746C.

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

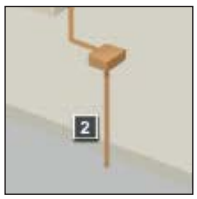
Furse offer three types of conductor: Flat tape, solid circular and stranded cable.

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 66.

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.

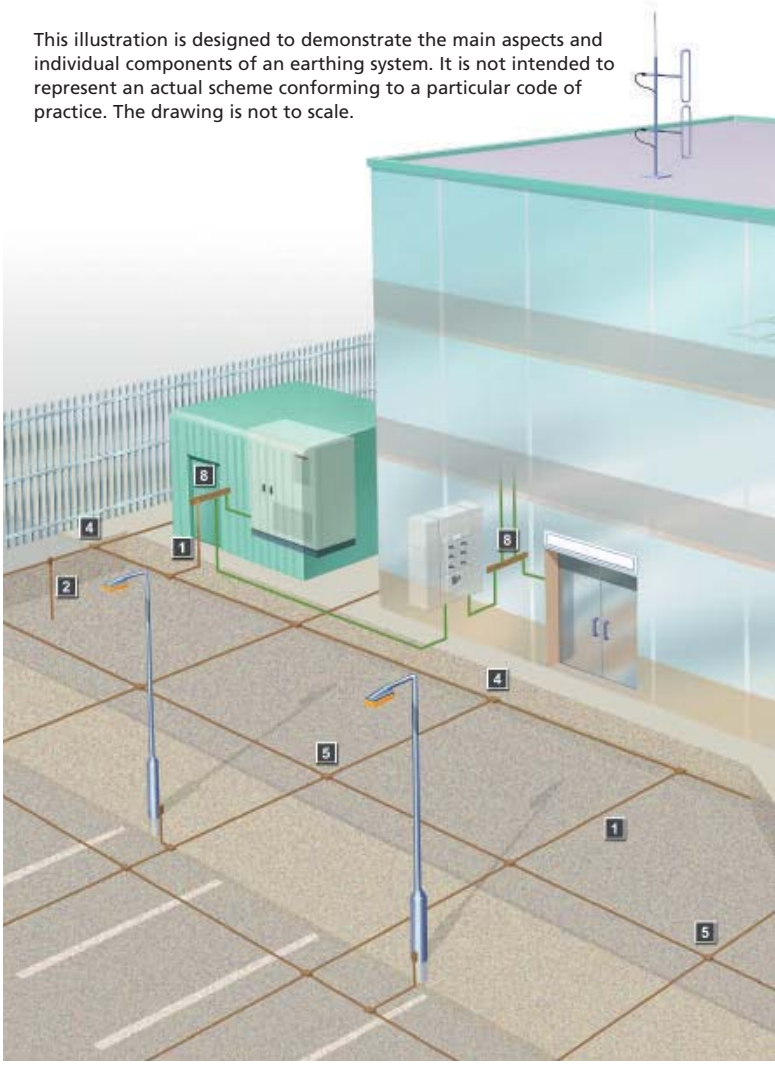
Connectors and terminations

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.

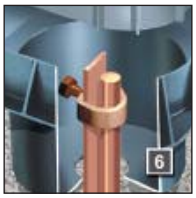
Compression connectors

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.

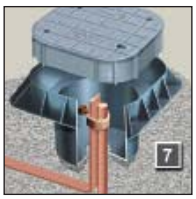
Mechanical clamps

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.

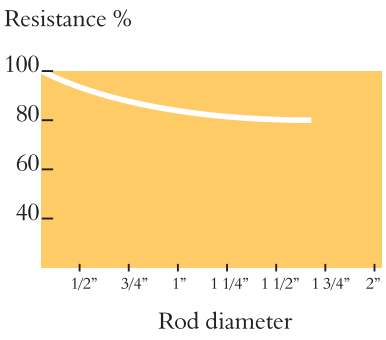
Furse can supply all three types, but the copperbonded steel cored rod is by far the most popular, due to its combination of strength, corrosion resistance, and comparatively low cost.

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.



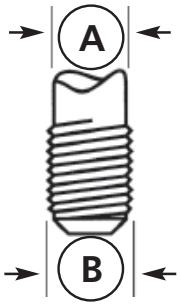
Effect of electrode diameter on resistance

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

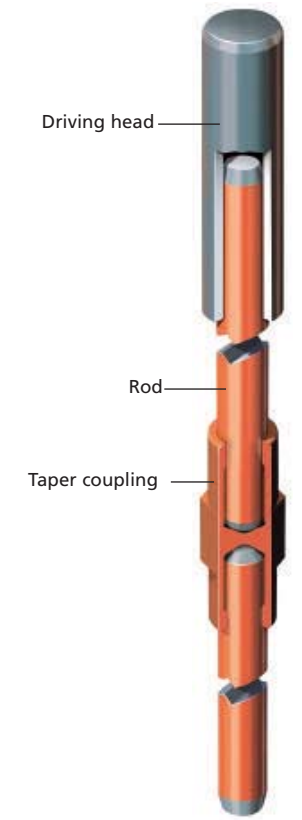
Nominal diameter	Length	Thread diameter 'B'	Shank diameter 'A'	Weight each	Part No.
½"	1200mm	9/16"	12.7mm	1.18kg	RB105
½"	1500mm	9/16"	12.7mm	1.55kg	RB110
½"	1800mm	9/16"	12.7mm	1.76kg	RB115
½"	2400mm	9/16"	12.7mm	2.36kg	RB125
5/8"	1200mm	5/8"	14.2mm	1.53kg	RB205-FU
5/8"	1500mm	5/8"	14.2mm	1.88kg	RB210
5/8"	1800mm	5/8"	14.2mm	2.29kg	RB215
5/8"	2100mm	5/8"	14.2mm	2.51kg	RB220-FU
5/8"	2400mm	5/8"	14.2mm	3.00kg	RB225
5/8"	3000mm	5/8"	14.2mm	3.79kg	RB235
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
5/8" Coupling	0.08kg	CG270
¾" Coupling	0.13kg	CG370
½" Driving stud	0.05kg	ST100
5/8" Driving stud	0.08kg	ST200
¾" Driving stud	0.12kg	ST300



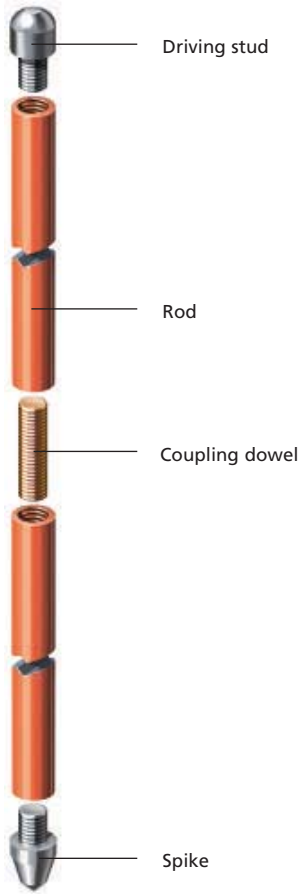
Unthreaded copperbond rod

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
Fittings to BS EN 50164-1



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*

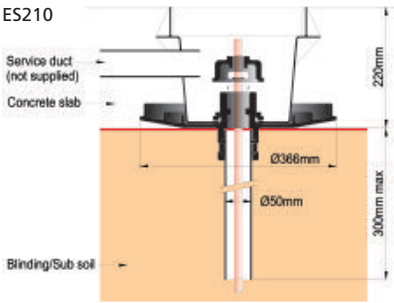
* For use with ⅜" UNC rods only.

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

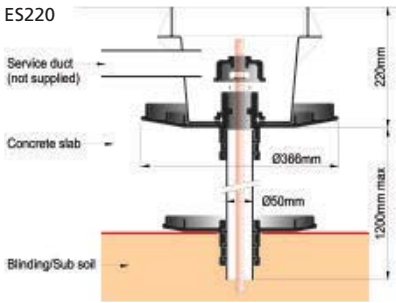
The unique design allows the seal to be effective across a broad range of rod diameters from a nominal ½" to ¾" rod, by the use of various compression rings and seal kits.

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

ES210

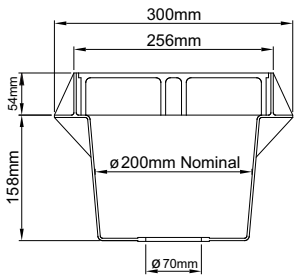


ES220



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

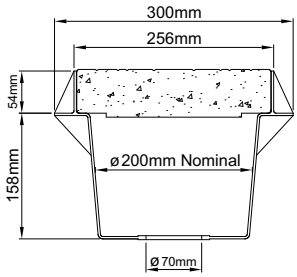
Accessories

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

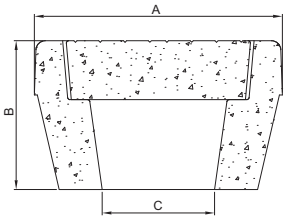
Description	Weight each	Part No.
Lightweight inspection pit with concrete lid	7.50kg	PT110

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

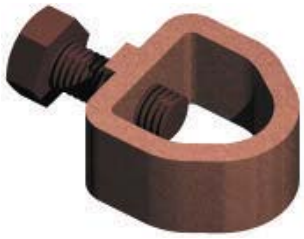
Accessories

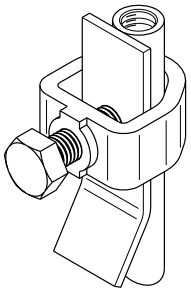
Description	Weight each	Part No.
5 hole earth bar	0.40kg	PT006
7 hole earth bar	0.58kg	PT007

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)





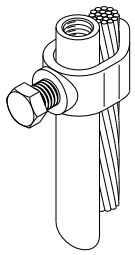
Nominal rod diameter		Max. conductor	Weight each	Part No.
½"	12.7mm	26 x 12mm	0.15kg	CR105
⅝"	16mm	26 x 12mm	0.15kg	CR105
¾"	20mm	26 x 10mm	0.15kg	CR105
⅝"	16mm	30 x 2mm	0.16kg	CR108
¾"	20mm	30 x 2mm	0.16kg	CR108
⅝"	16mm	40 x 12mm	0.24kg	CR110
⅝"	16mm	51 x 8mm	0.30kg	CR115
¾"	20mm	51 x 12mm	0.30kg	CR125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



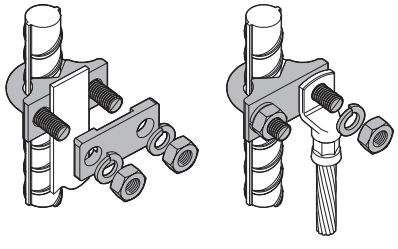
Nominal rod diameter		Max. conductor	Weight each	Part No.
⅜"	9.5mm	6 – 35mm²	0.03kg	CR505
½"	12.5mm	16 – 50mm²	0.05kg	CR510-FU*
⅝"	16mm	16 – 70mm²	0.06kg	CR515*
¾"	20mm	35 – 95mm²	0.06kg	CR520*
1"	25mm	70 – 120mm²	0.14kg	CR525

* 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)



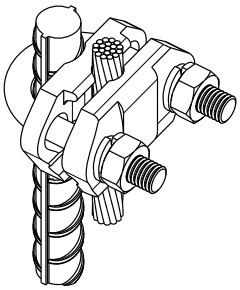
Nominal rod diameter	Hole centres	Tape width	Weight each	Part No.
⅝"	37mm	-	0.20kg	CR305
¾"	37mm	-	0.20kg	CR310
1"	37mm	-	0.20kg	CR315
⅝"	37mm	25mm	0.26kg	CR320*
1½"	54mm	-	0.37kg	CR325
2"	64mm	-	0.44kg	CR330

'U' Bolt threaded M10.

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

BS 7430

Earth rod clamps



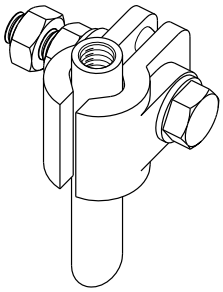
Rod to cable clamp (type GUV)

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

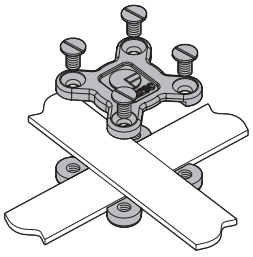
Reg. design

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 63.

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

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

Pat. Pending

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

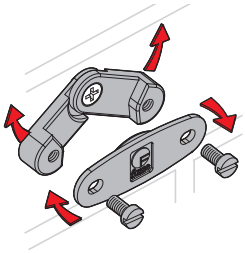
Fix using countersunk wood screws 1½" No. 10 or M6 (Part no. **SW005** or **SW105**) and wall plugs (Part no. **PS305**) – see Accessories page 63.

Adjustable DC tape clip NEW

Use with bare copper

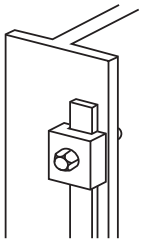
Conductor size	Weight each	Part No.
31 x 3mm and 31 x 6mm – use with bare copper	0.10kg	CP230-H
38 x 3mm, 38 x 6mm and 40 x 6mm – use with bare copper	0.12kg	CP240-H
50 x 3mm and 50 x 6mm – use with bare copper	0.16kg	CP260-H

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 63.



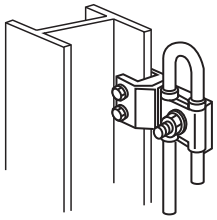
‘B’ bond

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



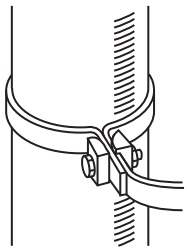
Metalwork bond

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.

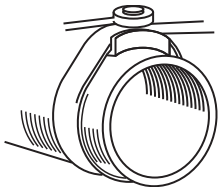
BS 7430

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



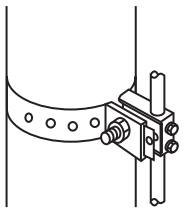
Pipe bond

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.

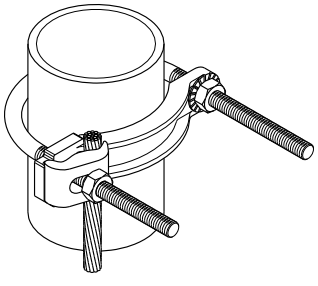
BS EN 50164-1 Class H, BS 7430

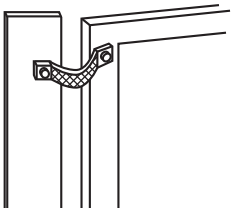
Tightening torque – M6 bolt: 6Nm, M10 bolt: 12Nm



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



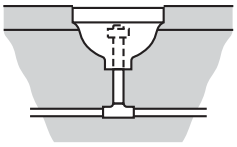


Flexible copper braid bond

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

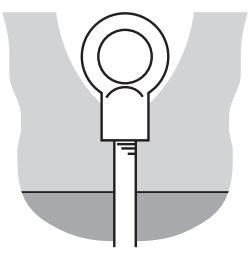


Static earth receptacle

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

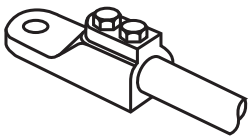
Nominal copperbond rod diameter	Weight each	Part No.
⅝"	0.52kg	BT150
¾"	0.52kg	BT160

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



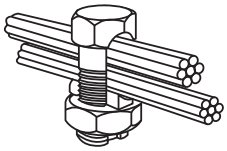
For bonding copper and aluminium conductors to steel work.

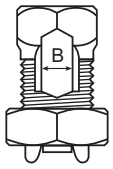
BS EN 50164-1 Class H

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



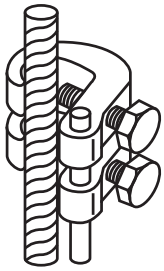


For copper to copper connections. No special tools required.

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

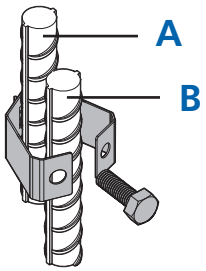


For bonding to reinforcing bars, steam pipes, handrails etc.

BS 7430

Rebar connecting clips

Pat. Pending



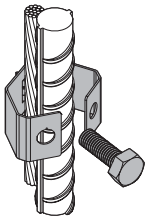
NEW Rebar to rebar connecting clip

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



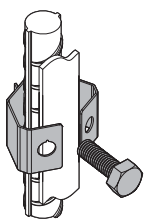
NEW Rebar to cable connecting clip

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.

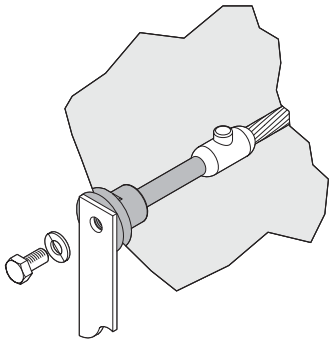
BS EN 50164-1 Class H

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

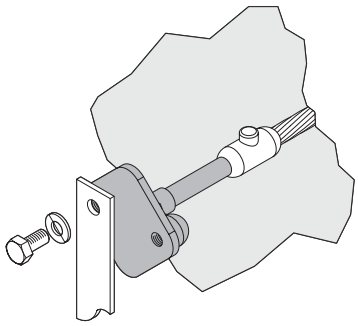


Two hole earth point

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

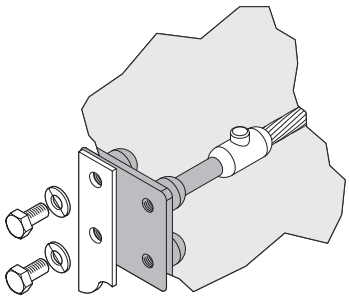


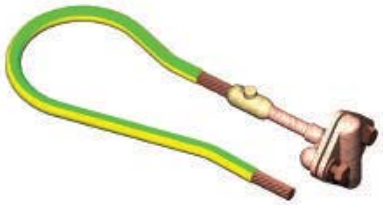
Four hole earth point

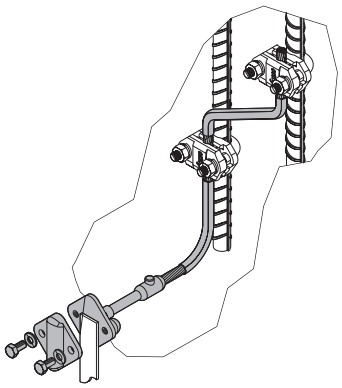
Hole size	Length	Weight each	Part No.
M8 x 14mm	75mm	0.41kg	PC110

Stem diameter = 10.7mm (70mm²).

BS 7430







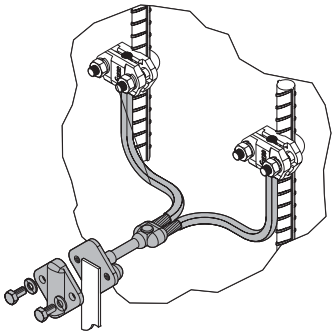
Earth point with pre-welded tail

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 89.

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 400mm prewelded long tail of 70mm² PVC insulated earth cable	1.23kg	PC216
As PC115-FU but with 2 x 400mm prewelded long tail of 70mm² PVC insulated earth cable	1.26kg	PC211
As PC120 but with 2 x 400mm prewelded long tail of 70mm² PVC insulated earth cable	1.26kg	PC221

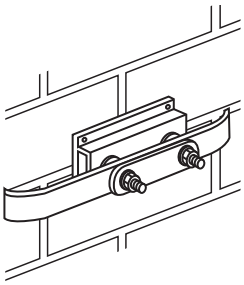
For earth points PC110 etc. please refer to page 89.

BS EN 50164-1 Class H, BS 7430

Tightening torque 8Nm

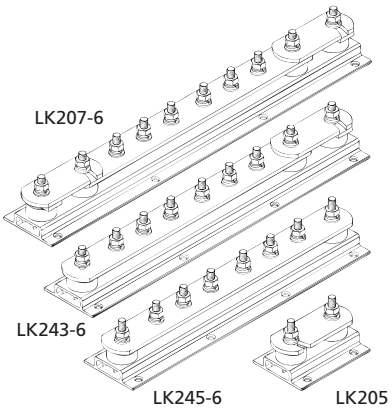
Earth bar

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

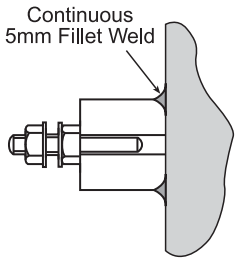
Description	Length	Width	Height	Weight each	Part No.
Swan-neck link	400mm	50mm	36mm	0.42kg	LK004
Disconnecting link	125mm	90mm	90mm	0.59kg	LK205

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 63.

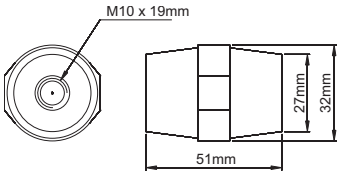
Earth boss/insulators



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 64).



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**

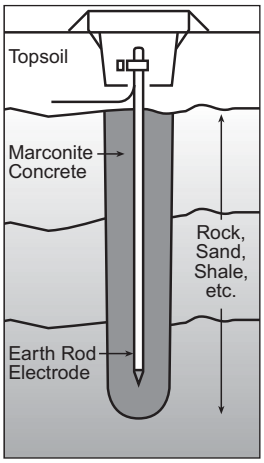
Marconite® conductive aggregate

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.

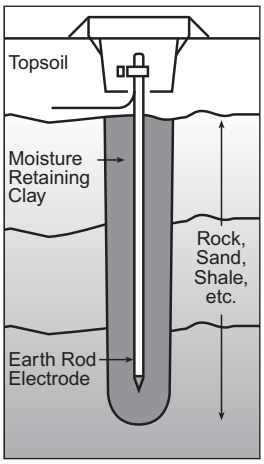
CoSHH Datasheet available on request.

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 Ⓔx 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 Ⓔx 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 Ⓔx II 1 GD T6 Reel Certification Ⓔx 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 Ⓔx II 1 GD T6 FM Approved
Reel Certification Ⓔx 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 99 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 99 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 99 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

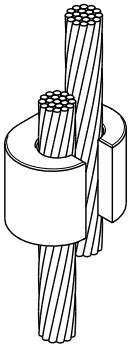
Main conductor	Conductor range	Weight each	Part No.
10mm²	1.5 – 10mm²	1.70kg	HD100
16mm²	1.5 – 16mm²	1.70kg	HD200
16 – 25mm²	1.5 – 10mm²	1.60kg	HD200
25mm²	16 – 25mm²	1.60kg	HD200
35mm²	1.5 – 16mm²	1.60kg	HD300
35mm²	25 – 35mm²	1.60kg	HD300
70mm²	1.5 – 25mm²	1.50kg	HD300
50mm²	4 – 25mm²	1.50kg	HD400
50mm²	35 – 50mm²	1.50kg	HD400
50 – 70mm²	4 – 35mm²	1.50kg	HD400
50 – 70mm²	35 – 70mm²	1.50kg	HD400
95mm²	4 – 35mm²	1.40kg	HD500
95mm²	35 – 70mm²	1.40kg	HD500
95mm²	70 – 95mm²	1.40kg	HD500
120mm²	25 – 120mm²	1.25kg	HD600
150mm²	25 – 120mm²	1.25kg	HD600
150mm²	70 – 150mm²	1.25kg	HD600
185mm²	16 – 95mm²	1.25kg	HD600

Die to suit tool type HT020 and pump HT030

Main conductor	Conductor range	Weight each	Part No.
120 – 185mm²	120 – 185mm²	2.63kg	HD700
150 – 240mm²	95 – 120mm²	2.63kg	HD700

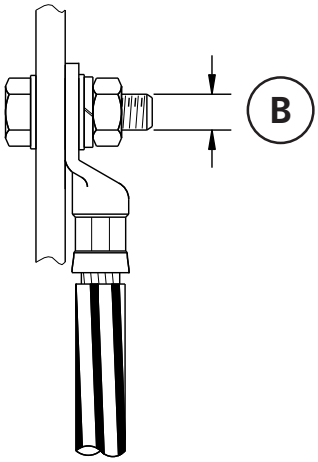
Manufactured from high quality stainless steel.

"C" Shape connectors



Main conductor	Conductor range	Box quantity	Weight each	Part No.
10mm²	1.5 – 10mm²	100	0.06kg	CN1010
16mm²	1.5 – 16mm²	100	0.19kg	CN1616
16 – 25mm²	1.5 – 10mm²	50	0.21kg	CN2510
25mm²	16 – 25mm²	50	0.22kg	CN2525
35mm²	1.5 – 16mm²	25	0.39kg	CN3516
35mm²	25 – 35mm²	25	0.39kg	CN3535
50mm²	4 – 25mm²	25	0.90kg	CN5025
50mm²	35 – 50mm²	25	0.90kg	CN5050
70mm²	1.5 – 25mm²	25	0.36kg	CN7025
50 – 70mm²	4 – 35mm²	25	0.97kg	CN7035
50 – 70mm²	35 – 70mm²	25	0.91kg	CN7070
95mm²	4 – 35mm²	25	1.50kg	CN9535
95mm²	35 – 70mm²	25	1.48kg	CN9570
95mm²	70 – 95mm²	25	1.43kg	CN9595
120mm²	25 – 120mm²	25	1.67kg	CN120120
150mm²	25 – 120mm²	25	1.61kg	CN150120
150mm²	70 - 150mm²	25	1.25kg	CN150150
185mm²	16 – 95mm²	25	1.32kg	CN18595
120 – 185mm²	120 – 185mm²	15	2.29kg	CN185185
150 – 240mm²	95 – 120mm²	15	2.36kg	CN240C120

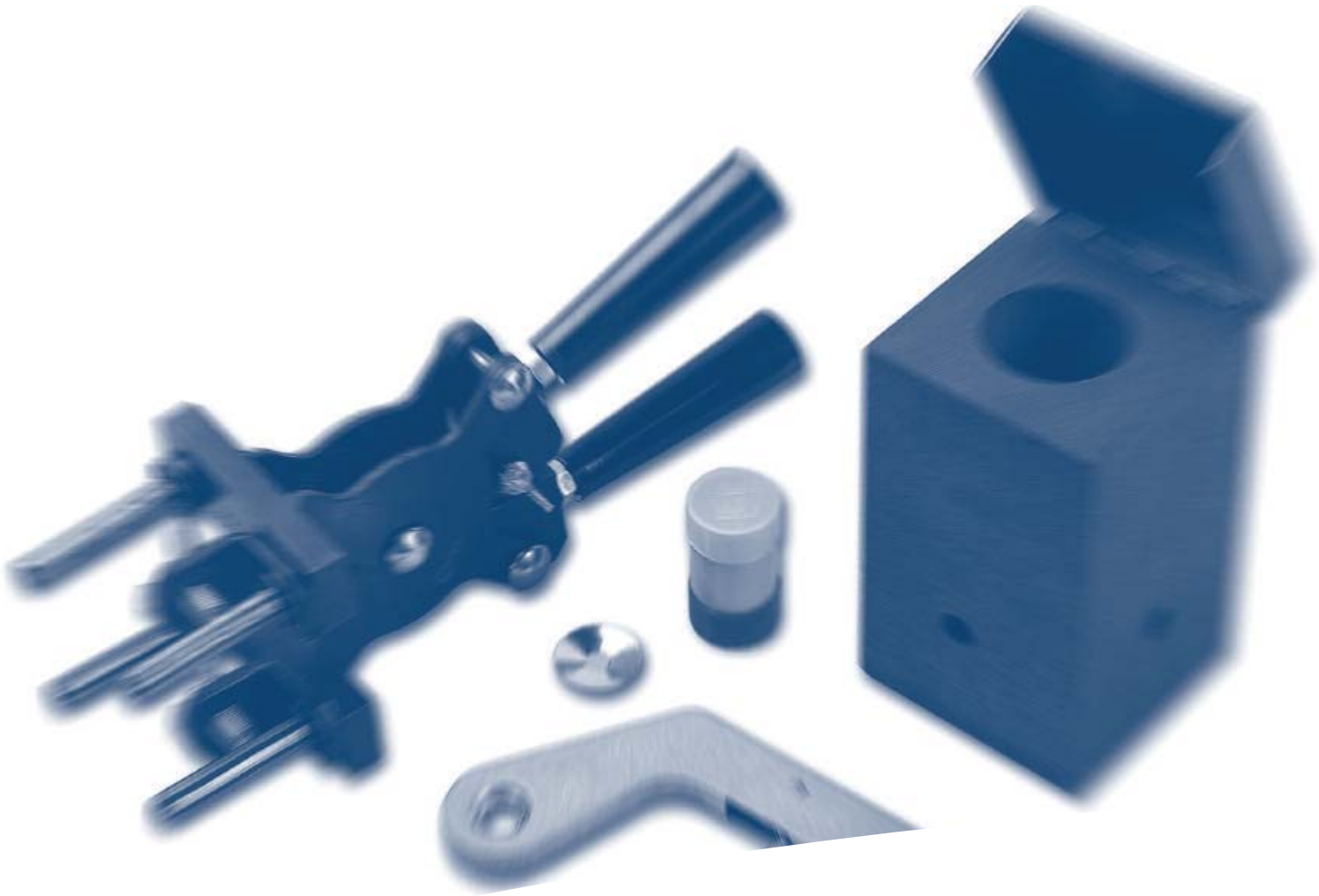
Manufactured from pure copper. All sizes also available in tinned, please contact our sales office to discuss specific requirements.



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 97.



FurseWELD

FurseWELD – How it works

The FurseWELD process

FurseWELD exothermic welding is a cost efficient method of making large or small numbers of high quality electrical connections. It is a simple, self-contained system that uses the high temperature reaction of powdered copper oxide and aluminium, within a mould, to form permanent electrical connections.

Typical applications include:

- Earthing for power plants and sub-stations
- Telecommunications
- Transmission and power distribution lines
- Cathodic protection
- Rail connections

The FurseWELD system:

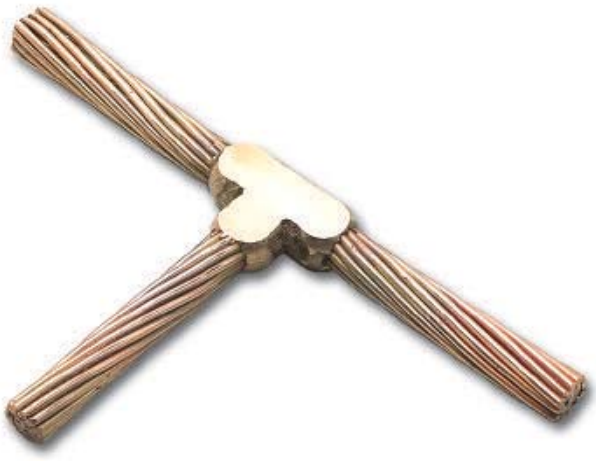
- requires no external power or heat source
- creates high quality electrical connections
- is completely portable
- can be used safely with minimum training
- is cost effective
- can be used for over 45 standard connection configurations

The FurseWELD connection

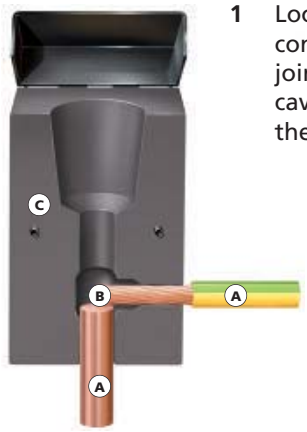
FurseWELD connections have several advantages:

- tolerant to repeated fault currents
- highly conductive
- do not loosen
- excellent corrosion resistance

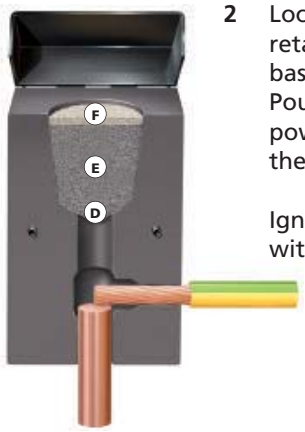
Most FurseWELD connections have at least twice the cross-sectional area of the conductors being joined, and an equivalent or greater current carrying capacity. Corrosion resistance is exceptional because of the very high copper content (>90%) of the alloy.



Making a FurseWELD joint is a simple procedure as illustrated below:

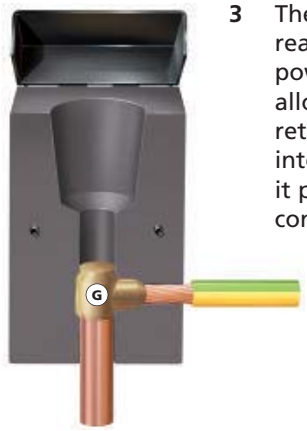


1 Locate the conductors (A) to be joined in the weld cavity (B) and close the mould (C).



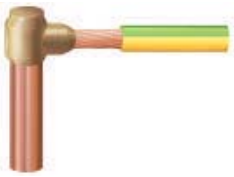
2 Locate the steel retaining disc in the base of the crucible (D). Pour in the weld powder (E) followed by the starting powder (F).

Ignite starting powder with a spark gun.



3 The resulting exothermic reaction reduces the weld powder to molten copper alloy which melts the retaining disc and flows into the weld cavity where it partially melts the conductors (G).

4 The molten copper alloy cools to leave a fusion weld of great mechanical and electrical integrity.



Moulds

The FurseWELD system of exothermic welding uses moulds to contain the exothermic reaction that creates safe and robust connections. Different types of moulds are available, whose use depends on the requirements of the project.

Graphite Moulds

Market leading FurseWELD graphite moulds are extremely robust and capable of producing over 75 connections each.

Mini-Moulds

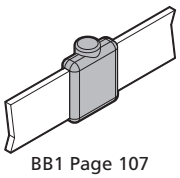
FurseWELD mini-moulds are a cost effective alternative to full-sized moulds, especially where lower numbers of connections are required. They are smaller overall, less robust and therefore lower priced. Care is required in order to achieve similar service lives to full-sized moulds.

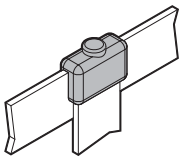
SureSHOT

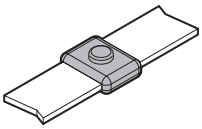
The FurseWELD SureSHOT system is a single-use ceramic mould supplied complete with retaining disc and powders. It has been designed for use in applications where only a few connections are required. Details of the SureSHOT system can be found on pages 135 – 136.

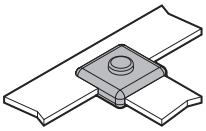
Connection selector

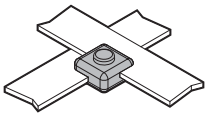
Bar to bar


BB1 Page 107

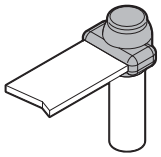

BB3 Page 107

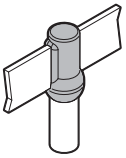

BB7 Page 108


BB14 Page 108

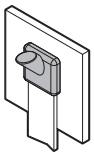

BB41 Page 109

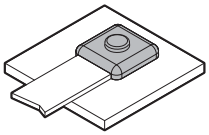
Bar to earth rod

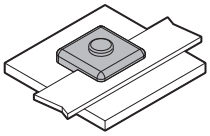

BR1 Page 110


BR2 Page 111

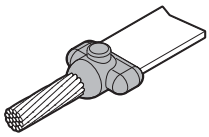
Bar to steel surface

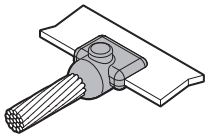

BS1 Page 112

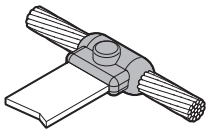

BS2 Page 112


BS3 Page 113

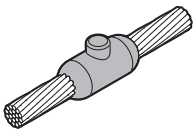
Cable to bar

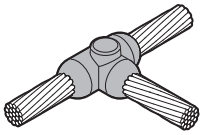

CB1 Page 114

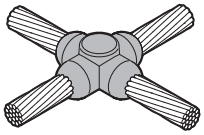

CB4 Page 115

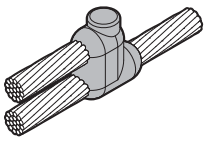

CB5 Page 116

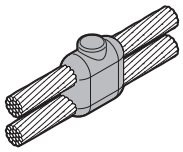
Cable to cable

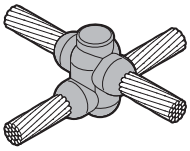

CC1 Page 117

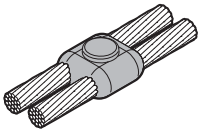

CC2 Page 118


CC4 Page 119

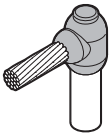

CC6 Page 120

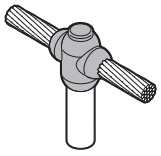

CC7 Page 121

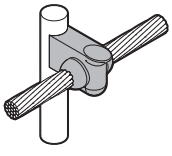

CC11 Page 122


CC14 Page 122

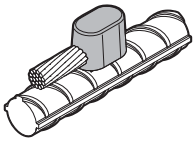
Cable to earth rod

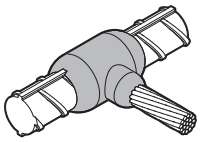

CR1 Page 123

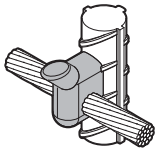

CR2 Page 124

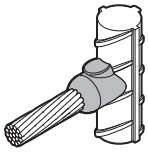

CR3 Page 125

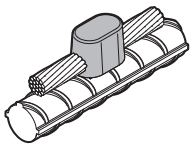
Cable to reinforcing bar


CRE1 Page 126

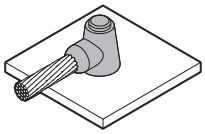

CRE2 Page 126 – 127

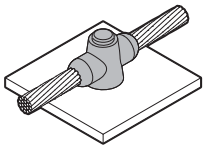

CRE3 Page 127

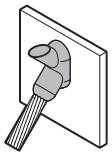

CRE6 Page 128

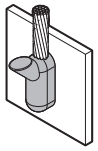

CRE17 Page 128

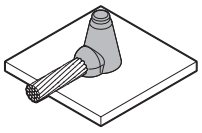
Cable to steel surface and pipe

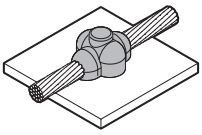

CS1 Page 129

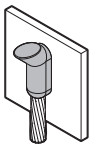

CS2 Page 129

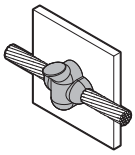

CS3 Page 130

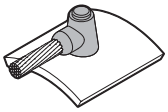

CS7 Page 130

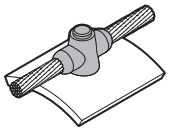

CS8 Page 130


CS9 Page 131

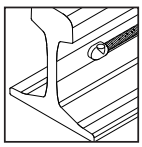

CS25 Page 131

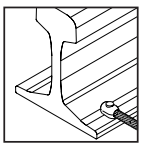

CS27 Page 131

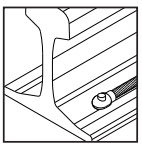

CS32 Page 132

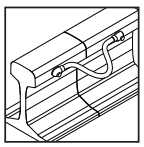

CS34 Page 132

Cable to rail

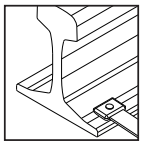

R4 Page 133


R5 Page 133

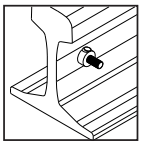

R10 Page 133


R12 Page 134

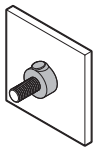
Bar to rail

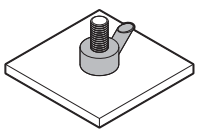

R6 Page 134

Stud to rail


R8 Page 134

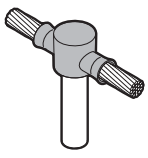
Stud to steel surface


RS1 Page 134


RS2 Page 134

SureSHOT


SS1 Page 136

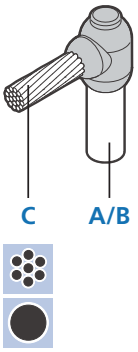

SS2 Page 136

If connections shown do not meet your requirements, please contact the sales office on +44 (0)115 964 3800

Product selector – how to use

Use the 'Connection Selector' on pages 104 – 105 to choose your required joint type.

			CR1				
A mm ø	B inches ø	C mm²				MINI	MINI
12.7	½"	16*	65P10	CR1-4-12716	HCPK4	CR1-3-12716	HCPK3
12.7	½"	25	65P10	CR1-4-12725	HCPK4	CR1-3-12725	HCPK3
12.7	½"	35	65P10	CR1-4-12735	HCPK4	CR1-3-12735	HCPK3
12.7	½"	50	65P10	CR1-4-12750	HCPK4	CR1-3-12750	HCPK3
12.7	½"	8mm Ø	65P10	CR1-4-1278SC	HCPK4	CR1-3-1278SC	HCPK3
12.7	½"	70	90P10	CR1-4-12770	HCPK4	CR1-3-12770	HCPK3
12.7	½"	95	90P10	CR1-4-12795	HCPK4	CR1-3-12795	HCPK3
12.7	½"	120	90P10	CR1-4-127120	HCPK4	CR1-3-127120	HCPK3
14.2	⅝"	16*	65P10	CR1-4-14216	HCPK4	CR1-3-14216	HCPK3
14.2	⅝"	25	65P10	CR1-4-14225	HCPK4	CR1-3-14225	HCPK3
14.2	⅝"	35	65P10	CR1-4-14235	HCPK4	CR1-3-14235	HCPK3



Find the required conductor sizes

A mm ø	B inches ø	C mm²
12.7	½"	16*

FurseWELD products

A powder cartridge is required for each joint to be made

Less robust, more cost effective versions of the mould and handle clamp are available

A single mould is capable of producing on average 75 joints

Sleeves are required when joining conductors smaller than 16mm²

Handle clamps for handling the mould, or clamping the halves together

Packing is required when welding to reinforcing bar

Accessories

Hammer die

Rail bond

Stud

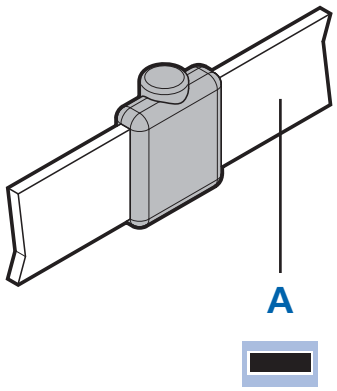
Conductors

Flat tape conductor

Stranded conductor

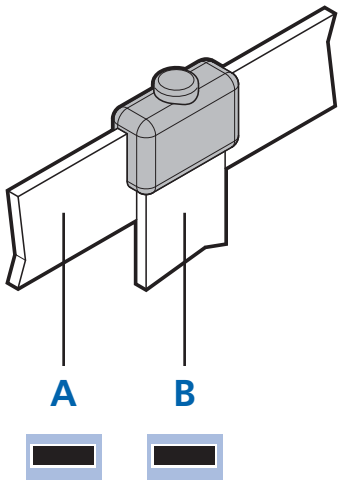
Solid circular conductor

BB1



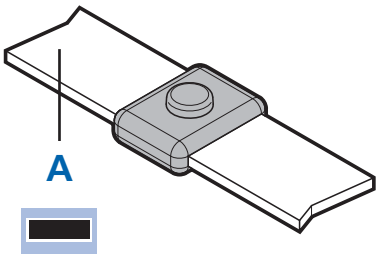
A mm x mm				MINI	MINI
20 x 3	45P10	BB1-4-203	HCPK4	BB1-3-203	HCPK3
25 x 3	65P10	BB1-4-253	HCPK4	BB1-3-253	HCPK3
25 x 4	90P10	BB1-4-254	HCPK4	BB1-3-254	HCPK3
25 x 6	150P10	BB1-4-256	HCPK4	-	-
30 x 2	65P10	BB1-4-302	HCPK4	BB1-3-302	HCPK3
30 x 3	90P10	BB1-4-303	HCPK4	BB1-3-303	HCPK3
30 x 4	115P10	BB1-4-304	HCPK4	BB1-3-304	HCPK3
30 x 5	115P10	BB1-4-305	HCPK4	BB1-3-305	HCPK3
31 x 3	90P10	BB1-4-313	HCPK4	BB1-3-313	HCPK3
31 x 6	150P10	BB1-4-316	HCPK4	-	-
38 x 3	115P10	BB1-4-383	HCPK4	-	-
38 x 5	150P10	BB1-4-385	HCPK4	-	-
38 x 6	200P10	BB1-4-386	HCPK4	-	-
40 x 3	115P10	BB1-4-403	HCPK4	-	-
40 x 4	150P10	BB1-4-404	HCPK4	-	-
40 x 5	150P10	BB1-4-405	HCPK4	-	-
40 x 6	200P10	BB1-4-406	HCPK4	-	-
50 x 3	150P10	BB1-4-503	HCPK4	-	-
50 x 4	200P10	BB1-4-504	HCPK4	-	-
50 x 5	200P10	BB1-4-505	HCPK4	-	-
50 x 6	250P10	BB1-4-506	HCPK4	-	-

BB3



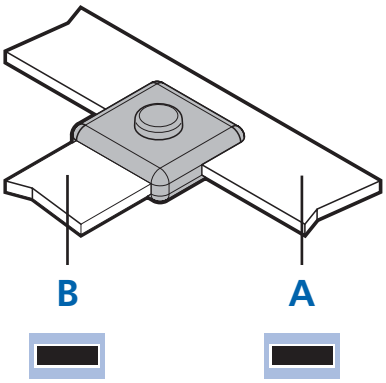
A mm x mm	B mm x mm				MINI	MINI
20 x 3	20 x 3	65P10	BB3-4-203203	HCPK4	BB3-3-203203	HCPK3
25 x 3	25 x 3	65P10	BB3-4-253253	HCPK4	BB3-3-253253	HCPK3
25 x 4	25 x 4	90P10	BB3-4-254254	HCPK4	BB3-3-254254	HCPK3
25 x 6	25 x 6	150P10	BB3-4-256256	HCPK4	-	-
30 x 2	30 x 2	65P10	BB3-4-302302	HCPK4	BB3-3-302302	HCPK3
30 x 3	30 x 3	90P10	BB3-4-303303	HCPK4	BB3-3-303303	HCPK3
30 x 4	30 x 4	115P10	BB3-4-304304	HCPK4	BB3-3-304304	HCPK3
30 x 5	30 x 5	115P10	BB3-4-305305	HCPK4	BB3-3-305305	HCPK3
31 x 3	31 x 3	115P10	BB3-4-313313	HCPK4	BB3-3-313313	HCPK3
31 x 6	31 x 6	200P10	BB3-4-316316	HCPK4	-	-
38 x 3	38 x 3	115P10	BB3-4-383383	HCPK4	-	-
38 x 5	38 x 5	150P10	BB3-4-385385	HCPK4	-	-
38 x 6	38 x 6	200P10	BB3-4-386386	HCPK4	-	-
40 x 3	40 x 3	115P10	BB3-4-403403	HCPK4	-	-
40 x 4	40 x 4	150P10	BB3-4-404404	HCPK4	-	-
40 x 5	40 x 5	150P10	BB3-4-405405	HCPK4	-	-
40 x 6	40 x 6	200P10	BB3-4-406406	HCPK4	-	-
50 x 3	50 x 3	200P10	BB3-4-503503	HCPK4	-	-
50 x 4	50 x 4	200P10	BB3-4-504504	HCPK4	-	-
50 x 5	50 x 5	200P10	BB3-4-505505	HCPK4	-	-
50 x 6	50 x 6	250P10	BB3-4-506506	HCPK4	-	-

Bar to bar



BB7

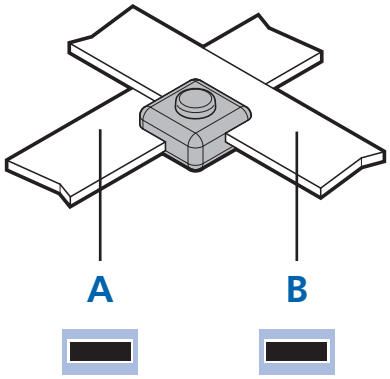
A mm x mm				MINI	MINI
20 x 3	45P10	BB7-4-203	HCPK4	BB7-3-203	HCPK3
25 x 3	65P10	BB7-4-253	HCPK4	BB7-3-253	HCPK3
25 x 4	90P10	BB7-4-254	HCPK4	BB7-3-254	HCPK3
25 x 6	115P10	BB7-4-256	HCPK4	BB7-3-256	HCPK3
30 x 2	65P10	BB7-4-302	HCPK4	BB7-3-302	HCPK3
30 x 3	65P10	BB7-4-303	HCPK4	BB7-3-303	HCPK3
30 x 4	90P10	BB7-4-304	HCPK4	BB7-3-304	HCPK3
30 x 5	115P10	BB7-4-305	HCPK4	BB7-3-305	HCPK3
31 x 3	65P10	BB7-4-313	HCPK4	BB7-3-313	HCPK3
31 x 6	150P10	BB7-4-316	HCPK4	-	-
38 x 3	90P10	BB7-4-383	HCPK4	-	-
38 x 5	150P10	BB7-4-385	HCPK4	-	-
38 x 6	200P10	BB7-4-386	HCPK4	-	-
40 x 3	90P10	BB7-4-403	HCPK4	-	-
40 x 4	115P10	BB7-4-404	HCPK4	-	-
40 x 5	150P10	BB7-4-405	HCPK4	-	-
40 x 6	200P10	BB7-4-406	HCPK4	-	-
50 x 3	150P10	BB7-5-503	HCPK5	-	-
50 x 4	200P10	BB7-5-504	HCPK5	-	-
50 x 5	200P10	BB7-5-505	HCPK5	-	-
50 x 6	250P10	BB7-5-506	HCPK5	-	-



BB14

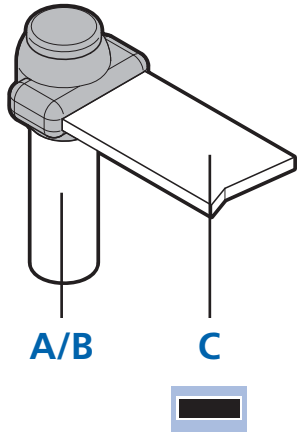
A mm x mm	B mm x mm				MINI	MINI
20 x 3	20 x 3	45P10	BB14-4-203203	HCPK4	BB14-3-203203	HCPK3
25 x 3	25 x 3	65P10	BB14-4-253253	HCPK4	BB14-3-253253	HCPK3
25 x 4	25 x 4	90P10	BB14-4-254254	HCPK4	BB14-3-254254	HCPK3
25 x 6	25 x 6	115P10	BB14-4-256256	HCPK4	BB14-3-256256	HCPK3
30 x 2	30 x 2	65P10	BB14-4-302302	HCPK4	BB14-3-302302	HCPK3
30 x 3	30 x 3	65P10	BB14-4-303303	HCPK4	BB14-3-303303	HCPK3
30 x 4	30 x 4	90P10	BB14-4-304304	HCPK4	BB14-3-304304	HCPK3
30 x 5	30 x 5	115P10	BB14-4-305305	HCPK4	BB14-3-305305	HCPK3
31 x 3	31 x 3	90P10	BB14-4-313313	HCPK4	BB14-3-313313	HCPK3
31 x 6	31 x 6	150P10	BB14-4-316316	HCPK4	-	-
38 x 3	38 x 3	90P10	BB14-4-383383	HCPK4	-	-
38 x 5	38 x 5	150P10	BB14-4-385385	HCPK4	-	-
38 x 6	38 x 6	200P10	BB14-4-386386	HCPK4	-	-
40 x 3	40 x 3	90P10	BB14-4-403403	HCPK4	-	-
40 x 4	40 x 4	115P10	BB14-4-404404	HCPK4	-	-
40 x 5	40 x 5	150P10	BB14-4-405405	HCPK4	-	-
40 x 6	40 x 6	200P10	BB14-4-406406	HCPK4	-	-
50 x 3	50 x 3	150P10	BB14-5-503503	HCPK5	-	-
50 x 4	50 x 4	200P10	BB14-5-504504	HCPK5	-	-
50 x 5	50 x 5	200P10	BB14-5-505505	HCPK5	-	-
50 x 6	50 x 6	250P10	BB14-5-506506	HCPK5	-	-

BB41



A mm x mm	B mm x mm				MINI	MINI
20 x 3	20 x 3	65P10	BB41-4-203203	HCPK4	BB41-3-203203	HCPK3
25 x 3	25 x 3	65P10	BB41-4-253253	HCPK4	BB41-3-253253	HCPK3
25 x 4	25 x 4	90P10	BB41-4-254254	HCPK4	BB41-3-254254	HCPK3
25 x 6	25 x 6	115P10	BB41-4-256256	HCPK4	BB41-3-256256	HCPK3
30 x 2	30 x 2	65P10	BB41-4-302302	HCPK4	BB41-3-302302	HPCK3
30 x 3	30 x 3	115P10	BB41-4-303303	HCPK4	BB41-3-303303	HPCK3
30 x 4	30 x 4	115P10	BB41-4-304304	HCPK4	BB41-3-304304	HCPK3
30 x 5	30 x 5	115P10	BB41-4-305305	HCPK4	BB41-3-305305	HCPK3
31 x 3	31 x 3	115P10	BB41-4-313313	HCPK4	BB41-3-313313	HCPK3
31 x 6	31 x 6	115P10	BB41-4-316316	HCPK4	BB41-3-316316	HCPK3
38 x 3	38 x 3	150P10	BB41-4-383383	HCPK4	-	-
38 x 5	38 x 5	150P10	BB41-4-385385	HCPK4	-	-
38 x 6	38 x 6	200P10	BB41-4-386386	HCPK4	-	-
40 x 3	40 x 3	200P10	BB41-4-403403	HCPK4	-	-
40 x 4	40 x 4	200P10	BB41-4-404404	HCPK4	-	-
40 x 5	40 x 5	200P10	BB41-4-405405	HCPK4	-	-
40 x 6	40 x 6	200P10	BB41-4-406406	HCPK4	-	-
50 x 3	50 x 3	200P10	BB41-5-503503	HCPK5	-	-
50 x 4	50 x 4	200P10	BB41-5-504504	HCPK5	-	-
50 x 5	50 x 5	200P10	BB41-5-505505	HCPK5	-	-
50 x 6	50 x 6	200P10	BB41-5-506506	HCPK5	-	-

Bar to earth rod



BR1

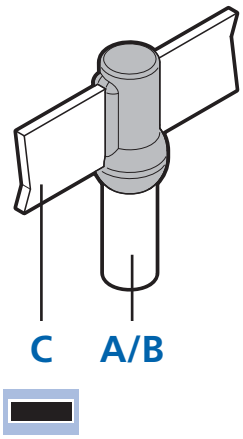
A mm ø	B inches ø	C mm x mm				MINI	MINI
12.7	½"	20 x 3	90P10	BR1-4-127203	HCPK4	BR1-3-128203	HCPK3
12.7	½"	25 x 3	90P10	BR1-4-127253	HCPK4	BR1-3-128253	HCPK3
12.7	½"	25 x 4	90P10	BR1-4-127254	HCPK4	BR1-3-128254	HCPK3
12.7	½"	30 x 2	90P10	BR1-4-127302	HCPK4	BR1-3-128302	HCPK3
12.7	½"	30 x 3	90P10	BR1-4-127303	HCPK4	BR1-3-128303	HCPK3
12.7	½"	31 x 3	90P10	BR1-4-127313	HCPK4	BR1-3-128313	HCPK3
12.7	½"	38 x 3	90P10	BR1-4-127383	HCPK4	-	-
12.7	½"	40 x 3	90P10	BR1-4-127403	HCPK4	-	-
12.7	½"	50 x 3	115P10	BR1-4-127503	HCPK4	-	-
12.7	½"	50 x 6	115P10	BR1-4-127506	HCPK4	-	-
14.2	⅝"	20 x 3	90P10	BR1-4-142203	HCPK4	BR1-3-142203	HCPK3
14.2	⅝"	25 x 3	90P10	BR1-4-142253	HCPK4	BR1-3-142253	HCPK3
14.2	⅝"	25 x 4	115P10	BR1-4-142254	HCPK4	BR1-3-142254	HCPK3
14.2	⅝"	25 x 6	115P10	BR1-4-142256	HCPK4	BR1-3-142256	HCPK3
14.2	⅝"	30 x 2	115P10	BR1-4-142302	HCPK4	BR1-3-142302	HCPK3
14.2	⅝"	30 x 3	115P10	BR1-4-142303	HCPK4	BR1-3-142303	HCPK3
14.2	⅝"	30 x 4	150P10	BR1-4-142304	HCPK4	-	-
14.2	⅝"	30 x 5	150P10	BR1-4-142305	HCPK4	-	-
14.2	⅝"	31 x 3	115P10	BR1-4-142313	HCPK4	BR1-3-142313	HCPK3
14.2	⅝"	31 x 6	150P10	BR1-4-142316	HCPK4	-	-
14.2	⅝"	38 x 3	115P10	BR1-4-142383	HCPK4	-	-
14.2	⅝"	38 x 5	150P10	BR1-4-142385	HCPK4	-	-
14.2	⅝"	38 x 6	200P10	BR1-4-142386	HCPK4	-	-
14.2	⅝"	40 x 3	115P10	BR1-4-142403	HCPK4	-	-
14.2	⅝"	40 x 4	150P10	BR1-4-142404	HCPK4	-	-
14.2	⅝"	40 x 5	150P10	BR1-4-142405	HCPK4	-	-
14.2	⅝"	40 x 6	200P10	BR1-4-142406	HCPK4	-	-
14.2	⅝"	50 x 3	150P10	BR1-4-142503	HCPK4	-	-
14.2	⅝"	50 x 4	200P10	BR1-4-142504	HCPK4	-	-
14.2	⅝"	50 x 5	200P10	BR1-4-142505	HCPK4	-	-
14.2	⅝"	50 x 6	200P10	BR1-4-142506	HCPK4	-	-
17.2	¾"	20 x 3	115P10	BR1-4-172203	HCPK4	BR1-3-172203	HCPK3
17.2	¾"	25 x 3	150P10	BR1-4-172253	HCPK4	-	-
17.2	¾"	25 x 4	150P10	BR1-4-172254	HCPK4	-	-
17.2	¾"	25 x 6	200P10	BR1-4-172256	HCPK4	-	-
17.2	¾"	30 x 2	150P10	BR1-4-172302	HCPK4	-	-
17.2	¾"	30 x 3	150P10	BR1-4-172303	HCPK4	-	-
17.2	¾"	30 x 4	250P10	BR1-4-172304	HCPK4	-	-
17.2	¾"	30 x 5	200P10	BR1-4-172305	HCPK4	-	-
17.2	¾"	31 x 3	150P10	BR1-4-172313	HCPK4	-	-
17.2	¾"	31 x 6	250P10	BR1-4-172316	HCPK4	-	-
17.2	¾"	38 x 3	200P10	BR1-4-172383	HCPK4	-	-
17.2	¾"	38 x 5	200P10	BR1-4-172385	HCPK4	-	-
17.2	¾"	38 x 6	2 x 150P10	BR1-5-172386	HCPK5	-	-
17.2	¾"	40 x 3	200P10	BR1-4-172403	HCPK4	-	-
17.2	¾"	40 x 4	200P10	BR1-4-172404	HCPK4	-	-
17.2	¾"	40 x 5	200P10	BR1-4-172405	HCPK4	-	-
17.2	¾"	40 x 6	2 x 150P10	BR1-5-172406	HCPK5	-	-
17.2	¾"	50 x 3	2 x 150P10	BR1-5-172503	HCPK5	-	-
17.2	¾"	50 x 4	2 x 150P10	BR1-5-172504	HCPK5	-	-
17.2	¾"	50 x 5	2 x 150P10	BR1-5-172505	HCPK5	-	-
17.2	¾"	50 x 6	2 x 200P10	BR1-5-172506	HCPK5	-	-

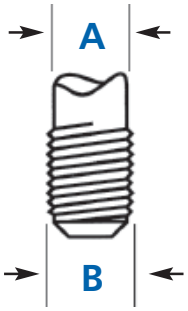
Suitable for connections to copperbond rods – for connections to solid copper and stainless steel rods please contact our sales office.

Threaded portion of copperbond rods must be removed prior to welding.

BR2

A mm ø	B inches ø	C mm x mm				MINI	MINI
12.7	½"	20 x 3	90P10	BR2-4-127203	HCPK4	BR2-3-128203	HCPK3
12.7	½"	25 x 3	90P10	BR2-4-127253	HCPK4	BR2-3-128253	HCPK3
12.7	½"	25 x 4	90P10	BR2-4-127254	HCPK4	BR2-3-128254	HCPK3
12.7	½"	30 x 2	90P10	BR2-4-127302	HCPK4	BR2-3-128302	HCPK3
12.7	½"	30 x 3	90P10	BR2-4-127303	HCPK4	BR2-3-128303	HCPK3
12.7	½"	31 x 3	90P10	BR2-4-127313	HCPK4	BR2-3-128313	HCPK3
12.7	½"	38 x 3	90P10	BR2-4-127383	HCPK4	BR2-3-128383	HCPK3
12.7	½"	40 x 3	90P10	BR2-4-127403	HCPK4	BR2-3-128403	HCPK3
12.7	½"	50 x 3	115P10	BR2-4-127503	HCPK4	-	-
14.2	⅝"	20 x 3	90P10	BR2-4-142203	HCPK4	BR2-3-142203	HCPK3
14.2	⅝"	25 x 3	90P10	BR2-4-142253	HCPK4	BR2-3-142253	HCPK3
14.2	⅝"	25 x 4	115P10	BR2-4-142254	HCPK4	BR2-3-142254	HCPK3
14.2	⅝"	25 x 6	150P10	BR2-4-142256	HCPK4	-	-
14.2	⅝"	30 x 2	90P10	BR2-4-142302	HCPK4	BR2-3-142302	HCPK3
14.2	⅝"	30 x 3	115P10	BR2-4-142303	HCPK4	BR2-3-142303	HCPK3
14.2	⅝"	30 x 4	150P10	BR2-4-142304	HCPK4	-	-
14.2	⅝"	30 x 5	150P10	BR2-4-142305	HCPK4	-	-
14.2	⅝"	31 x 3	115P10	BR2-4-142313	HCPK4	BR2-3-142313	HCPK3
14.2	⅝"	31 x 6	150P10	BR2-4-142316	HCPK4	-	-
14.2	⅝"	38 x 3	150P10	BR2-4-142383	HCPK4	-	-
14.2	⅝"	38 x 5	150P10	BR2-4-142385	HCPK4	-	-
14.2	⅝"	38 x 6	200P10	BR2-4-142386	HCPK4	-	-
14.2	⅝"	40 x 3	150P10	BR2-4-142403	HCPK4	-	-
14.2	⅝"	40 x 4	150P10	BR2-4-142404	HCPK4	-	-
14.2	⅝"	40 x 5	150P10	BR2-4-142405	HCPK4	-	-
14.2	⅝"	40 x 6	200P10	BR2-4-142406	HCPK4	-	-
14.2	⅝"	50 x 3	200P10	BR2-4-142503	HCPK4	-	-
14.2	⅝"	50 x 4	200P10	BR2-4-142504	HCPK4	-	-
14.2	⅝"	50 x 5	200P10	BR2-4-142505	HCPK4	-	-
14.2	⅝"	50 x 6	250P10	BR2-4-142506	HCPK4	-	-
17.2	¾"	20 x 3	150P10	BR2-4-172203	HCPK4	-	-
17.2	¾"	25 x 3	150P10	BR2-4-172253	HCPK4	-	-
17.2	¾"	25 x 4	200P10	BR2-4-172254	HCPK4	-	-
17.2	¾"	25 x 6	200P10	BR2-4-172256	HCPK4	-	-
17.2	¾"	30 x 2	150P10	BR2-4-172302	HCPK4	-	-
17.2	¾"	30 x 3	150P10	BR2-4-172303	HCPK4	-	-
17.2	¾"	30 x 4	250P10	BR2-4-172304	HCPK4	-	-
17.2	¾"	30 x 5	200P10	BR2-4-172305	HCPK4	-	-
17.2	¾"	31 x 3	200P10	BR2-4-172313	HCPK4	-	-
17.2	¾"	31 x 6	250P10	BR2-4-172316	HCPK4	-	-
17.2	¾"	38 x 3	200P10	BR2-4-172383	HCPK4	-	-
17.2	¾"	38 x 5	200P10	BR2-4-172385	HCPK4	-	-
17.2	¾"	38 x 6	250P10	BR2-4-172386	HCPK4	-	-
17.2	¾"	40 x 3	200P10	BR2-4-172403	HCPK4	-	-
17.2	¾"	40 x 4	200P10	BR2-4-172404	HCPK4	-	-
17.2	¾"	40 x 5	200P10	BR2-4-172405	HCPK4	-	-
17.2	¾"	40 x 6	250P10	BR2-4-172406	HCPK4	-	-
17.2	¾"	50 x 3	2 x 150P10	BR2-5-172503	HCPK5	-	-
17.2	¾"	50 x 4	2 x 150P10	BR2-5-172504	HCPK5	-	-
17.2	¾"	50 x 5	2 x 150P10	BR2-5-172505	HCPK5	-	-
17.2	¾"	50 x 6	2 x 150P10	BR2-5-172506	HCPK5	-	-

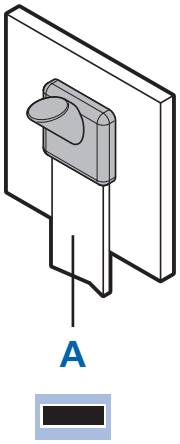




Suitable for connections to copperbond rods – for connections to solid copper and stainless steel rods please contact our sales office.

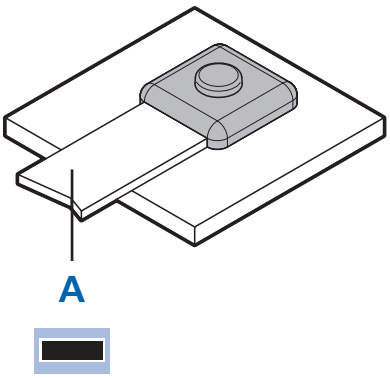
Threaded portion of copperbond rods must be removed prior to welding.

Bar to steel surface



BS1

A mm x mm				MINI	MINI
20 x 3	65P10	BS1-4-203	HCPK4	BS1-3-203	HCPK3
25 x 3	90P10	BS1-4-253	HCPK4	BS1-3-253	HCPK3
25 x 4	90P10	BS1-4-254	HCPK4	BS1-3-254	HCPK3
25 x 6	150P10	BS1-4-256	HCPK4	-	-
30 x 2	90P10	BS1-4-302	HCPK4	BS1-3-302	HCPK3
30 x 3	90P10	BS1-4-303	HCPK4	BS1-3-303	HCPK3
30 x 4	115P10	BS1-4-304	HCPK4	BS1-3-304	HCPK3
30 x 5	150P10	BS1-4-305	HCPK4	-	-
31 x 3	90P10	BS1-4-313	HCPK4	BS1-3-313	HCPK3
31 x 6	200P10	BS1-4-316	HCPK4	-	-
38 x 3	150P10	BS1-4-383	HCPK4	-	-
38 x 5	200P10	BS1-4-385	HCPK4	-	-
38 x 6	250P10	BS1-4-386	HCPK4	-	-
40 x 3	150P10	BS1-4-403	HCPK4	-	-
40 x 4	200P10	BS1-4-404	HCPK4	-	-
40 x 5	200P10	BS1-4-405	HCPK4	-	-
40 x 6	250P10	BS1-4-406	HCPK4	-	-
50 x 3	200P10	BS1-4-503	HCPK4	-	-
50 x 4	250P10	BS1-4-504	HCPK4	-	-
50 x 5	250P10	BS1-4-505	HCPK4	-	-
50 x 6	2 x 150P10	BS1-5-506	HCPK5	-	-

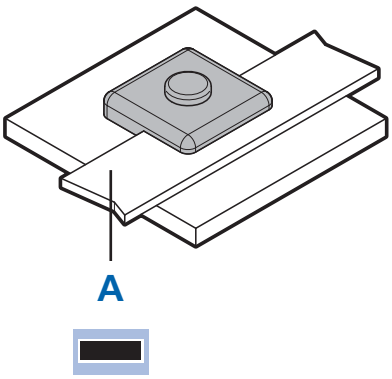


BS2

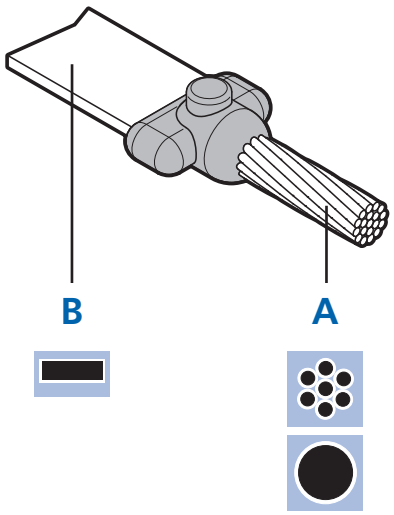
A mm x mm				MINI	MINI
20 x 3	90P10	BS2-4-203	HCPK4	BS2-3-203	HCPK3
25 x 3	90P10	BS2-4-253	HCPK4	BS2-3-253	HCPK3
25 x 4	90P10	BS2-4-254	HCPK4	BS2-3-254	HCPK3
25 x 6	150P10	BS2-4-256	HCPK4	-	-
30 x 2	115P10	BS2-4-302	HCPK4	BS2-3-302	HCPK3
30 x 3	115P10	BS2-4-303	HCPK4	BS2-3-303	HCPK3
30 x 4	150P10	BS2-4-304	HCPK4	-	-
30 x 5	200P10	BS2-4-305	HCPK4	-	-
31 x 3	115P10	BS2-4-313	HCPK4	BS2-3-313	HCPK3
31 x 6	200P10	BS2-4-316	HCPK4	-	-
38 x 3	150P10	BS2-4-383	HCPK4	-	-
38 x 5	200P10	BS2-4-385	HCPK4	-	-
38 x 6	200P10	BS2-4-386	HCPK4	-	-
40 x 3	115P10	BS2-4-403	HCPK4	-	-
40 x 4	200P10	BS2-4-404	HCPK4	-	-
40 x 5	200P10	BS2-4-405	HCPK4	-	-
40 x 6	250P10	BS2-4-406	HCPK4	-	-
50 x 3	200P10	BS2-4-503	HCPK4	-	-
50 x 4	2 x 150P10	BS2-5-504	HCPK5	-	-
50 x 5	2 x 150P10	BS2-5-505	HCPK5	-	-
50 x 6	2 x 150P10	BS2-5-506	HCPK5	-	-

BS3

A mm x mm				MINI	MINI
20 x 3	65P10	BS1-4-203	HCPK4	BS1-3-203	HCPK3
20 x 3	90P10	BS3-4-203	HCPK4	BS3-3-203	HCPK3
25 x 3	115P10	BS3-4-253	HCPK4	BS3-3-253	HCPK3
25 x 4	115P10	BS3-4-254	HCPK4	BS3-3-254	HCPK3
25 x 6	150P10	BS3-4-256	HCPK4	-	-
30 x 2	115P10	BS3-4-302	HCPK4	BS3-3-302	HCPK3
30 x 3	115P10	BS3-4-303	HCPK4	BS3-3-303	HCPK3
30 x 4	150P10	BS3-4-304	HCPK4	-	-
30 x 5	200P10	BS3-4-305	HCPK4	-	-
31 x 3	115P10	BS3-4-313	HCPK4	BS3-3-313	HCPK3
31 x 6	200P10	BS3-4-316	HCPK4	-	-
38 x 3	150P10	BS3-4-383	HCPK4	-	-
38 x 5	200P10	BS3-4-385	HCPK4	-	-
38 x 6	250P10	BS3-4-386	HCPK4	-	-
40 x 3	150P10	BS3-4-403	HCPK4	-	-
40 x 4	200P10	BS3-4-404	HCPK4	-	-
40 x 5	250P10	BS3-4-405	HCPK4	-	-
40 x 6	250P10	BS3-4-406	HCPK4	-	-
50 x 3	250P10	BS3-4-503	HCPK4	-	-
50 x 4	250P10	BS3-4-504	HCPK4	-	-
50 x 5	250P10	BS3-4-505	HCPK4	-	-
50 x 6	250P10	BS3-4-506	HCPK4	-	-



Cable to bar



CB1

A mm²	B mm x mm				MINI	MINI
16*	20 x 3	45P10	CB1-4-16203	HCPK4	CB1-3-16203	HCPK3
16*	25 x 3	45P10	CB1-4-16253	HCPK4	CB1-3-16253	HCPK3
25	20 x 3	32P10	CB1-4-25203	HCPK4	CB1-3-25203	HCKP3
25	25 x 3	45P10	CB1-4-25253	HCPK4	CB1-3-25253	HCPK3
35	20 x 3	45P10	CB1-4-35203	HCPK4	CB1-3-35203	HCPK3
35	25 x 3	45P10	CB1-4-35253	HCPK4	CB1-3-35253	HCPK3
50	20 x 3	45P10	CB1-4-50203	HCPK4	CB1-3-50203	HCPK3
50	25 x 3	65P10	CB1-4-50253	HCPK4	CB1-3-50253	HCPK3
8mm Ø	20 x 3	45P10	CB1-4-8SC203	HCPK4	CB1-3-8SC203	HCPK3
8mm Ø	25 x 3	65P10	CB1-4-8SC253	HCPK4	CB1-3-8SC253	HCPK3
70	25 x 3	65P10	CB1-4-70253	HCPK4	CB1-3-70253	HCPK3
70	25 x 4	65P10	CB1-4-70254	HCPK4	CB1-3-70254	HCPK3
70	25 x 6	65P10	CB1-4-70256	HCPK4	CB1-3-70256	HCPK3
10mm Ø	25 x 3	65P10	CB1-4-10SC253	HCPK4	CB1-3-10SC253	HCPK3
10mm Ø	25 x 4	65P10	CB1-4-10SC254	HCPK4	CB1-3-10SC254	HCPK3
10mm Ø	25 x 6	65P10	CB1-4-10SC256	HCPK4	CB1-3-10SC256	HCPK3
95	25 x 4	90P10	CB1-4-95254	HCPK4	CB1-3-95254	HCPK3
95	25 x 6	90P10	CB1-4-95256	HCPK4	CB1-3-95256	HCPK3
120	25 x 6	90P10	CB1-4-120256	HCPK4	CB1-3-120256	HCPK3
120	30 x 5	115P10	CB1-4-120305	HCPK4	CB1-3-120305	HCPK3
150	25 x 6	115P10	CB1-4-150256	HCPK4	CB1-3-150256	HCPK3
150	30 x 5	115P10	CB1-4-150305	HCPK4	CB1-3-150305	HCPK3
150	40 x 5	150P10	CB1-4-150405	HCPK4	-	-
185	31 x 6	150P10	CB1-4-185316	HCPK4	-	-
185	40 x 5	150P10	CB1-4-185405	HCPK4	-	-
185	50 x 5	200P10	CB1-5-185505	HCPK5	-	-
240	50 x 5	200P10	CB1-5-240505	HCPK5	-	-
240	50 x 6	2 x 150P10	CB1-5-240506	HCPK5	-	-
300	50 x 6	2 x 150P10	CB1-5-300506	HCPK5	-	-

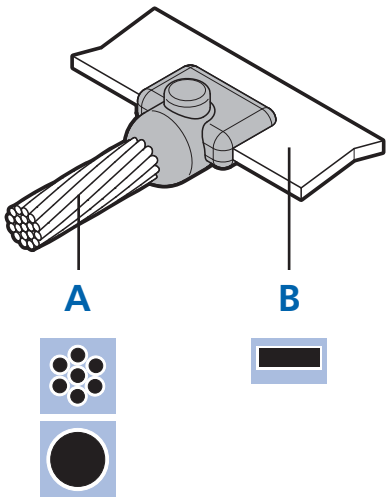
Terminal lugs – see page 137

* 1 x S103

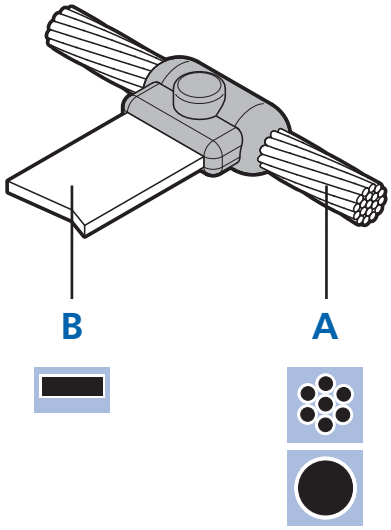
CB4

A mm²	B mm x mm				MINI	MINI
16*	20 x 3	45P10	CB4-4-16203	HCPK4	CB4-3-16203	HCPK3
16*	25 x 3	45P10	CB4-4-16253	HCPK4	CB4-3-16253	HCPK3
25	20 x 3	32P10	CB4-4-25203	HCPK4	CB4-3-25203	HCPK3
25	25 x 3	32P10	CB4-4-25253	HCPK4	CB4-3-25253	HCPK3
35	20 x 3	45P10	CB4-4-35203	HCPK4	CB4-3-35203	HCPK3
35	25 x 3	45P10	CB4-4-35253	HCPK4	CB4-3-35253	HCPK3
50	20 x 3	45P10	CB4-4-50203	HCPK4	CB4-3-50203	HCPK3
50	25 x 3	45P10	CB4-4-50253	HCPK4	CB4-3-50253	HCPK3
8mm Ø	20 x 3	45P10	CB4-4-8SC203	HCPK4	CB4-3-8SC203	HCPK3
8mm Ø	25 x 3	45P10	CB4-4-8SC253	HCPK4	CB4-3-8SC253	HCPK3
70	25 x 3	65P10	CB4-4-70253	HCPK4	CB4-3-70253	HCPK3
70	25 x 4	65P10	CB4-4-70254	HCPK4	CB4-3-70254	HCPK3
70	25 x 6	90P10	CB4-4-70256	HCPK4	CB4-3-70256	HCPK3
10mm Ø	25 x 3	65P10	CB4-4-10SC253	HCPK4	CB4-3-10SC253	HCPK3
10mm Ø	25 x 4	65P10	CB4-4-10SC254	HCPK4	CB4-3-10SC254	HCPK3
10mm Ø	25 x 6	90P10	CB4-4-10SC256	HCPK4	CB4-3-10SC256	HCPK3
95	25 x 4	90P10	CB4-4-95254	HCPK4	CB4-3-95254	HCPK3
95	25 x 6	115P10	CB4-4-95256	HCPK4	CB4-3-95256	HCPK3
120	25 x 6	115P10	CB4-4-120256	HCPK4	CB4-3-120256	HCPK3
120	30 x 5	115P10	CB4-4-120305	HCPK4	CB4-3-120305	HCPK3
150	25 x 6	115P10	CB4-4-150256	HCPK4	CB4-3-150256	HCPK3
150	30 x 5	115P10	CB4-4-150305	HCPK4	CB4-3-150305	HCPK3
150	40 x 5	115P10	CB4-4-150405	HCPK4	-	-
185	31 x 6	150P10	CB4-4-185316	HCPK4	-	-
185	40 x 5	150P10	CB4-4-185405	HCPK4	-	-
185	50 x 5	150P10	CB4-4-185505	HCPK4	-	-
240	50 x 5	200P10	CB4-4-240505	HCPK4	-	-
240	50 x 6	250P10	CB4-4-240506	HCPK4	-	-
300	50 x 6	2 x 150P10	CB4-5-300506	HCPK5	-	-

* 1 x S103



Cable to bar



CB5

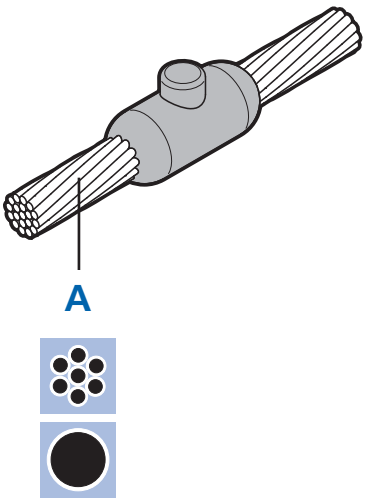
A mm²	B mm x mm				MINI	MINI
16*	20 x 3	45P10	CB5-4-16203	HCPK4	CB5-3-16303	HCPK3
16*	25 x 3	65P10	CB5-4-16253	HCPK4	CB5-3-16253	HCPK3
25	20 x 3	45P10	CB5-4-25203	HCPK4	CB5-3-25203	HCPK3
25	25 x 3	65P10	CB5-4-25253	HCPK4	CB5-3-25253	HCPK3
35	20 x 3	45P10	CB5-4-35203	HCPK4	CB5-3-35203	HCPK3
35	25 x 3	65P10	CB5-4-35253	HCPK4	CB5-3-35253	HCPK3
50	20 x 3	65P10	CB5-4-50203	HCPK4	CB5-3-50203	HCPK3
50	25 x 3	65P10	CB5-4-50253	HCPK4	CB5-3-50253	HCPK3
8mm Ø	20 x 3	65P10	CB5-4-8SC203	HCPK4	CB5-3-8SC203	HCPK3
8mm Ø	25 x 3	65P10	CB5-4-8SC253	HCPK4	CB5-3-8SC253	HCPK3
70	25 x 3	90P10	CB5-4-70253	HCPK4	CB5-3-70253	HCPK3
70	25 x 4	115P10	CB5-4-70254	HCPK4	CB5-3-70254	HCPK3
70	25 x 6	115P10	CB5-4-70256	HCPK4	CB5-3-70256	HCPK3
10mm Ø	25 x 3	115P10	CB5-4-10SC253	HCPK4	CB5-3-10SC253	HCPK3
10mm Ø	25 x 4	150P10	CB5-4-10SC254	HCPK4	-	-
10mm Ø	25 x 6	150P10	CB5-4-10SC256	HCPK4	-	-
95	25 x 4	150P10	CB5-4-95254	HCPK4	-	-
95	25 x 6	150P10	CB5-4-95256	HCPK4	-	-
120	25 x 6	150P10	CB5-4-120256	HCPK4	-	-
120	30 x 5	200P10	CB5-4-120305	HCPK4	-	-
150	25 x 6	200P10	CB5-4-150256	HCPK4	-	-
150	30 x 5	200P10	CB5-4-150305	HCPK4	-	-
150	40 x 5	250P10	CB5-4-150405	HCPK4	-	-
185	31 x 6	250P10	CB5-4-185316	HCPK4	-	-
185	40 x 5	250P10	CB5-4-185405	HCPK4	-	-
185	50 x 5	2 x 150P10	CB5-5-185505	HCPK5	-	-
240	50 x 5	2 x 150P10	CB5-5-240505	HCPK5	-	-
240	50 x 6	2 x 200P10	CB5-5-240506	HCPK5	-	-
300	50 x 6	2 x 250P10	CB5-5-300506	HCPK5	-	-

* 2 x S103

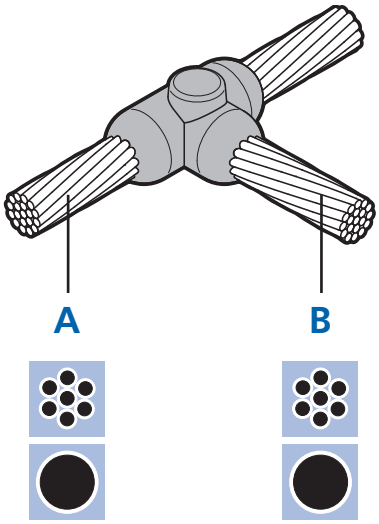
CC1

A mm²				MINI	MINI
16*	32P10	CC1-4-16	HCPK4	CC1-3-16	HCPK3
25	32P10	CC1-4-25	HCPK4	CC1-3-25	HCPK3
35	32P10	CC1-4-35	HCPK4	CC1-3-35	HCPK3
50	45P10	CC1-4-50	HCPK4	CC1-3-50	HCPK3
8mm Ø	45P10	CC1-4-8SC	HCPK4	CC1-3-8SC	HCPK3
70	65P10	CC1-4-70	HCPK4	CC1-3-70	HCPK3
10mm Ø	65P10	CC1-4-10SC	HCPK4	CC1-3-10SC	HCPK3
95	90P10	CC1-4-95	HCPK4	CC1-3-95	HCPK3
120	115P10	CC1-4-120	HCPK4	CC1-3-120	HCPK3
150	115P10	CC1-4-150	HCPK4	CC1-3-150	HCPK3
185	150P10	CC1-4-185	HCPK4	-	-
240	200P10	CC1-4-240	HCPK4	-	-
300	250P10	CC1-4-300	HCPK4	-	-
400	2 x 150P10	CC1-5-400	HCPK5	-	-

*  2 x S103



Cable to cable



CC2

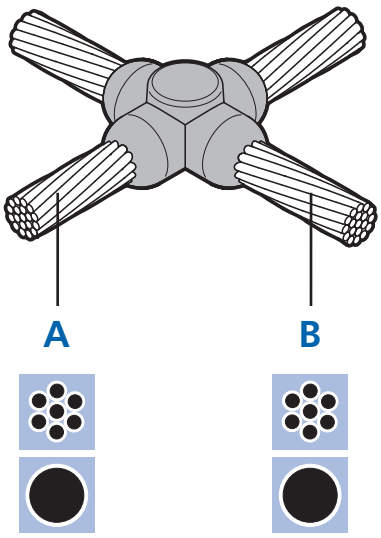
A mm²	B mm²				MINI	MINI
16*	16*	45P10	CC2-4-1616	HCPK4	CC2-3-1616	HCPK3
25	25	45P10	CC2-4-2525	HCPK4	CC2-3-2525	HCPK3
35	35	45P10	CC2-4-3535	HCPK4	CC2-3-3535	HCPK3
35	25	45P10	CC2-4-3525	HCPK4	CC2-3-3525	HCPK3
8mm Ø	8mm Ø	65P10	CC2-4-88SC	HCPK4	CC2-3-88SC	HCPK3
50	50	90P10	CC2-4-5050	HCPK4	CC2-3-5050	HCPK3
50	35	65P10	CC2-4-5035	HCPK4	CC2-3-5035	HCPK3
50	25	65P10	CC2-4-5025	HCPK4	CC2-3-5025	HCPK3
10mm Ø	10mm Ø	90P10	CC2-4-1010SC	HCPK4	CC2-3-1010SC	HCPK3
70	70	90P10	CC2-4-7070	HCPK4	CC2-3-7070	HCPK3
70	50	90P10	CC2-4-7050	HCPK4	CC2-3-7050	HCPK3
70	35	65P10	CC2-4-7035	HCPK4	CC2-3-7035	HCPK3
70	25	65P10	CC2-4-7025	HCPK4	CC2-3-7025	HCPK3
95	95	115P10	CC2-4-9595	HCPK4	CC2-3-9595	HCPK3
95	70	90P10	CC2-4-9570	HCPK4	CC2-3-9570	HCPK3
95	50	90P10	CC2-4-9550	HCPK4	CC2-3-9550	HCPK3
95	35	90P10	CC2-4-9535	HCPK4	CC2-3-9535	HCPK3
120	120	150P10	CC2-4-120120	HCPK4	-	-
120	95	150P10	CC2-4-12095	HCPK4	-	-
120	70	90P10	CC2-4-12070	HCPK4	CC2-3-12070	HCPK3
120	50	90P10	CC2-4-12050	HCPK4	CC2-3-12050	HCPK3
150	150	200P10	CC2-4-150150	HCPK4	-	-
150	120	150P10	CC2-4-150120	HCPK4	-	-
150	95	150P10	CC2-4-15095	HCPK4	-	-
150	70	90P10	CC2-4-15070	HCPK4	CC2-3-15070	HCPK3
185	185	200P10	CC2-4-185185	HCPK4	-	-
185	150	200P10	CC2-4-185150	HCPK4	-	-
185	120	200P10	CC2-4-185120	HCPK4	-	-
185	95	150P10	CC2-4-18595	HCPK4	-	-
240	240	2 x 150P10	CC2-4-240240	HCPK4	-	-
240	185	200P10	CC2-4-240185	HCPK4	-	-
240	150	200P10	CC2-4-240150	HCPK4	-	-
240	120	200P10	CC2-4-240120	HCPK4	-	-
300	300	2 x 200P10	CC2-5-300300	HCPK5	-	-
300	240	2 x 200P10	CC2-5-300240	HCPK5	-	-
300	185	250P10	CC2-4-300185	HCPK4	-	-

* 3 x S103

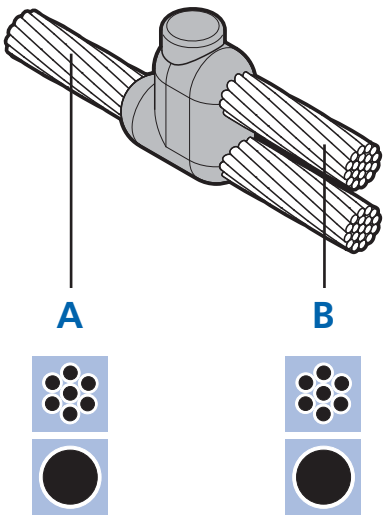
CC4

A mm²	B mm²				MINI	MINI
16*	16*	65P10	CC4-4-1616	HCPK4	CC4-3-1616	HCPK3
25	25	45P10	CC4-4-2525	HCPK4	CC4-3-2525	HCPK3
35	35	65P10	CC4-4-3535	HCPK4	CC4-3-3535	HCPK3
35	25	65P10	CC4-4-3525	HCPK4	CC4-3-3525	HCPK3
8mm Ø	8mm Ø	90P10	CC4-4-88SC	HCPK4	CC4-3-88SC	HCPK3
50	50	90P10	CC4-4-5050	HCPK4	CC4-3-5050	HCPK3
50	35	90P10	CC4-4-5035	HCPK4	CC4-3-5035	HCPK3
50	25	90P10	CC4-4-5025	HCPK4	CC4-3-5025	HCPK3
10mm Ø	10mm Ø	115P10	CC4-4-1010SC	HCPK4	CC4-3-1010SC	HCPK3
70	70	115P10	CC4-4-7070	HCPK4	CC4-3-7070	HCPK3
70	50	115P10	CC4-4-7050	HCPK4	CC4-3-7050	HCPK3
70	35	115P10	CC4-4-7035	HCPK4	CC4-3-7035	HCPK3
70	25	115P10	CC4-4-7025	HCPK4	CC4-3-7025	HCPK3
95	95	150P10	CC4-4-9595	HCPK4	-	-
95	70	150P10	CC4-4-9570	HCPK4	-	-
95	50	115P10	CC4-4-9550	HCPK4	-	-
95	35	115P10	CC4-4-9535	HCPK4	-	-
120	120	200P10	CC4-4-120120	HCPK4	-	-
120	95	200P10	CC4-4-12095	HCPK4	-	-
120	70	150P10	CC4-4-12070	HCPK4	-	-
120	50	150P10	CC4-4-12050	HCPK4	-	-
150	150	250P10	CC4-4-150150	HCPK4	-	-
150	120	250P10	CC4-4-150120	HCPK4	-	-
150	95	200P10	CC4-4-15095	HCPK4	-	-
150	70	150P10	CC4-4-15070	HCPK4	-	-
185	185	2 x 150P10	CC4-4-185185	HCPK4	-	-
185	150	250P10	CC4-4-185150	HCPK4	-	-
185	120	250P10	CC4-4-185120	HCPK4	-	-
185	95	200P10	CC4-4-18595	HCPK4	-	-
185	70	200P10	CC4-4-18570	HCPK4	-	-
240	240	2 x 250P10	CC4-5-240240	HCPK5	-	-
240	185	2 x 200P10	CC4-5-240185	HCPK5	-	-
240	150	2 x 200P10	CC4-5-240150	HCPK5	-	-
240	120	2 x 150P10	CC4-5-240120	HCPK5	-	-

* 4 x S103



Cable to cable



CC6

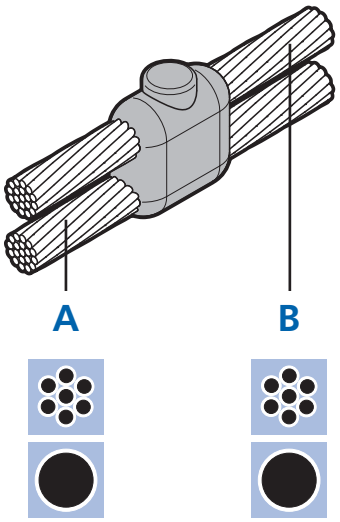
A mm²	B mm²				MINI	MINI
16*	16*	65P10	CC6-4-1616	HCPK4	CC6-3-1616	HCPK3
25	25	45P10	CC6-4-2525	HCPK4	CC6-3-2525	HCPK3
35	35	65P10	CC6-4-3535	HCPK4	CC6-3-3535	HCPK3
35	25	65P10	CC6-4-3525	HCPK4	CC6-3-3525	HCPK3
50	50	90P10	CC6-4-5050	HCPK4	CC6-3-5050	HCPK3
50	35	65P10	CC6-4-5035	HCPK4	CC6-3-5035	HCPK3
50	25	65P10	CC6-4-5025	HCPK4	CC6-3-5025	HCPK3
70	70	115P10	CC6-4-7070	HCPK4	CC6-3-7070	HCPK3
70	50	115P10	CC6-4-7050	HCPK4	CC6-3-7050	HCPK3
70	35	90P10	CC6-4-7035	HCPK4	CC6-3-7035	HCPK3
70	25	90P10	CC6-4-7025	HCPK4	CC6-3-7025	HCPK3
95	95	150P10	CC6-4-9595	HCPK4	-	-
95	70	115P10	CC6-4-9570	HCPK4	CC6-3-9570	HCPK3
95	50	115P10	CC6-4-9550	HCPK4	CC6-3-9550	HCPK3
95	35	115P10	CC6-4-9535	HCPK4	CC6-3-9535	HCPK3
120	120	200P10	CC6-4-120120	HCPK4	-	-
120	95	200P10	CC6-4-12095	HCPK4	-	-
120	70	150P10	CC6-4-12070	HCPK4	-	-
120	50	115P10	CC6-4-12050	HCPK4	CC6-3-12050	HCPK3

* 3 x S103

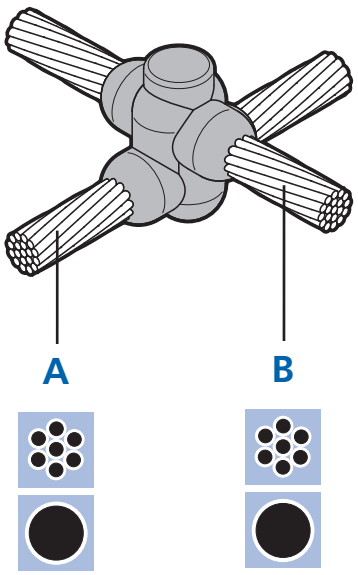
CC7

A mm²	B mm²				MINI	MINI
16*	16*	65P10	CC7-4-1616	HCPK4	CC7-3-1616	HCPK3
25	25	45P10	CC7-4-2525	HCPK4	CC7-3-2525	HCPK3
35	35	65P10	CC7-4-3535	HCPK4	CC7-3-3535	HCPK3
35	25	65P10	CC7-4-3525	HCPK4	CC7-3-3525	HCPK3
8mm Ø	8mm Ø	90P10	CC7-4-88SC	HCPK4	CC7-3-88SC	HCPK3
50	50	90P10	CC7-4-5050	HCPK4	CC7-3-5050	HCPK3
50	35	90P10	CC7-4-5035	HCPK4	CC7-3-5035	HCPK3
50	25	65P10	CC7-4-5025	HCPK4	CC7-3-5025	HCPK3
10mm Ø	10mm Ø	115P10	CC7-4-1010SC	HCPK4	CC7-3-1010SC	HCPK3
70	70	115P10	CC7-4-7070	HCPK4	CC7-3-7070	HCPK3
70	50	115P10	CC7-4-7050	HCPK4	CC7-3-7050	HCPK3
70	35	90P10	CC7-4-7035	HCPK4	CC7-3-7035	HCPK3
70	25	90P10	CC7-4-7025	HCPK4	CC7-3-7025	HCPK3
95	95	150P10	CC7-4-9595	HCPK4	-	-
95	70	115P10	CC7-4-9570	HCPK4	CC7-3-9570	HCPK3
95	50	115P10	CC7-4-9550	HCPK4	CC7-3-9550	HCPK3
95	35	115P10	CC7-4-9535	HCPK4	CC7-3-9535	HCPK3
120	120	200P10	CC7-4-120120	HCPK4	-	-
120	95	200P10	CC7-4-12095	HCPK4	-	-
120	70	150P10	CC7-4-12070	HCPK4	-	-
120	50	150P10	CC7-4-12050	HCPK4	-	-
150	150	2 x 150P10	CC7-5-150150	HCPK5	-	-
150	120	250P10	CC7-4-150120	HCPK4	-	-
150	95	200P10	CC7-4-15095	HCPK4	-	-
150	70	150P10	CC7-4-15070	HCPK4	-	-
185	185	2 x 150P10	CC7-5-185185	HCPK5	-	-
185	150	2 x 150P10	CC7-5-185150	HCPK5	-	-
185	120	250P10	CC7-4-185120	HCPK4	-	-
185	95	200P10	CC7-4-18595	HCPK4	-	-
240	240	2 x 200P10	CC7-5-240240	HCPK5	-	-
240	185	2 x 200P10	CC7-5-240185	HCPK5	-	-
240	150	2 x 150P10	CC7-5-240150	HCPK5	-	-
240	120	250P10	CC7-4-240120	HCPK4	-	-
300	300	2 x 250P10	CC7-5-300300	HCPK5	-	-
300	240	2 x 250P10	CC7-5-300240	HCPK5	-	-
300	185	2 x 200P10	CC7-5-300185	HCPK5	-	-
300	150	2 x 150P10	CC7-5-300150	HCPK5	-	-

* 4 x S103

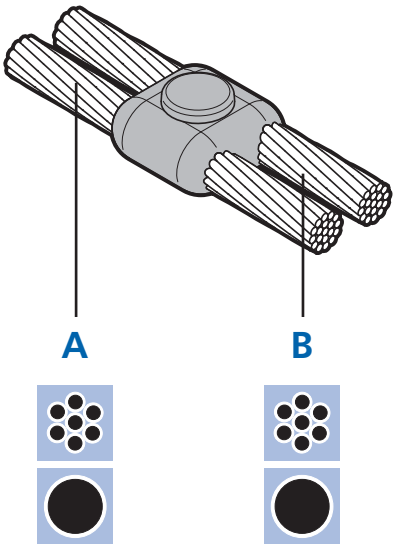


Cable to cable



CC11

A mm²	B mm²			
50	50	150P10	CC11-7-5050	HCPK7
70	70	200P10	CC11-7-7070	HCPK7
95	95	250P10	CC11-7-9595	HCPK7
120	120	2 x 150P10	CC11-7-120120	HCPK7
150	150	2 x 200P10	CC11-8-150150	HCPK8
185	185	2 x 250P10	CC11-8-185185	HCPK8
240	240	3 x 250P10	CC11-8-240240	HCPK8
8mm Ø	8mm Ø	150P10	CC11-7-8SC8SC	HCPK7
10mm Ø	10mm Ø	150P10	CC11-7-1010SC	HCPK7



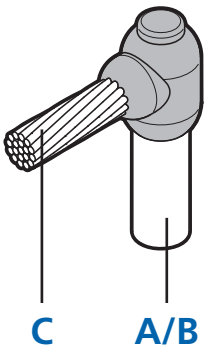
CC14

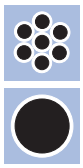
A mm²	B mm²				MINI	MINI
16*	16*	65P10	CC14-4-1616	HCPK4	CC14-3-1616	HCPK3
25	25	45P10	CC14-4-2525	HCPK4	CC14-3-2525	HCPK3
35	35	65P10	CC14-4-3535	HCPK4	CC14-3-3535	HCPK3
35	25	65P10	CC14-4-3525	HCPK4	CC14-3-3525	HCPK3
8mm Ø	8mm Ø	90P10	CC14-4-88SC	HCPK4	CC14-3-88SC	HCPK3
50	50	90P10	CC14-4-5050	HCPK4	CC14-3-5050	HCPK3
50	35	90P10	CC14-4-5035	HCPK4	CC14-3-5035	HCPK3
50	25	90P10	CC14-4-5025	HCPK4	CC14-3-5025	HCPK3
10mm Ø	10mm Ø	115P10	CC14-4-1010SC	HCPK4	CC14-3-1010SC	HCPK3
70	70	115P10	CC14-4-7070	HCPK4	CC14-3-7070	HCPK3
70	50	115P10	CC14-4-7050	HCPK4	CC14-3-7050	HCPK3
70	35	90P10	CC14-4-7035	HCPK4	CC14-3-7035	HCPK3
70	25	90P10	CC14-4-7025	HCPK4	CC14-3-7025	HCPK3
95	95	150P10	CC14-4-9595	HCPK4	-	-
95	70	150P10	CC14-4-9570	HCPK4	-	-
95	50	150P10	CC14-4-9550	HCPK4	-	-
95	35	115P10	CC14-4-9535	HCPK4	CC14-3-9535	HCPK3
120	120	200P10	CC14-4-120120	HCPK4	-	-
120	95	200P10	CC14-4-12095	HCPK4	-	-
120	70	200P10	CC14-4-12070	HCPK4	-	-
120	50	150P10	CC14-4-12050	HCPK4	-	-

* 4 x S103

CR1

A mm ø	B inches ø	C mm²				MINI	MINI
12.7	½"	16*	65P10	CR1-4-12716	HCPK4	CR1-3-12716	HCPK3
12.7	½"	25	65P10	CR1-4-12725	HCPK4	CR1-3-12725	HCPK3
12.7	½"	35	65P10	CR1-4-12735	HCPK4	CR1-3-12735	HCPK3
12.7	½"	50	65P10	CR1-4-12750	HCPK4	CR1-3-12750	HCPK3
12.7	½"	8mm Ø	65P10	CR1-4-1278SC	HCPK4	CR1-3-1278SC	HCPK3
12.7	½"	70	90P10	CR1-4-12770	HCPK4	CR1-3-12770	HCPK3
12.7	½"	95	90P10	CR1-4-12795	HCPK4	CR1-3-12795	HCPK3
12.7	½"	120	90P10	CR1-4-127120	HCPK4	CR1-3-127120	HCPK3
14.2	⅝"	16*	65P10	CR1-4-14216	HCPK4	CR1-3-14216	HCPK3
14.2	⅝"	25	65P10	CR1-4-14225	HCPK4	CR1-3-14225	HCPK3
14.2	⅝"	35	65P10	CR1-4-14235	HCPK4	CR1-3-14235	HCPK3
14.2	⅝"	50	90P10	CR1-4-14250	HCPK4	CR1-3-14250	HCPK3
14.2	⅝"	8mm Ø	90P10	CR1-4-1428SC	HCPK4	CR1-3-1428SC	HCPK3
14.2	⅝"	70	90P10	CR1-4-14270	HCPK4	CR1-3-14270	HCPK3
14.2	⅝"	95	90P10	CR1-4-14295	HCPK4	CR1-3-14295	HCPK3
14.2	⅝"	120	90P10	CR1-4-142120	HCPK4	CR1-3-142120	HCPK3
14.2	⅝"	150	115P10	CR1-4-142150	HCPK4	CR1-3-142150	HCPK3
14.2	⅝"	185	115P10	CR1-4-142185	HCPK4	CR1-3-142185	HCKP3
14.2	⅝"	240	150P10	CR1-4-142240	HCPK4	-	-
17.2	¾"	16*	65P10	CR1-4-17216	HCPK4	CR1-3-17216	HCPK3
17.2	¾"	25	65P10	CR1-4-17225	HCPK4	CR1-3-17225	HCPK3
17.2	¾"	35	65P10	CR1-4-17235	HCPK4	CR1-3-17235	HCPK3
17.2	¾"	50	90P10	CR1-4-17250	HCPK4	CR1-3-17250	HCPK3
17.2	¾"	8mm Ø	90P10	CR1-4-1728SC	HCPK4	CR1-3-1728SC	HCPK3
17.2	¾"	70	90P10	CR1-4-17270	HCPK4	CR1-3-17270	HCPK3
17.2	¾"	95	90P10	CR1-4-17295	HCPK4	CR1-3-17295	HCPK3
17.2	¾"	120	90P10	CR1-4-172120	HCPK4	CR1-3-172120	HCPK3
17.2	¾"	150	115P10	CR1-4-172150	HCPK4	CR1-3-172150	HCPK3
17.2	¾"	185	115P10	CR1-4-172185	HCPK4	CR1-3-172185	HCPK3
17.2	¾"	240	150P10	CR1-4-172240	HCPK4	-	-
17.2	¾"	300	200P10	CR1-4-172300	HCPK4	-	-



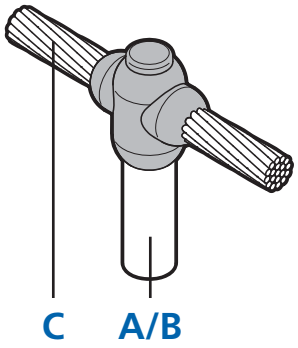


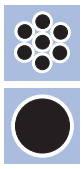
Suitable for connections to copperbond rods –
for connections to solid copper and stainless steel rods please contact our sales office.

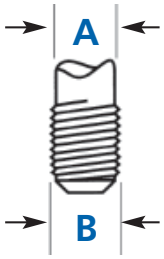
Threaded portion of copperbond rods must be removed prior to welding.

*  1 x S103

Cable to earth rod







CR2

A mm ø	B inches ø	C mm²				MINI	MINI
12.7	½"	16*	90P10	CR2-4-12716	HCPK4	CR2-3-12716	HCPK3
12.7	½"	25	90P10	CR2-4-12725	HCPK4	CR2-3-12725	HCPK3
12.7	½"	35	90P10	CR2-4-12735	HCPK4	CR2-3-12735	HCPK3
12.7	½"	50	90P10	CR2-4-12750	HCPK4	CR2-3-12750	HCPK3
12.7	½"	8mm Ø	90P10	CR2-4-1278SC	HCPK4	CR2-3-1278SC	HCPK3
12.7	½"	70	90P10	CR2-4-12770	HCPK4	CR2-3-12770	HCPK3
12.7	½"	95	115P10	CR2-4-12795	HCPK4	CR2-3-12795	HCPK3
12.7	½"	120	150P10	CR2-4-127120	HCPK4	-	-
14.2	⅝"	16*	90P10	CR2-4-14216	HCPK4	CR2-3-14216	HCPK3
14.2	⅝"	25	90P10	CR2-4-14225	HCPK4	CR2-3-14225	HCPK3
14.2	⅝"	35	90P10	CR2-4-14235	HCPK4	CR2-3-14235	HCPK3
14.2	⅝"	50	90P10	CR2-4-14250	HCPK4	CR2-3-14250	HCPK3
14.2	⅝"	8mm Ø	90P10	CR2-4-1428SC	HCPK4	CR2-3-1428SC	HCPK3
14.2	⅝"	70	115P10	CR2-4-14270	HCPK4	CR2-3-14270	HCPK3
14.2	⅝"	95	115P10	CR2-4-14295	HCPK4	CR2-3-14295	HCPK3
14.2	⅝"	120	150P10	CR2-4-142120	HCPK4	-	-
14.2	⅝"	150	200P10	CR2-4-142150	HCPK4	-	-
14.2	⅝"	185	200P10	CR2-4-142185	HCPK4	-	-
14.2	⅝"	240	250P10	CR2-4-142240	HCPK4	-	-
17.2	¾"	16*	90P10	CR2-4-17216	HCPK4	CR2-3-17216	HCPK3
17.2	¾"	25	90P10	CR2-4-17225	HCPK4	CR2-3-17225	HCPK3
17.2	¾"	35	90P10	CR2-4-17235	HCPK4	CR2-3-17235	HCPK3
17.2	¾"	50	115P10	CR2-4-17250	HCPK4	CR2-3-17250	HCPK3
17.2	¾"	8mm Ø	115P10	CR2-4-1728SC	HCPK4	CR2-3-1728SC	HCPK3
17.2	¾"	70	115P10	CR2-4-17270	HCPK4	CR2-3-17270	HCPK3
17.2	¾"	95	115P10	CR2-4-17295	HCPK4	CR2-3-17295	HCPK3
17.2	¾"	120	150P10	CR2-4-172120	HCPK4	-	-
17.2	¾"	150	200P10	CR2-4-172150	HCPK4	-	-
17.2	¾"	185	200P10	CR2-4-172185	HCPK4	-	-
17.2	¾"	240	250P10	CR2-4-172240	HCPK4	-	-
17.2	¾"	300	2 x 150P10	CR2-5-172300	HCPK5	-	-

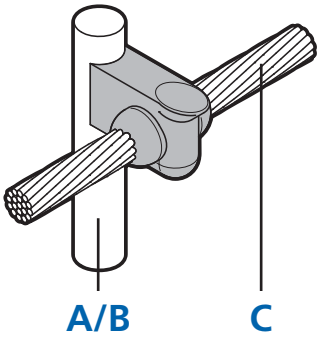
Suitable for connections to copperbond rods –
for connections to solid copper and stainless steel rods please contact our sales office.

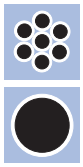
Threaded portion of copperbond rods must be removed prior to welding.

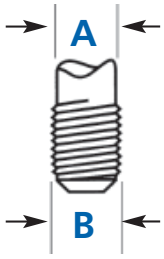
*  2 x S103

CR3

A mm ø	B inches ø	C mm²			
12.7	½"	16*	90P10	CR3-9-12716	HCPK4
12.7	½"	25	90P10	CR3-9-12725	HCPK4
12.7	½"	35	90P10	CR3-9-12735	HCPK4
12.7	½"	50	115P10	CR3-9-12750	HCPK4
12.7	½"	8mm Ø	115P10	CR3-9-1278SC	HCPK4
12.7	½"	70	115P10	CR3-9-12770	HCPK4
12.7	½"	95	115P10	CR3-9-12795	HCPK4
12.7	½"	120	150P10	CR3-9-127120	HCPK4
14.2	⅝"	16*	90P10	CR3-9-14216	HCPK4
14.2	⅝"	25	90P10	CR3-9-14225	HCPK4
14.2	⅝"	35	90P10	CR3-9-14235	HCPK4
14.2	⅝"	50	115P10	CR3-9-14250	HCPK4
14.2	⅝"	8mm Ø	115P10	CR3-9-1428SC	HCPK4
14.2	⅝"	70	115P10	CR3-9-14270	HCPK4
14.2	⅝"	95	115P10	CR3-9-14295	HCPK4
14.2	⅝"	120	150P10	CR3-9-142120	HCPK4
14.2	⅝"	150	150P10	CR3-9-142150	HCPK4
14.2	⅝"	185	250P10	CR3-9-142185	HCPK4
14.2	⅝"	240	2 x 200P10	CR3-10-142240	HCPK5
17.2	¾"	16*	90P10	CR3-9-17216	HCPK4
17.2	¾"	25	90P10	CR3-9-17225	HCPK4
17.2	¾"	35	90P10	CR3-9-17235	HCPK4
17.2	¾"	50	115P10	CR3-9-17250	HCPK4
17.2	¾"	8mm Ø	115P10	CR3-9-1728SC	HCPK4
17.2	¾"	70	150P10	CR3-9-17270	HCPK4
17.2	¾"	95	150P10	CR3-9-17295	HCPK4
17.2	¾"	120	200P10	CR3-9-172120	HCPK4
17.2	¾"	150	250P10	CR3-9-172150	HCPK4
17.2	¾"	185	2 x 200P10	CR3-10-172185	HCPK5
17.2	¾"	240	2 x 250P10	CR3-10-172240	HCPK5
17.2	¾"	300	3 x 200P10	CR3-10-172300	HCPK5







Suitable for connections to copperbond rods –
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Threaded portion of copperbond rods must be removed prior to welding.

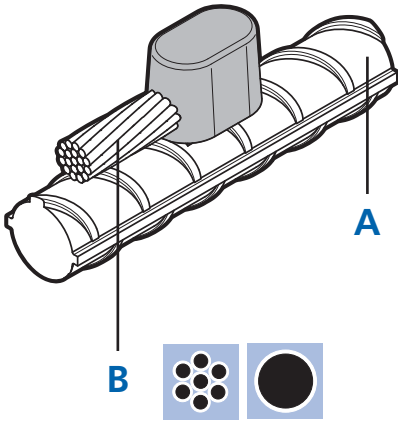
*  2 x S103

Frames

The CR3 joint type utilises a 3 part mould. For this reason, a Frame is required in addition to the standard Handle Clamp.

Description	Part No.
Frame for use with Handle Clamp HCPK4	F1-FU
Frame for use with Handle Clamp HCPK5	F2-FU

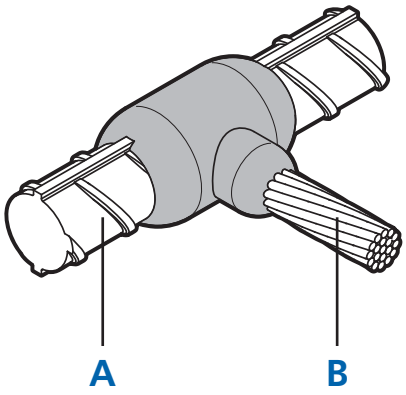
Cable to reinforcing bar



CRE1

A mm ø	B mm²				
10 – 40	16*	45P10	CRE1-3-16	HCPK3-B	PACK-A
10 – 40	25	45P10	CRE1-3-25	HCPK3-B	PACK-A
10 – 40	35	45P10	CRE1-3-35	HCPK3-B	PACK-A
10 – 40	8mm Ø	90P10	CRE1-3-8SC	HCPK3-B	PACK-A
10 – 40	50	90P10	CRE1-3-50	HCPK3-B	PACK-A
10 – 40	10mm Ø	90P10	CRE1-3-10SC	HCPK3-B	PACK-A
10 – 40	70	90P10	CRE1-3-70	HCPK3-B	PACK-A
10 – 40	95	90P10	CRE1-3-95	HCPK3-B	PACK-A
10 – 40	120	90P10	CRE1-3-120	HCPK3-B	PACK-A

* 1 x S103



CRE2

A mm ø	B mm²			
16	16*	90P10	CRE2-4-16R16	HCPK4
16	25	90P10	CRE2-4-16R25	HCPK4
16	35	90P10	CRE2-4-16R35	HCPK4
16	8mm Ø	115P10	CRE2-4-16R8SC	HCPK4
16	50	115P10	CRE2-4-16R50	HCPK4
16	10mm Ø	115P10	CRE2-4-16R10SC	HCPK4
16	70	115P10	CRE2-4-16R70	HCPK4
16	95	150P10	CRE2-4-16R95	HCPK4
16	120	150P10	CRE2-4-16R120	HCPK4
16	150	200P10	CRE2-4-16R150	HCPK4
16	185	200P10	CRE2-4-16R185	HCPK4
16	240	250P10	CRE2-4-16R240	HCPK4
16	300	2 x 150P10	CRE2-4-16R300	HCPK4
18	16*	115P10	CRE2-4-18R16	HCPK4
18	25	115P10	CRE2-4-18R25	HCPK4
18	35	115P10	CRE2-4-18R35	HCPK4
18	8mm Ø	150P10	CRE2-4-18R8SC	HCPK4
18	50	150P10	CRE2-4-18R50	HCPK4
18	10mm Ø	150P10	CRE2-4-18R10SC	HCPK4
18	70	150P10	CRE2-4-18R70	HCPK4
18	95	150P10	CRE2-4-18R95	HCPK4
18	120	200P10	CRE2-4-18R120	HCPK4
18	150	200P10	CRE2-4-18R150	HCPK4
18	185	200P10	CRE2-4-18R185	HCPK4
18	240	250P10	CRE2-4-18R240	HCPK4
18	300	2 x 150P10	CRE2-4-18R300	HCPK4
20	16*	115P10	CRE2-4-20R16	HCPK4
20	25	115P10	CRE2-4-20R25	HCPK4
20	35	115P10	CRE2-4-20R35	HCPK4
20	8mm Ø	150P10	CRE2-4-20R8SC	HCPK4
20	50	150P10	CRE2-4-20R50	HCPK4
20	10mm Ø	150P10	CRE2-4-20R10SC	HCPK4
20	70	200P10	CRE2-4-20R70	HCPK4
20	95	200P10	CRE2-4-20R95	HCPK4
20	120	200P10	CRE2-4-20R120	HCPK4
20	150	200P10	CRE2-4-20R150	HCPK4
20	185	250P10	CRE2-4-20R185	HCPK4

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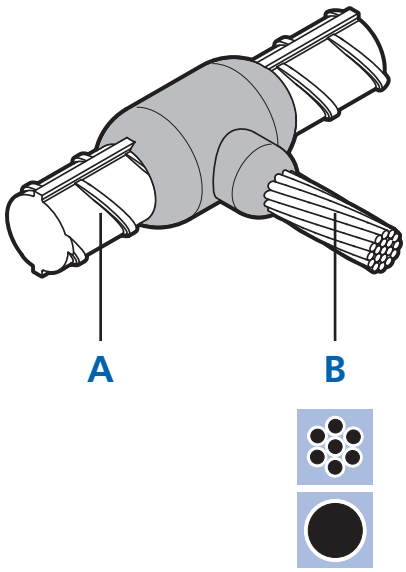
* 1 x S103

CRE2 continued

A mm ø	B mm²			
20	240	2 x 150P10	CRE2-4-20R240	HCPK4
20	300	2 x 200P10	CRE2-5-20R300	HCPK5
25	16*	200P10	CRE2-4-25R16	HCPK4
25	25	200P10	CRE2-4-25R25	HCPK4
25	35	200P10	CRE2-4-25R35	HCPK4
25	8mm Ø	200P10	CRE2-4-25R8SC	HCPK4
25	50	200P10	CRE2-4-25R50	HCPK4
25	10mm Ø	250P10	CRE2-4-25R10SC	HCPK4
25	70	250P10	CRE2-4-25R70	HCPK4
25	95	250P10	CRE2-4-25R95	HCPK4
25	120	250P10	CRE2-4-25R120	HCPK4
25	150	2 x 150P10	CRE2-4-25R150	HCPK4
25	185	2 x 150P10	CRE2-5-25R185	HCPK5
25	240	2 x 200P10	CRE2-5-25R240	HCPK5
25	300	2 x 200P10	CRE2-5-25R300	HCPK5
30	16*	250P10	CRE2-4-30R16	HCPK4
30	25	250P10	CRE2-4-30R25	HCPK4
30	35	250P10	CRE2-4-30R35	HCPK4
30	8mm Ø	2 x 150P10	CRE2-4-30R8SC	HCPK4
30	50	2 x 150P10	CRE2-4-30R50	HCPK4
30	10mm Ø	2 x 150P10	CRE2-4-30R10SC	HCPK4
30	70	2 x 150P10	CRE2-4-30R70	HCPK4
30	95	2 x 150P10	CRE2-5-30R95	HCPK5
30	120	2 x 200P10	CRE2-5-30R120	HCPK5
30	150	2 x 200P10	CRE2-5-30R150	HCPK5
30	185	2 x 250P10	CRE2-5-30R185	HCPK5
30	240	3 x 200P10	CRE2-5-30R240	HCPK5
30	300	3 x 200P10	CRE2-5-30R300	HCPK5



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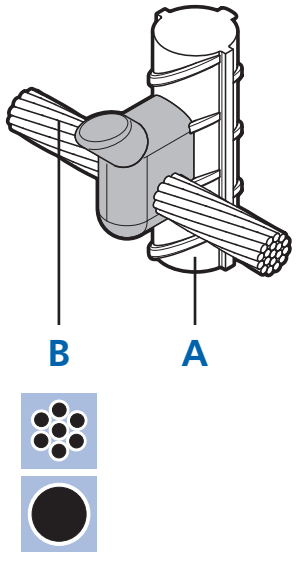
* 1 x S103

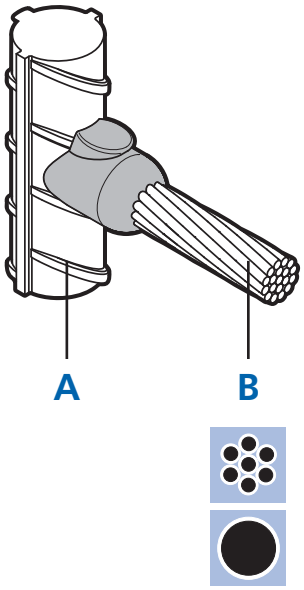
CRE3

A mm ø	B mm²				
10 – 40	16*	45P10	CRE3-3-16	HCPK3-A	PACK-A
10 – 40	25	45P10	CRE3-3-25	HCPK3-A	PACK-A
10 – 40	35	45P10	CRE3-3-35	HCPK3-A	PACK-A
10 – 40	8mm Ø	90P10	CRE3-3-8SC	HCPK3-A	PACK-A
10 – 40	50	90P10	CRE3-3-50	HCPK3-A	PACK-A
10 – 40	10mm Ø	90P10	CRE3-3-10SC	HCPK3-A	PACK-A
10 – 40	70	90P10	CRE3-3-70	HCPK3-A	PACK-A
10 – 40	95	90P10	CRE3-3-95	HCPK3-A	PACK-A
10 – 40	120	90P10	CRE3-3-120	HCPK3-A	PACK-A



* 2 x S103

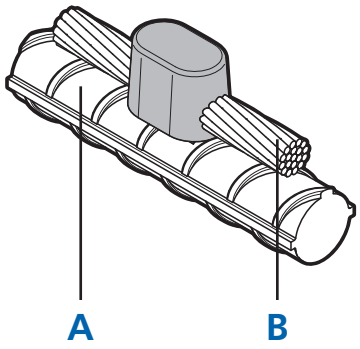
Cable to reinforcing bar



CRE6

A mm ø	B mm²				
10 – 40	16*	45P10	CRE6-3-16	HCPK3-A	PACK-A
10 – 40	25	45P10	CRE6-3-25	HCPK3-A	PACK-A
10 – 40	35	45P10	CRE6-3-35	HCPK3-A	PACK-A
10 – 40	8mm Ø	65P10	CRE6-3-8SC	HCPK3-A	PACK-A
10 – 40	50	65P10	CRE6-3-50	HCPK3-A	PACK-A
10 – 40	10mm Ø	90P10	CRE6-3-10SC	HCPK3-A	PACK-A
10 – 40	70	90P10	CRE6-3-70	HCPK3-A	PACK-A
10 – 40	95	90P10	CRE6-4-95	HCPK3-A	PACK-A
10 – 40	120	115P10	CRE6-4-120	HCPK3-A	PACK-A

* 1 x S103



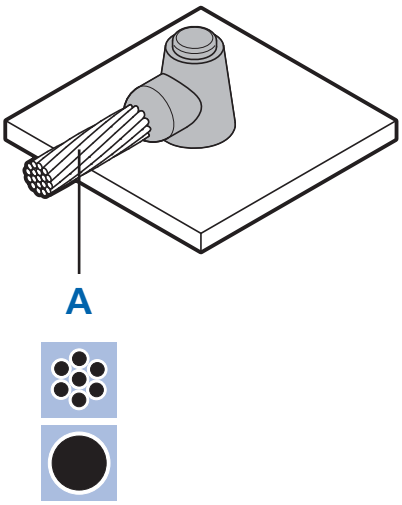
CRE17

A mm ø	B mm²				
10 – 40	16*	45P10	CRE17-3-16	HCPK3-B	PACK-A
10 – 40	25	45P10	CRE17-3-25	HCPK3-B	PACK-A
10 – 40	35	45P10	CRE17-3-35	HCPK3-B	PACK-A
10 – 40	8mm Ø	90P10	CRE17-3-8SC	HCPK3-B	PACK-A
10 – 40	50	90P10	CRE17-3-50	HCPK3-B	PACK-A
10 – 40	10mm Ø	90P10	CRE17-3-10SC	HCPK3-B	PACK-A
10 – 40	70	90P10	CRE17-3-70	HCPK3-B	PACK-A
10 – 40	95	90P10	CRE17-3-95	HCPK3-B	PACK-A
10 – 40	120	90P10	CRE17-3-120	HCPK3-B	PACK-A

* 2 x S103

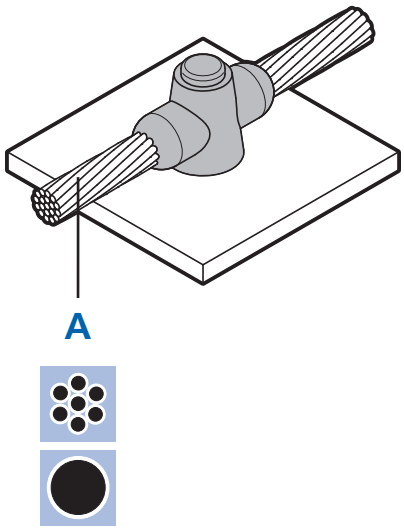
CS1

A mm²			
16	USE CS8 PAGE 130		
25			
35			
8mm Ø	90P10	CS1-4-8SC	HCPK4
50	90P10	CS1-4-50	HCPK4
10mm Ø	90P10	CS1-4-10SC	HCPK4
70	90P10	CS1-4-70	HCPK4
95	115P10	CS1-4-95	HCPK4
120	115P10	CS1-4-120	HCPK4
150	150P10	CS1-4-150	HCPK4
185	200P10	CS1-4-185	HCPK4
240	200P10	CS1-4-240	HCPK4
300	250P10	CS1-4-300	HCPK4

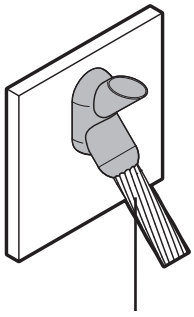


CS2

A mm²			
16	USE CS9 PAGE 131		
25			
35			
8mm Ø	90P10	CS2-4-8SC	HCPK4
50	90P10	CS2-4-50	HCPK4
10mm Ø	115P10	CS2-4-10SC	HCPK4
70	115P10	CS2-4-70	HCPK4
95	115P10	CS2-4-95	HCPK4
120	150P10	CS2-4-120	HCPK4
150	200P10	CS2-4-150	HCPK4
185	250P10	CS2-4-185	HCPK4
240	2 x 150P10	CS2-5-240	HCPK5
300	2 x 200P10	CS2-5-300	HCPK5



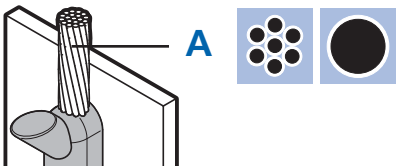
Cable to steel surface and pipe



* 1 x S103

CS3

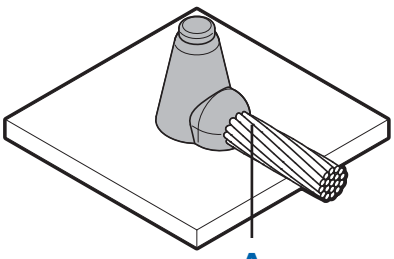
A mm²				MINI	MINI
16*	45P10	CS3-4-16	HCPK4	CS3-3-16	HCPK3
25	45P10	CS3-4-25	HCPK4	CS3-3-25	HCPK3
35	45P10	CS3-4-35	HCPK4	CS3-3-35	HCPK3
8mm Ø	65P10	CS3-4-8SC	HCPK4	CS3-3-8SC	HCPK3
50	65P10	CS3-4-50	HCPK4	CS3-3-50	HCPK3
10mm Ø	90P10	CS3-4-10SC	HCPK4	CS3-3-10SC	HCPK3
70	90P10	CS3-4-70	HCPK4	CS3-3-70	HCPK3
95	115P10	CS3-4-95	HCPK4	CS3-3-95	HCPK3
120	115P10	CS3-4-120	HCPK4	CS3-3-120	HCPK3
150	115P10	CS3-4-150	HCPK4	CS3-3-150	HCPK3
185	200P10	CS3-4-185	HCPK4	-	-
240	200P10	CS3-4-240	HCPK4	-	-
300	250P10	CS3-4-300	HCPK4	-	-



* 1 x S103

CS7

A mm²				MINI	MINI
16*	65P10	CS7-4-16	HCPK4	CS7-3-16	HCPK3
25	65P10	CS7-4-25	HCPK4	CS7-3-25	HCPK3
35	65P10	CS7-4-35	HCPK4	CS7-3-35	HCPK3
8mm Ø	90P10	CS7-4-8SC	HCPK4	CS7-3-8SC	HCPK3
50	90P10	CS7-4-50	HCPK4	CS7-3-50	HCPK3
10mm Ø	150P10	CS7-4-10SC	HCPK4	-	-
70	150P10	CS7-4-70	HCPK4	-	-
95	200P10	CS7-5-95	HCPK4	-	-
120	200P10	CS7-5-120	HCPK4	-	-
150	250P10	CS7-5-150	HCPK4	-	-
185	2 x 150P10	CS7-9-185	HCPK4	-	-
240	2 x 150P10	CS7-9-240	HCPK4	-	-
300	2 x 200P10	CS7-10-300	HCPK5	-	-



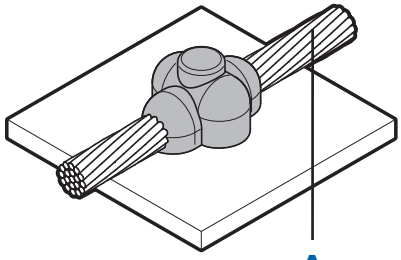
* 1 x S103

CS8

A mm²			
16*	45P10	CS8-2-16	HCPK2
25	45P10	CS8-2-25	HCPK2
35	45P10	CS8-2-35	HCPK2
8mm Ø	45P10	CS8-2-8SC	HCPK2
50	45P10	CS8-2-50	HCPK2
10mm Ø	65P10	CS8-2-10SC	HCPK2
70	65P10	CS8-2-70	HCPK2
95	90P10	CS8-2-95	HCPK2
120	115P10	CS8-4-120	HCPK4
150	150P10	CS8-4-150	HCPK4
185	200P10	CS8-4-185	HCPK4
240	200P10	CS8-4-240	HCPK4
300	250P10	CS8-4-300	HCPK4

CS9

A mm²			
16*	45P10	CS9-2-16	HCPK2
25	45P10	CS9-2-25	HCPK2
35	45P10	CS9-2-35	HCPK2
8mm Ø	90P10	CS9-4-8SC	HCPK4
50	90P10	CS9-4-50	HCPK4
10mm Ø	115P10	CS9-4-10SC	HCPK4
70	115P10	CS9-4-70	HCPK4
95	115P10	CS9-4-95	HCPK4
120	150P10	CS9-4-120	HCPK4
150	200P10	CS9-4-150	HCPK4
185	250P10	CS9-4-185	HCPK4
240	2 x 150P10	CS9-5-240	HCPK5

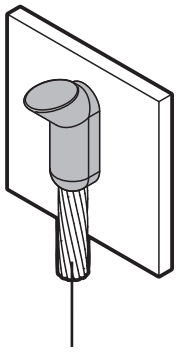


DUXSEAL

* 1 x S103

CS25

A mm²				MINI	MINI
16*	45P10	CS25-4-16	HCPK4	CS25-3-16	HCPK3
25	45P10	CS25-4-25	HCPK4	CS25-3-25	HCPK3
35	45P10	CS25-4-35	HCPK4	CS25-3-35	HCPK3
8mm Ø	65P10	CS25-4-8SC	HCPK4	CS25-3-8SC	HCPK3
50	65P10	CS25-4-50	HCPK4	CS25-3-50	HCPK3
10mm Ø	90P10	CS25-4-10SC	HCPK4	-	-
70	90P10	CS25-4-70	HCPK4	CS25-3-70	HCPK3
95	115P10	CS25-4-95	HCPK4	-	-
120	115P10	CS25-4-120	HCPK4	-	-
150	150P10	CS25-4-150	HCPK4	-	-
185	200P10	CS25-4-185	HCPK4	-	-
240	200P10	CS25-4-240	HCPK4	-	-
300	250P10	CS25-4-300	HCPK4	-	-

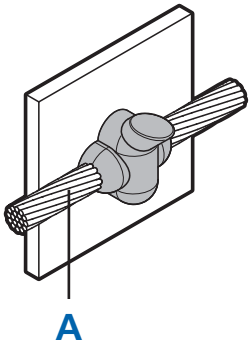


DUXSEAL

* 1 x S103

CS27

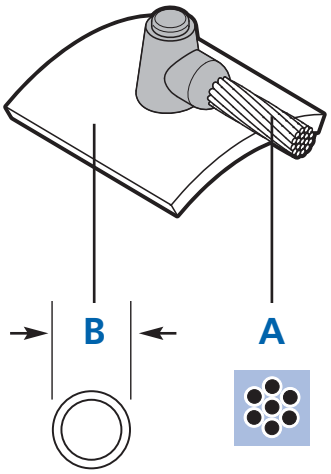
A mm²			
16*	45P10	CS27-4-16	HCPK4
25	45P10	CS27-4-25	HCPK4
35	45P10	CS27-4-35	HCPK4
8mm Ø	65P10	CS27-4-8SC	HCPK4
50	65P10	CS27-4-50	HCPK4
10mm Ø	115P10	CS27-4-10SC	HCPK4
70	115P10	CS27-4-70	HCPK4
95	150P10	CS27-4-95	HCPK4
120	150P10	CS27-4-120	HCPK4
150	200P10	CS27-5-150	HCPK5
185	250P10	CS27-5-185	HCPK5
240	2 x 150P10	CS27-5-240	HCPK5
300	2 x 200P10	CS27-5-300	HCPK5



DUXSEAL

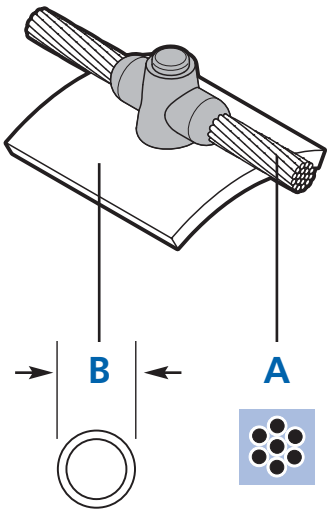
* 1 x S103

Cable to steel surface and pipe



CS32

A mm²	B mm ø				
2.5	<125	15P10	CS32-1-2.5-A	HCPK1	1 x S105
2.5	>125	15P10	CS32-1-2.5-B	HCPK1	1 x S105
4	<125	15P10	CS32-1-4-A	HCPK1	1 x S105
4	>125	15P10	CS32-1-4-B	HCPK1	1 x S105
6	<125	15P10	CS32-1-6-A	HCPK1	1 x S105
6	>125	15P10	CS32-1-6-B	HCPK1	1 x S105
10	<125	25P10	CS32-1-10-A	HCPK1	1 x S102
10	>125	25P10	CS32-1-10-B	HCPK1	1 x S102
16	<125	45P10	CS32-2-16-A	HCPK2	1 x S103
16	>125	45P10	CS32-2-16-B	HCPK2	1 x S103
25	<70	25P10	CS32-1-25-C	HCPK1	-
25	70 – 165	25P10	CS32-1-25-D	HCPK1	-
25	>165	25P10	CS32-1-25-E	HCPK1	-
35	<70	45P10	CS32-2-35-C	HCPK2	-
35	70 – 165	45P10	CS32-2-35-D	HCPK2	-
35	165 – 250	45P10	CS32-2-35-F	HCPK2	-
35	>250	45P10	CS32-2-35-G	HCPK2	-
50	<70	45P10	CS32-2-50-C	HCPK2	-
50	70 – 165	45P10	CS32-2-50-D	HCPK2	-
50	165 – 250	45P10	CS32-2-50-F	HCPK2	-
50	>250	45P10	CS32-2-50-G	HCPK2	-
70	<70	65P10	CS32-2-70-C	HCPK2	-
70	70 – 165	65P10	CS32-2-70-D	HCPK2	-
70	165 – 250	65P10	CS32-2-70-F	HCPK2	-
70	>250	65P10	CS32-2-70-G	HCPK2	-

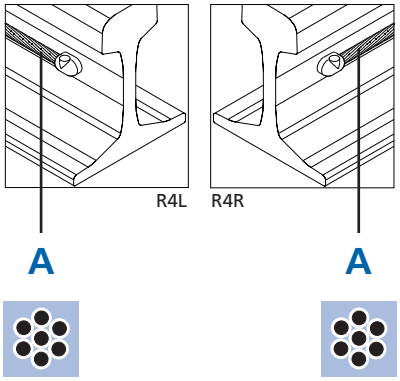


CS34

A mm²	B mm ø				
2.5	<125	15P10	CS34-2-2.5-A	HCPK2	2 x S105
2.5	>125	15P10	CS34-2-2.5-B	HCPK2	2 x S105
4	<125	15P10	CS34-2-4-A	HCPK2	2 x S105
4	>125	15P10	CS34-2-4-B	HCPK2	2 x S105
6	<125	15P10	CS34-2-6-A	HCPK2	2 x S105
6	>125	15P10	CS34-2-6-B	HCPK2	2 x S105
10	<125	32P10	CS34-2-10-A	HCPK2	2 x S102
10	>125	32P10	CS34-2-10-B	HCPK2	2 x S102
16	<125	45P10	CS34-2-16-A	HCPK2	2 x S103
16	>125	45P10	CS34-2-16-B	HCPK2	2 x S103
25	<70	32P10	CS34-2-25-C	HCPK2	-
25	70 – 165	32P10	CS34-2-25-D	HCPK2	-
25	>165	32P10	CS34-2-25-E	HCPK2	-
35	<70	45P10	CS34-2-35-C	HCPK2	-
35	70 – 165	45P10	CS34-2-35-D	HCPK2	-
35	165 – 250	45P10	CS34-2-35-F	HCPK2	-
35	>250	45P10	CS34-2-35-G	HCPK2	-
50	<70	65P10	CS34-2-50-C	HCPK2	-
50	70 – 165	65P10	CS34-2-50-D	HCPK2	-
50	165 – 250	65P10	CS34-2-50-F	HCPK2	-
50	>250	65P10	CS34-2-50-G	HCPK2	-

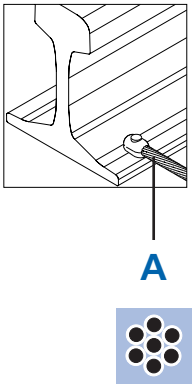
R4

A mm²					
16	45P10	R4L-4-16	HCR1	S103	-
16	45P10	R4R-4-16	HCR1	S103	-
25	45P10	R4L-4-25	HCR1	-	-
25	45P10	R4R-4-25	HCR1	-	-
35	45P10	R4L-4-35	HCR1	S106	HD35
35	45P10	R4R-4-35	HCR1	S106	HD35
50	65P10	R4L-4-50	HCR1	S107	HD50
50	65P10	R4R-4-50	HCR1	S107	HD50
70	90P10	R4L-4-70	HCR1	S108A	HD70
70	90P10	R4R-4-70	HCR1	S108A	HD70
95	90P10	R4L-9-95	HCR1	S109A	HD95
95	90P10	R4R-9-95	HCR1	S109A	HD95
120	115P10	R4L-9-120	HCR1	S110A	HD120
120	115P10	R4R-9-120	HCR1	S110A	HD120
150	150P10	R4L-9-150	HCR1	S111A	HD150
150	150P10	R4R-9-150	HCR1	S111A	HD150



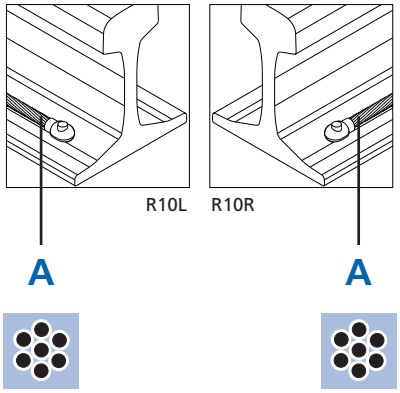
R5

A mm²					
16	25P10	R5-3-16	HCPK2	S103	-
25	25P10	R5-3-25	HCPK2	-	-
35	32P10	R5-3-35	HCPK2	S106	HD35
50	45P10	R5-3-50	HCPK2	S107	HD50
70	65P10	R5-3-70	HCPK2	S108	HD70
95	65P10	R5-3-95	HCPK2	S109	HD95
120	90P10	R5-3-120	HCPK2	S110	HD120
150	115P10	R5-3-150	HCPK2	S111	HD150

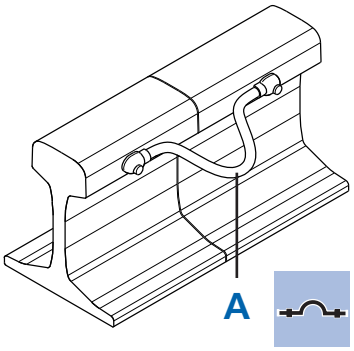


R10

A mm²					
16	25P10	R10L-3-16	HCPK2	S103	-
16	25P10	R10R-3-16	HCPK2	S103	-
25	25P10	R10L-3-25	HCPK2	-	-
25	25P10	R10R-3-25	HCPK2	-	-
35	32P10	R10L-3-35	HCPK2	S106	HD35
35	32P10	R10R-3-35	HCPK2	S106	HD35
50	45P10	R10L-3-50	HCPK2	S107	HD50
50	45P10	R10R-3-50	HCPK2	S107	HD50
70	65P10	R10L-3-70	HCPK2	S108	HD70
70	65P10	R10R-3-70	HCPK2	S108	HD70
95	65P10	R10L-3-95	HCPK2	S109	HD95
95	65P10	R10R-3-95	HCPK2	S109	HD95
120	90P10	R10L-3-120	HCPK2	S110	HD120
120	90P10	R10R-3-120	HCPK2	S110	HD120
150	115P10	R10L-3-150	HCPK2	S111	HD150
150	115P10	R10R-3-150	HCPK2	S111	HD150

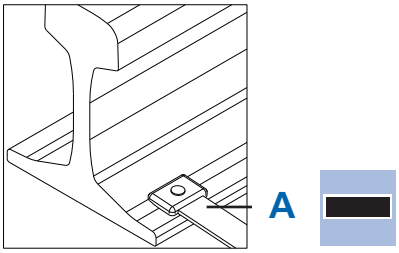


Cable, bar and stud to rail and stud to steel surface



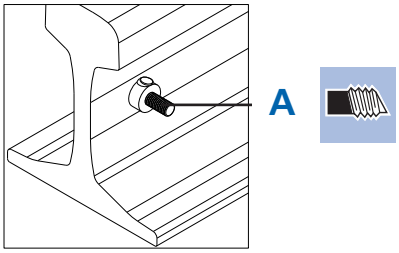
R12 – Cable to rail

A mm²				
50	45P10	R12-3-50	HCR2	RB50
70	65P10	R12-3-70	HCR2	RB70
95	90P10	R12-3-95	HCR2	RB95



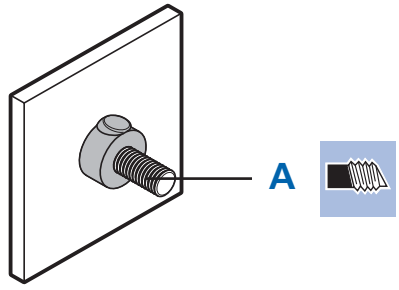
R6 – Bar to rail

A mm x mm			
25 x 3	65P10	R6-3-253	HCPK2



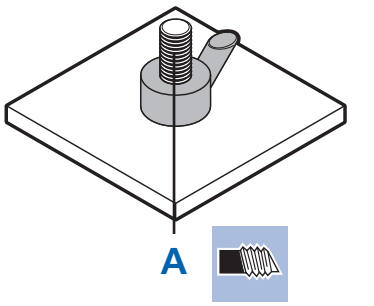
R8 – Stud to rail

A				
M6	45P10	R8-4-M6	HCPK4	RSSM6
M8	45P10	R8-4-M8	HCPK4	RSSM8
M10	65P10	R8-4-M10	HCPK4	RSSM10
M12	90P10	R8-4-M12	HCPK4	RSSM12
M16	115P10	R8-5-M16	HCPK4	RSSM16



RS1 – Stud to steel surface

A				
M6	25P10	RS1-4-M6	HCPK4	RSSM6
M8	32P10	RS1-4-M8	HCPK4	RSSM8
M10	45P10	RS1-4-M10	HCPK4	RSSM10
M12	65P10	RS1-4-M12	HCPK4	RSSM12
M16	115P10	RS1-4-M16	HCPK4	RSSM16



RS2 – Stud to steel surface

A				
M6	25P10	RS2-4-M6	HCPK4	RSSM6
M8	32P10	RS2-4-M8	HCPK4	RSSM8
M10	45P10	RS2-4-M10	HCPK4	RSSM10
M12	65P10	RS2-4-M12	HCPK4	RSSM12
M16	115P10	RS2-5-M16	HCPK5	RSSM16

The FurseWELD SureSHOT system is a cost effective solution for applications requiring only a small number of high quality electrical connections.

Like all FurseWELD products, SureSHOT uses the high temperature reaction between powdered copper oxide and aluminium to create fault tolerant electrical connections without any external power or heat source.

SureSHOT connections have the same benefits as FurseWELD connections:

- tolerant to repeated fault currents
- highly conductive
- do not loosen
- excellent corrosion resistance

Unlike the graphite FurseWELD moulds, the SureSHOT moulds are ceramic and specifically designed to be used only once. They are disposed of or buried in place with the joint once it has been completed.

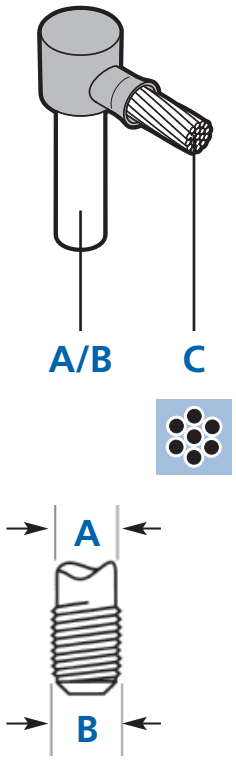
SureSHOT moulds are supplied complete with powders and retaining disc.

1 Insert the rod and conductor into the mould, locate the retaining disc and pour in the weld powder.

2 Place the lid on top of the mould, add starting powder and ignite with spark gun.

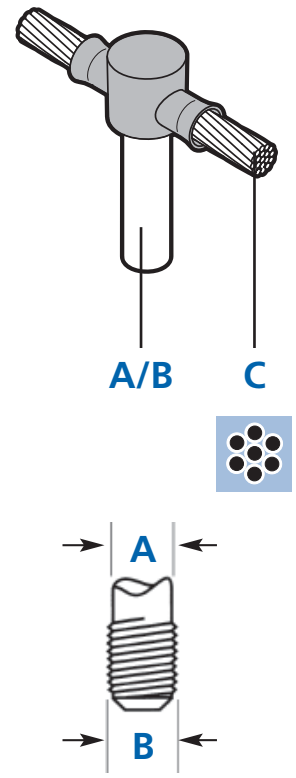
3 The resulting exothermic reaction reduces the weld powder to molten copper alloy which melts the retaining disc and flows into the weld cavity where it partially melts the conductors. The molten copper alloy cools to leave a fusion weld of great mechanical and electrical integrity.

4 Once the joint is completed, the ceramic mould can either be disposed of or buried in place.



SS1

A mm ø	B inches ø	C mm²		
14.2	⅝"	16	4	SS1-14216
14.2	⅝"	25	4	SS1-14225
14.2	⅝"	35	4	SS1-14235
14.2	⅝"	50	4	SS1-14250
14.2	⅝"	70	4	SS1-14270
14.2	⅝"	95	4	SS1-14295
17.2	¾"	16	4	SS1-17216
17.2	¾"	25	4	SS1-17225
17.2	¾"	35	4	SS1-17235
17.2	¾"	50	4	SS1-17250
17.2	¾"	70	4	SS1-17270
17.2	¾"	95	4	SS1-17295



SS2

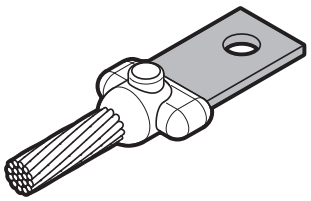
A mm ø	B inches ø	C mm²		
14.2	⅝"	16	4	SS2-14216
14.2	⅝"	25	4	SS2-14225
14.2	⅝"	35	4	SS2-14235
14.2	⅝"	50	4	SS2-14250
14.2	⅝"	70	4	SS2-14270
14.2	⅝"	95	4	SS2-14295
17.2	¾"	16	4	SS2-17216
17.2	¾"	25	4	SS2-17225
17.2	¾"	35	4	SS2-17235
17.2	¾"	50	4	SS2-17250
17.2	¾"	70	4	SS2-17270
17.2	¾"	95	4	SS2-17295

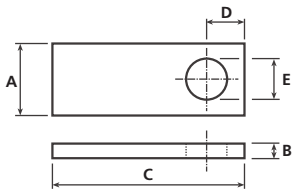
Suitable for connections to copperbond rods – for connections to solid copper and stainless steel rods please contact our sales office.

Threaded portion of copperbond rods must be removed prior to welding.

Straight type lug

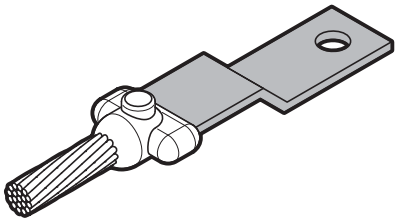
A mm	B mm	C mm	D mm	E mm	Part No.
20	3	45	10	8.5	LS101-FU
25	3	50	12	8.5	LS102-FU
25	3	50	12	10.5	LS103-FU
31	6	75	15	10.5	LS104-FU
31	6	75	15	12.5	LS105-FU
38	5	75	18	10.5	LS106-FU
38	6	75	18	10.5	LS107-FU
38	6	75	20	12.5	LS108-FU
50	6	95	25	10.5	LS109-FU
50	6	95	25	12.5	LS110-FU

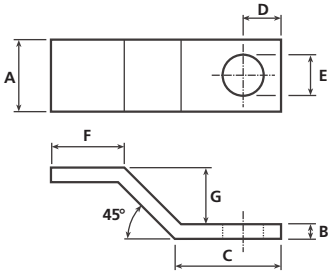




Cranked type lug

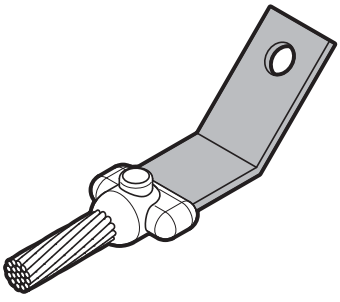
A mm	B mm	C mm	D mm	E mm	F mm	G mm	Part No.
20	3	40	10	8.5	40	10	LC101-FU
25	3	45	12	8.5	40	10	LC102-FU
25	3	45	12	10.5	40	10	LC103-FU
31	6	50	15	10.5	40	15	LC104-FU
31	6	50	16	12.5	40	15	LC105-FU
38	5	55	18	10.5	40	15	LC106-FU
38	6	55	18	10.5	40	15	LC107-FU
38	6	55	20	12.5	40	15	LC108-FU
50	6	75	25	10.5	60	20	LC109-FU
50	6	75	25	12.5	60	20	LC110-FU

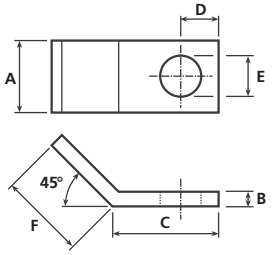




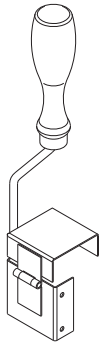
Offset type lug

A mm	B mm	C mm	D mm	E mm	F mm	Part No.
20	3	40	10	8.5	40	LO101
25	3	45	12	8.5	40	LO102-FU
25	3	45	12	10.5	40	LO103-FU
31	6	50	15	10.5	40	LO104
31	6	50	16	12.5	40	LO105
38	5	55	18	10.5	40	LO106
38	6	55	18	10.5	40	LO107
38	6	55	20	12.5	40	LO108
50	6	75	25	10.5	60	LO109
50	6	75	25	12.5	60	LO110

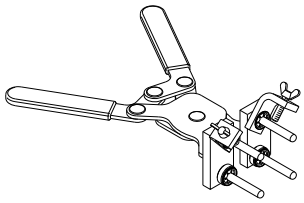




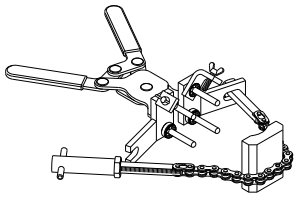
Handle clamps and accessories



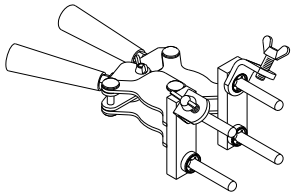
HCPK2



HCPK3



HCPK3A



HCPK4

Handle clamps

Description	Part No.
Single part moulds (Price Key 1)	HCPK1
Single part moulds (Price Key 2)	HCPK2
Two part moulds (Price Key 3)	HCPK3
With chain grip, two part moulds (Price Key 3)	HCPK3A
Sprung, single part moulds (Price Key 3)	HCPK3B
Two-part moulds (Price Key 4)	HCPK4
With chain grip, multi-part moulds (Price Key 4)	HCPK4A
Multi-part moulds (Price Key 5)	HCPK5
Multi-part moulds (Price Key 7)	HCPK7
Multi-part moulds (Price Key 8)	HCPK8
Single block rail moulds	HCR1
Double block rail moulds	HCR2

Frames

Description	Part No.
Frame for use with Handle Clamp HCPK4	F1-FU
Frame for use with Handle Clamp HCPK5	F2-FU

Accessories

Description	Part No.
Cable cleaning brush	B135 [1]
Mould cleaning brush	BCM [2]
Tape cleaning brush	BFC [3]
Duxseal sealing compound (1lb)	DUXSEAL [4]
Flint gun	FGUN [5]
Replacement flints (pack of 100)	FLINTS
Hammer die	HD35-HD150
Mould jacket	MJ4-MJ5 [6]
Packing	PACK-A [7]
Rail bonds	RB25-RB120
Rail head scraper	RCH01
Rail web scraper	RCW01
Rail foot scraper	RCF01
Copper sleeve	S102-S111 [8]
Copper sleeve	S108A-S111A [8]
Mould cleaning scraper	STM1-FU [9]
Welding toolbox	TB100-FU [10]
Standard toolkit for bar to bar joints	TK100
Standard toolkit for cable to cable joints	TK200

Electronic Systems Protection

Transient overvoltages

Transient overvoltages are short duration, high magnitude voltages peaks with fast rising edges, also known as surges. Often described as a “spike”, transient voltages can reach up to 6000V on a low-voltage consumer network, with no more than millisecond duration.

Lightning strikes are the most common source of extreme transient overvoltages where total outage of an unprotected system can occur with damage to cabling insulation through flashover potentially resulting in loss of life through fire and electric shock.

However, electrical and electronic equipment is also continually stressed by hundreds of transients that occur everyday on the power supply network through switching operations of inductive loads such as air-conditioning units, lift motors and transformers. Switching transients may also occur as a result of interrupting short-circuit currents (such as fuses blowing). Although switching transients are of a lower magnitude than lightning transients, they occur more frequently and equipment failures unexpectedly occur often after a time delay; degradation of electronic components within the equipment is accelerated due to the continual stress caused by these switching transients.

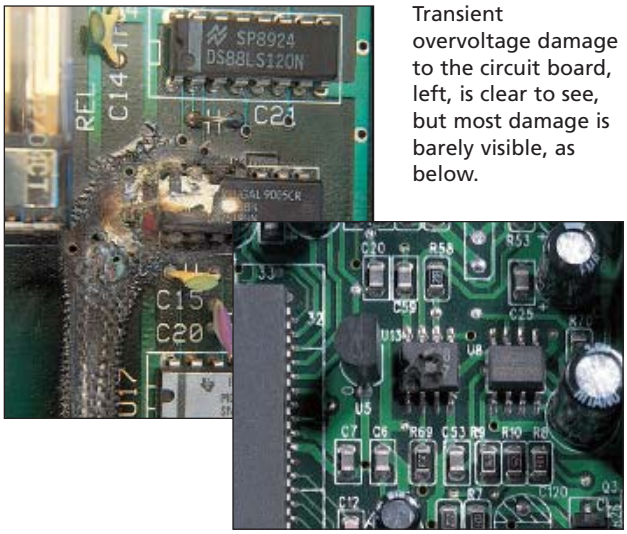
Transient overvoltages, whether caused by lightning or by electrical switching, have similar effects: disruption (e.g. data loss, RCD tripping), degradation (reduced equipment lifespan), damage (outright equipment failure, particularly concerning for essential services such as fire and security alarm systems) and downtime – the biggest cost to any business such as lost productivity and product spoilage, staff overtime, delays to customers and sales lost to competitors.

Protection against lightning and switching transients

BS EN 62305 takes account of protection measures on metallic service lines (typically power, signal and telecom lines) using transient overvoltage or surge protection devices (SPDs) against both direct lightning strikes as well as the more common indirect lightning strikes (often described as the secondary effects of lightning) and switching transients.

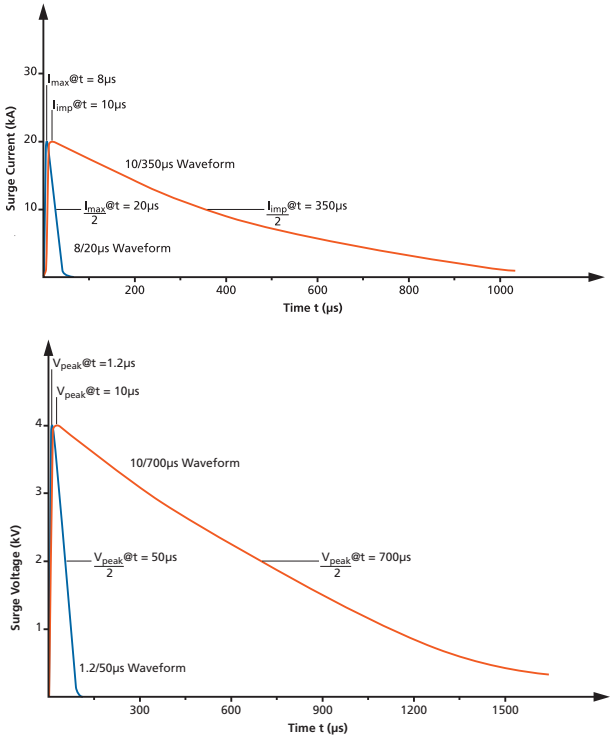
Standards such as BS EN 61643 series define the characteristics of lightning currents and voltages to enable reliable and repeatable testing of SPDs (as well as lightning protection components). Although these waveforms may differ from actual transients, the standardized forms are based upon years of observation and measurement (and in some cases simulation). In general they provide a fair approximation of the real world transient.

Transient waveforms have a fast rising edge and a longer tail. They are described through their peak value (or magnitude), rise time and their duration (or fall time). The duration is measured as the time taken for the test transient to decay to half its peak value.



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

The figures below illustrate the common current and voltage waveforms that are used to test SPDs for mains, signal and telecom lines.



Figures 18 & 19: The common current and voltage waveforms used to test SPDs for mains, signal and telecom lines

Lightning currents as a result of direct lightning strikes are represented by the simulated 10/350µs waveform with a fast rise time and long decay that replicates the high energy content of direct lightning.

Direct lightning can inject partial lightning currents of the 10/350µs waveform into a system where a structure with a structural Lightning Protection System receives a direct strike (Source S1) or where lightning directly strikes an overhead service line (Source S3).

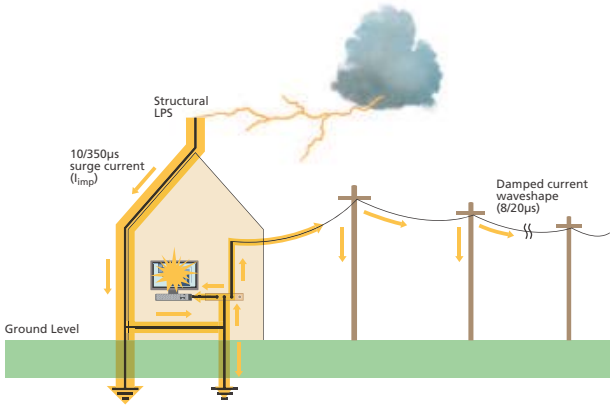


Figure 20: Illustration of lightning current flow from a direct strike to a structure (Source S1)

Remote or indirect lightning flashes near the structure (Source S2) or near a connected service to the structure (Source S4) of up to 1km radius away (and hence far more common) are represented by the 8/20µs waveform. Induced surges from direct lightning flashes and switching sources are also represented by this waveform. With a much shorter decay or fall time relative to the 10/350µs waveform, the 8/20µs waveform presents significantly less energy (for an equivalent peak current) but is still devastating enough to damage electrical and electronic equipment.

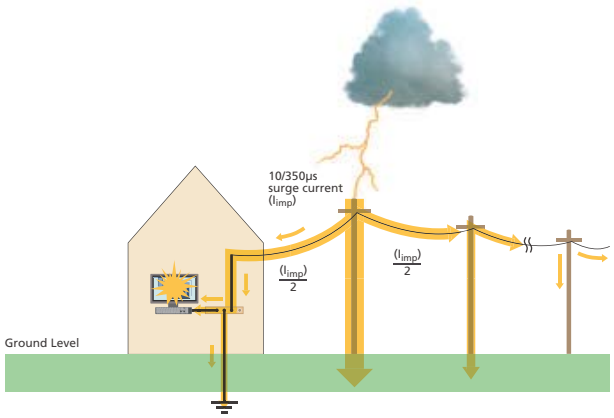


Figure 21: Illustration of lightning current flow from a direct strike to a nearby service (Source S3)

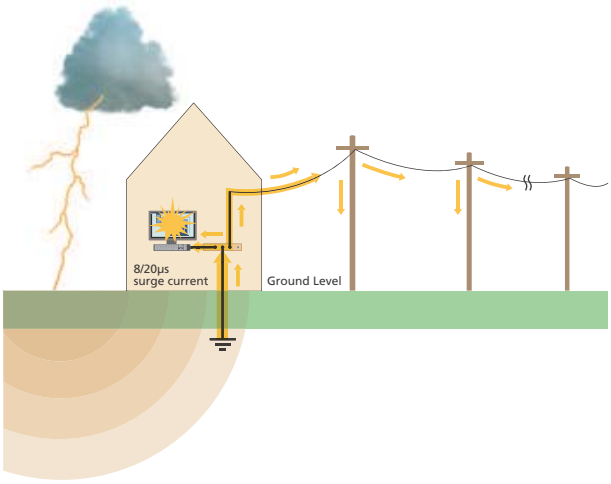


Figure 22: Illustration of lightning current flow from a direct strike near the structure (Source S2)

BS EN 62305-1 recognises that failure of internal systems (Damage Type D3) due to Lightning Electromagnetic Impulse (LEMP) is possible from all points of strike to the structure or service – direct or indirect (all Source's: S1, S2, S3 and S4). To ensure continuous operation of critical systems even in the event of a direct strike, SPDs are essential and are suitably deployed, based on the source of surge and its intensity using the Lightning Protection Zones (LPZ) concept within BS EN 62305-4.

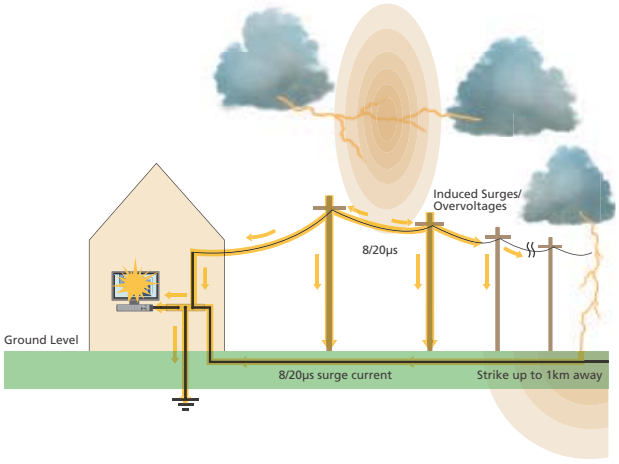


Figure 23: Illustration of lightning current flow from lightning flashes near connected services (Source S4)

A series of zones are created within the structure according to the level of threat posed by the LEMP with each zone to have successively less exposure to the effects of lightning – for example LPZ 0_A (outside the structure) where the threat of lightning currents and fields are most severe being more onerous than LPZ 3 (within the structure) where the threat of lightning is considerably reduced such that electronics can be safely located within this zone.

Figure 24 illustrates the basic LPZ concept defined by protection measures against LEMP as detailed in BS EN 62305-4. Equipment is protected against both direct and indirect lightning strikes to the structure and connected services, with a LEMP Protection Measures System (LPMS). To achieve this reduction in LEMP severity, from conducted surge currents and transient overvoltages, as well as radiated magnetic field effects, successive zones use a combination of shielding measures, bonding of incoming metallic services such as water and gas and the use of coordinated SPDs (further details can be found in "A Guide to BS EN 62305:2006 protection against lightning".

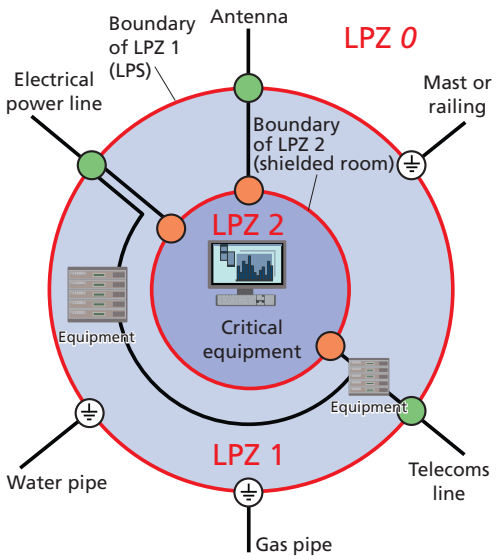


Figure 24: Basic LPZ concept – BS EN 62305-4

Given that the live cores of metallic electrical services such as mains power, data and telecom cables cannot be bonded directly to earth wherever a line penetrates each LPZ, a suitable SPD is therefore needed. The SPD's characteristics at the boundary of each given zone or installation location need to take account of the surge energy they are to be subject to as well as ensure the transient overvoltages are limited to safe levels for equipment within the respective zone.

The following table details the standardized test waveforms with peak currents used to test SPDs typically located at each zone boundary.

SPD location/LPZ boundary

	LPZ 0/1	LPZ 1/2	LPZ 2/3
Typical SPD installation point	Service Entrance (e.g. Main distribution board or telecom NTP)	Sub-distribution board or telecom PBX frame	Terminal Equipment (e.g. socket outlet)
Mains Test Class/SPD Type[1]	I/1	II/2	III/3
Surge test waveform	10/350 current	8/20 current	Combination 8/20 current and 1.2/50 voltage
Typical peak test current (per mode)	25kA[2]	40kA	3kA (with 6kV)
Signal/Telecom Test Category[1]	D1[3]	C2[3]	C1
Surge test waveform	10/350 current	Combination 8/20 current and 1.2/50 voltage	Combination 8/20 current and 1.2/50 voltage
Typical peak test current (per mode)	2.5kA	2kA (with 4kV)	0.5kA (with 1kV)

[1] Tests to BS EN 61643 series
[2] Peak current (per mode) for a 3 phase SPD to protect a TNS mains system
[3] Test category B2 10/700 voltage waveform (also within ITU-T standards) up to 4kV peak also permissible

Table 8: Standardized test waveforms with peak currents used to test SPDs at each LPZ boundary

Types of SPD

BS EN 62305 deals with the provision of SPDs to protect against both the effects of indirect lightning strikes and high-energy direct lightning strikes.

- Direct lightning strikes are protected by lightning current or equipotential bonding SPDs (Mains Type 1 SPDs & Signal/Telecom SPDs to Test Category D)
- Indirect lightning strikes and switching transients are protected by transient overvoltage (Mains Type 2 and Type 3 SPDs and Signal/Telecom SPDs to Test Category C)

Lightning current or equipotential bonding SPDs

Designed to prevent dangerous sparking caused by flashover. Flashover is caused when the extremely high voltages associated with a direct lightning strike breaks down cable insulation. This can occur between the structural LPS and electrical services and presents a potential fire hazard and risk from electric shock.

Transient overvoltage SPDs

Designed to protect electrical/electronic equipment from the secondary effects of indirect lightning and against switching transients. SPDs should be installed at sub-distribution boards and at equipment level for critical equipment.

IMPORTANT

The primary purpose of lightning current or equipotential bonding SPDs is to prevent dangerous sparking caused by flashover to protect against the loss of human life. In order to protect electronic equipment and ensure the continual operation of systems, transient overvoltage SPDs are required. BS EN 62305-4 specifically states that "a lightning protection system which only employs equipotential bonding SPDs provides not effective protection against failure of sensitive electrical or electronic systems.".

BS EN 62305 refers to the correct application of lightning current and transient overvoltage SPDs as a coordinated set where the service entrance lightning current SPD handles the majority of surge energy and prevents flashover whilst the downstream transient overvoltage SPDs ensure equipment protection by sufficiently limiting the overvoltages. For further information, please refer to "A Guide to BS EN 62305:2006 protection against lightning" available from Furse.

BS EN 62305-2 Risk Management is used to evaluate the required level of lightning protection measures necessary to lower the risk of damage to a particular structure, its contents and occupants to a defined tolerable level. If the risk evaluation demands that a structural LPS is required, then lightning current or equipotential bonding SPDs are always required for any metallic electrical services entering the structure. These SPDs are necessary to divert the partial lightning currents safely to earth and limit the transient overvoltage to prevent possible flashover. They are therefore an integral part of the structural LPS and typically form the first part of a coordinated SPD set for effective protection of electronic equipment.

If the risk evaluation shows that a structural LPS is not required but there is an indirect risk, any electrical services feeding the structure via an overhead line will require lightning current SPDs typically installed at the service entrance, with coordinated transient overvoltage SPDs downstream to protect electronic equipment.

In order to provide effective protection, a transient overvoltage protector/SPD must:

- be compatible with the system it is protecting
- survive repeated transients
- have a low `let-through' voltage, for all combinations of conductors (enhanced SPDs to BS EN 62305)
- not leave the user unprotected, at the end of its life, and
- be properly installed

Table 9: General indication of system impairments which manufacturers of transient overvoltage protectors should provide details of

	Protectors for mains supplies		Protectors for data lines		
	Parallel protectors	In-line protectors	Low frequency protectors	Network protectors	Radio frequency protectors
Nominal operating voltage	✓	✓	✓	✓	✓
Maximum operating voltage	✓	✓	✓	✓	✓
Leakage current	✓	✓	✓	✓	✓
Nominal current rating	✗	✓	✓	✓	✓
Max continuous current rating	✗	✓	✓	✓	✓
In-line impedance	✗	✓	✓	✓	✓
Shunt capacitance	✗	✗	✗	✓	✓
Bandwidth	✗	✗	✓	✓	✓
Voltage standing wave ratio	✗	✗	✗	✓	✓

Table 9 summarises potential sources of system impairment.

Compatibility

The protector must not interfere with the system's normal operation:

- mains power supply SPDs should not disrupt the normal power supply such as creating follow current that could blow supply fuses, or cause high leakage currents to earth
- SPDs for data communication, signal and telephone lines should not impair or restrict the systems data or signal transmission.

Survival

It is vital that the protector is capable of surviving the worst case transients expected at its installation point/LPZ boundary. More importantly, since lightning is a multiple event, the protector must be able to withstand repeated transients.

The highest surge currents occur at the service entrance (boundary LPZ 0_A to LPZ 1). For buildings with a structural LPS, the lightning current SPD could be subject to as high as 25kA 10/350µs surge currents per mode on a 3-phase TNS mains system (up to 2.5kA 10/350µs per mode on a signal or telecom line) for a worst-case lightning strike of 200,000A.

However, this 200kA level of lightning current itself is extremely rare (approx. 1% probability of occurring) and the peak current the SPD would be subject to further assumes that a structure is only fed with one metallic service. Almost all structures have several metallic services connected to them such as gas, water,

mains, data & telecoms. Each service shares a portion of the lightning current when the protected building receives a strike, greatly reducing the overall current seen by any single service, and as such any SPD fitted to the electric service lines.

Transient overvoltages caused by the secondary effects of lightning are considerably more common (lightning flash near a connected service up to 1km away from the structure) and therefore are unlikely to have currents exceeding 10kA 8/20µs.

Let-through voltage

The larger the transient overvoltage, the greater the risk of flashover, equipment interference, physical damage and hence system downtime. Therefore, the transient overvoltage let through the protector (also known as the protection level U_p of the SPD) should be as low as possible and certainly lower than the level at which flashover, interference or component degradation may occur.

Transient overvoltages can exist between any pair of conductors:

- phase to neutral, phase to earth and neutral to earth on mains power supplies
- line to line and line(s) to earth on data communication, signal and telephone lines

Thus, a good protector (enhanced SPDs to BS EN 62305) must have a low let-through voltage between every pair of conductors.

Enhanced performance SPDs - SPD*

BS EN 62305-2 details the application of improved performance SPDs to further lower the risk from damage. The lower the sparkover voltage, the lower the chance of flashover causing insulation breakdown, electric shock and fire.

SPDs that offer lower voltage protection levels further reduce the risks of injury to living beings, physical damage as well as failure and malfunction of internal systems. All Furse ESP protectors offer such superior protection and are termed as enhanced performance SPDs (SPD*) in line with BS EN 62305.

Enhanced SPDs can also satisfy more than one test class/category by handling both high-energy partial lightning currents of 10/350µs waveshape whilst offering very low let-through voltages. Such enhanced SPDs may be suitable for changing a lightning protection zone from LPZ 0_A right through to LPZ 3 at a single boundary or installation point. As such they provide both technical and economic advantages over standard SPDs.

End of life

When an SPD comes to the end of its working life it should not leave equipment unprotected. Thus in-line protectors should take the line out of commission, preventing subsequent transients from damaging equipment. SPDs for data communication, signal and telephone lines and protectors for low current mains power supplies are usually in-line devices.

Where SPDs are installed at mains power distribution boards it is usually unacceptable for these to suddenly fail, cutting the power supply. Consequently, to prevent equipment being left unprotected, the SPD should have a clear pre end-of-life warning, which allows plenty of time for it to be replaced.

Installation

The performance of SPDs is heavily dependent upon their correct installation. Thus, it is vital that SPDs are supplied with clear installation instructions. The following is intended to supplement the detailed guidance given with each product in order to give a general overview of installation. This should not be viewed as a substitute for the Installation Instructions supplied with the SPD. Copies of these are available separately on request.

Installing parallel connected SPDs for mains power supplies:

- SPDs should be installed very close to the power supply to be protected, either within the distribution panel or directly alongside of it (in an enclosure to the required IP rating)
- Connections between the SPD and phase(s), neutral and earth of the supply should be kept very short (ideally 25cm or less, but no more than 50cm)
- SPD performance is further enhanced by tightly binding connecting leads together (simply using cable ties or similar), over their entire length
- For safety and convenient means of isolation, the phase/live connecting leads should be suitably fused using HRC fuses or switchfuse, MCB or MCCB

Installing in-line SPDs for data, signal, telephone or power:

- SPDs are usually installed between where cabling enters or leaves buildings and the equipment being protected (or actually within its control panel)
- The installation position should be close to the system's earth star point (usually the mains power earth) to enable a short and direct connection to earth
- In-line, or series, connected SPDs generally have connections marked line and clean. The line end of the SPD should be connected to the incoming or "dirty" line (from where the transient is expected). The clean end of the SPD should be connected to the line or cable feeding the equipment
- Cables connected to the SPD's clean end should never be routed next to dirty line cables or the SPDs earth bond
- Unless ready boxed, SPD's should be installed within an existing cabinet/cubicle or in an enclosure to the required IP rating

How to apply protection

Transient overvoltages are conducted into the sensitive circuitry of electronic equipment on power and data communication, signal and telephone lines. Protection is recommended for:

- all cables which enter or leave the building (except fibre optic)
- the power supply local to important equipment
- electronic equipment outside the main building(s)

Protect incoming and outgoing electrical services

Lightning strikes between clouds or to ground (and objects upon it) can cause transient overvoltages to be coupled onto electrical cables, and hence into the sensitive electronic equipment connected to them. To protect the electronic equipment inside a building, all cables that enter or leave the building must be protected. Cables leaving the building can also provide a route back into the building for transients.

For each building protect incoming/outgoing:

- mains power supplies (including UPS supplies)
- data communication and local area network cables
- signal, control, instrumentation and alarm lines
- CCTV, satellite, TV and antenna cables
- telephone and telemetry lines

Protect the power supply locally to important equipment

In addition to installing protection on the mains power supply as it enters/leaves the building, protection should also be installed locally to important equipment. Protection at the main LV (low voltage) incomer(s) is necessary to prevent large transients from entering the building's power distribution system, where they could have farreaching effects. However, where the cable run to equipment exceeds approximately 20 metres, transient overvoltages may appear on the mains after the protector at the main LV incomer.

These transients can result from:

- the electrical switching of large inductive loads within the building
- a lightning strike to the building – as lightning currents flow through down conductors transient overvoltages can be induced on to nearby power cables
- the natural inductance and capacitance of long cable runs, `amplifying' the voltage `let-through' the protector at the main LV incomer.

Additionally, local protection guards against the possibility of a supply which enters/leaves the building being overlooked and left unprotected.

Protect data lines locally

Generally, the biggest risk to data, signal, telecom and network wiring is associated with cables that enter and leave the building. These should always be protected. However, data cables within a building can additionally have transients induced on to them when loops between data and power cables "pick up" voltages from the magnetic field caused by a lightning strike.

As part of the overall LEMP Protection Measures System (LPMS), BS EN 62305 advocates the use of metal in the structure, and a Faraday cage lightning protection scheme to help exclude magnetic fields. Cable management practices eliminate loops by routeing data and power cables along the same general path.

In these cases, the need for local data line protection is minimal. However, where these steps are not possible, data line protection, local to the equipment requiring protection, should be considered.

Protect electronic equipment outside the building

Onsite or field-based electronic equipment with mains power, data communication, video, signal or telephone line inputs will need to be protected against transient overvoltages. It may be helpful to think of each equipment cabinet or cubicle as a separate building with incoming/outgoing cables to be protected.

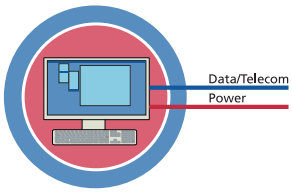
Complementary techniques

As well as the use of transient overvoltage protectors, BS EN 62305 outlines additional protection techniques, which can be used to help reduce the transient threat as part of the overall LPMS. These are described further in the Furse document "A Guide to BS EN 62305:2006 Protection Against Lightning." Where these can be used, principally on new build or refurbishment projects, they need to be supported by the use of SPDs.

Simplified product selection

All Furse ESP products are designed to provide simple system integration whilst achieving highest levels of effective protection against transients.

Tested in line with the BS EN 61643 standards series, ESP protection can be selected and applied to BS EN 62305 easily using the new SPD product application tables and data sheets. Key product and application features are represented using the following symbols:



WARNING Equipment is ONLY protected if all incoming lines have protection fitted

LPZ $0_A \rightarrow 3$

Lightning Protection Zone (LPZ) details the boundary (to BS EN 62305-4) or installation point of the SPD. For example, LPZ $0_A \rightarrow 3$ signifies that the SPD can be installed at the service entrance boundary and create an immediate LPZ 3 suitable for protecting electronic equipment close to the SPD installation. Equipment further downstream of this location may require additional protection against switching transients for example.

MAINS TEST TYPE 1 + 2 + 3

Mains Test Type defines the Type of mains SPD (BS EN 61643 Type 1, 2, 3 or I, II, III to IEC 61643) tested with the respective test Class I (high energy 10/350µs current waveform), II (8/20µs current waveform) or III (combined 8/20µs current and 1.2/50µs voltage waveform) from the BS EN/IEC 61643 series. Where more than one Type is stated (for combined, enhanced Type SPDs), the SPD has been tested to each respective test Class, with the results detailed on its transient performance specification.

SIGNAL/ TELECOM TEST CAT D + C + B

Signal/Telecom Test Category indicates the Test Categories (as defined in BS EN/IEC 61643 series) that SPDs for signal and telecom systems have been subject to, with the results detailed on the transient performance specification. Test Category D is a high-energy test typically using the 10/350µs current waveform. Test Category C is a fast rate of rise test using the 1.2/50µs voltage waveform combined with 8/20µs current waveform. Test Category B is a slow rate of rise test using the 10/700µs waveform, also used within ITU standards. Enhanced SPDs tested with categories D, C and B can offer up to LPZ $0_A \rightarrow 3$ protection.

COMMON MODE Equipotential Bonding

Common Mode signifies that the SPD specifically offers protection on conductors with respect to earth. For a mains system, this would be between phases and earth or neutral and earth. For a data/telecom line this would be between signal line(s) to earth. Common mode surges can result in flashover if the insulation withstand voltage of connected wiring or equipment is exceeded. Flashover could lead to dangerous sparking potentially causing fire or electric shock risks. Equipotentially bonding Type 1 mains SPDs or Test Cat D tested signal/telecom SPDs reduce the risk of flashover by limiting common mode surges.

FULL MODE Bonding + Equipment Protection

Full Mode means that the SPD protects in all possible modes; common mode (live conductors with respect to earth) and differential mode (between live conductors). For example, full mode mains SPDs offer protection between phase(s) to earth, phases(s) to neutral and neutral to earth. Whilst common mode protection ensures flashover is prevented, differential mode protection is critical to ensure sensitive electronics are protected as well as operational during surge activity.

e ENHANCED Low let-through voltage

Enhanced SPDs (SPD* within BS EN 62305 series) have lower (better) let-through voltage or protection levels (U_p) and therefore further reduce the risk of injury to living beings, physical damage and failure of internal electronic systems. Enhanced Type 1 mains SPDs (for a 230V/400V system) should have a protection level U_p of no more than 1600V whilst Type 2 and Type 3 mains SPDs should have a protection level U_p of no more than 600V in all modes when tested in accordance with BS EN 61643 series. Enhanced signal/telecom SPDs should typically have a protection level U_p no more than twice the peak operating voltage of the protected system.

3-WAY + N-E FAULT STATUS INDICATION

Status Indication for mains wire-in power distribution SPDs is essential as they are installed in parallel or shunt with the supply and as such could potentially leave the system unprotected should the SPD fail. 3-way status indication of the SPDs' condition provides simple and clear visual inspection and further provides advanced pre-failure warning such that the system is never unprotected. Furthermore warning of potentially fatal neutral to earth faults due to incorrect earthing and wiring faults for example is provided with additional flashing indication.

REMOTE INDICATION LED DISPLAY

Remote Indication is an innovative feature that further optimizes mains wire-in SPD protection. A parallel or shunt installed SPD has additive let-through voltage because of its connecting leads that need to be kept as short as possible – ideally no more than 25cm. Often an SPD cannot be mounted in its optimum position without compromising the visibility of its status indication. Innovative remote status indication displays overcome this by allowing the SPD to be mounted with short connecting leads with the separate status display being conveniently mounted in a visible position such as the front of a power distribution cabinet providing convenient and effective equipment protection.

ACTIVE VOLT-FREE CONTACT

Active Volt-free Contact is an essential addition to the visual 3-way status indication. The changeover volt-free contact is simply connected or linked to an existing building management system, buzzer or light and should the SPD have a pre-failure condition, this would be remotely indicated – particularly important for remote installations where the building management system would be connected to a telecom modem. Active contacts further enable the SPD to also conveniently warn of phase loss from a power failure or blown fuse.

Intelligent Display iD is a new innovation from Furse that encompasses existing features of 3-way SPD status indication with Neutral to Earth voltage warning but through clear easy to read text on an illuminated LCD display. Often SPDs should be mounted on their side in order to facilitate short connecting leads for better protection levels but as this compromises the position and appearance of the status indication, it is not widely practiced. Also available in a remote display option, the iD feature enhances mains wire-in SPD installation as the status indication text can easily be rotated (in 90° steps, in either direction) at the push of a button to aid good installation practice.

Current Rating indicates the maximum continuous current rating of in-line SPDs for data communication, signal and telephone lines. The SPD's quoted maximum continuous current rating should always exceed the peak running current of the protected system to ensure normal system operation is not impaired. Damage, through overheating, would result if its quoted current rating were exceeded.

Low Inline Resistance states the resistance value in Ohms (Ω) per line of SPDs for data communication, signal and telephone lines. A low in-line resistance is desirable; particularly for systems with high running currents in order to reduce any voltage drops across the SPD and ensure normal system operation is not impaired. Consideration should be made for additional SPDs installed on the same line to protect connected equipment at each end of the line (e.g. CCTV camera and connected monitoring equipment) as the in-line resistance of each SPD is introduced into the system.

High Bandwidth SPDs ensure the full system frequency range of transmission signals, for protected data communication, signal and telephone lines, is not impaired. Signal frequencies outside the stated SPD bandwidth may potentially be distorted causing information loss or corruption. As the SPD should accommodate the characteristics of the protected system, the stated SPD bandwidth (typically quoted for a 50Ω system) should always exceed the protected system's bandwidth.

BX IP is an International Protection (IP) rating (to BS EN/IEC 60529) for ready-boxed (BX) SPDs typically used in dusty and damp environments. The IP rating system (also interpreted as "Ingress Protection") classifies the degrees of protection provided against the intrusion of solid objects (including body parts like hands and fingers), dust, accidental contact and water in electrical enclosures. For example, an IP66 rated enclosure provides no ingress of dust and therefore complete protection against contact as well as against water projected in powerful jets against the enclosure from any direction with no harmful effects. Unboxed SPDs should be installed within distribution panels/cabinets or within external enclosures to the required IP rating (such as the Furse weatherproof WBX enclosure range).

Common terminology and definitions

The following common terminologies, as recognized by BS EN/IEC 61643, is used throughout SPD specifications in order to aid correct selection and are defined as follows:

Nominal Voltage U_o is the phase to neutral AC RMS voltage of the mains system (derived from the nominal system voltage) for which the SPD is designed. U_o is the voltage by which the power system is designated – e.g. 230V.

Maximum Continuous Operating Voltage U_c is the maximum RMS voltage that may be continuously applied to the SPD's mode of protection e.g. phase to neutral mode. This is equivalent to the SPDs rated peak voltage.

Temporary Overvoltage U_T is the stated test value of momentary voltage increase or overvoltage that the power SPD must withstand safely for a defined time. Temporary overvoltages, typically lasting up to several seconds, usually originate from switching operations or wiring faults (for example, sudden load rejection, single-phase faults,) as well as mains abnormalities such as ferro-resonance effects and harmonics.

Impulse Current I_{imp} is defined by three parameters, a current peak with a charge and a specific energy typically simulated with the 10/350µs waveform to represent partial lightning currents. This waveform is used, with peak I_{imp} current value stated, for the mains Type 1 SPD Class I test and typically for data/telecom SPD Test Category D.

Nominal Discharge Current I_n is a defined nominal peak current value through the SPD, with an 8/20µs current waveshape. This is used for classification of mains SPDs (Class II test) and also for preconditioning of SPDs in Class I and Class II tests.

Maximum Discharge Current I_{max} is the peak current value through the SPD, with an 8/20µs waveshape. I_{max} is declared for mains Type 2 SPDs in accordance to the test sequence of the Class II operating duty test. In general, I_{max} is greater than I_n.

Combined Impulse Test with Open Circuit Voltage U_{oc} is a hybrid 1.2/50µs voltage test combined with an 8/20µs current. The test is performed using a combination wave generator where its open circuit voltage is defined as U_{oc}, typically 6kV 1.2/50µs for the mains Class III test and up to 4kV 1.2/50µs for signal/telecom Test Category C. With an impedance of 2 Ω, the generator also produces a peak short circuit current (sometimes referred to as I_{sc}) at half the value of U_{oc} (3kA 8/20µs for the mains Class III test and up to 2kA 8/20µs for signal/telecom Test Category C). With both voltage and current test waveforms, the combined impulse test is designed to stress all technologies used within SPDs.

Voltage Protection Level U_p is the key parameter that characterizes the performance of the SPD in limiting the transient overvoltage across its terminals. A low protection level value (also known as let-through voltage) is therefore particularly critical for the effective protection and continued operation of electronic equipment. The peak voltage protection level U_p is declared when the SPD is tested with its stated nominal discharge current In (or the peak current (I_{peak}) of I_{imp}) and is also declared when the SPD is subject to combined impulse test (mains Class III test for Type 3 SPDs) as well as data/telecom Test Categories C and B.

How to apply protection and what to use

We've seen how protection should be installed on all cables which enter or leave the building (except fibre optic); the power supply local to important equipment; electronic equipment outside the main building(s).

With the aid of the illustration we can see how this might be applied in practice.

Protect incoming and outgoing electrical services

We'll start by considering the main (office) building in isolation.

Incoming mains power supplies

Install protection on the incoming mains power supply at the incoming distribution board(s).

If, as in this example, there are any other power supplies entering the building install protection on these near where they enter the building.

Outgoing mains power supplies

Outgoing supplies can provide transient overvoltages with a route back into the building's power distribution system.

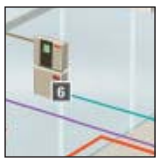
Install protection on supplies to other buildings. (Note how, if correctly positioned, the protector at the incoming distribution board (1), also protects against transients from the outgoing supply to the UPS building.)

Install protection on outgoing supplies to site services, such as CCTV systems and site lighting.

Protect all incoming/outgoing data communication, signal and telephone lines (unless fibre optic).

Telephone lines

Incoming telephone lines and extensions that leave the building have protectors installed on them at the PBX's distribution frame.



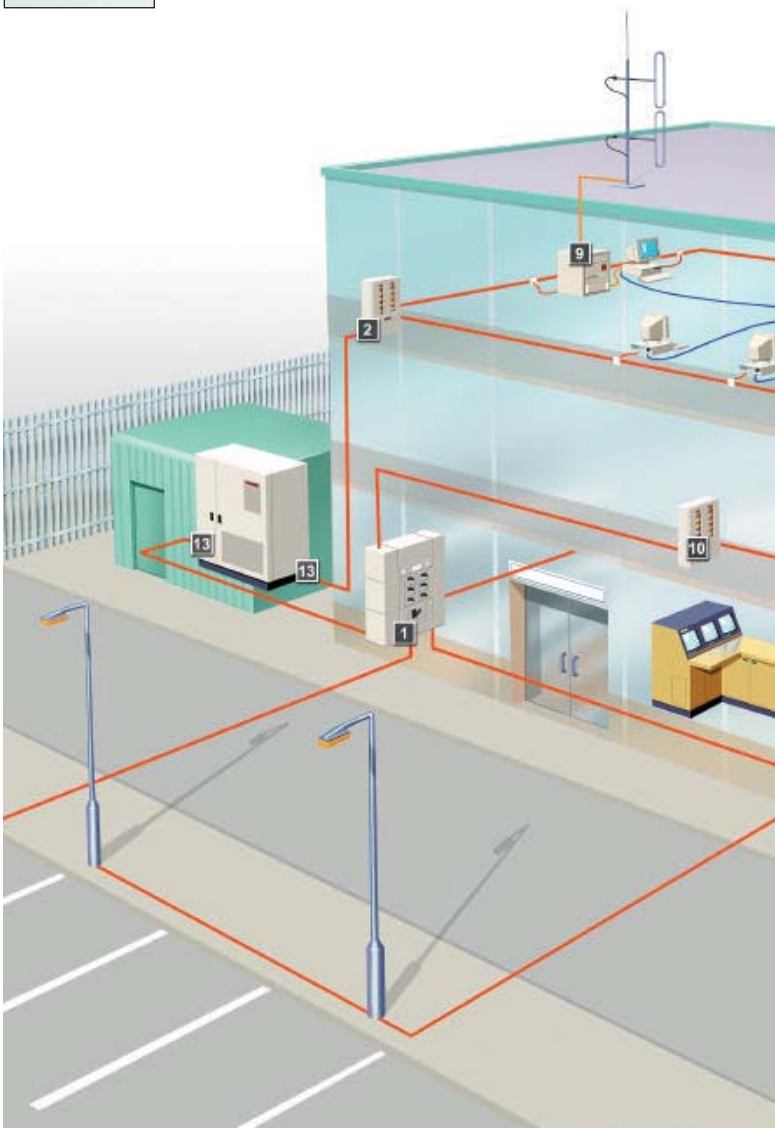
In our example, there is a direct (i.e. not via the PBX) telephone line to an alarm panel, which also needs protecting.

Signal and data communication lines

Protectors are installed on CCTV video cables from outdoor cameras to prevent damage to the control desk.

A protector is installed at the network hub to protect it from transients on the between building data link.

Equipment such as our RF receiver, with antenna (or satellite) links will also need protecting.

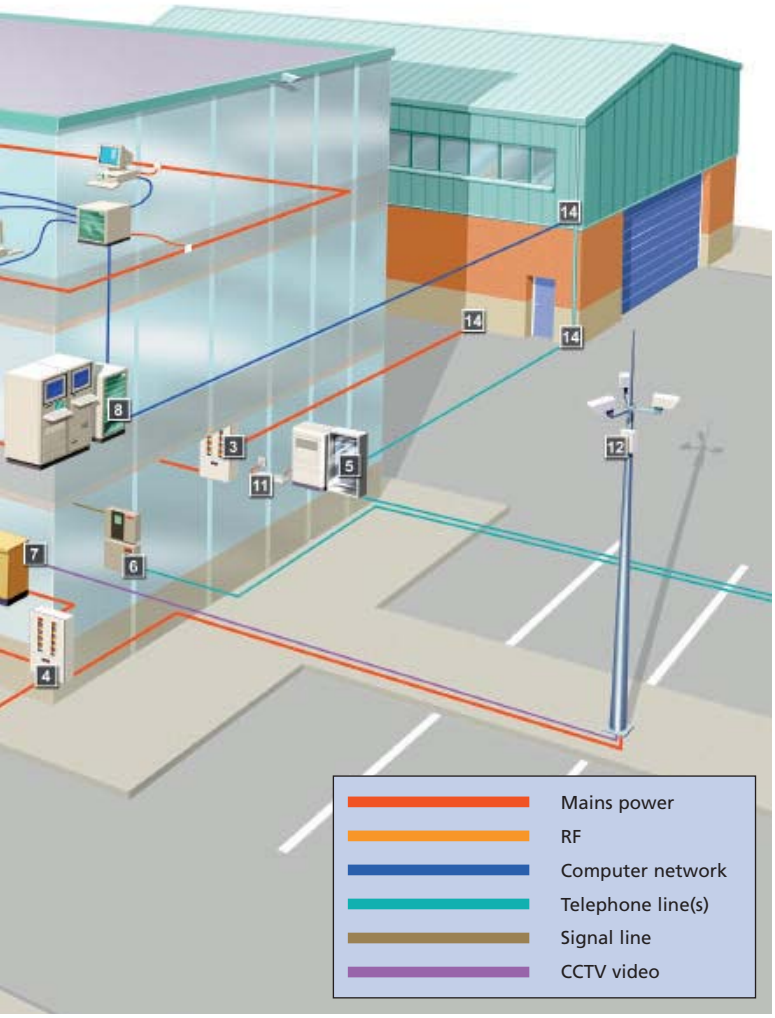


Protect the power supply locally to important equipment

Within the building transient overvoltages can be injected on to the mains power supply (downstream of the protector at the incomer). Consequently, protectors should be installed close to important pieces of equipment.

Protection is installed on the local distribution board feeding the servers and network hub. (Note how the top floor PC network and RF receiver is protected by the protector on the distribution board (2).)

The telephone PBX is protected locally by a plug-in protector.

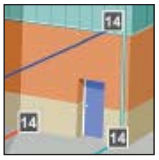


Protect electronic equipment outside the building

Electronic equipment outside the main building in ancillary buildings, on site or in the field should also be protected.

Protect outdoor CCTV cameras with protectors on the power supply, and video cable (and, if relevant, telemetry control line).

If the UPS is housed in a separate building with a separate earth, incoming and outgoing supplies will need to be protected. This is because most modern UPS systems contain electronics that makes them vulnerable to being disabled by transient overvoltages. To prevent transient overvoltage damage to the UPS it must have a protector installed on its input and (because its outgoing supply leaves the building) on its output. A protector will also need to be installed on the power supply into the main building (2).

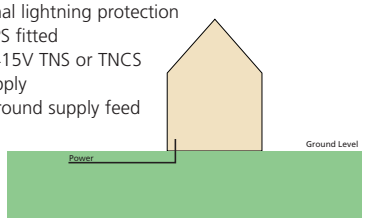
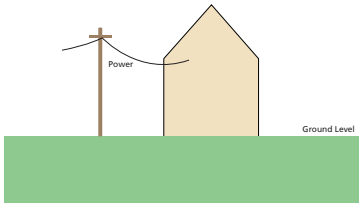
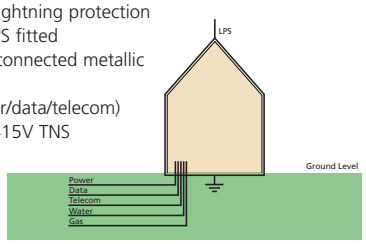
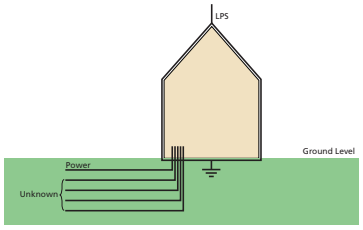


Protection is also installed on mains power, data communication and telephone lines entering the neighbouring building. Additional protection (not shown) may be required within this building (whether it's a computer-controlled warehouse or automated manufacturing operation with PLCs, drives and computer controls).

Protector selector

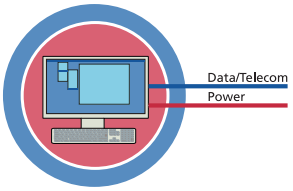
(1)	Mains wire-in protectors	p152–163
(2)	Mains wire-in protectors	p156-157, 160-161
(3)	Mains wire-in protectors	p152–163
(4)	Mains wire-in protectors	p152–163
(5)	PBX telephone/ISDN line protection	p190–191
(6)	Plug-in telephone line protection, or	p188–189
	Wire-in telephone line protection	172–173, 178–179
(7)	CCTV video protectors	p204–205
(8)	Computer network protector	p192–193
(9)	RF signal protector	p200–203
(10)	Mains wire-in protector	p156-157, 160–161
(11)	Plug-in mains protector	p168–169
(12)	Protectors for	
	low current mains power supplies,	p166–167
	CCTV video and	p204–205
	telemetry lines	p172–177
(13)	Mains wire-in protectors	p152–163
(14)	Mains wire-in protectors	p152–163
	Computer network protector	p192–193
	PBX telephone/ISDN line protection	p190–191

Mains product selection

Structure configuration – Typical	Installation Locations		
	Service entrance – after meter Main Distribution Board (MDB)	Sub Distribution Board (SDB) – located >10m from MDB	Critical terminal equipment – located >10m from SDB
No external lightning protection system LPS fitted 3 Phase 415V TNS or TNCS mains supply – underground supply feed 	 New ESP 415 D1 or ESP 415 M1 for 3 phase 415V supplies See pages 156 & 160	 New ESP 415 D1 or ESP 415 M1 for 3 phase 415V supplies See page 156 & 160  New ESP 240 D1 or ESP 240 M1 for single phase 240V supplies See page 156 & 160	 ESP MC (e.g. Hospital/Laboratory/ Server Equipment) See page 168  New ESP MC/TN/RJ11-/6 (e.g. fax machines/modems) See page 168  New ESP MC/Cat-5e (e.g. computer network hubs) See page 168
No external lightning protection system LPS fitted 3 Phase 415V TNS or TNCS mains supply – exposed overhead supply feed 	 ESP 415/III/TNS  ESP 415 M2 where electronics are located near MDB before SDB See pages 154 & 158		
External lightning protection system LPS fitted Mulitple connected metallic services (gas/water/data/telecom) 3 Phase 415V TNS or TNCS mains supply 	 New ESP 415 D1 or ESP 415 M1 for 3 phase 415V supplies See pages 156 & 160		
External lightning protection system LPS fitted Metallic gas/water/data/telecom services – unknown 3 Phase 415V TNS or TNCS mains supply 	 ESP 415/I/TNS for LPS to LPL level I and II ESP 415/III/TNS for LPS to LPL level III and IV  ESP 415 M4 for LPS level I and II where electronics are located near MDB before SDB ESP 415 M2 for LPS level III and IV where electronics are located near MDB before SDB See page 154 & 158		

Mains protectors for specific systems

Fire/intruder alarm panels and CCTV systems	Photovoltaic (solar) panels
 ESP 240-5A (or -16A) series See page 166	 ESP DC series See page 164



WARNING Equipment is ONLY protected if all incoming lines have protection fitted

Protectors for mains power supplies

ESP 240/XXX Series

LPZ $0_A \rightarrow 2$

COMMON MODE Equipotential Bonding

MAINS TEST TYPE 1 + 2

e ENHANCED Low let-through voltage

STATUS INDICATION + VOLT-FREE CONTACT

Combined Type 1 and 2 tested protector (to BS EN 61643-11) for use on the main distribution board, particularly where a structural Lightning Protection System (LPS) is employed, for equipotential bonding. For use at boundaries up to LPZ 0_A to protect against flashover (typically the main distribution board location) through to LPZ 2 to protect electrical equipment from damage.

Features and benefits

- ✔ Enhanced protection (to BS EN 62305) offering low let-through voltage further minimizing the risk of flashover creating dangerous sparking or electric shock
- ✔ Repeated protection in lightning intense environments
- ✔ The varistor based design eliminates the high follow current (I_f) associated with spark gap based surge protection
- ✔ Compact, space saving design
- ✔ Indicator shows when the protector requires replacement
- ✔ Remote signal contact can indicate the protectors' status through interfacing with a building management system

Application

- ✔ Use on single phase mains supplies and power distribution systems for protection against partial direct or indirect lightning strikes
- ✔ ESP 240/I/XXX versions for use with Class I or II Lightning Protection Systems (LPS)
- ✔ ESP 240/III/XXX versions for use with Class III or IV LPS; or exposed overhead single phase power lines where no LPS is fitted
- ✔ ESP 240/X/TNS versions also cover TNC-S earthing systems

Installation

Protector to be installed in the main distribution panel with connecting leads of minimal length. The protector should be fused and is suitable for attachment to a 35mm top hat DIN rail.

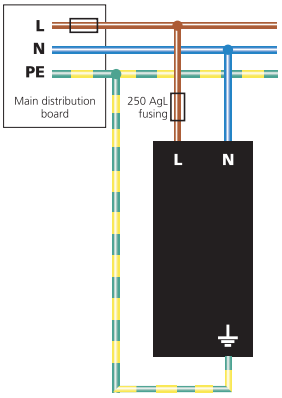
IMPORTANT

The primary purpose of Lightning current or Equipotential bonding mains Type 1 Surge Protective Devices (SPDs) is to prevent dangerous sparking caused by flashover to protect against the loss of human life. In order to protect electronic equipment and ensure the continual operation of systems, transient overvoltage mains Type 2 and 3 SPDs such as the ESP 240 M1 are further required, typically installed at downstream sub-distribution boards feeding sensitive equipment. BS EN 62305 refers to the correct application of mains Type 1, 2 and 3 SPDs as a coordinated set.

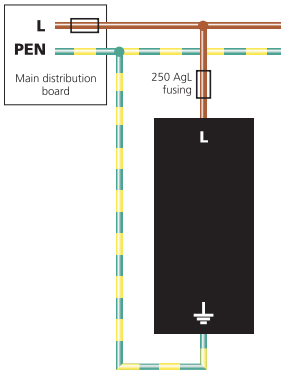
For further information, please refer to "A Guide to BS EN 62305:2006 Protection Against Lightning" available from Furse.

Installation

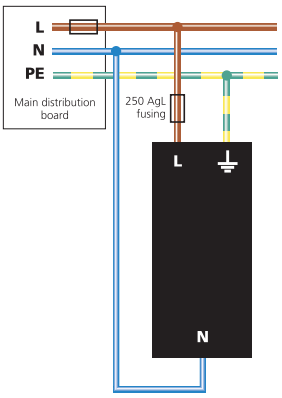
The diagrams below illustrate how to wire the appropriate ESP protector according to your chosen electrical system



TNS earthing system



TNC earthing system



TT earthing system

Accessories

Weatherproof enclosure

WBX D4

Electrical specification	NEW ESP 240/I/TNS	NEW ESP 240/III/TNS	NEW ESP 240/I/TNC	NEW ESP 240/III/TNC	NEW ESP 240/I/TT	NEW ESP 240/III/TT
Nominal voltage - Phase - Neutral *Uo* (RMS)	240V					
Maximum voltage - Phase-Neutral *Uc* (RMS/DC)	320V/420V					
Temporary Overvoltage TOV *UT* [1]	335V					
Short circuit withstand capability	25kA/50Hz					
Back-up fuse (see installation instructions)	250A					
Leakage current (to earth)	<2.5mA	<2.5mA	<2.5mA	<2.5mA	–	–
Volt free contact **– current rating** **– nominal voltage** (RMS)	0.5A 250V					

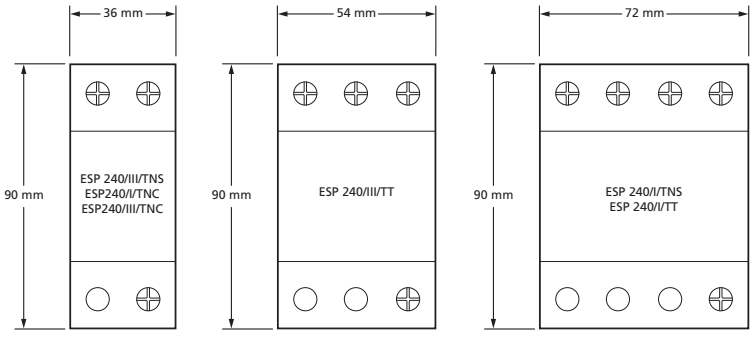
[1] Temporary Overvoltage rating is for a maximum duration of 5 seconds tested to BS/EN/IEC 61643

Transient specification ***Type 1 (BS/EN), Class I (IEC)***	ESP 240/I/TNS	ESP 240/III/TNS	ESP 240/I/TNC	ESP 240/III/TNC	ESP 240/I/TT	ESP 240/III/TT
Nominal discharge current 8/20µs (per mode) *In*	50kA	25kA	50kA	25kA	50kA/100kA (N-E)	25kA/50kA (N-E)
Let-through voltage *Up* at *In*[1]	<1.5kV	<1.3kV	<1.5kV	<1.3kV	<1.5kV	<1.3kV
Impulse discharge current 10/350µs *Iimp* (per mode)[2]	50kA	25kA	50kA	25kA	50kA/100kA (N-E)	25kA/50kA (N-E)
Let-through voltage *Up* at *Iimp*[1]	<1.2kV	<1.2kV	<1.2kV	<1.2kV	<1.2kV	<1.2kV
Let-through voltage *Up* at 1.2/50µs (N-E, TT system)	–	–	–	–	<1.2kV	<1.2kV
Type 2 (BS/EN), Class II (IEC)						
Nominal discharge current 8/20µs (per mode) *In*	50kA	25kA	50kA	25kA	50kA/100kA (N-E)	25kA/50kA (N-E)
Let-through voltage Up at *In*[1]	<1.5kV	<1.3kV	<1.5kV	<1.3kV	<1.5kV	<1.3kV
Maximum discharge current *I*max (per mode)[2]	100kA	100kA	100kA	100kA	100kA/160kA (N-E)	100kA/100kA (N-E)

[1] The maximum transient voltage let-through of the protector throughout the test (±5%), phase to earth and neutral to earth.
[2] The electrical system, external to the unit, may constrain the actual current rating achieved in a particular installation.

Mechanical specification	ESP 240/I/TNS	ESP 240/III/TNS	ESP 240/I/TNC	ESP 240/III/TNC	ESP 240/I/TT	ESP 240/III/TT
Temperature range	–40 to +80°C					
Connection type	Screw Terminal					
Conductor size (stranded)	25mm²					
Earth connection	Screw Terminal					
Volt free contact	Connect via screw terminal with conductor up to 1.5mm² (stranded)					
Degree of protection (IEC 60529)	IP20					
Case material	Thermoplastic, UL 94 V-0					
Mounting	Indoor, 35mm top hat DIN rail					
Weight – unit	0.84kg	0.44kg	0.44kg	0.29kg	0.68kg	0.44kg
– packaged	0.94kg	0.54kg	0.54kg	0.39kg	0.78kg	0.54kg
Dimensions to DIN 43880 - HxDxW [1]	90mm x 68mm x 72mm (4TE)	90mm x 68mm x 36mm (2TE)	90mm x 68mm x 36mm (2TE)	90mm x 68mm x 36mm (2TE)	90mm x 68mm x 72mm (4TE)	90mm x 68mm x 54mm (3TE)

[1] The remote signal contact (removable) adds 10mm to height



Standard depth 68 mm

ESP 415/XXX Series

LPZ $0_A \rightarrow 2$

COMMON MODE Equipotential Bonding

MAINS TEST TYPE 1 + 2

e ENHANCED Low let-through voltage

STATUS INDICATION + VOLT-FREE CONTACT

Combined Type 1 and 2 tested protector (to BS EN 61643-11) for use on the main distribution board, particularly where a structural Lightning Protection System (LPS) is employed, for equipotential bonding. For use at boundaries up to LPZ 0_A to protect against flashover (typically the main distribution board location) through to LPZ 2 to protect electrical equipment from damage.

Features and benefits

- ✔ Enhanced protection (to BS EN 62305) offering low let-through voltage further minimizing the risk of flashover creating dangerous sparking or electric shock
- ✔ Repeated protection in lightning intense environments
- ✔ The varistor based design eliminates the high follow current (I_f) associated with spark gap based surge protection
- ✔ Compact, space saving design
- ✔ Indicator shows when the protector requires replacement
- ✔ Remote signal contact can indicate the protectors' status through interfacing with a building management system

Application

- ✔ Use on three phase mains supplies and power distribution systems for protection against partial direct or indirect lightning strikes
- ✔ ESP 415/I/XXX versions for use with Class I or II Lightning Protection Systems (LPS)
- ✔ ESP 415/III/XXX versions for use with Class III or IV LPS; or exposed overhead three phase power lines where no LPS is fitted
- ✔ ESP 415/X/TNS versions also cover TNC-S earthing systems

Installation

Protector to be installed in the main distribution panel with connecting leads of minimal length. The protector should be fused and is suitable for attachment to a 35mm top hat DIN rail.

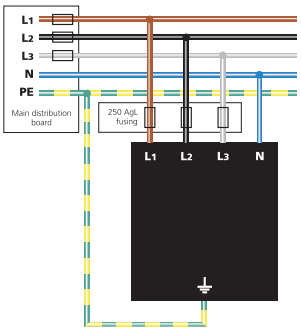
IMPORTANT

The primary purpose of Lightning current or Equipotential bonding mains Type 1 Surge Protective Devices (SPDs) is to prevent dangerous sparking caused by flashover to protect against the loss of human life. In order to protect electronic equipment and ensure the continual operation of systems, transient overvoltage mains Type 2 and 3 SPDs such as the ESP 240 M1 are further required, typically installed at downstream sub-distribution boards feeding sensitive equipment. BS EN 62305 refers to the correct application of mains Type 1, 2 and 3 SPDs as a coordinated set.

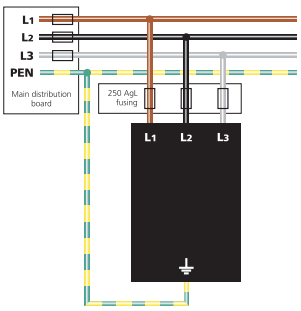
For further information, please refer to "A Guide to BS EN 62305:2006 Protection Against Lightning" available from Furse.

Installation

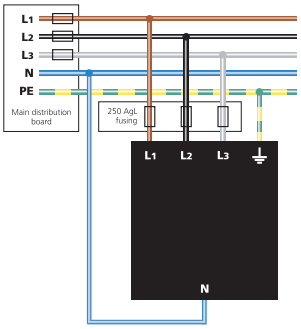
The diagrams below illustrate how to wire the appropriate ESP protector according to your chosen electrical system.



TNS earthing system



TNC earthing system



TT earthing system

Accessories

Weatherproof enclosures

WBX D4
Use with TNS and TNC versions

WBX D8
Use with TT versions

Electrical specification	NEW ESP 415/I/TNS	NEW ESP 415/III/TNS	NEW ESP 415/I/TNC	NEW ESP 415/III/TNC	NEW ESP 415/I/TT	NEW ESP 415/III/TT
Nominal voltage - Phase - Neutral *Uo* (RMS)	240V					
Maximum voltage - Phase-Neutral *Uc* (RMS/DC)	320V/420V					
Temporary Overvoltage TOV *UT* [1]	335V					
Short circuit withstand capability	25kA/50Hz					
Back-up fuse (see installation instructions)	250A					
Leakage current (to earth)	<2.5mA	<2.5mA	<2.5mA	<2.5mA	–	–
Volt free contact **– current rating** **– nominal voltage** (RMS)	0.5A 250V					

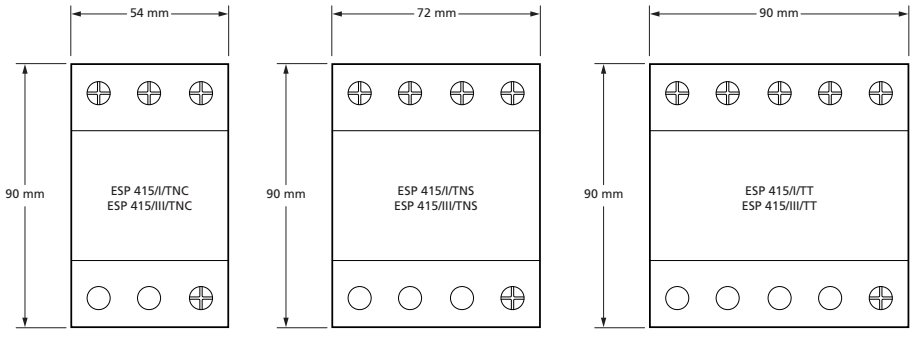
[1] Temporary Overvoltage rating is for a maximum duration of 5 seconds tested to BS/EN/IEC 61643

Transient specification ***Type 1 (BS/EN), Class I (IEC)***	ESP 415/I/TNS	ESP 415/III/TNS	ESP 415/I/TNC	ESP 415/III/TNC	ESP 415/I/TT	ESP 415/III/TT
Nominal discharge current 8/20µs (per mode) *In*	25kA	20kA	25kA	20kA	25kA/100kA (N-E)	20kA/50kA (N-E)
Let-through voltage *Up* at *In*[1]	<1.4kV	<1.5kV	<1.4kV	<1.5kV	<1.4kV	<1.5kV
Impulse discharge current 10/350µs *Iimp* (per mode)[2]	25kA	12.5kV	25kA	12.5kV	25kA/100kA (N-E)	25kA/100kA (N-E)
Let-through voltage *Up* at *Iimp*[1]	<1.3kV	<1.2kV	<1.3kV	<1.2kV	<1.3kV	<1.2kV
Let-through voltage *Up* at 1.2/50µs (N-E, TT system)	–	–	–	–	<1.2kV	<1.2kV
Type 2 (BS/EN), Class II (IEC)						
Nominal discharge current 8/20µs (per mode) *In*	25kA	20kA	25kA	20kA	25kA/100kA (N-E)	20kA/50kA (N-E)
Let-through voltage *Up* at *In*[1]	<1.4kV	<1.5kV	<1.4kV	<1.5kV	<1.4kV	<1.5kV
Maximum discharge current *Imax* (per mode)[2]	100kA	50kA	100kA	50kA	100kA/160kA (N-E)	50kA/100kA (N-E)

[1] The maximum transient voltage let-through of the protector throughout the test (±5%), phase to earth and neutral to earth.
[2] The electrical system, external to the unit, may constrain the actual current rating achieved in a particular installation.

Mechanical specification	ESP 415/I/TNS	ESP 415/III/TNS	ESP 415/I/TNC	ESP 415/III/TNC	ESP 415/I/TT	ESP 415/III/TT
Temperature range	–40 to +80°C					
Connection type	Screw Terminal					
Conductor size (stranded)	25mm²					
Earth connection	Screw Terminal					
Volt free contact	Connect via screw terminal with conductor up to 1.5mm² (stranded)					
Degree of protection (IEC 60529)	IP20					
Case material	Thermoplastic, UL 94 V-0					
Mounting	Indoor, 35mm top hat DIN rail					
Weight – unit	0.84kg	0.59kg	0.64kg	0.44kg	0.9kg	0.67kg
– packaged	0.94kg	0.69kg	0.74kg	0.54kg	1.0kg	0.77kg
Dimensions to DIN 43880 - HxDxW [1]	90mm x 68mm x 72mm (4TE)	90mm x 68mm x 72mm (4TE)	90mm x 68mm x 54mm (3TE)	90mm x 68mm x 54mm (3TE)	90mm x 68mm x 90mm (5TE)	90mm x 68mm x 90mm (5TE)

[1] The remote signal contact (removable) adds 10mm to height



Standard depth 68 mm

ESP D1 Series NEW – COMING SOON

LPZ $0_B \rightarrow 3$

FULL MODE Bonding + Equipment Protection

MAINS TEST TYPE 1 + 2 + 3

ENHANCED Low let-through voltage

ACTIVE VOLT-FREE CONTACT

Combined Type 1, 2 and 3 tested protector (to BS EN 61643) for use on mains power distribution systems primarily to protect connected electronic equipment from transient overvoltages on the mains supply, e.g. computer, communications or control equipment. Innovative remote display options allow both protector and display to be mounted in their optimum position. For use at boundaries up to LPZ 0_B to protect against flashover (typically the main distribution board location, with multiple metallic services entering) through to LPZ 3 to protect sensitive electronic equipment.

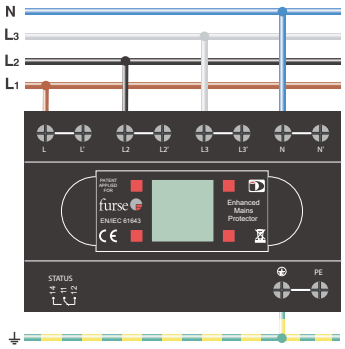
Features and benefits

- ✔ Very low let-through voltage (enhanced protection to BS EN 62305) between all sets of conductors (phase to neutral, phase to earth, neutral to earth – Full Mode protection)
- ✔ Full mode design capable of handling partial lightning currents as well as allowing continual operation of protected equipment
- ✔ Repeated protection in lightning intense environments
- ✔ Innovative multiple thermal disconnect technology for safe disconnection from faulty or abnormal supplies (without compromising protective performance)
- ✔ Three way visual indication of protection status and advanced pre-failure warning so you need never be unprotected
- ✔ Three phase ESP XXX D1R/LED or ESP XXX D1R/LCD units (where XXX = 208, or 415, or 480) have a remote display that allows the protector to be mounted close to the incoming feed or distribution board with the display being mounted in a visible position e.g. at the front of the panel
- ✔ Three phase ESP XXX D1/LCD or ESP XXX D1R/LCD units have backlit LCD intelligent display offering clear status information that can be rotated should the unit be mounted on its side to facilitate short connecting leads for optimal protection
- ✔ Remote indication facility allows pre-failure warning to be linked to a building management system, buzzer or light
- ✔ Changeover active volt free contact enables the protector to be used to warn of phase loss (i.e. power failure, blown fuses etc)
- ✔ Flashing warning of potentially fatal neutral to earth supply faults (due to incorrect earthing, wiring errors or unbalanced conditions)
- ✔ Through terminal facility allows series connection on low current supplies to eliminate high additive voltage associated with connecting leads on units installed in parallel
- ✔ Compact space saving DIN housing

Installation

Install in parallel, within the power distribution board or directly (via fuses) on to the supply feeding equipment. Can be installed in series for low current supplies – see installation instructions.

For three phase ESP XXX D1R/LED or ESP XXX D1R/LCD units, position remote display, making sure that the cable is long enough, is unimpeded within the cabinet, and allows a minimum of 60mm behind the panel front (for the interconnection cable).



Parallel connection of ESP 415 D1, ESP 208 D1 and ESP 480 D1 series to three phase star (4 wire and earth) supplies (fuses not shown for clarity)

At distribution boards, the protector can be installed either on the load side of the incoming isolator, or on the closest outgoing way to the incoming supply. Connect, with very short connecting leads, to phase(s), neutral and earth.

Accessories

Weatherproof enclosures

WBX D4
Use with single phase protectors

WBX D8
Use with three phase protectors

ESP RLA HD-1
Spare 1 metre cable assembly for three phase ESP XXX D1R/LED or ESP XXX D1R/LCD

ESP RLA HD-4
Spare 4 metre cable assembly for three phase ESP XXX D1R/LED or ESP XXX D1R/LCD

Electrical specification	SINGLE PHASE			THREE PHASE SERIES[1]		
	NEW ESP 120 D1	NEW ESP 240 D1	NEW ESP 277 D1	NEW ESP 208 D1 Series	NEW ESP 415 D1 Series	NEW ESP 480 D1 Series
Nominal voltage - Phase - Neutral *Uo* (RMS)	120V	240V	277V	208V	415V	480V
Maximum voltage - Phase-Neutral *Uc* (RMS)	150V	280V	350V	150V	280V	350V
Temporary Overvoltage TOV *Ut*[2]	208V	415V	480V	208V	415V	480V
Short circuit withstand capability	25kA, 50Hz					
Working voltage (RMS)	90-150V	200-280V	232-350V	156-260V	346-484V	402-600V
Frequency range	47-63Hz					
Back-up fuse (see installation instructions)	125A					
Leakage current (to earth)	<250µA					
Indicator circuit current	<10mA					
Volt free contact[3]	Screw terminal					
– current rating	1A					
– nominal voltage (RMS)	250V					

[1] Three phase series (208V, 415V or 480V) include fixed (D1) or remote (D1R) LED or LCD options e.g. ESP 415 D1/LED, ESP 415 D1/LCD, ESP 415 D1R/LED, ESP 415 D1R/LCD

[2] Temporary Overvoltage rating is for a maximum duration of 5 seconds tested to BS/EN/IEC 61643

[3] Minimum permissable load is 5V DC, 10mA to ensure reliable operation

Transient specification	ESP 120 D1	ESP 240 D1	ESP 277 D1	ESP 208 D1 Series	ESP 415 D1 Series	ESP 480 D1 Series
Type 1 (BS/EN), Class I (IEC)						
Nominal discharge current 8/20µs (per mode) *In*	20kA					
Let-through voltage *Up* at *In*[1]	<600V	<900V	<1kV	<600V	<900V	<1kV
Impulse discharge current 10/350µs *Iimp* (per mode)[2]	4kA					
Let-through voltage *Up* at *Iimp*[1]	<500V	<750V	<850V	<500V	<750V	<850V
Impulse discharge current (per phase) *Iimp*[3]	6.25kA					
Type 2 (BS/EN), Class II (IEC)						
Nominal discharge current 8/20µs (per mode) *In*	20kA					
Let-through voltage *Up* at *In*[1]	<600V	<900V	<1kV	<600V	<900V	<1kV
Maximum discharge current *Imax* (per mode)[2]	40kA					
Maximum discharge current *Imax* (per phase)	80kA					
Type 3 (BS/EN), Class III (IEC)						
Let-through voltage at *Uoc* of 6kV 1.2/50µs and *Isc* of 3kA 8/20µs (per mode)[4]	<390V	<600V	<680V	<390V	<600V	<680V

[1] The maximum transient voltage let-through of the protector throughout the test (±5%), phase to neutral, phase to earth and neutral to earth.

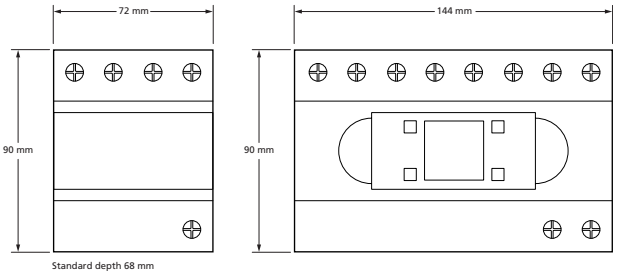
[2] The electrical system, external to the unit, may constrain the actual current rating achieved in a particular installation.

[3] Rating is considered as the current capability of the protector for equipotential bonding near the service entrance.

[4] Combination wave test within BS 6651:1999 App. C, Cats C-Low & B-High, IEEE C62.41-2002 Location Cats C1 & B3, SS CP 33:1996 App. F, AS 1768-1991 App. B, Cat B, UL1449 mains wire-in

Mechanical specification	ESP 120 D1	ESP 240 D1	ESP 277 D1	ESP 208 D1 Series	ESP 415 D1 Series	ESP 480 D1 Series
Temperature range	–40 to +70°C					
Connection type	Screw terminal					
Conductor size (stranded)	25mm²					
Earth connection	Screw terminal					
Volt free contact	Connect via screw terminal with conductor up to 2.5mm² (stranded)					
Display connection (three phase 208/415/480 D1R/LED or D1R/LCD versions)	–			HD-D Type 1 metre interconnection cable – 4 metre cable (ESP RLA HD-4) optional		
Degree of protection (IEC 60529)	IP20					
Case material	PBT UL-94 V-0					
Weight – unit	0.4kg			0.85kg		
– packaged	0.5kg			0.95kg		
Dimensions to DIN 43880 – HxDxW[1]	90mm x 68mm x 72mm (4TE)			90mm x 68mm x 144mm (8TE)		

[1] The remote signal contact (removable) adds 10mm to height



If you desire a protector with an extra high maximum surge current use the ESP M2 or M4 series. If your supply is fused at 16 amps, or less, the in-line protectors (and their ready boxed derivatives) may be more suitable.

ESP M2/M4 Series

LPZ $0_A \rightarrow 3$

FULL MODE Bonding + Equipment Protection

MAINS TEST TYPE 1 + 2 + 3

e ENHANCED Low let-through voltage

ACTIVE VOLT-FREE CONTACT

3-WAY + N-E FAULT STATUS INDICATION

Combined Type 1, 2 and 3 tested protector (to BS EN 61643-11) for use on the main distribution board directly feeding electronic equipment such as computers, communication and control equipment, particularly where a structural Lightning Protection System (LPS) is employed. For use at boundaries up to LPZ 0_A to protect against flashover (typically the main distribution board location) through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

- ✔ Very low let-through voltage between all sets of conductors (phase to neutral, phase to earth and neutral to earth)
- ✔ Full mode design capable of handling high energy partial lightning currents as well as allowing continual operation of protected equipment
- ✔ Innovative multiple thermal disconnect technology, for safe disconnection from faulty or abnormal supplies (without compromising protective performance)
- ✔ Three way visual indication of protection status
- ✔ Advanced pre-failure warning so you need never be unprotected
- ✔ Remote indication facility allows pre-failure warning to be linked to a building management system, buzzer or light
- ✔ Changeover active volt free contact enables the protector to be used to warn of phase loss (i.e. power failure, blown fuses, etc)
- ✔ Unique flashing warning of potentially fatal neutral to earth supply faults (caused by incorrect earthing, wiring errors or unbalanced conditions)
- ✔ Robust steel housing
- ✔ Protector base provides ultra low inductance earth bond to metal panels
- ✔ Convenient holes for flat mounting

For main distribution boards with multiple metallic services (gas, water, telecom/data lines) entering and for sub-distribution boards, the ESP M1 Series are more suited. If your supply is fused at 16 amps, or less, the in-line protection (ESP 240 (or 120-5A (or -16A) and ready-boxed derivatives) may be suitable. If you need to mount the the display panel separately from the main protector unit, use the ESP XXX M2R or ESP XXX M4R.

Application

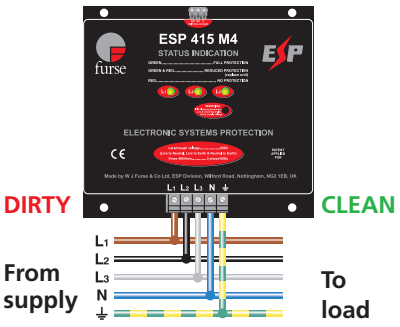
Use ESP M2 versions on main distribution panel for buildings with a Class III or IV structural LPS fitted or exposed 3 phase power lines where no LPS is fitted. Use ESP M4 versions on main distribution panel for buildings with a Class I or II LPS fitted.

Installation

Install in parallel, within the power distribution board, either on the load side of the incoming isolator, or on the closest outgoing way to the incoming supply.

Live connecting leads should be fused accordingly

Connect, with very short connecting leads, to phase(s), neutral and earth. Phase/live connecting leads should be fused with high rupture capacity (HRC) fuses, a switchfuse, MCCB or type 'C' MCB.



Parallel connection to three phase star (4 wire and earth) supplies (fuses not shown for clarity)

Accessories

Weatherproof enclosures

WBX M2
For use with the ESP XXX M2

WBX M4
For use with the ESP XXX M4

Electrical specification	ESP 415 M2	ESP 415 M4	NEW ESP 480 M2	NEW ESP 480 M4
Nominal voltage - Phase - Neutral *Uo* (RMS)	415V	415V	480V	480V
Maximum voltage - Phase-Neutral *Uc* (RMS)	280V	280V	350V	350V
Temporary Overvoltage TOV *Ut*[1]	415V	415V	480V	480V
Short circuit withstand capability	25kA, 50Hz			
Working voltage (RMS)	346-484V	346-484V	402-600V	402-600V
Frequency range	47-63Hz			
Back-up fuse (see installation instructions)	200A	315A	200A	315A
Leakage current (to earth)	<500µA	<1000µA	<500µA	<1000µA
Indicator circuit current	<20mA	<40mA	<20mA	<40mA
Volt free contact[2]	Screw terminal			
– current rating	1A			
– nominal voltage (RMS)	250V			

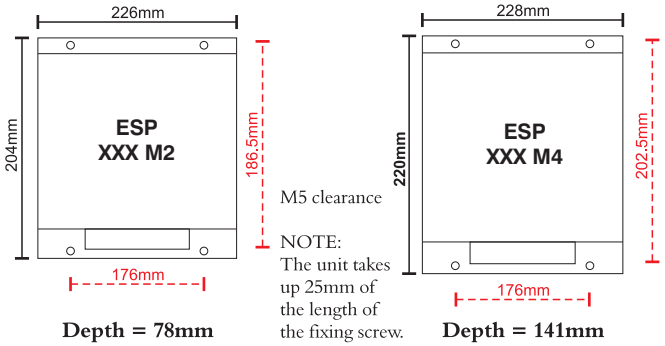
[1] Temporary Overvoltage rating is for a maximum duration of 5 seconds tested to BS/EN/IEC 61643
[2] Minimum permissable load is 5V DC, 10mA to ensure reliable operation

Transient specification *Type 1 (BS/EN), Class I (IEC)*	ESP 415 M2	ESP 415 M4	ESP 480 M2	ESP 480 M4
Nominal discharge current 8/20µs (per mode) *In*	40kA	80kA	40kA	80kA
Let-through voltage *Up* at *In*[1]	<900V	<900V	<1kV	<1kV
Impulse discharge current 10/350µs *Iimp* (per mode)[2]	8kA	16kA	8kA	16kA
Let-through voltage *Up* at *Iimp*[1]	<750V	<750V	<850V	<850V
Impulse discharge current (per phase) *Iimp*[3]	12.5kA	25kA	12.5kA	25kA
Type 2 (BS/EN), Class II (IEC)				
Nominal discharge current 8/20µs (per mode) *In*	40kA	80kA	40kA	80kA
Let-through voltage *Up* at *In*[1]	<900V	<900V	<1kV	<1kV
Maximum discharge current *Imax* (per mode)[2]	80kA	160kA	80kA	160kA
Maximum discharge current *Imax* (per phase)	160kA	320kA	160kA	320kA
Type 3 (BS/EN), Class III (IEC)				
Let-through voltage at *Uoc* of 6kV 1.2/50µs and *Isc* of 3kA 8/20µs (per mode)[4]	<590V	<570V	<670V	<650V

[1] The maximum transient voltage let-through of the protector throughout the test (±5%), phase to neutral, phase to earth and neutral to earth.
[2] The electrical system, external to the unit, may constrain the actual current rating achieved in a particular installation.
[3] Rating is considered as the current capability of the protector for equipotential bonding near the service entrance.
[4] Combination wave test within BS 6651:1999 App. C, Cats C-Low & B-High, IEEE C62.41-2002 Location Cats C1 & B3, SS CP 33:1996 App. F, AS 1768-1991 App. B, Cat B, UL1449 mains wire-in

Mechanical specification	ESP 415 M2	ESP 415 M4	ESP 480 M2	ESP 480 M4
Temperature range	–40 to +70°C			
Connection type	Screw terminal			
Conductor size (stranded)	25mm²	50mm²	25mm²	50mm²
Earth connection	Screw terminal			
Volt free contact	Connect via screw terminal with conductor up to 2.5mm² (stranded)			
Degree of protection (IEC 60529)	IP20			
Case material	Steel			
Weight – unit	2.35kg	3.9kg	2.35kg	3.9kg
– packaged	2.5kg	4.2kg	2.5kg	4.2kg

Dimensions



LPZ $0_B \rightarrow 3$	FULL MODE Bonding + Equipment Protection
MAINS TEST TYPE 1 + 2 + 3	e ENHANCED Low let-through voltage
ACTIVE VOLT-FREE CONTACT	3-WAY + N-E FAULT STATUS INDICATION

Combined Type 1, 2 and 3 tested protector (to BS EN 61643) for use on mains power distribution systems primarily to protect connected electronic equipment from transient overvoltages on the mains supply, e.g. computer, communications or control equipment. For use at boundaries up to LPZ 0_B to protect against flashover (typically the main distribution board location, with multiple metallic services entering) through to LPZ 3 to protect sensitive electronic equipment.

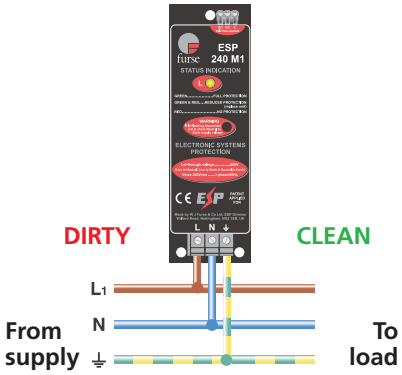
Features and benefits

- ✔ Very low let-through voltage (enhanced protection to BS EN 62305) between all sets of conductors (phase to neutral, phase to earth, neutral to earth – Full Mode protection)
- ✔ Full mode design capable of handling partial lightning currents as well as allowing continual operation of protected equipment
- ✔ Repeated protection in lightning intense environments
- ✔ Innovative multiple thermal disconnect technology for safe disconnection from faulty or abnormal supplies (without compromising protective performance)
- ✔ Three way visual indication of protection status and advanced pre-failure warning so you need never be unprotected
- ✔ Remote indication facility allows pre-failure warning to be linked to a building management system, buzzer or light
- ✔ Changeover active volt free contact enables the protector to be used to warn of phase loss (i.e. power failure, blown fuses etc)
- ✔ Flashing warning of potentially fatal neutral to earth supply faults (due to incorrect earthing, wiring errors or unbalanced conditions)
- ✔ Robust steel housing
- ✔ Base provides ultra low inductance earth bond to metal panels
- ✔ Compact size for installation in the power distribution board
- ✔ ESP 240 M1 has Network Rail Approval PA05/01832. NRS PADS reference 086/047149

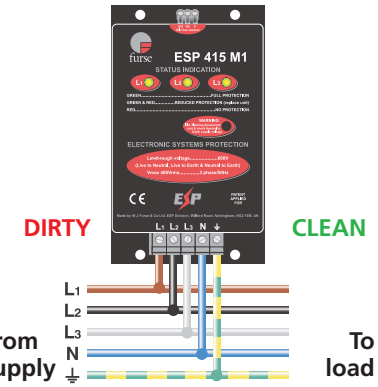
ESP 415 M1 installed within a control panel on the mains input to protect the panel's control systems. Note the remote indication connection (top of protector)

Installation

Install in parallel, within the power distribution board or directly (via fuses) on to the supply feeding equipment.



Parallel connection of single phase protectors ESP 240 M1, ESP 120 M1 or ESP 277 M1 (fuses not shown for clarity)



Parallel connection of ESP 415 M1, ESP 208 M1 or ESP 480 M1 to three phase star (4 wire and earth) supplies (fuses not shown for clarity)

At distribution boards, the protector can be installed either on the load side of the incoming isolator, or on the closest outgoing way to the incoming supply. Connect, with very short connecting leads, to phase(s), neutral and earth.

Accessories

Weatherproof enclosures

WBX 3
Use with single phase protectors

WBX 4
Use with three phase protectors

Electrical specification	ESP 120 M1	ESP 208 M1	ESP 240 M1	ESP 415 M1	ESP 277 M1	ESP 480 M1
Nominal voltage - Phase - Neutral *Uo* (RMS)	120V	208V	240V	415V	277V	480V
Maximum voltage - Phase-Neutral *Uc* (RMS)	150V	150V	280V	280V	350V	350V
Temporary Overvoltage TOV *Ut*[1]	208V	208V	415V	415V	480V	480V
Short circuit withstand capability	25kA, 50Hz					
Working voltage (RMS)	90-150V	156-260V	200-280V	346-484V	232-350V	402-600V
Frequency range	47-63Hz					
Back-up fuse (see installation instructions)	125A					
Leakage current (to earth)	<250µA					
Indicator circuit current	<10mA					
Volt free contact[2]	Screw terminal					
– current rating	1A					
– nominal voltage (RMS)	250V					

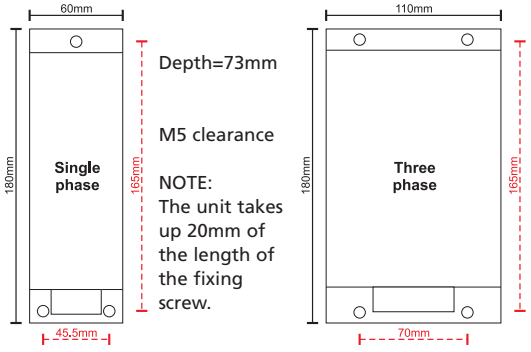
[1] Temporary Overvoltage rating is for a maximum duration of 5 seconds tested to BS/EN/IEC 61643
[2] Minimum permissable load is 5V DC, 10mA to ensure reliable operation

Transient specification ***Type 1 (BS/EN), Class I (IEC)***	ESP 120 M1	ESP 208 M1	ESP 240 M1	ESP 415 M1	ESP 277 M1	ESP 480 M1
Nominal discharge current 8/20µs (per mode) *In*	20kA					
Let-through voltage *Up* at *In*[1]	<600V	<600V	<900V	<900V	<1kV	<1kV
Impulse discharge current 10/350µs *Iimp* (per mode)[2]	4kA					
Let-through voltage *Ures* at *Iimp*[1]	<500V	<500V	<750V	<750V	<850V	<850V
Impulse discharge current (per phase) *Iimp*[3]	6.25kA					
Type 2 (BS/EN), Class II (IEC)						
Nominal discharge current 8/20µs (per mode) *In*	20kA					
Let-through voltage *Up* at *In*[1]	<600V	<600V	<900V	<900V	<1kV	<1kV
Maximum discharge current *Imax* (per mode)[2]	40kA					
Maximum discharge current *Imax* (per phase)	80kA					
Type 3 (BS/EN), Class III (IEC)						
Let-through voltage at *Uoc* of 6kV 1.2/50µs and *Isc* of 3kA 8/20µs (per mode)[4]	<390V	<390V	<600V	<600V	<680V	<680V

[1] The maximum transient voltage let-through of the protector throughout the test (±5%), phase to neutral, phase to earth and neutral to earth.
[2] The electrical system, external to the unit, may constrain the actual current rating achieved in a particular installation.
[3] Rating is considered as the current capability of the protector for equipotential bonding near the service entrance.
[4] Combination wave test within BS 6651:1999 App. C, Cats C-Low & B-High, IEEE C62.41-2002 Location Cats C1 & B3, SS CP 33:1996 App. F, AS 1768-1991 App. B, Cat B, UL1449 mains wire-in

Mechanical specification	ESP 120 M1	ESP 208 M1	ESP 240 M1	ESP 415 M1	ESP 277 M1	ESP 480 M1
Temperature range	–40 to +70°C					
Connection type	Screw terminal					
Conductor size (stranded)	16mm²					
Earth connection	Screw terminal					
Volt free contact	Connect via screw terminal with conductor up to 2.5mm² (stranded)					
Degree of protection (IEC 60529)	IP20					
Case material	Steel					
Weight – unit	0.6kg	1.0kg	0.6kg	1.0kg	0.6kg	1.0kg
– packaged	0.7kg	1.1kg	0.7kg	1.1kg	0.7kg	1.1kg

Dimensions



If you desire a protector with an extra high maximum surge current use the ESP M2 or M4 series. If your supply is fused at 16 amps, or less, the in-line protectors (ESP 240 (or 120-5A (or -16A) and their ready boxed derivatives) may be more suitable. If you need to mount the display panel separately from the main protector unit, use the ESP M1R series.

ESP M1R, M2R, M4R Series

FULL MODE Bonding + Equipment Protection

MAINS TEST TYPE 1 + 2 + 3

e ENHANCED Low let-through voltage

ACTIVE VOLT-FREE CONTACT

3-WAY + N-E FAULT STATUS INDICATION

LPZ
M1R $0_B \rightarrow 3$
M2R $0_A \rightarrow 3$
M4R $0_A \rightarrow 3$

REMOTE INDICATION LED DISPLAY

Combined Type 1, 2 and 3 tested protector (to BS EN 61643-11) for use on mains power distribution systems primarily to protect connected electronic equipment from transient overvoltages on the mains supply, e.g. computer, communications or control equipment. Remote display allows both display and protector unit to be mounted in their optimum positions. For use at boundaries up to LPZ 0_A to protect against flashover (typically the main distribution board location, with multiple metallic services entering) through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

- ✔ The remote display means the protector can be mounted close to the incoming feed or first way on the distribution board and the display in an easily visible position, e.g. on front of cabinet
- ✔ Very low let-through voltage (enhanced protection to BS EN 62305) between all sets of conductors (phase to neutral, phase to earth, neutral to earth – Full Mode protection)
- ✔ Full mode design capable of handling partial lightning currents as well as allowing continual operation of protected equipment
- ✔ Repeated protection in lightning intense environments
- ✔ Innovative multiple thermal disconnect technology for safe disconnection from abnormal or faulty supplies
- ✔ Remote display gives three way visual indication of protection status and is easily installed using standard drilling tools
- ✔ Plug-in cable connections between protector and display enable easy connection (1m cable supplied as standard)
- ✔ Advanced pre-failure warning so you need never be unprotected
- ✔ Remote indication facility allows pre-failure warning to be linked to a building management system, buzzer or light
- ✔ Changeover active volt free contact enables the protector to be used to warn of phase loss (i.e. power failure, blown fuses, etc)
- ✔ Unique flashing warning of potentially fatal neutral to earth supply faults (caused by incorrect earthing, wiring errors or unbalanced conditions)
- ✔ Robust steel housing (protector), and sturdy ABS housing (display)
- ✔ Base provides ultra-low inductance earth bond to metal panels
- ✔ Remote display comes with integral fixings and a panel drilling template

Front view of a cabinet with the display unit, easily visible, mounted on the front of the door, whilst the protector unit is installed deep within

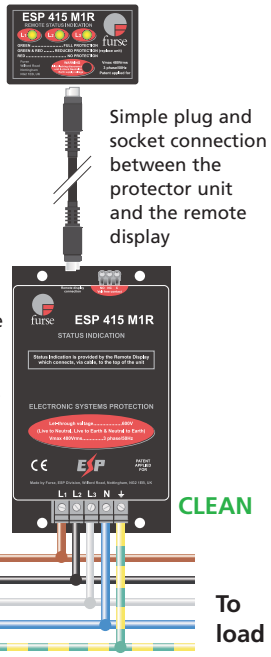
Application

Use ESP M1R versions on main distribution panel for buildings with multiple metallic services (e.g. gas, water, telephone lines) and on sub-distribution boards feeding sensitive equipment. Use ESP M2R versions on main distribution panel for buildings with a Class III or IV structural LPS fitted or exposed 3 phase power lines where no LPS is fitted. Use ESP M4R versions on main distribution panel for buildings with a Class I or II LPS fitted.

Installation

Installation of the protector unit is identical to the ESP M1, M2 or M4 Series.

Position remote display, making sure that the cable is long enough, is unimpeded within the cabinet, and allows a minimum of 60mm behind the panel front (for the interconnection cable).



Accessories

ESP RLA-1
Spare 1 metre cable assembly

ESP RLA-4
Spare 4 metre cable assembly

ESP RDU
Spare display unit

For three phase applications where a remote display is unnecessary, use the respective ESP M1, M2 or M4 Series.

Electrical specification	ESP 415 M1R	NEW ESP 480 M1R	NEW ESP 415 M2R	NEW ESP 480 M2R	NEW ESP 415 M4R	NEW ESP 480 M4R
Nominal voltage - Phase - Neutral *Uo* (RMS)	415V	480V	415V	480V	415V	480V
Maximum voltage - Phase-Neutral *Uc* (RMS)	280V	350V	280V	350V	280V	350V
Temporary Overvoltage TOV *Ut*[1]	415V	480V	415V	480V	415V	480V
Short circuit withstand capability	25kA, 50Hz					
Working voltage (RMS)	346-484V	402-600V	346-484V	402-600V	346-484V	402-600V
Frequency range	47-63Hz					
Back-up fuse (see installation instructions)	125A	125A	200A	200A	315A	315A
Leakage current (to earth)	<250µA	<250µA	<500µA	<500µA	<1000µA	<1000µA
Indicator circuit current	<10mA	<10mA	<20mA	<20mA	<40mA	<40mA
Volt free contact[2]	Screw terminal					
– current rating	1A					
– nominal voltage (RMS)	250V					

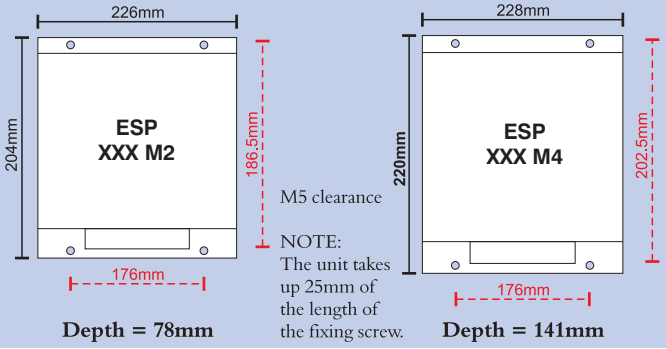
[1] Temporary Overvoltage rating is for a maximum duration of 5 seconds tested to BS/EN/IEC 61643.
[2] Minimum permissable load is 5V DC, 10mA to ensure reliable operation.
Under fault conditions, the remote display will go blank if the L1 phase loses power or becomes faulty. This is due to the isolation requirements needed for circuitry mounted externally to the main protector unit.

Transient specification *Type 1 (BS/EN), Class I (IEC)*	ESP 415 M1R	ESP 480 M1R	ESP 415 M2R	ESP 480 M2R	ESP 415 M4R	ESP 480 M4R
Nominal discharge current 8/20µs (per mode) *In*	20kA	20kA	40kA	40kA	80kA	80kA
Let-through voltage *Up* at *In*[1]	<900V	<1kV	<900V	<1kV	<900V	<1kV
Impulse discharge current 10/350µs *Iimp* (per mode)[2]	4kA	4kA	8kA	8kA	16kA	16kA
Let-through voltage *Up* at *Iimp*[1]	<750V	<850V	<750V	<850V	<750V	<850V
Impulse discharge current (per phase) *Iimp*[3]	6.25kA	6.25kA	12.5kA	12.5kA	25kA	25kA
Type 2 (BS/EN), Class II (IEC)						
Nominal discharge current 8/20µs (per mode) *In*	20kA	20kA	40kA	40kA	80kA	80kA
Let-through voltage *Up* at *In*[1]	<900V	<1kV	<900V	<1kV	<900V	<1kV
Maximum discharge current *Imax* (per mode)[2]	40kA	40kA	80kA	80kA	160kA	160kA
Maximum discharge current *Imax* (per phase)	80kA	80kA	160kA	160kA	320kA	320kA
Type 3 (BS/EN), Class III (IEC)						
Let-through voltage at *Uoc* of 6kV 1.2/50µs and *Isc* of 3kA 8/20µs (per mode)[4]	<600V	<680V	<590V	<670V	<570V	<650V

[1] The maximum transient voltage let-through of the protector throughout the test (±5%), phase to neutral, phase to earth and neutral to earth.
[2] The electrical system, external to the unit, may constrain the actual current rating achieved in a particular installation.
[3] Rating is considered as the current capability of the protector for equipotential bonding near the service entrance.
[4] Combination wave test within BS 6651:1999 App. C, Cats C-Low & B-High, IEEE C62.41-2002 Location Cats C1 & B3, SS CP 33:1996 App. F, AS 1768-1991 App. B, Cat B, UL1449 mains wire-in

Mechanical specification	ESP 415 M1R	ESP 480 M1R	ESP 415 M2R	ESP 480 M2R	ESP 415 M4R	ESP 480 M4R
Temperature range	–40 to +70°C					
Connection type	Screw terminal					
Conductor size (stranded)	16mm²	16mm²	25mm²	25mm²	50mm²	50mm²
Earth connection	Screw terminal					
Volt free contact	Connect via screw terminal with conductor up to 2.5mm² (stranded)					
Degree of protection (IEC 60529)	IP20					
Display connection	6 way 1 metre interconnection cable - 4 metre cable optional (ESP RLA-4)					
Case material	Unit – Steel, Display – ABS					
Weight – unit	1.1kg	1.1kg	2.45kg	2.45kg	4kg	4kg
– packaged	1.2kg	1.2kg	2.55kg	2.55kg	4.3kg	4.3kg

Dimensions



ESP DC Series

FULL MODE Bonding + Equipment Protection

MAINS TEST TYPE 2 + 3

ENHANCED Low let-through voltage

LPZ 1→3

STATUS INDICATION + VOLT-FREE CONTACT

Combined Type 2 and 3 tested protector (to BS EN 61643-11) for use on DC systems to protect connected electronic equipment from transient overvoltages on the mains supply, e.g. control equipment. Available for 12, 24, 36 and 48V DC systems. For use at boundaries LPZ 1 through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

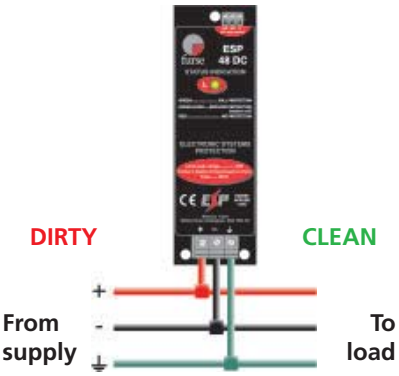
- ✔ Low let-through voltage (enhanced protection to BS EN 62305) between all sets of conductors (positive to negative, positive to earth and negative to earth) – Full Mode protection) allowing continuous operation of equipment
- ✔ Repeated protection in lightning intense environments
- ✔ Visual indication of protector status
- ✔ Advanced pre-failure warning so you need never be unprotected
- ✔ Remote indication facility allows pre-failure warning to be linked to a building management system, buzzer or light
- ✔ Robust steel housing
- ✔ Simple parallel connection
- ✔ Base provides ultra low inductance earth bond to metal panels
- ✔ Compact size for installation in the power distribution board
- ✔ Maintenance free

Application

Use on DC power distribution systems to protect connected electronic equipment from transient overvoltages on the DC supply, e.g. DC fed communications or control equipment.

Installation

Install in parallel, within the power distribution board or directly on the supply feeding the equipment.



Parallel connection of ESP 48 DC

At distribution boards, the protector can be installed either on the load side of the incoming isolator, or on the closest outgoing way to the incoming supply. Connect, with very short connecting leads, to positive, negative and earth.

Accessories

WBX 3
Weatherproof enclosure

For low current applications, the H Series (4A), E Series (1.25A) or D Series (300mA) protectors may be suitable.

Electrical specification	ESP 12 DC	ESP 24 DC	ESP 36 DC	ESP 48 DC
Nominal voltage (RMS)	12V	24V	36V	48V
Maximum voltage (RMS)	15V	30V	45V	60V
Working voltage (RMS)	9-15V	18-30V	27-45V	36-60V
Back-up fuse (see installation instructions)	100A			
Leakage current (to earth)	<250µA			
Indicator circuit current	<10mA			
Volt free contact[1] **– current rating** **– nominal voltage** (RMS)	Screw terminal 1A 250V			

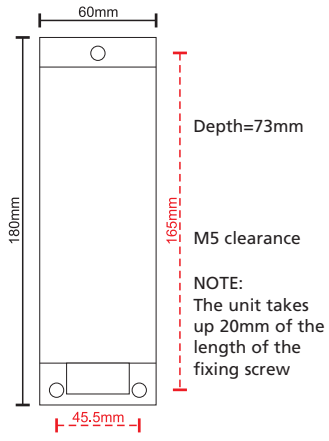
[1] Minimum permissable load is 5V DC, 10mA to ensure reliable operation

Transient specification *Type 2 (BS/EN), Class II (IEC)*	ESP 12 DC	ESP 24 DC	ESP 36 DC	ESP 48 DC
Nominal discharge current 8/20µs (per mode) *In*	5kA			
Let-through voltage *Up* at *In*[1]	<250V	<250V	<250V	<250V
Maximum discharge current *Imax* (per mode)[2]	20kA			
Type 3 (BS/EN), Class III (IEC)				
Let-through voltage at *Uoc* of 6kV 1.2/50µs and *Isc* of 3kA 8/20µs (per mode)[3]	<190V	<190V	<190V	<190V

[1] The maximum transient voltage let-through of the protector throughout the test (±5%) per mode.
[2] The electrical system, external to the unit, may constrain the actual current rating achieved in a particular installation.
[3] Combination wave test within BS 6651:1999 App. C, Cats C-Low & B-High, IEEE C62.41-2002 Location Cats C1 & B3, SS CP 33:1996 App. F, AS 1768-1991 App. B, Cat B, UL1449 mains wire-in

Mechanical specification	ESP 12 DC	ESP 24 DC	ESP 36 DC	ESP 48 DC
Temperature range	–40 to +70°C			
Connection type	Screw terminal			
Conductor size (stranded)	16mm²			
Earth connection	Screw terminal			
Volt free contact	Connect via screw terminal with conductor up to 2.5mm² (stranded)			
Degree of protection (IEC 60529)	IP20			
Case material	Steel			
Weight – unit	0.6kg	0.6kg	0.6kg	0.6kg
– packaged	0.7kg	0.7kg	0.7kg	0.7kg

Dimensions



ESP 5A/BX and 16A/BX Series

FULL MODE Bonding + Equipment Protection

MAINS TEST TYPE 2 + 3

ENHANCED Low let-through voltage

LPZ 1→3

BX IP66

Combined Type 2 and 3 tested protector (to BS EN 61643-11) for use on low current (up to 5 or 16A) single phase systems to protect connected electronic equipment from transient overvoltages on the mains supply, e.g. fire/intruder alarm panels. Protectors with /BX suffix come ready-boxed, to IP66, for use in dirty or damp environments. Available for 90-150 volts, 200-280 volts and 232-350 volts supplies. For use at boundaries LPZ 1 through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

- ✔ Very low let-through voltage (enhanced protection to BS EN 62305) between all sets of conductors (phase to neutral, phase to earth, neutral to earth - Full Mode protection) allowing continuous operation of equipment
- ✔ Repeated protection in lightning intense environments
- ✔ Compact size for easy incorporation in the protected system
- ✔ Removable DIN rail foot for simple clip-on mounting to top hat DIN rails (unboxed versions)
- ✔ Colour coded terminals give a quick and easy installation check – grey for the dirty (line) end and green for the clean end
- ✔ Available ready-boxed to IP66 for use in dirty or damp environments (protectors with /BX suffix)
- ✔ Robust housing and substantial earth stud
- ✔ Fixing holes ready for flat mounting
- ✔ Maintenance free
- ✔ ESP 240-5A/BX has Network Rail Approval PA05/02896. NRS PADS reference 087/037285

Ready boxed protector (here an ESP 240-5A/BX) installed on the fused connection (spur) to an alarm panel

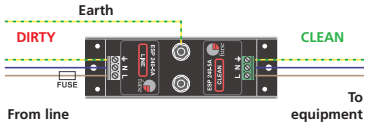
If your supply is fused at more than 16 amps the ESP 120 M1, ESP 240 M1 or ESP 277 M1 are suitable.

Application

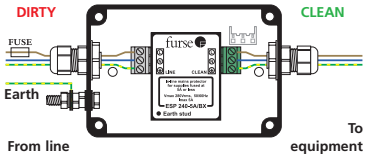
Use these protectors on low current mains power supplies, e.g. CCTV cameras, alarm panels and telemetry equipment.

Installation

Connect in-line with the power supply usually either within the equipment panel (or for CCTV cameras, in an enclosure close by), or on the fused connection that supplies equipment.



Connect in-line on supplies fused up to 5A (ESP 120-5A, ESP 240-5A or ESP 277-5A) or 16A (ESP 120-16A, ESP 240-16A or ESP 277-16A). Note how the protector can also be earthed from its earth stud



Connect in-line on supplies fused up to 5A (ESP 120-5A/BX, ESP 240-5A/BX or ESP 277-5A/BX) or 16A (ESP 120-16A/BX, ESP 240-16A/BX or ESP 277-16A/BX). Note how the protector can also be earthed from its earth stud

To protect equipment inside a building from transients entering on an outgoing feed (e.g. to CCTV cameras or to site lighting) the protector should be installed as close to where the cable leaves the building as possible. Unless ready-boxed, protectors should be installed either within an existing cabinet/cubicle or in a separate enclosure.

Accessories

If several ESP 120-5A or 16A, ESP 240-5A or 16A or ESP 277-5A or 16A protectors are to be installed together, or if one is in use alongside Lightning Barriers for video or signal lines, these can be simultaneously mounted and earthed on a CME kit and housed in a suitable WBX enclosure.

Electrical specification

	ESP 120-5A ESP 120-5A/BX	ESP 120-16A ESP 120-16A/BX	ESP 240-5A ESP 240-5A/BX	ESP 240-16A ESP 240-16A/BX	ESP 277-5A ESP 277-5A/BX	ESP 277-16A ESP 277-16A/BX
Nominal voltage - Phase - Neutral *Uo* (RMS)	120V	120V	240V	240V	277V	277V
Maximum voltage - Phase-Neutral *Uc* (RMS)	150V	150V	280V	280V	350V	350V
Working voltage (RMS)	90-150V	90-150V	200-280V	200-280V	232-350V	232-350V
Frequency range	47-63Hz					
Current rating (supply)	5A or less	16A or less	5A or less	16A or less	5A or less	16A or less
Back-up fuse (see installation instructions)	5A	16A	5A	16A	5A	16A
Leakage current (to earth)	<0.5mA					

Transient specification

Type 2 (BS/EN), Class II (IEC)

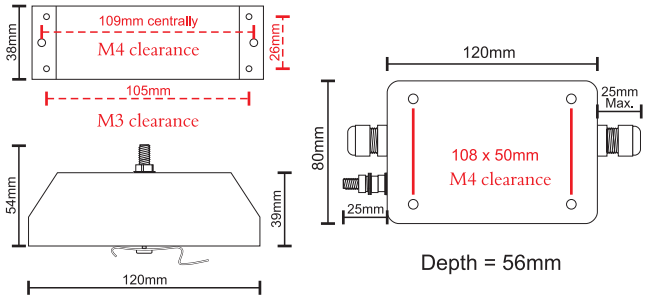
	120 volt protectors	240 volt protectors	277 volt protectors
Nominal discharge current 8/20µs (per mode) *In*	5kA		
Let-through voltage *Up* at *In*[1]	450V	750V	790V
Maximum discharge current *Imax* (per mode)[2]	10kA		
Type 3 (BS/EN), Class III (IEC)			
Let-through voltage at *Uoc* of 6kV 1.2/50µs and *Isc* of 3kA 8/20µs (per mode)[3]	390V	590V	670V

[1] The maximum transient voltage let-through of the protector throughout the test (±5%), phase to neutral, phase to earth and neutral to earth.
[2] The electrical system, external to the unit, may constrain the actual current rating achieved in a particular installation.
[3] Combination wave test within BS 6651:1999 App. C, Cats C-Low & B-High, IEEE C62.41-2002 Location Cats C1 & B3, SS CP 33:1996 App. F, AS 1768-1991 App. B, Cat B, UL1449 mains wire-in

Mechanical specification

	ESP 120-5A ESP 240-16A	ESP 120-16A ESP 277-5A	ESP 240-5A ESP 277-16A	ESP 120-5A/BX ESP 240-16A/BX	ESP 120-16A/BX ESP 277-5A/BX	ESP 240-5A/BX ESP 277-16A/BX
Temperature range	–40 to +70°C			–40 to +70°C		
Connection type	Screw terminal			Screw terminal		
Conductor size (solid)	4mm²			4mm²		
Earth connection	Via earth terminal or M6 stud			Via earth terminal or M6 stud		
Cable glands	–			**-5A/BX** 4.8 – 8mm cable (PG9) **-16A/BX** 8 – 12mm cable (PG13.5)		
Degree of protection (IEC 60529)	IP20			IP66		
Case material	Steel			PVC		
Weight – unit	0.23kg			0.26kg		
– packaged	0.25kg			0.31kg		

Dimensions



ESP MC Series

FULL MODE
Bonding + Equipment Protection

SIGNAL/ TELECOM
TEST CAT D + C + B

MAINS
TEST TYPE 2 + 3

e
ENHANCED
Low let-through voltage

LPZ
Mains 1→3
Data 0_S→3

Combined Type 2 and 3 tested protector (to BS EN 61643-11) with telecom or network protection options. Suitable for use on 220/230/240 volts supplies. Available with British style (three square pin) plugs and sockets with double-pole action. For use at boundaries LPZ 1 through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

- ✔ Low let-through voltage between all sets of conductors
- ✔ Three way visual indication of protection status
- ✔ Protects against radio frequency interference
- ✔ TN and Cat-5e versions can conveniently protect both mains and telecom/data lines in one unit
- ✔ Rugged, heavy duty construction
- ✔ Bracket kit ESP MC/19BK available for rear or 19" rack mounting
- ✔ Maintenance free

Application

ESP MC series can be used to protect all sorts of plug-in equipment, including hospital laboratory equipment, modems, fax machines and PCs.

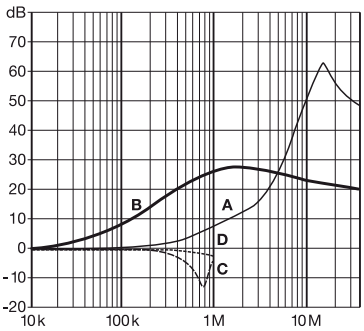
Installation

Simply plug the ESP MC series into the mains and your equipment into the ESP MC.

ESP MC installed within a network rack, protecting the externally-fed network switch

RFI performance

Per CISPR 17:
A = 50Ω/50Ω sym, B = 50Ω/50Ω asym, C = 0.1Ω/100Ω sym, D = 100Ω/0.1Ω sym



Accessories

ESP MC/19BK bracket kit can be used for rear mounting, or reversed for use in 19" cabinets. All fixings supplied.

For wire-in applications up to 16 amps, the 16A/BX Series may be more suitable. For all other supplies, consider the M1 Series.

Electrical specification – mains	ESP MC	NEW ESP MC/TN/RJ11-4/6	NEW ESP MC/Cat-5e
Nominal voltage - Phase - Neutral *Uo* (RMS)		220/230/240V	
Maximum voltage - Phase-Neutral *Uc* (RMS)		280V	
Frequency range		47-63Hz	
Current rating (supply)		13A	
Leakage current (to earth)		<0.5mA	

Electrical specification – telecom/data

Nominal voltage	–	296V	5V
Maximum working voltage *Uc* [1]	–	296V	5V [2]
Current rating (signal)	–	300mA	300mA
In-line resistance (per line ±10%)	–	4.4Ω	1Ω
Bandwidth (–3dB 50Ω system)	–	20MHz	–
Maximum data rate		–	100Mbps

[1] Maximum working voltage (DC or AC peak) of telecom/data protection measured at <10µA leakage for ESP MC/TN/RJ11-4/6 and 1mA for ESP MC/Cat-5e.
[2] Maximum working voltage is 5V for data pairs 1/2 & 3/6.

Transient specification – mains ***Type 2 (BS/EN), Class II (IEC)***	ESP MC	ESP MC/TN/RJ11-4/6	ESP MC/Cat-5e
Nominal discharge current 8/20µs (per mode) *In*		5kA	
Let-through voltage *Up* at *In* [1]		850V	
Maximum discharge current *Imax* (per mode) [2]		10kA	
Type 3 (BS/EN), Class III (IEC)			
Let-through voltage at *Uoc* of 6kV 1.2/50 and *Isc* of 3kA 8/20 (per mode) [3]		680V	
Let-through voltage at *Uoc* of 6kV 1.2/50 and *Isc* of 500A 8/20 (per mode) [4]		555V	

[1] The maximum transient voltage let-through of the protector throughout the test (±5%), phase to neutral, phase to earth and neutral to earth.
[2] The electrical system, external to the unit, may constrain the actual current rating achieved in a particular installation.
[3] Combination wave test within BS 6651:1999 App. C, Cats C-Low & B-High, IEEE C62.41-2002 Location Cats C1 & B3, SS CP 33:1996 App. F, AS 1768-1991 App. B, Cat B, UL1449 mains wire-in
[4] To BS 6651:1999 Appendix C, Category A-High, UL1449 mains plug-in

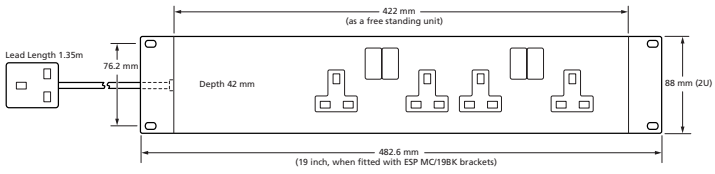
Transient specification – telecom/data

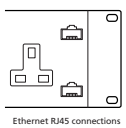
Let-through voltage (all conductors) [1] *Up*			
C2 test 4kV 1.2/50µs, 2kA 8/20µs to BS/EN/IEC 61643-21 – line to line / line to earth	–	390V / 390V	120V / 700V [3]
C1 test 1kV, 1.2/50µs, 0.5kA 8/20µs to BS/EN/IEC 61643-21 – line to line / line to earth	–	395V / 395V	74V / 600V [3]
B2 test 4kV 10/700µs to BS/EN/IEC 61643-21 – line to line / line to earth	–	295V / 295V	21V / 550V [3]
5kV, 10/700µs [2] – line to line / line to earth	–	300V / 300V	25V / 600V [3]
Maximum surge current [4]			
D1 test 10/350µs to BS/EN/IEC 61643-21	–	1kA	1kA
8/20µs to ITU (formerly CCITT), BS 6651:1999 Appendix C	–	10kA	10kA

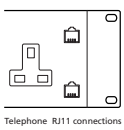
[1] The maximum transient voltage let-through the protector throughout the test (±10%), line to line & line to earth. Response time <10ns.
[2] Test to BS 6651:1999 Appendix C, Cat C-High, IEC 61000-4-5:1995, ITU-T (formerly CCITT) K.20, K.21 and K.45,Telcordia GR-1089-CORE, Issue 2:2002, ANSI TIA/EIA/IS-968-A:2002 (formerly FCC Part 68).
[3] The interfaces used in Cat-5/5e systems incorporate an isolation transformer that inherently provides an inbuilt immunity to transients between line and earth of 1,500 volts or more.
[4] The installation and connectors external to the protector may limit the capability of the protector.

Mechnical specification	ESP MC	ESP MC/TN/RJ11-4/6	ESP MC/Cat-5e
Temperature range		–25°C to +70°C	
Connection type		Via British style three square pin plug and socket to BS 1363	
Connection type – telecom/data	–	RJ11	RJ45
Earth connection		Via plug and socket	
Case material		Steel	
Weight – unit	1.70kg	1.75kg	1.75kg
– packaged	1.75kg	1.8kg	1.8kg

Dimensions



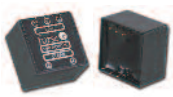

Ethernet RJ45 connections

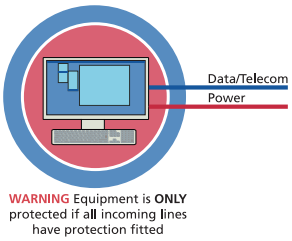

Telephone RJ11 connections

Data/signal and telecom product selector

Selection guide – data/signal and telecom systems	Installation Locations	
Common applications	**Service entrance**	**Critical terminal equipment – located >20m from service entrance**
Analogue Telecom systems (see Furse Application Note AN005) – for systems terminating on twisted pair cabling	 ESP TN, ESP TN/BX, ESP TN/2BX See pages 172 & 178	 New ESP MC/TN/RJ11-/6 (e.g. fax machines/modems) See page 168
– for systems terminating on BT type socket	 ESP TN/JP See page 188	
– for PBX systems terminating of LSA-Plus disconnection modules	 ESP KT1 Series See page 190	
Computer Networks (see Furse Application Note AN004)	 ESP Cat-5 Series See page 192	 ESP LN Series, New ESP MC/Cat-5e See page 196 & 168
Data interfaces – RS 232	 ESP 15D See page 172	 ESP LA Series See page 194
– RS 422, RS 423, RS 485	 ESP 06E See page 174	 ESP LB Series See page 194

Protectors for specific systems

System	Protector
ISDN telecom systems (see Furse Application Note AN002, AN005)	 ESP KT2 Series, ESP ISDN Series See pages 188 & 190
Coaxial CCTV systems	 ESP CCTV/B See page 204
Cable TV systems (see Furse Application Note AN006)	 ESP TV Series See page 208
4-20mA loops and low current telemetry systems	 ESP D, ESP Q and ESP KS Series See pages 172, 180 & 182
Data and telecom interfaces at PCB level (see Furse Application Note AN003)	 ESP PCB Series See page 184 & 185
DC systems up to 110V, 4A	 ESP H Series See page 176
RTD systems (see Furse Application Note AN001)	 ESP RTD and ESP Q Series See page 180 & 186
RF radio and antenna communication systems	 ESP RF Series See page 200



Protectors for data communication and signal lines

ESP D and TN Series

LPZ $0_A \rightarrow 3$

FULL MODE Bonding + Equipment Protection

SIGNAL/ TELECOM TEST CAT D + C + B

ENHANCED Low let-through voltage

LOW INLINE 9.4Ω RESISTANCE

CURRENT 300mA RATING

Combined Category D, C, B tested protector (to BS EN 61643-21) suitable for most twisted pair signalling applications. Available for working voltages of up to 6, 15, 30, 50 and 110 volts. ESP TN suitable for Broadband, POTS, dial-up, T1/E1, lease line and *DSL telephone applications. For use at boundaries up to LPZ 0_A to protect against flashover (typically the service entrance location) through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

- ✔ Very low let-through voltage (enhanced protection to BS EN 62305) between all lines – Full Mode protection
- ✔ Full mode design capable of handling partial lightning currents as well as allowing continual operation of protected equipment
- ✔ Repeated protection in lightning intense environments
- ✔ Low in-line resistance minimises unnecessary reductions in signal strength
- ✔ Strong, flame retardant, ABS housing
- ✔ Supplied ready for flat mounting on base or side
- ✔ Built-in DIN rail foot for simple clip-on mounting to top hat DIN rails
- ✔ Colour coded terminals give a quick and easy installation check – grey for the dirty (line) end and green for the clean end
- ✔ Screen terminal enables easy connection of cable screen to earth
- ✔ Substantial earth stud to enable effective earthing
- ✔ Integral earthing plate for enhanced connection to earth via a CME kit
- ✔ ESP 06D has Network Rail Approval PA05/00809. NRS PADS reference 086/000551
- ✔ ESP TN is suitable for telecommunication applications in accordance with Telcordia and ANSI Standards (see Application Note AN005)

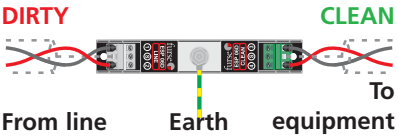
Protectors can be flat mounted via their base (left) or side, or mounted on top hat DIN rail (right) via an integral spring loaded DIN rail foot

Application

Use on twisted pair lines, e.g. those found in process control equipment, modems and computer communications interfaces.

Installation

Connect in series with the data communication or signal line either near where it enters or leaves the building or close to the equipment being protected (e.g. within its control panel). Either way, it must be very close to the systems earth star point. Install protectors either within an existing cabinet/cubicle or in a separate enclosure.



Install in series (in-line)

Accessories

Combined Mounting/Earthing kits

CME 4
Mount & earth up to 4 protectors

CME 8
Mount & earth up to 8 protectors

CME 16
Mount & earth up to 16 protectors

CME 32
Mount & earth up to 32 protectors

Weatherproof enclosures

WBX 2/G
For use with up to 2 protectors

WBX 3/G
For use with up to 3 protectors

WBX 4
For use with a CME4 and up to 4 protectors

WBX 8
For use with a CME 8 and up to 8 protectors

WBX 16/2/G
For use with one or two CME 16 and up to 32 protectors

Electrical specification	ESP 06D	ESP 15D	ESP 30D	ESP 50D	ESP 110D	ESP TN
Nominal voltage[1]	6V	15V	30V	50V	110V	–
Maximum working voltage[2] ***Uc***	7.79V	19V	37.1V	58V	132V	296V
Current rating (signal)	300mA					
In-line resistance (per line ±10%)	9.4Ω	9.4Ω	9.4Ω	9.4Ω	9.4Ω	4.4Ω
Bandwidth (–3dB 50Ω system)	800kHz	2.5MHz	4MHz	6MHz	9MHz	20MHz

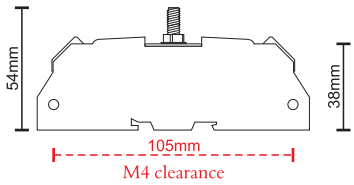
[1] Nominal voltage (DC or AC peak) measured at <5µA (ESP 15D, ESP 30D, ESP 50D, ESP 110D) and <200µA (ESP 06D)
[2] Maximum working voltage (DC or AC peak) measured at <1mA leakage (ESP 15D, ESP 30D, ESP 50D, ESP 110D), <10mA (ESP 06D) and <10µA (ESP TN)

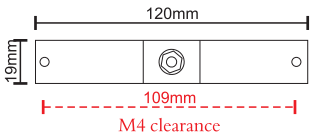
Transient specification	ESP 06D	ESP 15D	ESP 30D	ESP 50D	ESP 110D	ESP TN
Let-through voltage (all conductors)[1] *Up*						
C2 test 4kV 1.2/50µs, 2kA 8/20µs to BS/EN/IEC 61643-21	12.0V	25.0V	44.0V	78.0V	155V	395V
C1 test 1kV, 1.2/50µs, 0.5kA 8/20µs to BS/EN/IEC 61643-21	11.5V	24.5V	43.5V	76.0V	150V	390V
B2 test 4kV 10/700µs to BS/EN/IEC 61643-21	10.0V	23.0V	42.5V	73.0V	145V	295V
5kV, 10/700µs[2]	10.5V	23.8V	43.4V	74.9V	150V	300V
Maximum surge current						
D1 test 10/350µs to BS/EN/IEC 61643-21 – per signal wire – per pair	2.5kA 5kA					
8/20µs to ITU (formerly CCITT), BS 6651:1999 Appendix C – per signal wire – per pair	10kA 20kA					

[1] The maximum transient voltage let-through the protector throughout the test (±10%), line to line & line to earth, both polarities. Response time <10ns
[2] Test to BS 6651:1999 Appendix C, Cat C-High, IEC 61000-4-5:1995, ITU-T (formerly CCITT) K.20, K.21 and K.45,Telcordia GR-1089-CORE, Issue 2:2002, ANSI TIA/EIA/IS-968-A:2002 (formerly FCC Part 68).

Mechanical specification	ESP 06D	ESP 15D	ESP 30D	ESP 50D	ESP 110D	ESP TN
Temperature range	–25 to +70°C					
Connection type	Screw terminal					
Conductor size (stranded)	2.5mm²					
Earth connection	M6 stud					
Case material	ABS UL94 V-0					
Weight – unit	0.08kg					
– packaged (per 10)	0.85kg					

Dimensions





Derivatives of these protectors are available ready-boxed to IP66, for use in damp or dirty environments, PCB mount versions are also available. If your system requires a protector with a very low resistance or higher current, see the E & H Series. Also use the E Series for systems needing a higher bandwidth. A Protector for 3-wire RTD (ESP RTD) is available, as are the space saving protectors (Q Series). The KT and TN Series' are additional protectors specifically for telephone lines. The KS Series are protectors for data and signal lines on an LSA-PLUS module.

ESP E Series

LPZ $0_A \rightarrow 3$

FULL MODE Bonding + Equipment Protection

SIGNAL/ TELECOM TEST CAT D + C + B

e ENHANCED Low let-through voltage

LOW INLINE 1Ω RESISTANCE

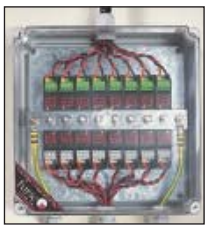
CURRENT 1.25A RATING

HIGH BANDWIDTH

Combined Category D, C, B tested protector (to BS EN 61643-21) suitable for twisted pair signalling applications which require either a lower in-line resistance, an increased current or a higher bandwidth than the D Series. Also suitable for DC power applications less than 1.25 amps. Available for working voltages of up to 6, 15, 30, 50 and 110 volts. For use at boundaries up to LPZ 0_A to protect against flashover (typically the service entrance location) through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

- ✔ Very low let-through voltage (enhanced protection to BS EN 62305) between all lines – Full Mode protection
- ✔ Full mode design capable of handling partial lightning currents as well as allowing continual operation of protected equipment
- ✔ Repeated protection in lightning intense environments
- ✔ Very low (1Ω) in-line resistance allows resistance critical applications (e.g. alarm loops) to be protected
- ✔ High (1.25A) maximum running current
- ✔ High bandwidth enables higher frequency (high traffic or bit rate) data communications
- ✔ Screen terminal enables easy connection of cable screen to earth
- ✔ Strong, flame retardant, ABS housing
- ✔ Built-in DIN rail foot for simple clip-on mounting to top hat DIN rails
- ✔ Colour coded terminals give a quick and easy installation check – grey for the dirty (line) end and green for clean
- ✔ Substantial earth stud to enable effective earthing
- ✔ Supplied ready for flat mounting on base or side
- ✔ Integral earthing plate for enhanced connection to earth via CME kit
- ✔ ESP 06E and ESP I5E have Network Rail Approval PA05/02047. NRS PADS reference 086/000201 (ESP 06E) and 086/000200 (ESP 15E)



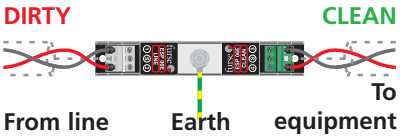
Protectors installed on a combined mounting and earthing kit (CME 8) within a WBX 8 enclosure

Application

Use these units to protect resistance sensitive, higher frequency or running current systems, e.g. high speed digital communications equipment or systems with long signal lines.

Installation

Connect in series with the data communication or signal line either near where it enters or leaves the building or close to the equipment being protected (e.g. within its control panel). Either way, it must be very close to the systems earth star point. Install protectors either within an existing cabinet/cubicle or in a separate enclosure.



Install in series (in-line)

Accessories

Combined Mounting/Earthing kits

CME 4
Mount & earth up to 4 protectors

CME 8
Mount & earth up to 8 protectors

CME 16
Mount & earth up to 16 protectors

CME 32
Mount & earth up to 32 protectors

Weatherproof enclosures

WBX 2/G
For use with up to 2 protectors

WBX 3/G
For use with up to 3 protectors

WBX 4
For use with a CME 4 and up to 4 protectors

WBX 8
For use with a CME 8 and up to 8 protectors

WBX 16/2/G
For use with one or two CME 16 and up to 32 protectors

Electrical specification	ESP 06E	ESP 15E	ESP 30E	ESP 50E	ESP 110E
Nominal voltage[1]	1 6V	15V	30V	50V	110V
Maximum working voltage *Uc*[2]	7.79V	16.7V	36.7V	56.7V	132V
Current rating (signal)			1.25A		
In-line resistance (per line ±10%)			1.0Ω		
Bandwidth (–3dB 50Ω system)	1.5MHz	>85MHz	>85MHz	>85MHz	>85MHz

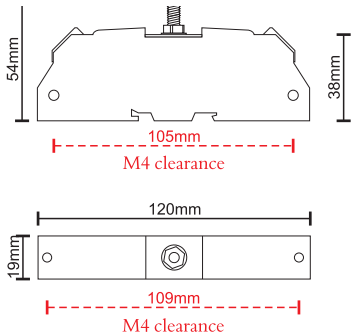
[1] Nominal voltage (DC or AC peak) measured at <10µA (ESP 15E, ESP 30E, ESP 50E, ESP 110E) and <200µA (ESP 06E).
[2] Maximum working voltage (DC or AC peak) measured at <5mA leakage (ESP 15E, ESP 30E, ESP 50E, ESP 110E) and <10mA (ESP 06E).

Transient specification	ESP 06E	ESP 15E	ESP 30E	ESP 50E	ESP 110E
Let-through voltage (all conductors)[1] *Up*					
C2 test 4kV 1.2/50µs, 2kA 8/20µs to BS/EN/IEC 61643-21	17.0V	39.0V	60.0V	86.0V	180V
C1 test 1kV, 1.2/50µs, 0.5kA 8/20µs to BS/EN/IEC 61643-21	11.5V	28.0V	49.0V	73.5V	170V
B2 test 4kV 10/700µs to BS/EN/IEC 61643-21	10.5V	25.5V	43.5V	65.0V	160V
5kV, 10/700µs[2]	10.8V	26.2V	44.3V	65.8V	165V
Maximum surge current					
D1 test 10/350µs to BS/EN/IEC 61643-21 – per signal wire – per pair			 2.5kA 5kA		
8/20µs to ITU (formerly CCITT), BS 6651:1999 Appendix C – per signal wire – per pair			 10kA 20kA		

[1] The maximum transient voltage let-through of the protector throughout the test (±10%), line to line & line to earth, both polarities. Response time <10ns.
[2] Test to BS 6651:1999 Appendix C, Cat C-High, IEC 61000-4-5:1995, ITU-T (formerly CCITT) K.20, K.21 and K.45,Telcordia GR-1089-CORE, Issue 2:2002, ANSI TIA/EIA/IS-968-A:2002 (formerly FCC Part 68).

Mechanical specification	ESP 06E	ESP 15E	ESP 30E	ESP 50E	ESP 110E
Temperature range			–25 to +70°C		
Connection type			Screw terminal		
Conductor size (stranded)			2.5mm²		
Earth connection			M6 stud		
Case material			ABS UL94 V-0		
Weight – unit			0.08kg		
– packaged (per 10)			0.85kg		

Dimensions



A PCB mount version is available. For many twisted pair data and signal applications, the lower cost D Series may be suitable. For applications requiring higher current (1.25A – 4A) or ultra low in-line resistance, the protectors H Series may be more suitable. For data and signal lines on LSA-PLUS modules, use the KS Series.

ESP H Series

LPZ $0_A \rightarrow 3$	FULL MODE Bonding + Equipment Protection
SIGNAL/ TELECOM TEST CAT D + C + B	ENHANCED Low let-through voltage
LOW INLINE 0.05Ω RESISTANCE	CURRENT 4A RATING

Combined Category D, C, B tested protector (to BS EN 61643-21) suitable for twisted pair signalling applications which require either a lower in-line resistance or an increased current than the D or E Series. Also suitable for DC power applications less than 4 amps. Available for working voltages of up to 6, 15, 30, 50 and 110 volts. For use at boundaries up to LPZ 0_A to protect against flashover (typically the service entrance location) through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

- ✔ Very low let-through voltage (enhanced protection to BS EN 62305) between all lines – Full Mode protection
- ✔ Full mode design capable of handling partial lightning currents as well as allowing continual operation of protected equipment
- ✔ Repeated protection in lightning intense environments
- ✔ Ultra low (<0.05Ω) in-line resistance allows resistance critical applications (e.g. alarm loops) to be protected
- ✔ Very high (4A) maximum running current
- ✔ Strong, flame retardant ABS housing
- ✔ Supplied ready for flat mounting on base or side
- ✔ Built-in DIN rail foot for simple clip-on mounting to top hat DIN rails
- ✔ Colour coded terminals give a quick and easy installation check – grey for the dirty (line) end and green for clean
- ✔ Screen terminal enables easy connection of cable screen to earth
- ✔ Substantial earth stud to enable effective earthing
- ✔ Integral earth plate enables enhanced connection to earth via CME kit

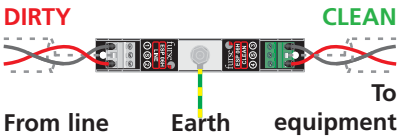
Two ESP 15H protectors mounted in a control cabinet and earthed via the cabinets' earthed chassis

Application

Use these applications to protect resistance sensitive or higher running current systems, e.g. systems with long signal lines, or DC power applications.

Installation

Connect in series with the data communication or signal line either near where it enters or leaves the building or close to the equipment being protected (e.g. within the control panel). Either way, it must be very close to the system's earth star point. Install protectors either within an existing cabinet/cubicle or in a separate enclosure.



Install in series (in-line)

Accessories

Combined Mounting/Earthing kits

CME 4
Mount & earth up to 4 protectors

CME 8
Mount & earth up to 8 protectors

CME 16
Mount & earth up to 16 protectors

CME 32
Mount & earth up to 32 protectors

Weatherproof enclosures

WBX 2/G
For use with up to 2 protectors

WBX 3/G
For use with up to 3 protectors

WBX 4
For use with a CME 4 and up to 4 protectors

WBX 8
For use with a CME 8 and up to 8 protectors

WBX 16/2/G
For use with one or two CME 16 and up to 32 protectors

Electrical specification	ESP 06H	ESP 15H	ESP 30H	ESP 50H	ESP 110H
Nominal voltage[1]	6V	15V	30V	50V	110V
Maximum working voltage *Uc* [2]	7.79V	16.7V	36.7V	56.7V	132V
Current rating (signal)			4A		
In-line resistance (per line ±10%)			0.05Ω		
Bandwidth (–3dB 50Ω system)	160KHz	140KHz	130KHz	120KHz	120KHz

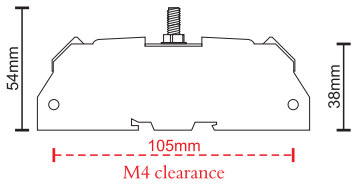
[1] Nominal voltage (DC or AC peak) measured at <10µA (ESP 15H, ESP 30H, ESP 50H, ESP 110H) and <200µA (ESP 06H).
[2] Maximum working voltage (DC or AC peak) measured at <5mA leakage (ESP 15H, ESP 30H, ESP 50H, ESP 110H) and <10mA (ESP 06H).

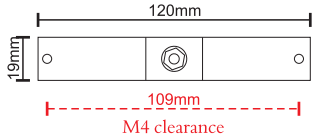
Transient specification	ESP 06H	ESP 15H	ESP 30H	ESP 50H	ESP 110H
Let-through voltage (all conductors)[1] *Up*					
C2 test 4kV 1.2/50µs, 2kA 8/20µs to BS/EN/IEC 61643-21	12.0V	27.5V	46.0V	67.0V	150V
C1 test 1kV, 1.2/50µs, 0.5kA 8/20µs to BS/EN/IEC 61643-21	11.0V	26.5V	45.0V	66.5V	145V
B2 test 4kV 10/700µs to BS/EN/IEC 61643-21	10.5V	25.5V	43.5V	65.0V	140V
5kV, 10/700µs[2]	10.8V	26.2V	44.3V	65.8V	145V
Maximum surge current					
D1 test 10/350µs to BS/EN/IEC 61643-21 – per signal wire – per pair			 2.5kA 5kA		
8/20µs to ITU (formerly CCITT), BS 6651:1999 Appendix C – per signal wire – per pair			 10kA 20kA		

[1] The maximum transient voltage let-through the protector throughout the test (±10%), line to line & line to earth, both polarities. Response time <10ns
[2] Test to BS 6651:1999 Appendix C, Cat C-High, IEC 61000-4-5:1995, ITU-T (formerly CCITT) K.20, K.21 and K.45,Telcordia GR-1089-CORE, Issue 2:2002, ANSI TIA/EIA/IS-968-A:2002 (formerly FCC Part 68).

Mechanical specification	ESP 06H	ESP 15H	ESP 30H	ESP 50H	ESP 110H
Temperature range			–25 to +70°C		
Connection type			Screw terminal		
Conductor size (stranded)			2.5mm²		
Earth connection			M6 stud		
Case material			ABS UL94 V-0		
Weight – unit			0.08kg		
– packaged (per 10)			0.85kg		

Dimensions





For some data and signal applications with lower current, higher in line resistance or higher bandwidth requirements, the D or E Series protectors may be more suitable. If the protector is to be mounted directly onto a PCB, use the ESP PCB/D or ESP PCB/**E protectors.**

ESP D/BX Series

LPZ $0_A \rightarrow 3$

FULL MODE Bonding + Equipment Protection

SIGNAL/ TELECOM TEST CAT D + C + B

ENHANCED Low let-through voltage

BX IP66

LOW INLINE 9.4Ω RESISTANCE

CURRENT 300mA RATING

Combined Category D, C, B tested protector (to BS EN 61643-21) based on the ESP D Series and ESP TN but ready boxed to IP66 for use in damp or dirty environments. Suitable for most twisted pair signalling applications. Available for working voltages of up to 6, 15, 30, 50 and 110 volts. ESP TN suitable for Broadband, POTS, dial-up, T1/E1, lease line and *DSL telephone applications. For use at boundaries up to LPZ 0_A to protect against flashover (typically the service entrance location) through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

- ✔ Very low let-through voltage (enhanced protection to BS EN 62305) between all lines – Full Mode protection
- ✔ Full mode design capable of handling partial lightning currents as well as allowing continual operation of protected equipment
- ✔ Repeated protection in lightning intense environments
- ✔ Low in-line resistance minimises unnecessary reductions in signal strength
- ✔ Ready-boxed to IP66 and supplied ready for flat mounting
- ✔ Available with screw terminals or with IDC terminals (by adding /I suffix to part number)
- ✔ Colour coded terminals for quick and easy installation check – grey for the dirty (line) end and green for clean
- ✔ Screen terminal enables easy connection of cable screen to earth
- ✔ Substantial earth stud to enable effective earthing
- ✔ ESP TN/BX and ESP TN/2BX are suitable for telecommunication applications in accordance with Telcordia and ANSI Standards (see Application Note AN005)
- ✔ Supplied as standard with screw terminals – for IDC terminals order part code plus /I (e.g. ESP TN/BX/I)
- ✔ ESP TN/BX has Network Rail Approval PA05/02877. NRS PADS reference 087/037286

For installation in the equipment panel, protectors which are not boxed may be more suitable. If your system requires a protector with a very low resistance, higher current or higher bandwidth use the E or H Series. Unboxed protectors for 3-wire RTD systems are available – as are plug-in protectors for telephone lines.

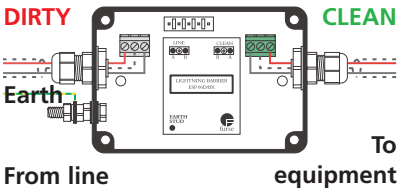
Application

Use these ready-boxed protectors on twisted pair lines in dirty or damp environments.

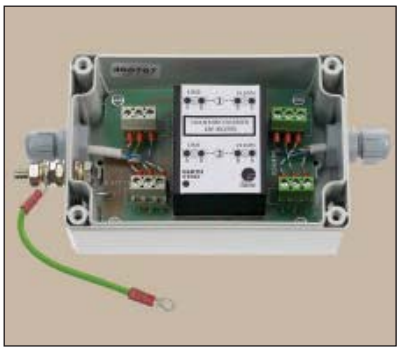
For two wire lines, use /BX versions. For four wire lines, use /2BX versions.

Installation

Connect in series with the data communication, signal or telephone line either near where it enters/leaves the building or close to the equipment being protected. Either way, it must be very close to the systems earth star point.



Install in series (in-line)



ESP 30D/2BX with lid removed to show internal connections. Note the colour coded, grey and green, terminals

Security alarm panel with ESP TN/BX (bottom) providing protection from transient overvoltages on the dial-up telephone line. Note how the ESP TN/BX is earthed via a bond to the ESP 240-16A/BX (top) installed on the mains power supply to the panel

Electrical specification

	ESP 06D/BX ESP 06D/2BX	ESP 15D/BX ESP 15D/2BX	ESP 30D/BX ESP 30D/2BX	ESP 50D/BX ESP 50D/2BX	ESP 110D/BX ESP 110D/2BX	ESP TN/BX ESP TN/2BX
Nominal voltage[1]	6V	15V	30V	50V	110V	-
Maximum working voltage *Uc*[2]	7.79V	19V	37.1V	58V	132V	296V
Current rating (signal)	300mA					
In-line resistance (per line ±10%)	9.4Ω	9.4Ω	9.4Ω	9.4Ω	9.4Ω	4.4Ω
Bandwidth (-3dB 50Ω system)	800kHz	2.5MHz	4MHz	6MHz	9MHz	20MHz

[1] Nominal voltage (DC or AC peak) measured at <5µA (ESP 15D/BX, ESP 15D/2BX, ESP 30D/BX, ESP 30D/2BX, ESP 50D/BX, ESP 50D/2BX, ESP 110D/BX, ESP 110D/2BX) and <200µA (ESP 06D/BX & ESP 06D/2BX).
[2] Maximum working voltage (DC or AC peak) measured at <1mA leakage (ESP 15D/BX, ESP 15D/2BX, ESP 30D/BX, ESP 30D/2BX, ESP 50D/BX, ESP 50D/2BX, ESP 110D/BX, ESP 110D/2BX), <10mA (ESP 06D/BX, ESP 06D/2BX) and <10µA (ESP TN/BX, ESP TN/2BX).

Transient specification

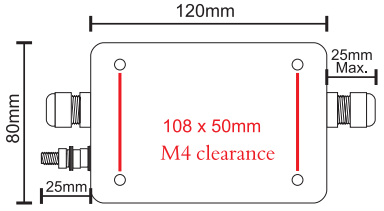
	ESP 06D/BX ESP 06D/2BX	ESP 15D/BX ESP 15D/2BX	ESP 30D/BX ESP 30D/2BX	ESP 50D/BX ESP 50D/2BX	ESP 110D/BX ESP 110D/2BX	ESP TN/BX ESP TN/2BX
Let-through voltage (all conductors)[1] *Up*						
C2 test 4kV 1.2/50µs, 2kA 8/20µs to BS/EN/IEC 61643-21	12.0V	25.0V	44.0V	78.0V	155V	395V
C1 test 1kV, 1.2/50µs, 0.5kA 8/20µs to BS/EN/IEC 61643-21	11.5V	24.5V	43.5V	76.0V	150V	390V
B2 test 4kV 10/700µs to BS/EN/IEC 61643-21	10.0V	23.0V	42.5V	73.0V	145V	295V
5kV, 10/700µs[2]	10.5V	23.8V	43.4V	74.9V	150V	300V
Maximum surge current D1 test 10/350µs to BS/EN/IEC 61643-21						
– per signal wire	2.5kA					
– per pair	5kA					
8/20µs to ITU (formerly CCITT), BS 6651:1999 Appendix C						
– per signal wire	10kA					
– per pair	20kA					

[1] The maximum transient voltage let-through the protector throughout the test (±10%), line to line & line to earth, both polarities. Response time <10ns.
[2] Test to BS 6651:1999 Appendix C, Cat C-High, IEC 61000-4-5:1995, ITU-T (formerly CCITT) K.20, K.21 and K.45,Telcordia GR-1089-CORE, Issue 2:2002, ANSI TIA/EIA/IS-968-A:2002 (formerly FCC Part 68).

Mechanical specification

	ESP 06D/BX ESP 06D/2BX	ESP 15D/BX ESP 15D/2BX	ESP 30D/BX ESP 30D/2BX	ESP 50D/BX ESP 50D/2BX	ESP 110D/BX ESP 110D/2BX	ESP TN/BX ESP TN/2BX
Temperature range	–25 to +70°C					
Connection type	Screw terminal – for IDC terminal use part number with /I					
Conductor size (stranded)	1.5mm²					
Earth connection	M6 stud					
Cable glands	Accommodate 2.3 – 6.7mm diameter cable (PG7)					
Degree of protection (IEC 60529)	IP66					
Case material	PVC					
Weight – unit	0.3kg					
– packaged	0.35kg					

Dimensions



Depth = 56mm

ESP Q, TNQ and RTDQ Series

LPZ $0_A \rightarrow 3$

FULL MODE Bonding + Equipment Protection

SIGNAL/ TELECOM TEST CAT D + C + B

e ENHANCED Low let-through voltage

CURRENT 750mA RATING

ULTRA COMPACT DESIGN

Combined Category D, C, B tested protector (to BS EN 61643-21) suitable for 4 twisted pair lines (ESP 06Q, ESP 15Q, ESP 30Q, ESP 50Q and ESP TNQ). Protection for three 3-wire lines (ESP RTDQ). Available for working voltages of up to 6, 15, 30, 50 and 110 volts. ESP TNQ suitable for Broadband, POTS, dial-up, T1/E1, lease line and *DSL telephone applications. For use at boundaries up to LPZ 0_A to protect against flashover (typically the service entrance location) through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

- ✔ Very low let-through voltage (enhanced protection to BS EN 62305) between all lines – Full Mode protection
- ✔ Full mode design capable of handling partial lightning currents as well as allowing continual operation of protected equipment
- ✔ Repeated protection in lightning intense environments
- ✔ ESP RTDQ protects three 3-wire lines in RTD applications
- ✔ Almost twice as space efficient as smallest competitor
- ✔ Standard DIN module (18mm) depth
- ✔ Removable (plug-in) terminals allow pre-wiring of cable looms, for easier installation
- ✔ Built-in DIN rail foot for clip-on mounting to top hat or G DIN rails
- ✔ Optional flat mounting on side
- ✔ 2.5mm² terminals allow for larger cross section wiring, stranded wires terminated with ferrules or fitting two wires into a single terminal
- ✔ Very low resistance to minimise unwanted signal strength reductions
- ✔ Strong, flame retardant, ABS housing
- ✔ Colour coded terminals (grey for line, green for clean) give a quick and easy installation check
- ✔ Screen terminal enables easy connection of cable screen to earth
- ✔ Simple, yet substantial, connection to earth via DIN rail
- ✔ ESP TNQ is suitable for telecommunication applications in accordance with Telcordia and ANSI Standards (see Application Note AN005)
- ✔ Available as a 'UL Listed' version, add /UL to part code (ESP 06Q, ESP 15Q, ESP 30Q and ESP 50Q only)

Protectors for individual data and signal lines are available (D Series), or ready-boxed to IP66 (ESP **D/BX etc). Alternatively, for individual protectors with higher current or bandwidth use the E and H Series. For individual wire-in protectors for RTD applications, use the ESP RTD.

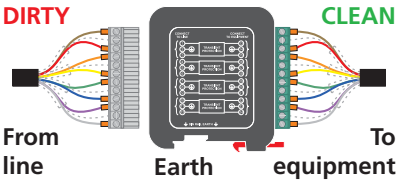
Application

Use these protectors where installation space is at a premium and large numbers of lines require protection.

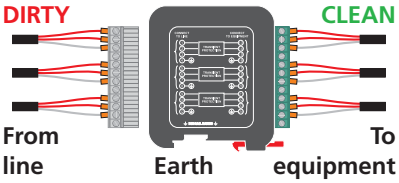
For further information on RTD applications, see separate Application Note AN001 (contact Furse for a copy).

Installation

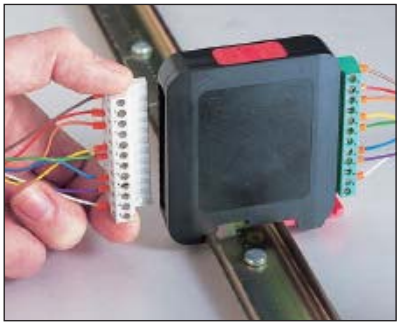
Connect in series with the signal or data line either near where it enters or leaves the building or close to the equipment being protected. Install in a cabinet/cubicle close to the systems earth star point.



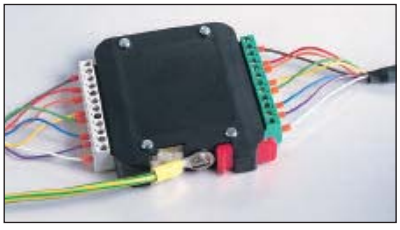
ESP 06Q, ESP 15Q, ESP 30Q, ESP 50Q, ESP 110Q and ESP TNQ installed in series (in-line)



ESP RTDQ installed in series (in-line)



A Q Series protector mounted on a top hat DIN rail. Note the plug-in terminals for easier installation in confined spaces



The Q Series can be earthed via DIN rail, or via the M5 threaded hole in its base

Electrical specification	ESP 06Q	ESP 15Q	ESP 30Q	ESP 50Q	ESP 110Q	ESP TNQ	ESP RTDQ
Nominal voltage[1]	6V	15V	30V	50V	110V	-	6V
Maximum working voltage *Uc*[2]	7.78V	18.8V	37.8V	57.8V	132V	296V	7.78V
Current rating (signal)	750mA	750mA	750mA	750mA	750mA	300mA	700mA
In-line resistance (per line ±10%)	1.0Ω	1.0Ω	1.0Ω	1.0Ω	1.0Ω	4.3Ω	1.0Ω
Bandwidth (-3dB 50Ω system)	1MHz	2.5MHz	6MHz	5MHz	15MHz	20MHz	800kHz

[1] Nominal voltage (DC or AC peak) measured at <5µA (ESP 15Q, ESP 30Q, ESP 50Q, ESP 110Q) and <200µA (ESP 06Q, ESP RTDQ).
[2] Maximum working voltage (DC or AC peak) measured at <5mA leakage (ESP 15Q, ESP 30Q, ESP 50Q, ESP 110Q), <10mA (ESP 06Q, ESP RTDQ) and <10µA (ESP TNQ).

Transient specification	ESP 06Q	ESP 15Q	ESP 30Q	ESP 50Q	ESP 110Q	ESP TNQ	ESP RTDQ
Let-through voltage (all conductors)[1] *Up*							
C2 test 4kV 1.2/50µs, 2kA 8/20µs to BS/EN/IEC 61643-21	15.0V	28.0V	53.0V	84.0V	188V	395V	15.0V
C1 test 1kV, 1.2/50µs, 0.5kA 8/20µs to BS/EN/IEC 61643-21	12.5V	26.5V	48.0V	76.0V	175V	390V	12.5V
B2 test 4kV 10/700µs to BS/EN/IEC 61643-21	10.0V	23.0V	43.5V	64.5V	145V	295V	10.0V
5kV, 10/700µs[2]	10.8V	26.2V	44.3V	65.8V	150V	300V	10.5V
Maximum surge current D1 test 10/350µs to BS/EN/IEC 61643-21							
– per signal wire				2.5kA			
– per pair				5kA			
8/20µs to ITU (formerly CCITT), BS 6651:1999 Appendix C							
– per signal wire				10kA			
– per pair				20kA			

[1] The maximum transient voltage let-through the protector throughout the test (±10%), line to line & line to earth, both polarities. Response time <10ns.
[2] Test to BS 6651:1999 Appendix C, Cat C-High, IEC 61000-4-5:1995, ITU-T (formerly CCITT) K.20, K.21 and K.45,Telcordia GR-1089-CORE, Issue 2:2002, ANSI TIA/EIA/IS-968-A:2002 (formerly FCC Part 68).

Mechanical specification	ESP 06Q	ESP 15Q	ESP 30Q	ESP 50Q	ESP 110Q	ESP TNQ	ESP RTDQ
Temperature range	–25 to +70°C						
Connection type	Plugable 12 way screw terminal						
Conductor size (stranded)	2.5mm²						
Earth connection	Via DIN rail or M5 threaded hole in base of unit						
Case material	ABS UL94 V-0						
Weight – unit	0.1kg						
– packaged (each)	0.12kg						
– packaged (per 10)	1.3kg						

Dimensions