Karnphon Suwanasin

IEC 62305
Lightning protection

Power and productivity for a better world™

Agenda

- Understanding furse
- What is lightning?
- IEC 62305 overview

Agenda

- **Understanding furse**
- What is lightning?
- IEC 62305 overview

 | Slide 3

ABB

furse overview
Background and capabilities

- Founded in 1893, head office in Nottingham, UK.
- Front runner in earthing & lightning protection
- Strong and excellent service, support and sales
- Active participation in developing British, European and International standards for lightning and transient overvoltage protection
- ISO 9001 registered
- Became part of Thomas&Betts in 1998
- T&B was acquired by ABB in 2012.

 | Slide 4

ABB

furse overview
Background and capabilities

Brief History of FURSE

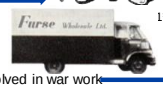
First advertisement in 1893

1893 - William Joseph Furse started the steeple-jacking business at Nottingham

1912 – Incorporation of W J Furse & Co Ltd with W. J. FURSE as chairman, and his sons W F Furse and H J Furse as directors.

1st Logo of the corporation

1923 : FURSE Wholesale Limited was incorporated



1941-1944 : Second World War – FURSE foundry was heavily involved in war work

1958 : FURSE was acquired by E V Industrial Ltd

1967 : FURSE was acquired by Crown House – Business was renamed as Crown House Engineering

1977 : National Electric Company Supplies Ltd acquired Crown House and started a division named FURSE Power Products Ltd

1982 : FURSE Power Products Ltd was acquired by Coloroll Plc

1987 : FURSE was sold this time to Thomas Robinson Group

1988 : W J Furse was a company created within Thomas Robinson Group

1991 : W J Furse was acquired by East Midlands Electricity Plc

1998 : Thomas & Betts acquired W J Furse

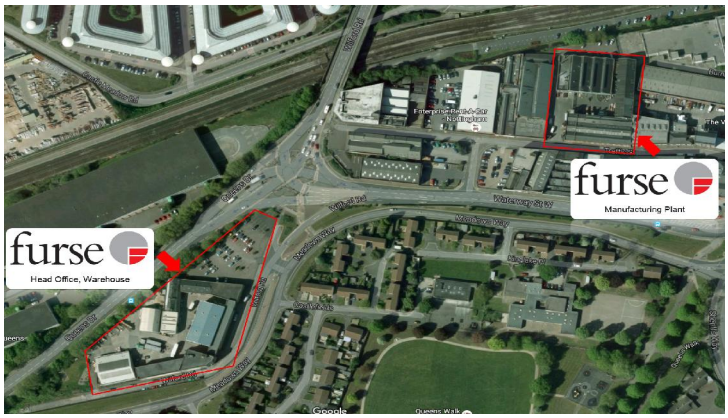
2012 : ABB Ltd acquired Thomas & Betts

FURSEWELD

furse

ABB

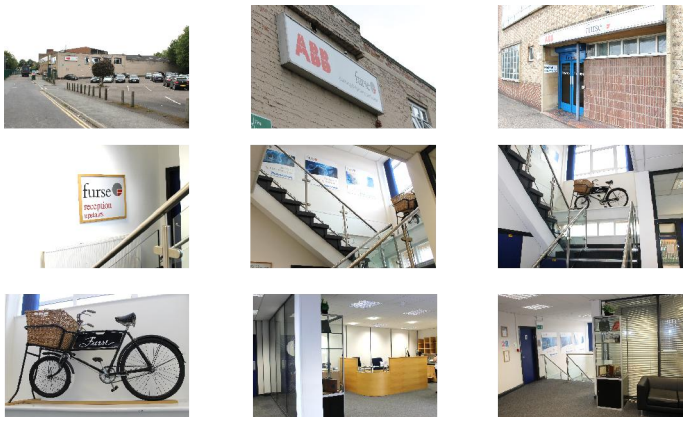
furse overview
Furse Factory, Nottingham UK



ABB

furse overview
Furse Factory, Nottingham UK

furse overview
Head Office



furse overview
Head Office









 | Slide 9

ABB

furse overview
Warehouse





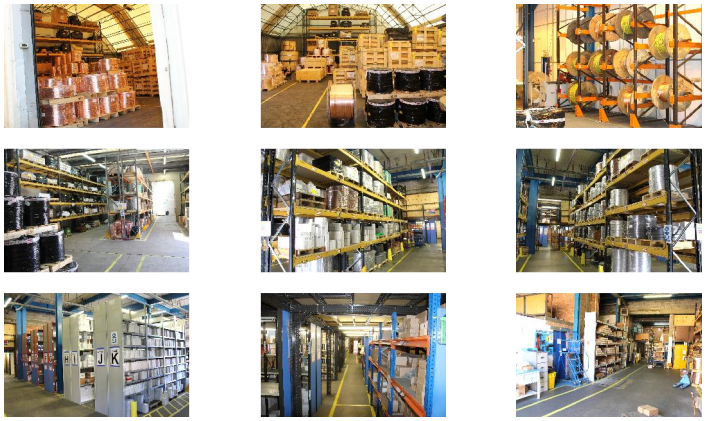




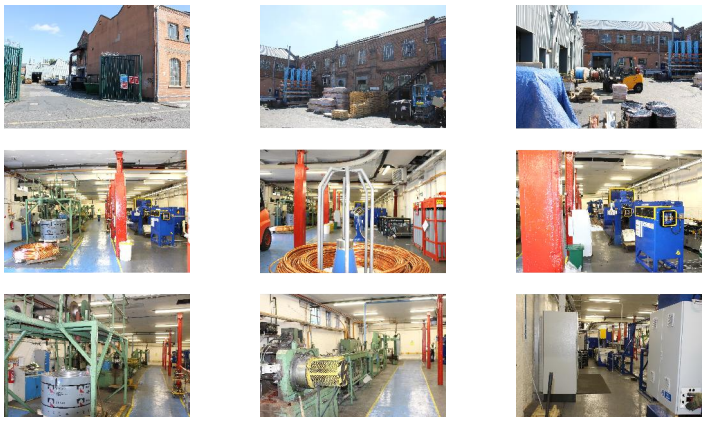
 | Slide 10

ABB

furse overview
Warehouse



furse overview
Manufacturing Plant



furse overview
Manufacturing Plant

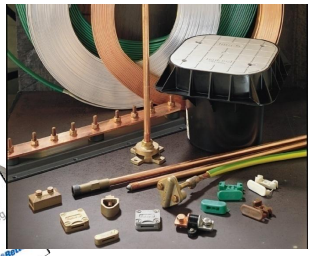


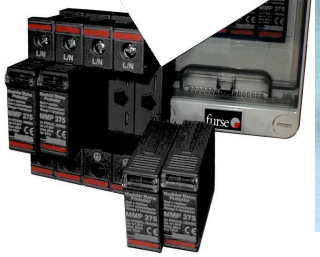






furse overview
Total solution



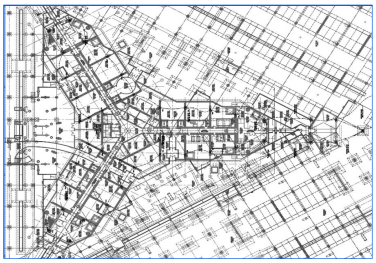

furse overview
When & Where do we start

Educate Consultants, clients, end users: Work shops / seminars on Standards

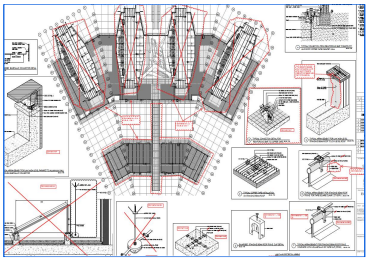
CIBSE CPD

ABB

furse overview
When & Where do we start



Burj Khalifa

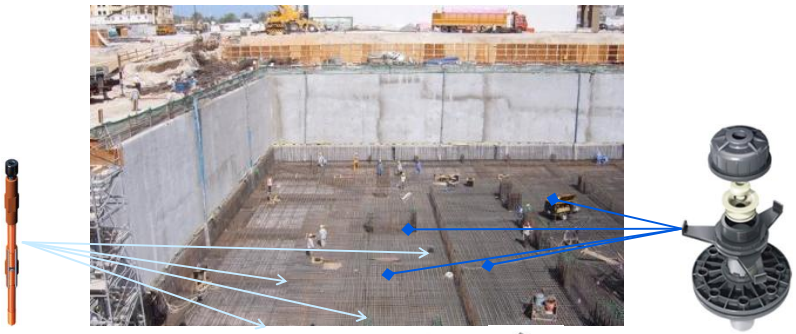


Mafraq Hospital

Design support

ABB

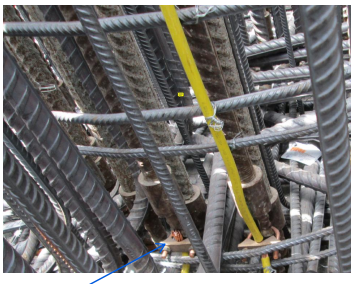
furse overview
When & Where do we start



Dubai Opera House

furse overview
When & Where do we start

Kingdom Tower - Saudi



Louvre Museum, Abu Dhabi

furse overview
When & Where do we start

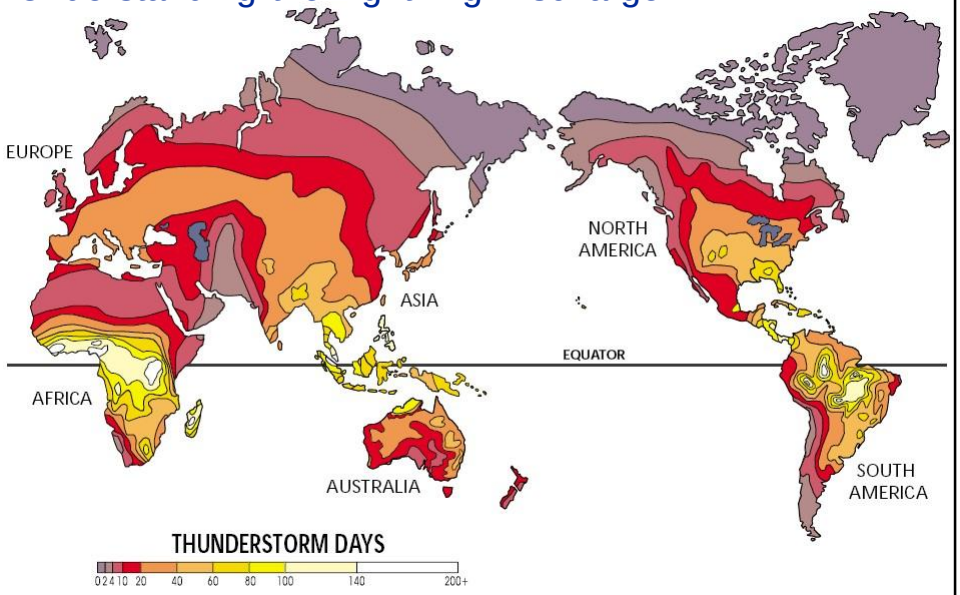
Jewel of the Creek, Dubai

Marriott Marquis, Dubai

Agenda

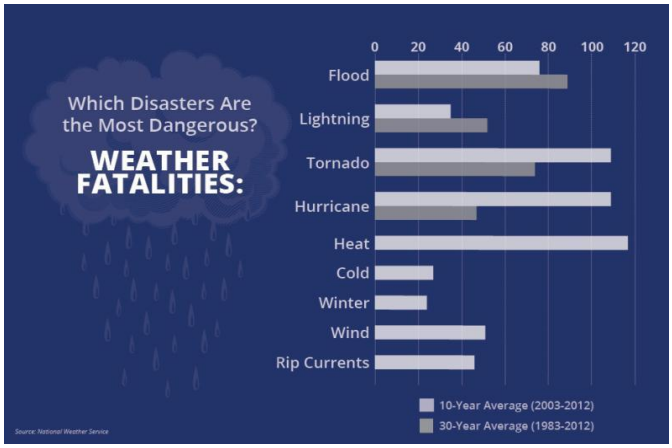
- Understanding furse
- **What is lightning?**
- IEC 62305 overview

Understanding the Lightning Discharge

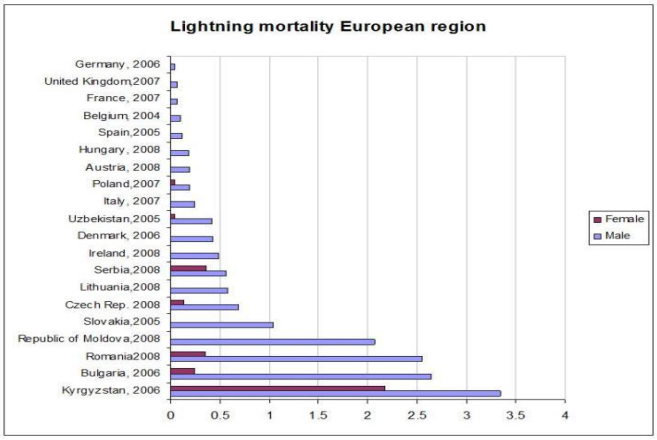


Understanding the Lightning Discharge

Understanding the Lightning Discharge



Understanding the Lightning Discharge



Understanding the Lightning Discharge

Lightning Expected to Increase as the Planet Warms

NOV 13, 2014 02:00 PM ET // BY PAUL HELTZEL

THINKSTOCK

Global warming will increase lightning across the United States, a new study finds, and will mean more wildfires started by lightning strikes.

Berkeley climate scientist David Romps and his colleagues were able to predict lightning strikes based on the energy available to make air in the atmosphere rise, and precipitation rates. Using 11 different climate models, they concluded that global warming will increase the number of

Understanding the Lightning Discharge

Understanding the Lightning Discharge

Common Misnomers -----

- Lightning Strikes only tall structures - FALSE
- Small structures do not require protection against lightning – FALSE
- Metal objects attract lightning – FALSE
- Lightning never strikes the same place twice – FALSE
- Lightning protection systems (air terminals, etc.) and buried (conductive) utilities attract lightning - FAUSE

Understanding the Lightning Discharge

Lightning Striking - Singapore 2016

Understanding the Lightning Discharge

Lightning Striking The BURJ KHALIFA 2016

Understanding the Lightning Discharge

Lightning strike leaves massive HOLE in the nose of plane... but pilots don't notice and carry on with eight-hour flight

Flight was traveling from Reykjavik, Iceland to Denver when it was struck. Passengers said it was hit by lightning shortly after the plane took off. Pilots reported the lighting and continued eight-hour flight to Denver.

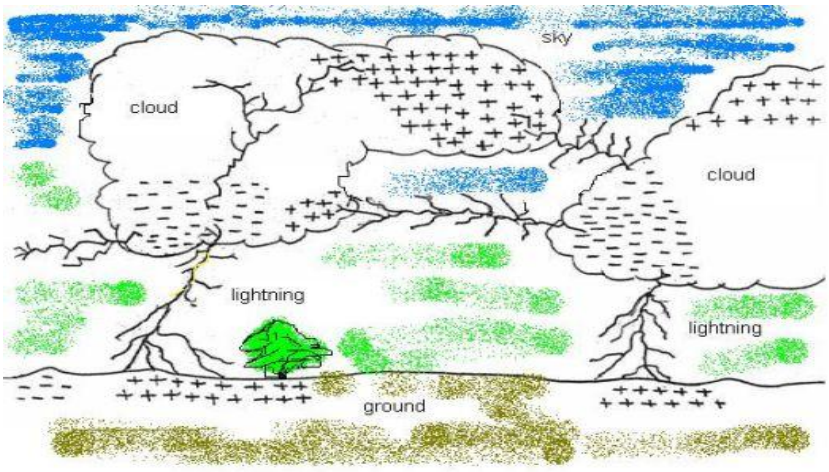
It wasn't until they landed that pilots notice huge hole at the nose of plane. No one on board was injured and the plane landed safely in Denver

By KELLY MCLAUGHLIN FOR DAILYMAIL.COM

PUBLISHED: 14:00 GMT, 9 April 2015 | UPDATED: 16:39 GMT, 9 April 2015

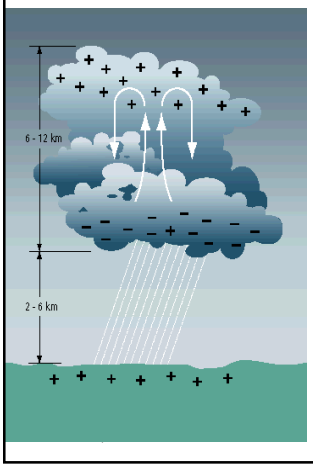
Understanding the Lightning Discharge

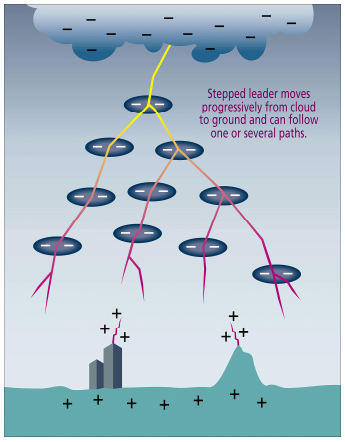
Understanding the Lightning Discharge



Understanding the Lightning Discharge

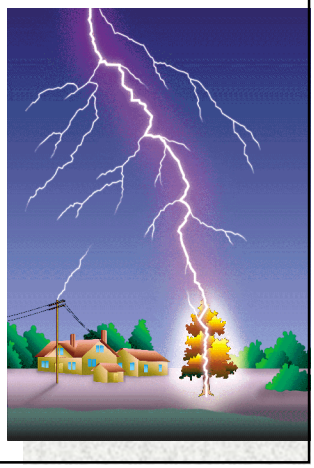
Cloud electrification – charge particle separation, quasi static E Field est. between cloud & ground



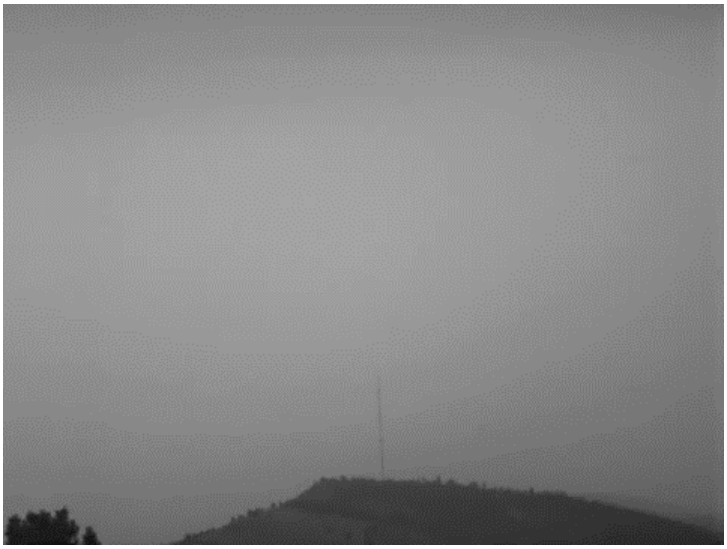


Downleader approaches, E Field increases to point of initiation of upward streamers

Upward leader propagates toward downleader to complete ionised path between cloud & ground



Downward lightning strike

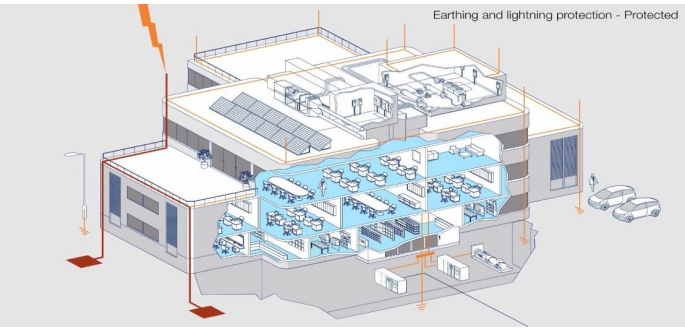


Lightning Protection Systems

All Lightning Protection Systems have three basic components:

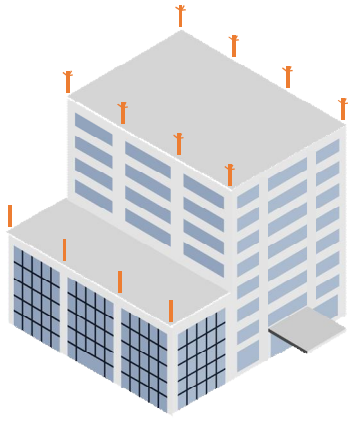
1. **Air terminal:** The attachment point for the lightning strike.
2. **Down Conductor:** The method of conducting the lightning energy from the air terminal to the ground.
3. **Earthing System:** The buried conductor network used to dissipate the lightning energy into the ground.

Lightning Protection Systems
External Lightning Protection



Lightning Protection Systems
Lightning Protection Design Example

Important Note: For illustration purposes only. This is not an actual design that conforms to any standard.



Lightning Protection Systems
Air Termination System, Air Rods

- **Purpose:**
  - To capture the lightning strike
- **Product Attributes:**
  - 0.5 to 3 m height
  - 10 or 15 mm diameter
  - Solid copper or aluminium
  - Domed ends
  - Locknut assembly to base
  - Facility for multiple point

* Multiple Point

"Field trials in the US, carried out over many years of 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

Lightning Protection Systems
Lightning Protection Design Example

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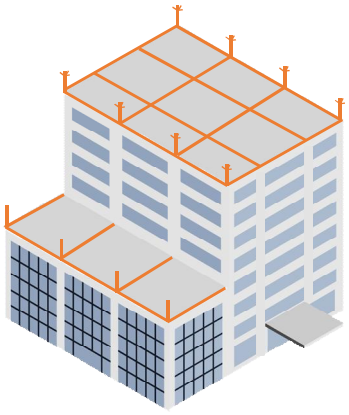
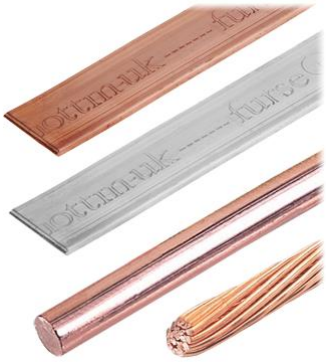


Lightning Protection Systems
Air Terminal Conductor Network

- **Purpose:**
  - To form a conducting network/path from Air Terminals
- **Product Attributes:**
  - Easy to install on to different types of surfaces
  - Bare copper or aluminium
  - Flat tape or solid circular conductor
  - Can be raised above combustible roof materials
  - Supplied in coils



Lightning Protection Systems
Lightning Protection Design Example

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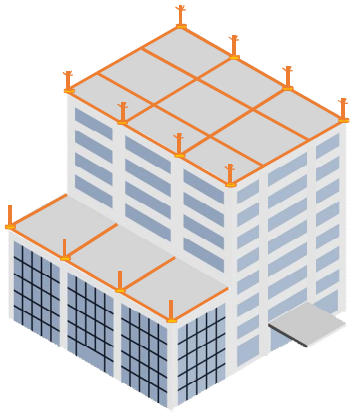


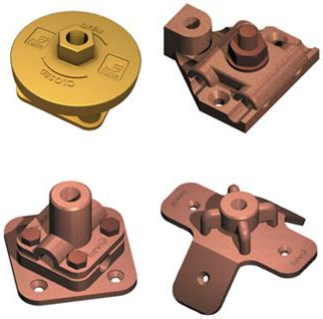
Lightning Protection Systems
Air Rod Bases

§ **Purpose:**

- To secure the air rod to the conductor & the structure

§ **Product Attributes:**

- Flat mount, ridge mount or vertical mount
- Copper or aluminium alloy
- Flat tape, solid circular and stranded conductor options
- Designed to conform to IEC 62561-1

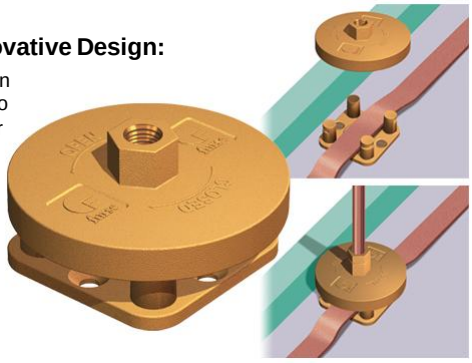


Lightning Protection Systems
Air Rod Bases Installation

§ **Improved, Innovative Design:**

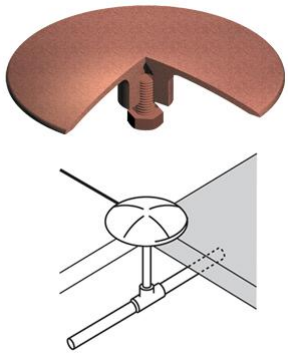
- Simple installation through click-fit to secure conductor without screws, after base secured to roof

* Old design



Lightning Protection Systems
Strike Pads

- **Purpose:**
  - For installation in locations where air rods & exposed conductors are not practical (e.g. car parks)
- **Product Attributes:**
  - Copper or aluminium
  - Easily fixed to lightning protection conductor or reinforcing bars
  - Non trip/fall hazard



Lightning Protection Systems
Free Standing Air Termination

- **Purpose:**
  - To capture the lightning strike, to protect rooftop mounted or exposed equipment
- **Product Attributes:**
  - 0.5 to 10 m height
  - Free standing & portable
  - Easy to assemble
  - Range of concrete blocks
  - Roof or floor mounted
  - Maximum wind loading 190 km/h

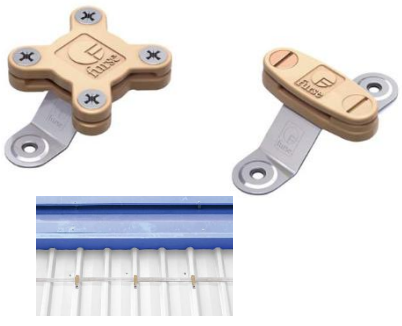
Lightning Protection Systems
Standing Seam Roof Fixings

- **Purpose:**
  - To achieve robust connection to new roofing type (standing seam)
- **Product Attributes:**
  - Patent pending design
  - Metallic clip, Non metallic conductor clip or square tape clamp
  - Spring steel base (coating 1000 hour salt spray tested)
  - Easy installation

Lightning Protection Systems
Trapezoidal Roof Clips/Clamps

New Developments
Innovative Design

- **Purpose:**
  - To connect lightning protection conductor to trapezoidal roof systems
- **Product Attributes:**
  - Copper & aluminium clips fixed to stainless steel base
  - Square tape clamp, DC clip and cast cable saddle variants
  - EDPM washer for waterproof seal to roof section



Lightning Protection Systems
Trapezoidal Roof Air Rod Bases

New Developments
Innovative Design

- **Purpose:**
  - To enable air terminal connection above a trapezoidal roof system
- **Product Attributes:**
  - Copper & aluminium terminals fixed to stainless steel base
  - For conductor runs and square joints
  - Ensures zone of protection above the metallic roof

Lightning Protection Systems
Lightning Protection Design Example

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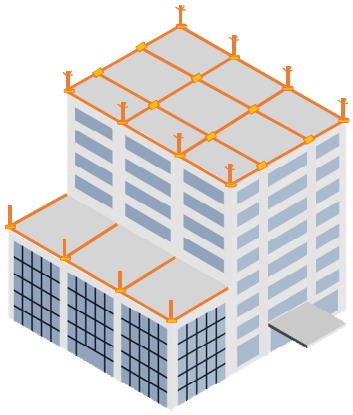

Lightning Protection Systems
Connection Components

§ **Purpose:**
- Provide the means of ;
  Straight connections
  Cross connections
  Tee connections

§ **Product Attributes:**
- Patented & registered designs
- Copper or aluminium alloy
- Square, tee & test clamps
- Options for flat tape, solid circular or stranded
- IEC 62561-1

Lightning Protection Systems
Conductor Clips

§ **Purpose:**
- Hold the conductor in place under normal and lightning strike conditions

§ **Product Attributes:**
- Patented & registered designs
- Copper or aluminium alloy
- Non-metallic clips
- Options for flat tape, solid circular or stranded
- IEC 62561-1

Lightning Protection Systems
Lightning Protection Design Example

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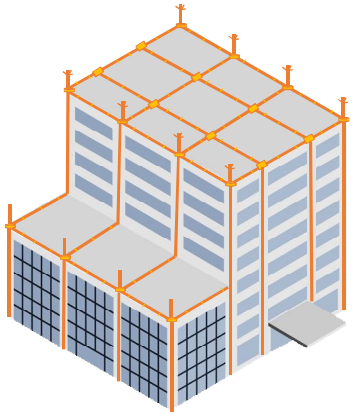
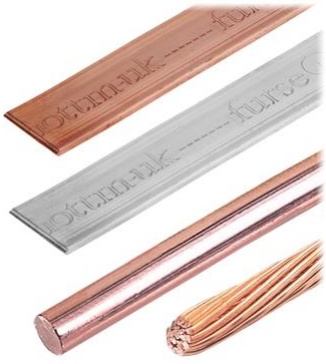


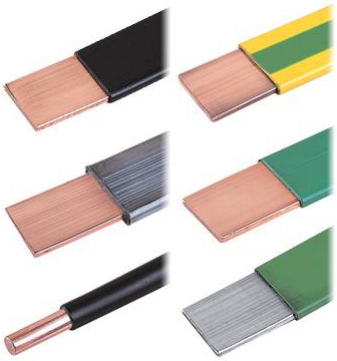
Lightning Protection Systems
Down Conductors

- **Purpose:**
  - To channel the lightning current from the air termination to the earth termination system
- **Product Attributes:**
  - Copper or aluminium
  - Flat tape, solid circular or stranded
  - Bare, tinned or PVC covered



Lightning Protection Systems
Down Conductors

- **Product Options:**
  - Bare conductor
  - PVC covered conductor
  - Tinned & PVC covered tinned conductor
  - LSOH covered conductor
  - Lead covered conductor
  - Conductor guards (PVC & metal)



Lightning Protection Systems
Lightning Protection Design Example

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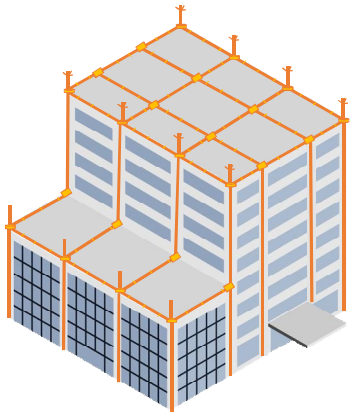

Lightning Protection Systems
Connection Components

- **Purpose:**
  - Provide the means of ;
    Straight connections
    Cross connections
    Tee connections
- **Product Attributes:**
  - Patented & registered designs
  - Copper or aluminium alloy
  - Square, tee & test clamps
  - Options for flat tape, solid circular or stranded
  - IEC 62561-1

Lightning Protection Systems
Lightning Protection Design Example

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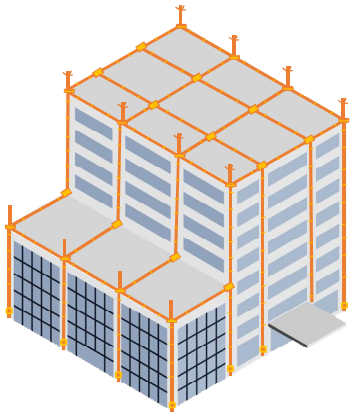

Lightning Protection Systems
Test / Junction Clamps

- **Purpose:**
  - Provide an effective low resistance connection between overlapping conductors and to allow for periodic testing
- **Product Attributes:**
  - Patented & registered designs
  - Copper or aluminium alloy
  - Options for flat tape, solid circular or stranded
  - IEC 62561-1

Lightning Protection Systems
Lightning Protection Design Example

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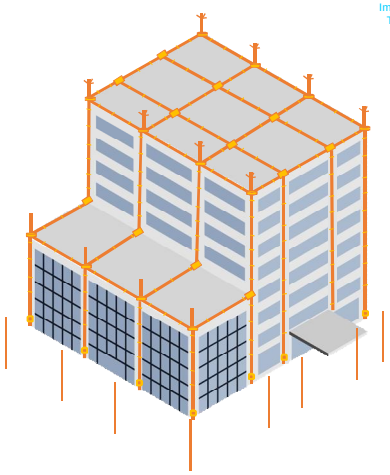
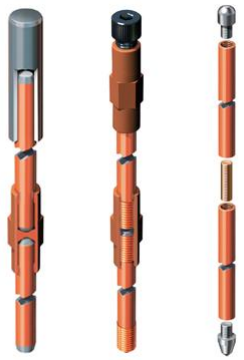


Lightning Protection Systems
Earthing Rods

- **Purpose:**
  - To disperse lightning current (and/or fault current) to earth
- **Product Attributes:**
  - Copper bonded (high tensile steel core with electro-plated copper (99.9%), 0.25 mm)
  - Threaded/Un-threaded
  - Solid copper & stainless steel for corrosive soils
  - IEC 62561-2 & UL467



Lightning Protection Systems
Lightning Protection Design Example

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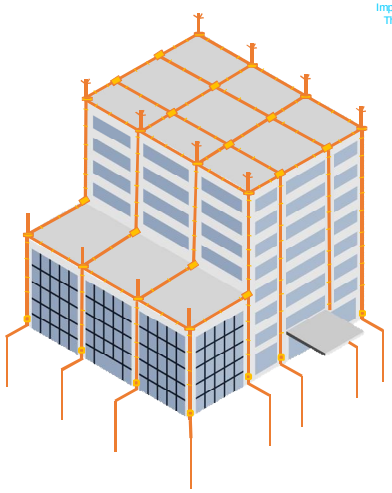
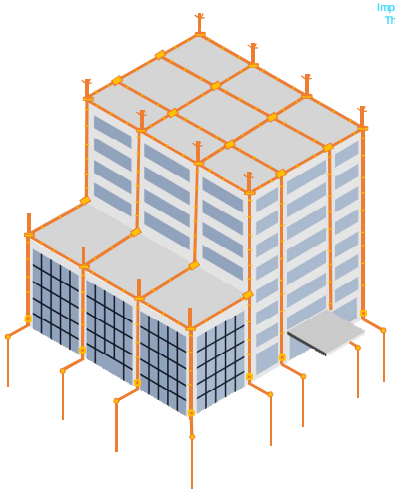


Lightning Protection Systems
Earthing Conductors

- **Purpose:**
  - To disperse lightning current (and/or fault current) to earth
- **Product Attributes:**
  - Range of sizes
  - Copper is recommended as can be used below ground & has lower resistivity
  - Conductor must be sized to safely conduct maximum expected earth fault and leakage current

Lightning Protection Systems
Lightning Protection Design Example

Important Note: For illustration purposes only. This is not an actual design that conforms to any standard.

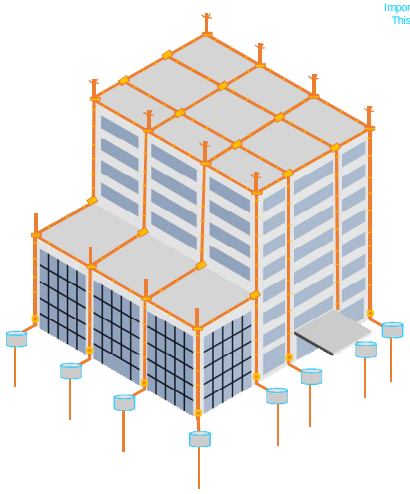


Lightning Protection Systems
Mechanical Clamps

- **Purpose:**
  - Robust, secure connection between conductors, earth electrodes & reinforcing bars
- **Product Attributes:**
  - High quality copper alloy
  - Solutions for flat tape, solid circular and stranded
  - BS 7430, IEC 62561-1 & UL467

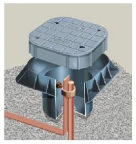
Lightning Protection Systems
Lightning Protection Design Example

Important Note: For illustration purposes only. This is not an actual design that conforms to any standard.



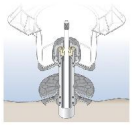
Lightning Protection Systems
Inspection Pits

- **Purpose:**
  - Permits periodic inspection & testing of the earth conductor connection to the earth rod
- **Product Attributes:**
  - Lightweight UV stable polymer inspection pit with polymer or concrete lid - load rated to 5000 kg
  - Concrete inspection pit - load rated to 3500 kg
  - IEC 62561-5

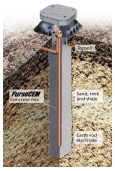


Lightning Protection Systems
Earth Rod Seals

- **Purpose:**
  - For use in building foundations, where the damp proof membrane must be pierced
- **Product Attributes:**
  - Watertight seal to 80 psi
  - Seal packs for all Furse rods
  - Full range of accessories & seal tubes
  - Patented & registered designs
  - IEC 62561-5



Lightning Protection Systems
Earth Electrode Backfills



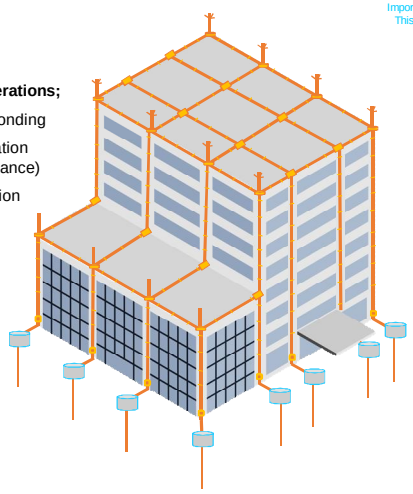
- **Purpose:**
  - To improve (lower) soil resistivity around earth electrodes
- **Product Attributes:**
  - FurseCEM conductive aggregate
  - Available with/without cement
  - IEC 62561-7
  - 3:1 FurseCEM to cement mix (approximately)
  - Bentonite moisture retaining clay

Lightning Protection Systems
Lightning Protection Design Example

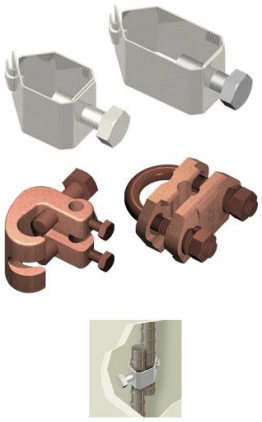
Important Note: For illustration purposes only. This is not an actual design that conforms to any standard.

Other Vital Considerations;

- Equipotential Bonding
- Electrical Insulation (separation distance)
- Internal Protection (SPD's etc.)

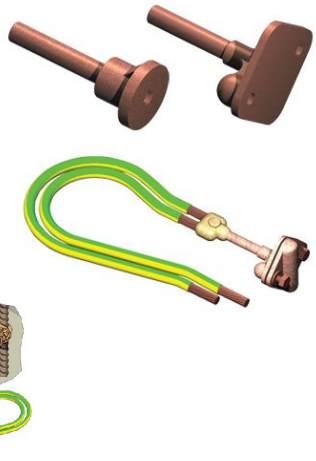


Lightning Protection Systems
Rebar Clips & Clamps



- **Purpose:**
  - Secure connection between steel reinforcing bars in structure and conductors
- **Product Attributes:**
  - High quality copper alloy or stainless steel
  - Solutions for flat tape, solid circular and stranded
  - BS 7430, IEC 62561-1 & UL467

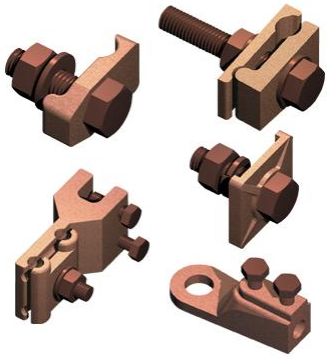
Lightning Protection Systems
Earthing Points



- **Purpose:**
  - To connect steel reinforcing bars in structure to conductor
- **Product Attributes:**
  - Single, two or four hole
  - 500 mm pre-welded single or double tails
  - Can be clamped or welded
  - BS 7430, IEC 62561-1 & UL96

Lightning Protection Systems
Metalwork Bonds

- **Purpose:**
  - Bonding of conductors to internal/external metalwork in structure
- **Product Attributes:**
  - High quality copper alloy
  - Solutions for flat tape, solid circular and stranded
  - BS 7430, IEC 62561-1 & UL467



Lightning Protection Systems
Pipe Bonds & Clamps

- **Purpose:**
  - Bonding of conductors to metal pipes & services (gas, water etc) in structure
- **Product Attributes:**
  - Solutions for flat tape, solid circular and stranded
  - BS 7430, IEC 62561-1 & UL467

Lightning Protection Systems
Flexible Braid Bonds

- **Purpose:**
  - Bonding of metallic parts where movement is expected, e.g. fences, gates etc
- **Product Attributes:**
  - Flat or circular braid
  - Copper or tinned copper
  - 200 & 400 mm standard lengths (other lengths available)
  - Cross-sectional areas up to 150 mm^2

Lightning Protection Systems
Earth Boss & Static Earthing

- **Purpose:**
  - Provides a connection to earth for steel vessels, tanks, boats, trucks, aircraft etc
- **Product Attributes:**
  - Earth boss in mild or stainless steel
  - Copper alloy static earth bonds
  - Stainless steel earthing clamps (with/without reel)

Lightning Protection Systems
Earth Bars

- **Purpose:**
  - Provides a common earth point for electrical equipment, metallic services etc

- **Product Attributes:**
  - Solid copper or tinned copper
  - High impact uPVC base
  - Disconnecting links optional
  - 6 to 30 way available
  - Special designs to order

Lightning Protection Systems
Compression Connectors

- **Purpose:**
  - Secure connection of earth conductor

- **Product Attributes:**
  - Solid copper or tinned copper ‘C’ shape connector
  - Tinned copper cable lugs
  - Tooling to suit
  - Dies to suit

Lightning Protection Systems
Exothermic Welding System

FURSEWELD

- Cost efficient method of making high quality electrical connections – copper to copper & copper to steel
- **75 joints per mould**
- High temperature reaction of powdered copper oxide & aluminium
- Requires no external power or heat source
- Is completely portable

Lightning Protection Systems
FurseWELD

§ **Purpose:**
- Exothermic welding between conductors and metallic parts

§ **Product Attributes:**
- Requires no external heat or power source
- Creates high quality electrical connections
- Over 150 standard connection configurations
- Special designs to order

Lightning Protection Systems
FurseWELD

MAIN CONSUMABLES

- Graphite Moulds
- FurseWELD Powders
- Copper sleeves (for smaller cables – 16mm2 or lower)
- Packing (for connections to rebar)

Lightning Protection Systems
FurseWELD

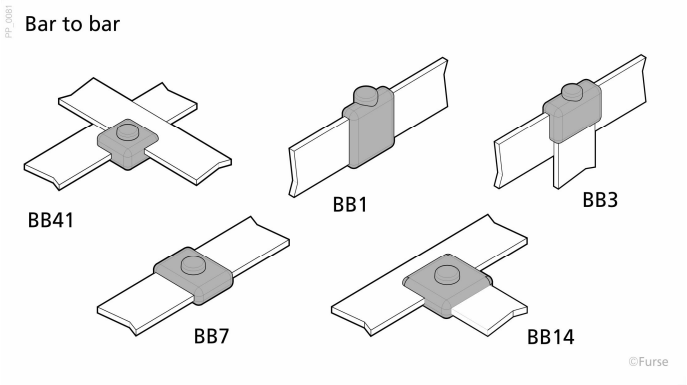
FURSEWELD TOOLS / ACCESSORIES

- Handle Clamp
- Flint Gun
- Toolkits including cable or tape cleaning brush, mould cleaning brush & mould scraping tool
- Gas torch (to preheat the mould)
- Optional toolbox & heat resistant mould jacket

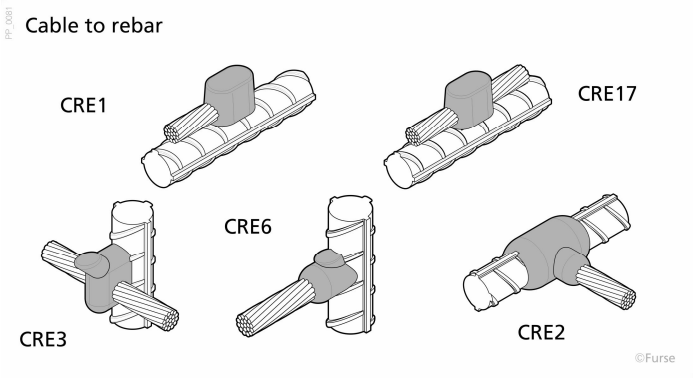
Lightning Protection Systems
FurseWELD, Where To Use It?

- Infrastructure projects
- Utility projects
- Power plants
- Substations
- Rail
- Windfarms
- Solar farms
- OHL
- Telecoms

Lightning Protection Systems
FurseWELD, Connection Types

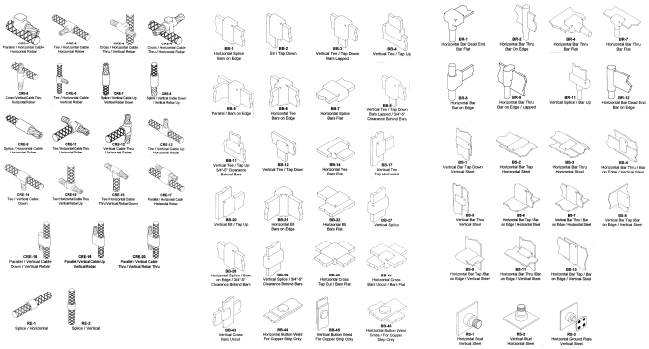


Lightning Protection Systems
FurseWELD, Connection Types

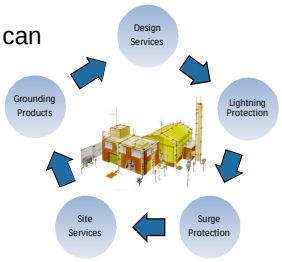


Lightning Protection Systems
FurseWELD, Connection Types

Lightning Protection Systems
FurseWELD, Connection Types



- **Strengths:**
  - Almost 120 years of experience you can rely on
  - Best Products
  - Full design capabilities
  - Total solution concept
  - Strong Distribution network
  - **NOW an ABB company – a big PLUS**



furse

A Total Solution to Earthing & Lightning protection

ABB

Agenda

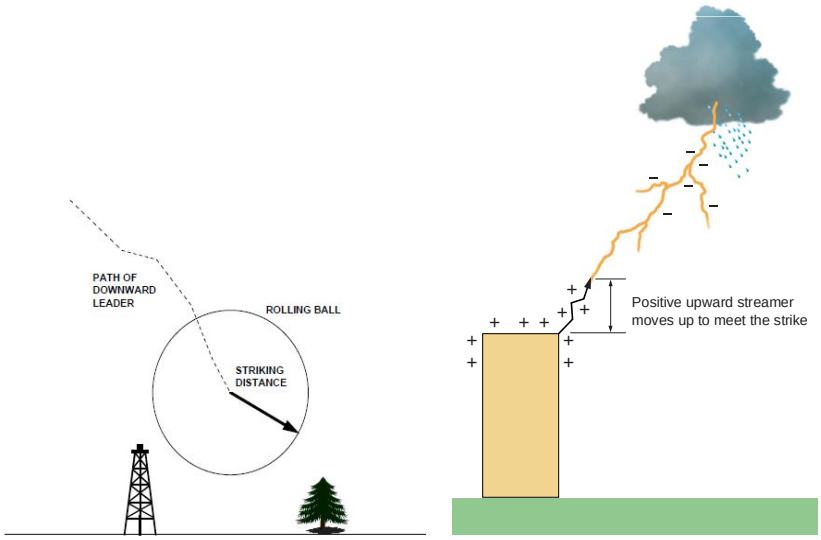
- Understanding furse
- What is lightning?
- **IEC 62305 overview**

ABB

IEC 62305
General overview

IEC 62305-1	General Principles
IEC 62305-2	Risk Management
IEC 62305-3	Physical damages and life hazard
IEC 62305-4	Electrical & electronic systems

IEC 62305-1 General Principles
Lightning Formation



IEC 62305-1 General Principles
Lightning Protection Level (LPL)

Dependent on LPL (Lightning Protection Level)

Number related to a set of lightning current parameters, which allows relevant protection measures to be applied

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

IEC 62305-1 General Principles
Lightning Protection Level (LPL)

4 Levels of protection (I to IV) are introduced. A set of maximum and minimum lightning current parameters is fixed for all the 4 LPL Class

LPL 1

•Peak current range between 3kA to 200kA

•Withstand up to 99% Strike ranging below 200kA

•Withstand up to 99% strike ranging above 3KA (Rolling Sphere 20m)

LPL 2

•Peak current range between 5kA to 150kA

•Withstand up to 98% Strike ranging below 150kA

•Withstand up to 97% strike ranging above 5KA (Rolling Sphere 30m)

IEC 62305-1 General Principles
Lightning Protection Level (LPL)

LPL 3

•Peak current range between 10kA to 100kA

•Withstand up to 97% Strike ranging below 100kA

•Withstand up to 91% strike ranging above 10KA (Rolling Sphere 45m)

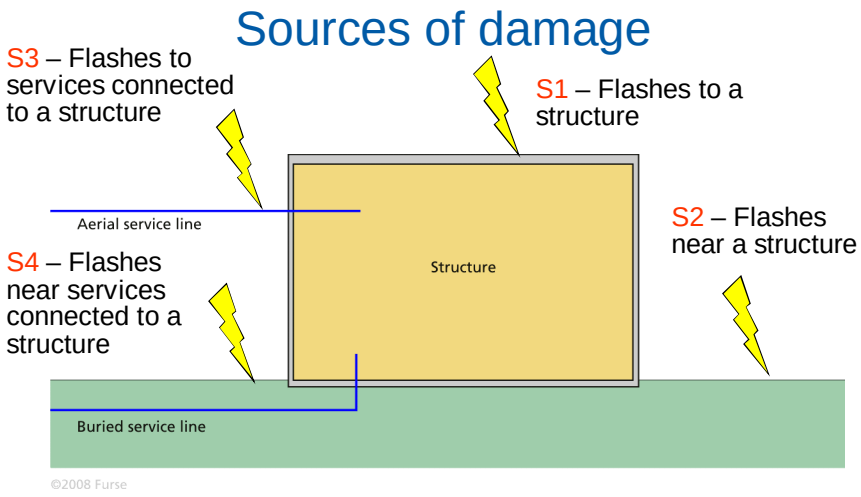
LPL 4

- Peak current range between 16kA to 100kA
- Withstand up to 97% Strike ranging below 100kA
- Withstand up to 84% strike ranging above 16KA (Rolling Sphere 60m)

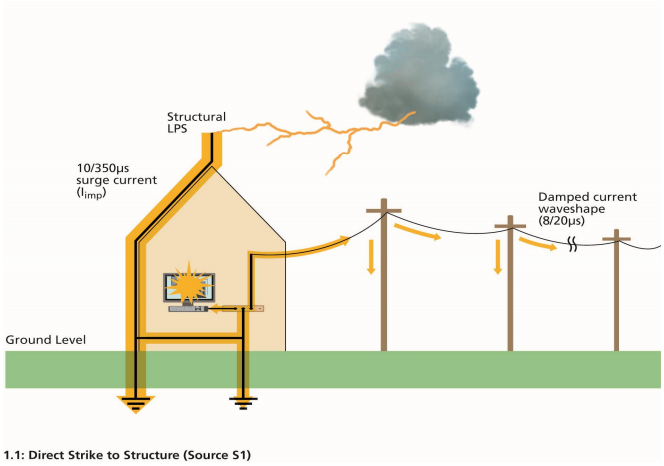
The maximum values of lightning current parameters of different LPL are used to design lightning protection components.

The minimum values of different LPL are used to derive the rolling sphere radius in order to define LPZ 0_B

IEC 62305-1 General Principles
Source of Damage



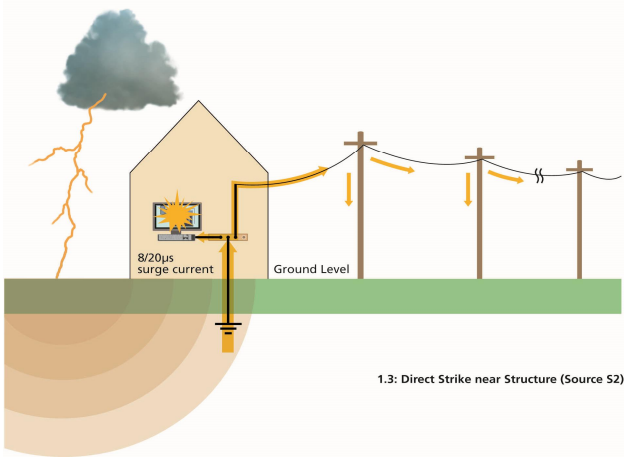
Types of Source



1.1: Direct Strike to Structure (Source S1)

Direct strike to structure (Source S1)

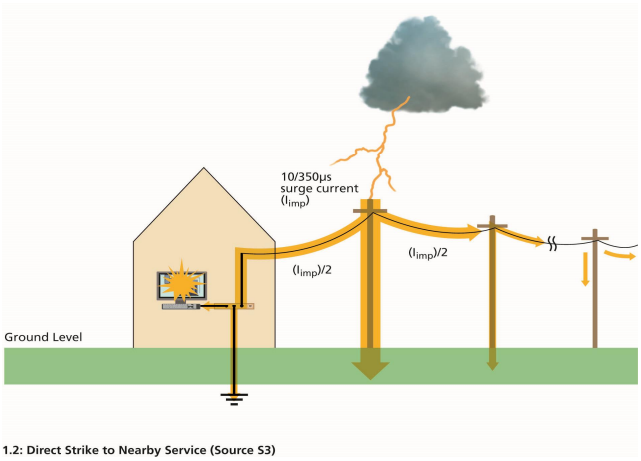
Types of Source



1.3: Direct Strike near Structure (Source S2)

Direct strike near structure (Source S2)

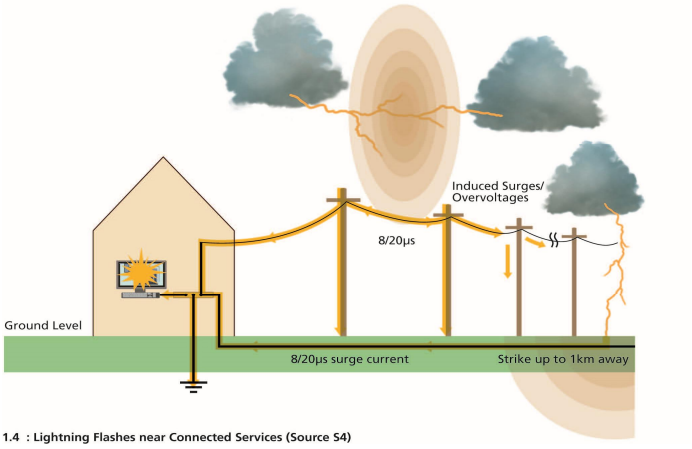
Types of Source



1.2: Direct Strike to Nearby Service (Source S3)

Direct strike to service line (Source S3)

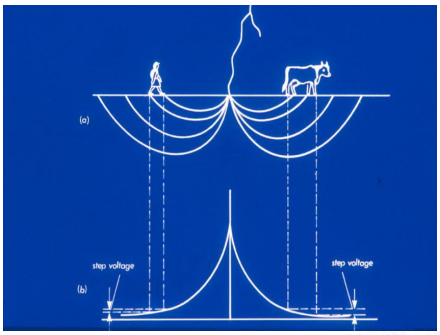
Types of Source

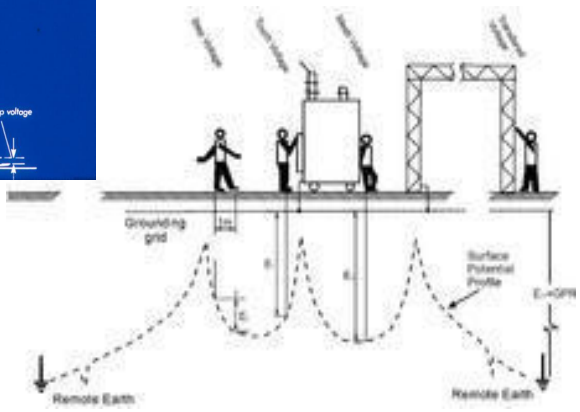


1.4 : Lightning Flashes near Connected Services (Source S4)

Lightning flash near service line (Source S4)

IEC 62305-1 General Principles
Understanding Damage
Step and Touch voltage





IEC 62305
General overview

IEC 62305-1	General Principles
IEC 62305-2	Risk Management
IEC 62305-3	Physical damages and life hazard
IEC 62305-4	Electrical & electronic systems

IEC 62305
General overview

What is performance guarantee of LPS?

Answer :

IEC provide performance guarantee

Protection against lightning is required if the calculated risk R_n (whether R_1 or R_2 or R_3) is greater than the tolerable level of risk R_T, ie $R_n > R_T$

Types of loss	R_T /annum
Loss of human life or permanent injuries	1×10^{-5}
Loss of service to the public	1×10^{-4}
Loss of cultural heritage	1×10^{-4}

Thus we must follow IEC 62305 (Protection against lightning)
And IEC 62561 (Lightning protection system components)

Introduction to StrikeRisk: IEC 62305-2 Risk Assessment

1 Use and type of structure (Lf)

2 Dimensions of structure (L x W x H in metres)

3 No of service lines feeding the structure

- power, single/three phase, overhead, underground

- telecon, how many lines, overhead, underground

4 Length of service lines (Lc)

5 Location (Cd)

6 Environment (urban, suburban, rural) (Ce)

7 Service line only or with transformer (Ct)

8 Special hazards (low, average, high level of panic) (hz)

9 Type of surface (concrete, asphalt, wood etc) (ra & ru)

10 Any fire protection provisions? (manual extinguisher, automatic extinguishing system) (rp)

11 Risk of fire (high, ordinary, low) (rf)

12 Soil resistivity (ρ)

13 Voltage withstand (Uw) of (a) power cable (b) telecom cable (KS4)

14 Any spatial screening (any re-inforcing bars/stanchions within the framework of the structure? (KS1)

15 - Any details of service lines? (KS3)

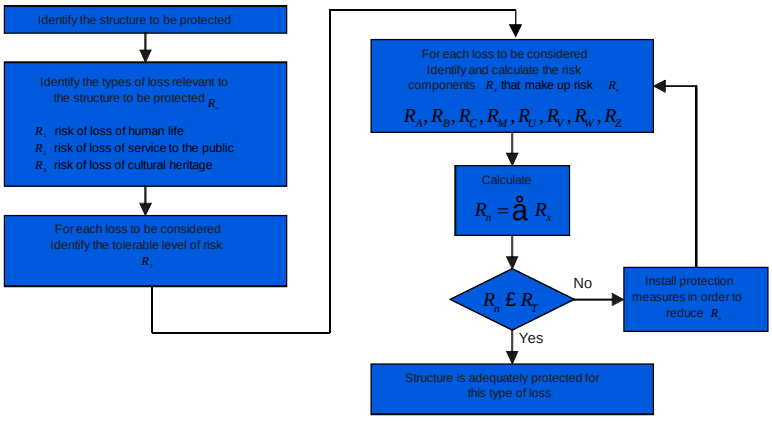
- Screened/unscreened cable

- routing

16 Flash Density (Ng)

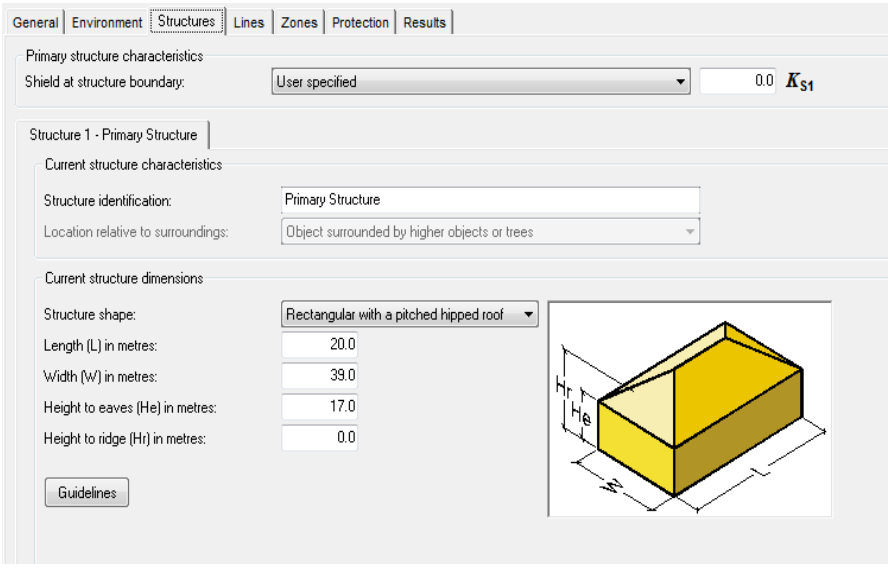
Introduction to StrikeRisk: IEC 62305-2 Risk Assessment

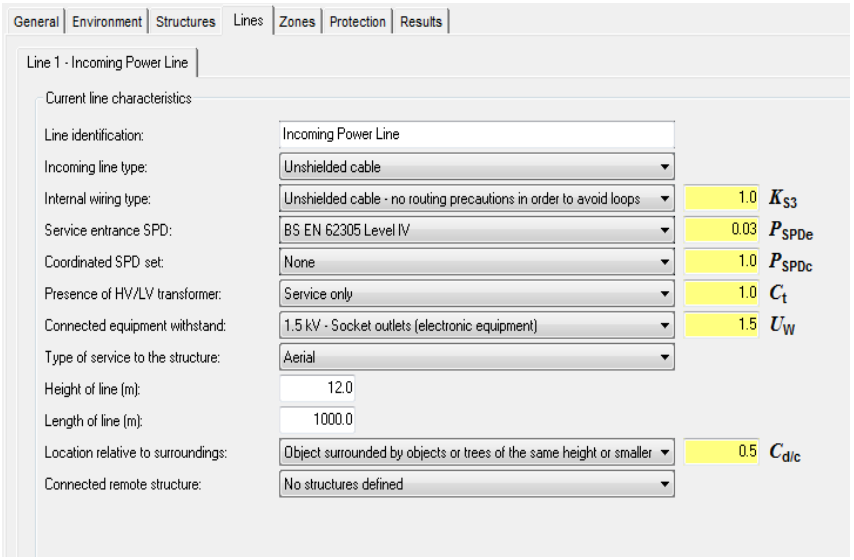
Calculation guide

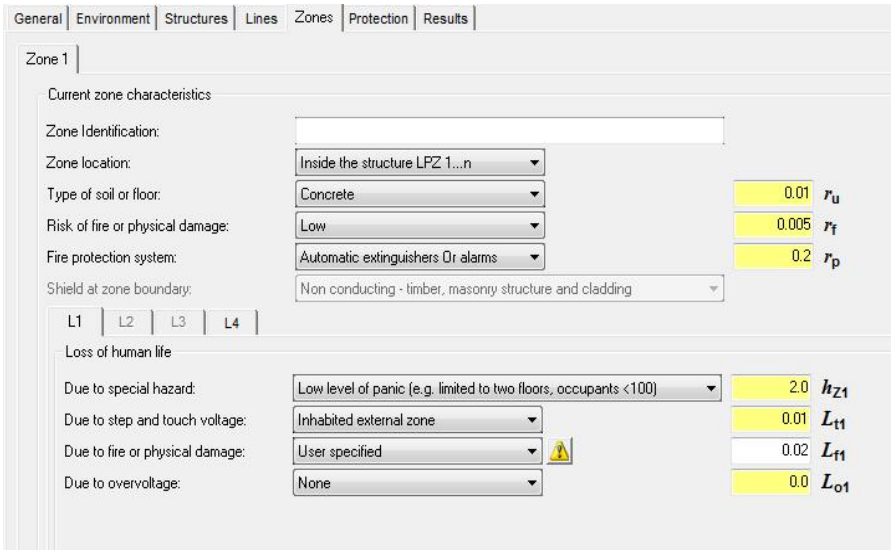


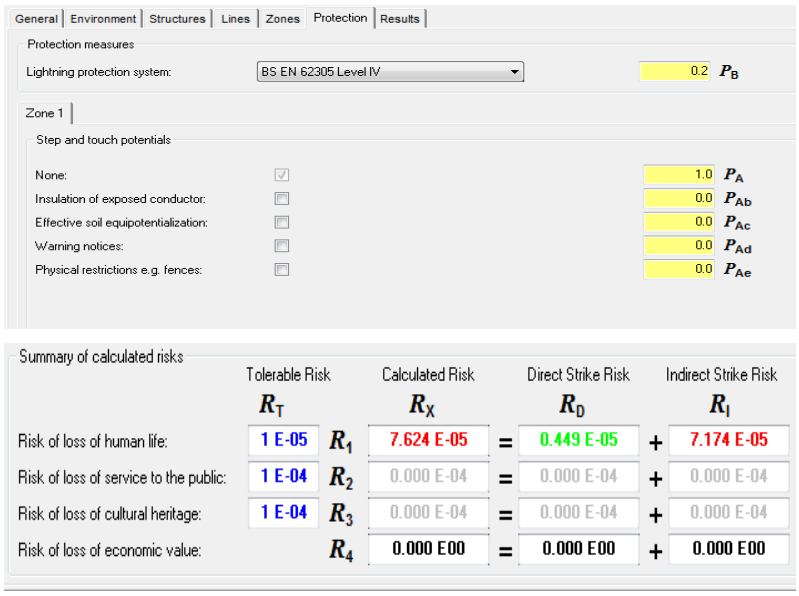
IEC 62305
Case study

Strike Risk 6.0




General
Environment
Structures
Lines
Zones
Protection
Results
Line 1 - Incoming Power Line
Current line characteristics
Line identification: Incoming Power Line
Incoming line type: Unshielded cable
Internal wiring type: Unshielded cable - no routing precautions in order to avoid loops 1.0 K_{S3}
Service entrance SPD: BS EN 62305 Level IV 0.03 P_{SPDe}
Coordinated SPD set: None 1.0 P_{SPDc}
Presence of HV/LV transformer: Service only 1.0 C_t
Connected equipment withstand: 1.5 kV - Socket outlets (electronic equipment) 1.5 U_W
Type of service to the structure: Aerial
Height of line (m): 12.0
Length of line (m): 1000.0
Location relative to surroundings: Object surrounded by objects or trees of the same height or smaller 0.5 $C_{d/c}$
Connected remote structure: No structures defined


General
Environment
Structures
Lines
Zones
Protection
Results
Zone 1
Current zone characteristics
Zone Identification:
Zone location: Inside the structure LPZ 1...n
Type of soil or floor: Concrete 0.01 r_u
Risk of fire or physical damage: Low 0.005 r_f
Fire protection system: Automatic extinguishers Or alarms 0.2 r_p
Shield at zone boundary: Non conducting - timber, masonry structure and cladding
L1
L2
L3
L4
Loss of human life
Due to special hazard: Low level of panic (e.g. limited to two floors, occupants <100) 2.0 h_{Z1}
Due to step and touch voltage: Inhabited external zone 0.01 L_{t1}
Due to fire or physical damage: User specified 0.02 L_{f1}
Due to overvoltage: None 0.0 L_{o1}



IEC 62305
General overview

IEC 62305-1	General Principles
IEC 62305-2	Risk Management
IEC 62305-3	Physical damages and life hazard
IEC 62305-4	Electrical & electronic systems


BRITISH STANDARD

BS EN 62305-3:2006

Protection against lightning —

Part 3: Physical damage to structures and life hazard

CONTROLLED

The European Standard EN 62305-3:2006 has the status of a British Standard

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BSi British Standards

Part 3: Physical damage to structures and life hazard

Air Termination System

3 basic protective methods for determining position of air termination system

- Rolling sphere method
- Protective angle method
- Mesh method

	Protective method			
Class of LPS	Rolling Sphere radius (m)	Mesh size (m x m)	Protection angle a °	Down conductor spacing (m)
I	20	5 x 5	see Information	10
II	30	10 x 10		10
III	45	15 x 15		15
IV	60	20 x 20		20

125

Air Termination System

Protective methods for determining position of air termination system

- Rolling sphere method

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

IEC 62305-1 General Principles
Lightning Protection Level (LPL)

$$r = 10 \times I^{0.65}$$

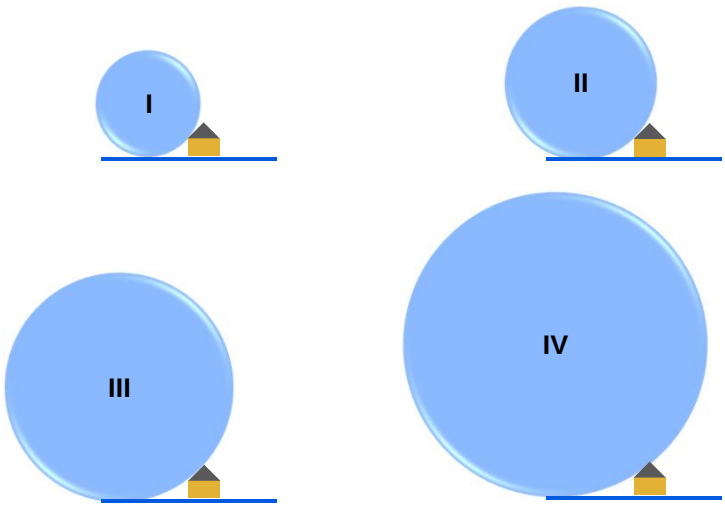
Where: r = radius of rolling sphere (m)

I = minimum peak current (kA)

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

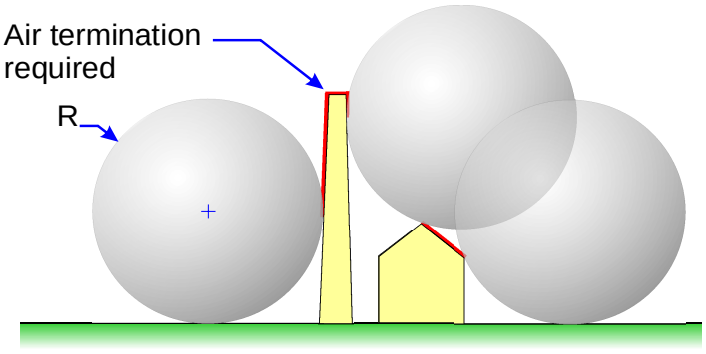
LPL	I	II	III	IV
Minimum current (kA)	3	5	10	16
Calculated radius of rolling sphere (m)	20.42	28.46	44.67	60.63
Adopted radius of rolling sphere (m)	20	30	45	60

Rolling sphere method



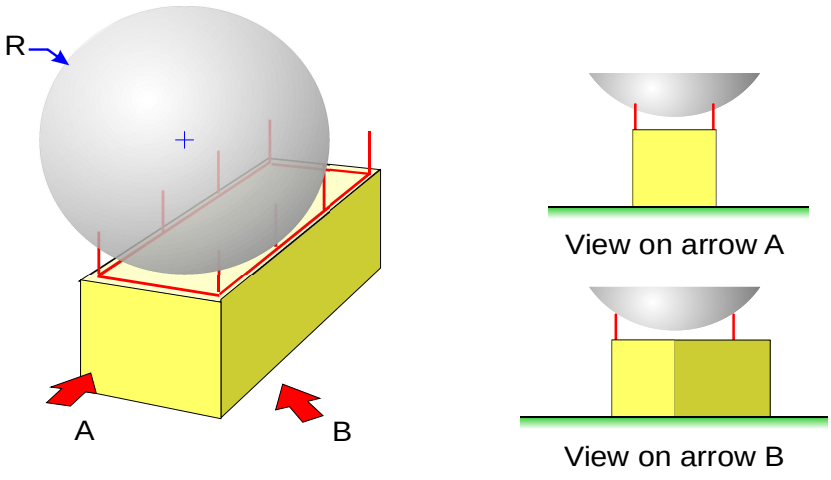
Rolling sphere method

Protective methods for determining position of air termination system

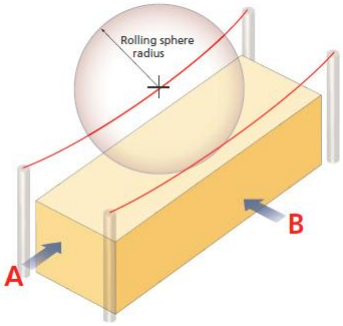


R - Radius of the rolling sphere

Rolling sphere method



Rolling sphere method



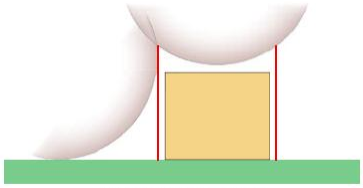


Figure 4.8b: View on arrow **A**

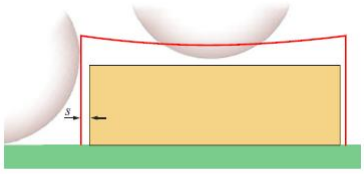
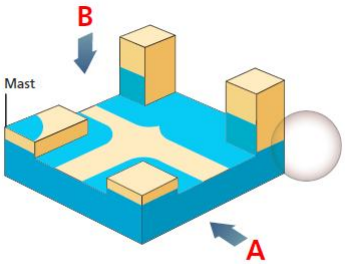
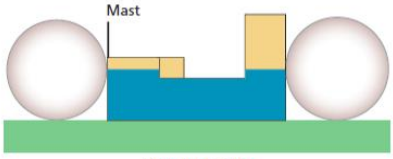


Figure 4.8c: View on arrow **B**

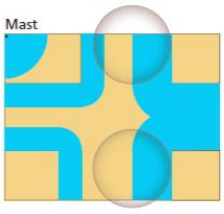
Rolling sphere method



All yellow areas and the mast should be assessed for the need for air terminations

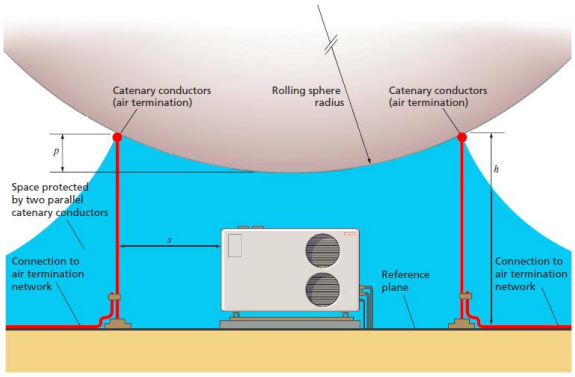


View on arrow **A**



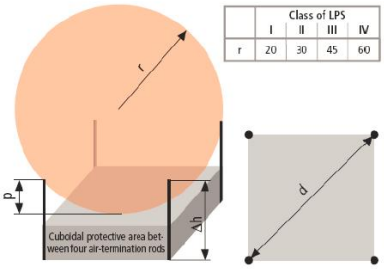
View on arrow **B**

Rolling sphere method

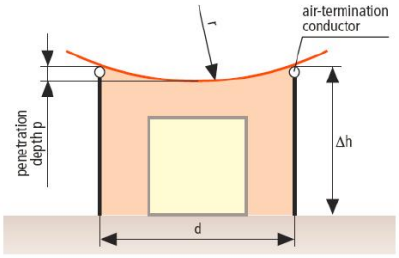


h Physical height of catenary conductors above the reference plane
s Separation distance
p Penetration distance of the rolling sphere

Rolling sphere method



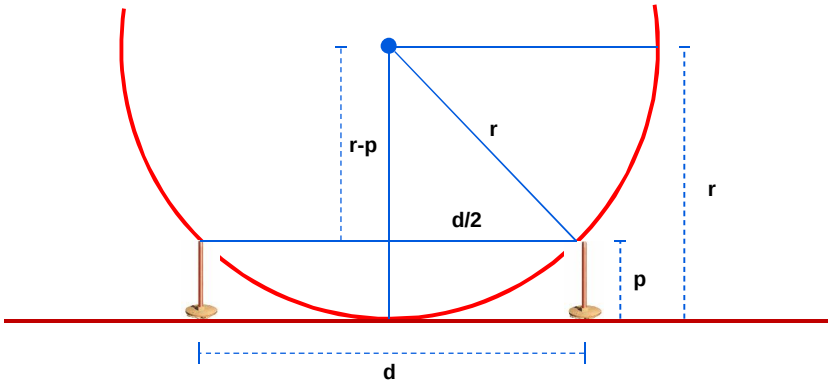
	Class of LPS			
	I	II	III	IV
r	20	30	45	60



$$p = r - \left[r^2 - (d/2)^2\right]^{\frac{1}{2}}$$

r Radius of the rolling sphere
d Distance between two air-termination rods or two parallel air-termination conductors

Rolling sphere method



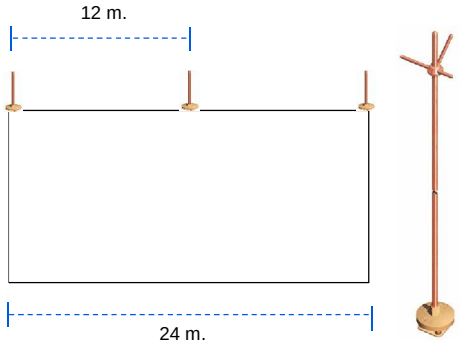
$$p = r - \left[r^2 - (d/2)^2\right]^{\frac{1}{2}}$$

Rolling sphere method

d	Sag of the rolling sphere [m] (rounded up)			
Distance between air-termniation rods [m]	Class of LPS with rolling sphere radius in meters			
	I (20 m)	II (30 m)	III (45 m)	IV (60 m)
2	0.03	0.02	0.01	0.01
4	0.10	0.07	0.04	0.03
6	0.23	0.15	0.10	0.08
8	0.40	0.27	0.18	0.13
10	0.64	0.42	0.28	0.21
12	0.92	0.61	0.40	0.30
14	1.27	0.83	0.55	0.41
16	1.67	1.09	0.72	0.54
18	2.14	1.38	0.91	0.68
20	2.68	1.72	1.13	0.84
23	3.64	2.29	1.49	1.11
26	4.80	2.96	1.92	1.43
29	6.23	3.74	2.40	1.78
32	8.00	4.62	2.94	2.17
35	10.32	5.63	3.54	2.61

Rolling sphere method

Example:
Risk Management à Loss of human life less than$1x10^{-5}$ in a year with LPL III

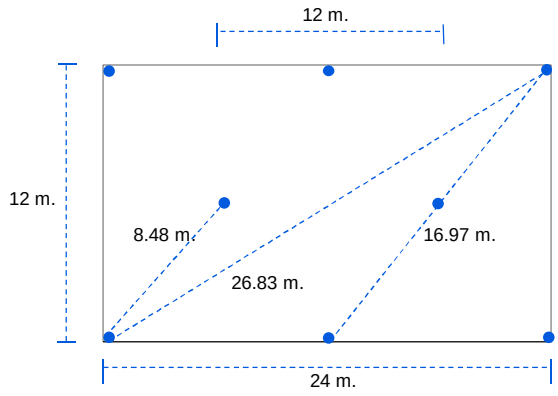


Air rod

Part no.	Rod length (mm)	Rod diameter (mm)	Thread size	Conductor material	Weight each (kg)
RA015	500	Ø 15	M16	Copper	0.73
RA025	1000	Ø 15	M16	Copper	1.31
RA030	1500	Ø 15	M16	Copper	2.35
RA040	2000	Ø 15	M16	Copper	3.00
RA050-HJ	3000	Ø 15	M16	Copper	4.70
RA015	500	Ø 15	M16	Aluminium	0.29
RA025	1000	Ø 15	M16	Aluminium	0.53
RA030	1500	Ø 15	M16	Aluminium	0.80
RA040	2000	Ø 15	M16	Aluminium	1.06
RA050	3000	Ø 15	M16	Aluminium	1.60
RA400-TL	500	Ø 10	M10	Copper	0.33
RA402	1000	Ø 10	M10	Copper	0.65
RA080	500	Ø 10	M10	Aluminium	0.11
RA085	1000	Ø 10	M10	Aluminium	0.22

Rolling sphere method

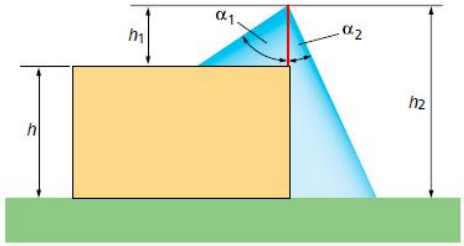
Example:
Risk Management à Loss of human life less than$1x10^{-5}$ in a year with LPL III



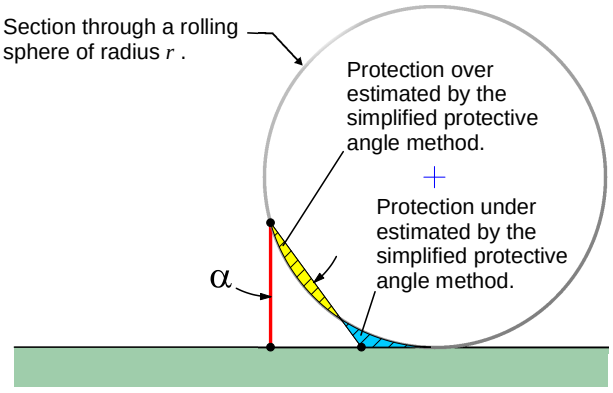
Air Termination System

Protective methods for determining position of air termination system

- Protective angle method



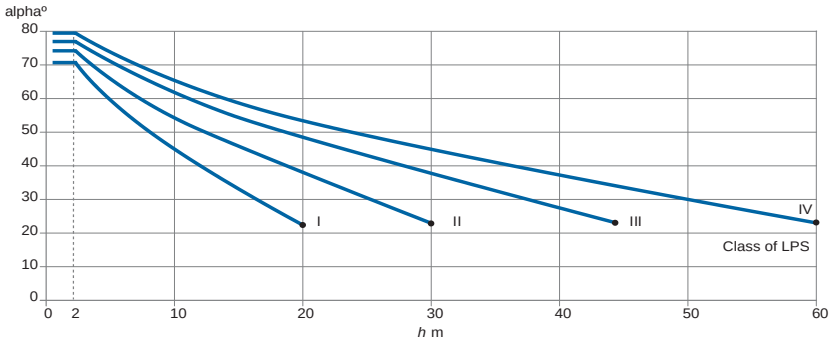
Protective angle method



Mathematical simplification of rolling sphere method

140

Protective angle method



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

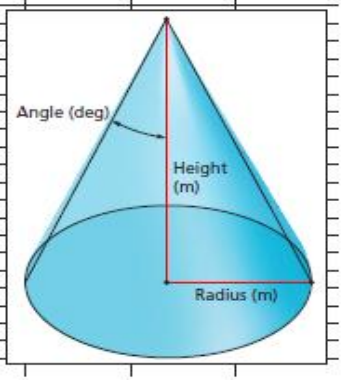
Determination of protective angle

Protective angle method

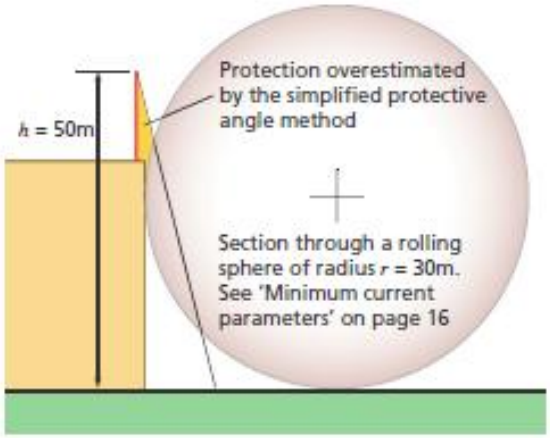
Height of air rod above reference plane (m)	LPS Class IV		LPS Class III		LPS Class II		LPS Class I	
	Angle (deg)	Radius (m)	Angle (deg)	Radius (m)	Angle (deg)	Radius (m)	Angle (deg)	Radius (m)
1	78.7	5.0	76.3	4.1	73.2	3.3	70.0	2.7
2	78.7	10.0	76.3	8.2	73.2	6.6	70.0	5.5
3	76.7	12.7	74.1	10.5	70.1	8.3	66.3	6.8
4	74.7	14.6	72.0	12.3	67.1	9.5	62.6	7.7
5	72.8	16.1	69.9	13.6	64.4	10.4	59.1	8.4
6	71.0	17.4	67.9	14.8	62.0	11.3	55.9	8.9
7	69.3	18.5	66.0	15.7	59.7	12.0	53.0	9.3
8	67.7	19.5	64.3	16.6	57.6	12.6	50.2	9.6
9	66.2	20.4	62.6	17.4	55.6	13.2	47.7	9.9
10	64.7	21.2	61.1	18.1	53.8	13.6	45.2	10.1
11	63.4	21.9	59.6	18.7	52.0	14.1	42.8	10.2
12	62.1	22.6	58.2	19.3	50.3	14.4	40.4	10.2
13	60.8	23.3	56.8	19.8	48.6	14.8	38.1	10.2
14	59.6	23.9	55.4	20.3	47.0	15.0	35.8	10.1
15	58.4	24.4	54.1	20.7	45.4	15.2	33.6	10.0
16	57.3	24.9	52.8	21.1	43.8	15.3	31.4	9.8
17	56.2	25.4	51.5	21.4	42.3	15.4	29.2	9.5
18	55.2	25.9	50.3	21.7	40.6	15.4	27.1	9.2
19	54.2	26.3	49.1	21.9	39.2	15.5	24.9	8.8
20	53.2	26.7	47.9	22.1	37.7	15.5	22.8	8.4
21	52.3	27.1	46.6	22.2	36.3	15.4		
22	51.3	27.5	45.5	22.4	34.8	15.3		
23	50.5	27.9	44.3	22.4	33.4	15.1		
24	49.6	28.2	43.1	22.5	31.9	15.0		
25	48.8	28.5	42.0	22.5	30.5	14.7		
26	48.0	28.8	40.9	22.5	29.0	14.4		
27	47.2	29.1	39.8	22.5	27.5	14.0		
28	46.4	29.4	38.7	22.5	25.9	13.6		
29	45.6	29.6	37.7	22.4	24.4	13.1		
30	44.8	29.8	36.7	22.3	22.8	12.6		

Protective angle method

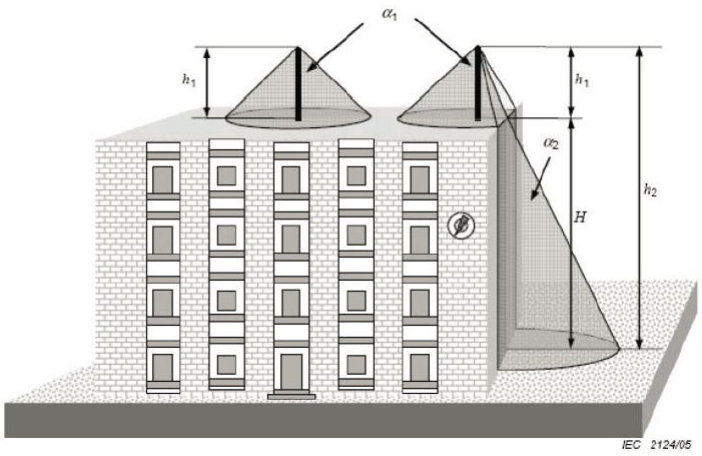
Height of air rod above reference plane (m)	LPS Class IV		LPS Class III		LPS Class II		LPS Class I	
	Angle (deg)	Radius (m)	Angle (deg)	Radius (m)	Angle (deg)	Radius (m)	Angle (deg)	Radius (m)
31	44.1	30.0	35.7	22.3				
32	43.3	30.2	34.7	22.1				
33	42.6	30.3	33.7	22.0				
34	41.8	30.4	32.8	21.9				
35	41.1	30.5	31.8	21.7				
36	40.3	30.6	30.9	21.5				
37	39.6	30.6	29.9	21.3				
38	38.8	30.6	29.0	21.1				
39	38.1	30.6	28.1	20.8				
40	37.3	30.5	27.2	20.5				
41	36.6	30.4	26.2	20.2				
42	35.9	30.3	25.3	19.9				
43	35.1	30.2	24.4	19.5				
44	34.4	30.1	23.5	19.2				
45	33.6	29.9	23.5	19.6				
46	32.9	29.8						
47	32.2	29.6						
48	31.5	29.4						
49	30.7	29.1						
50	30.0	28.9						
51	29.3	28.6						
52	28.5	28.3						
53	27.8	28.0						
54	27.1	27.6						
55	26.4	27.3						
56	25.7	26.9						
57	24.9	26.5						
58	24.2	26.1						
59	23.5	25.7						
60	22.8	25.2						



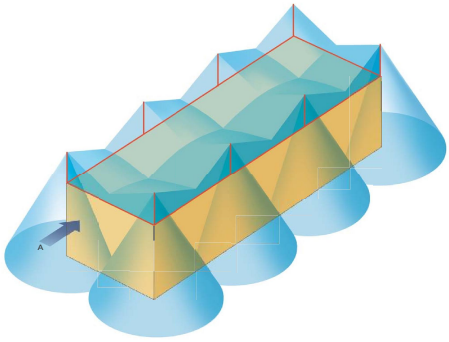
Protective angle method

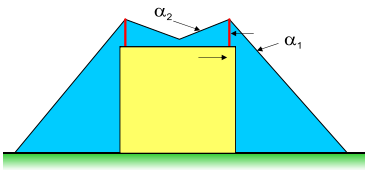


Protective angle method



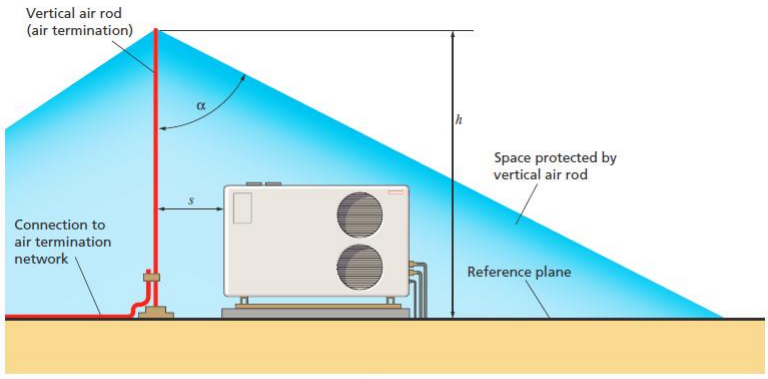
Protective angle method





View on arrow A

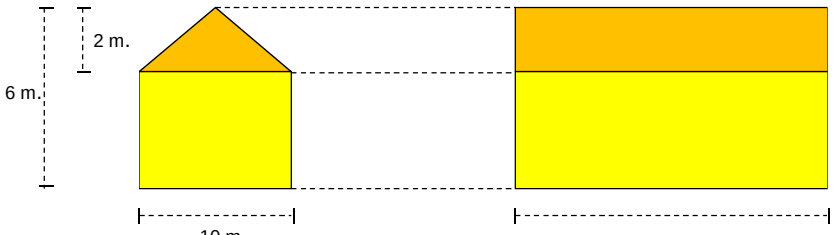
Protective angle method



h Physical height of air rod above the reference plane
α Protective angle (alpha)
s Separation distance

Protective angle method

Example:
Risk Management à Loss of human life less than$1x10^{-5}$ in a year with LPL III



Air rod

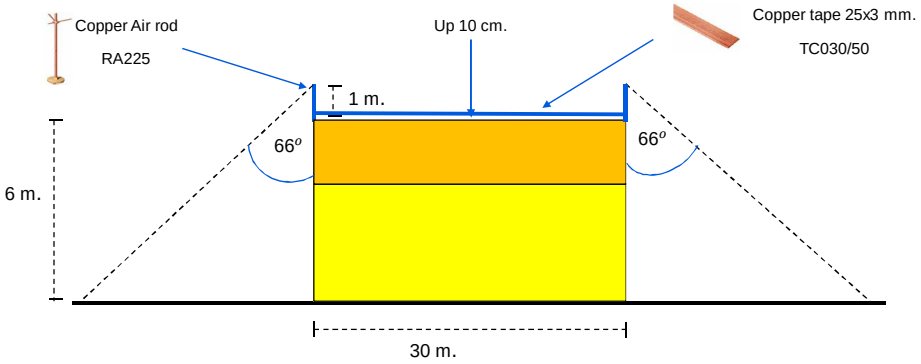
Part no.	Rod length (mm)	Rod diameter (mm)	Thread size	Conductor material	Weight each (kg)
FA215	500	Ø 15	M16	Copper	0.73
FA225	1000	Ø 15	M16	Copper	1.51
FA230	1500	Ø 15	M16	Copper	2.35
FA240	2000	Ø 15	M16	Copper	3.00
FA250-FU	3000	Ø 15	M16	Copper	4.70
FA015	500	Ø 15	M16	Aluminium	0.29
FA025	1000	Ø 15	M16	Aluminium	0.53
FA030	1500	Ø 15	M16	Aluminium	0.80
FA040	2000	Ø 15	M16	Aluminium	1.06
FA050	3000	Ø 15	M16	Aluminium	1.60
FA400-FU	500	Ø 10	M10	Copper	0.33
FA402	1000	Ø 10	M10	Copper	0.65
FA080	500	Ø 10	M10	Aluminium	0.11
FA085	1000	Ø 10	M10	Aluminium	0.22

Protective angle method

Example:

Risk Management à Loss of human life less than$1x10^{-5}$ in a year with LPL III

H = 7 m. à 66 degree

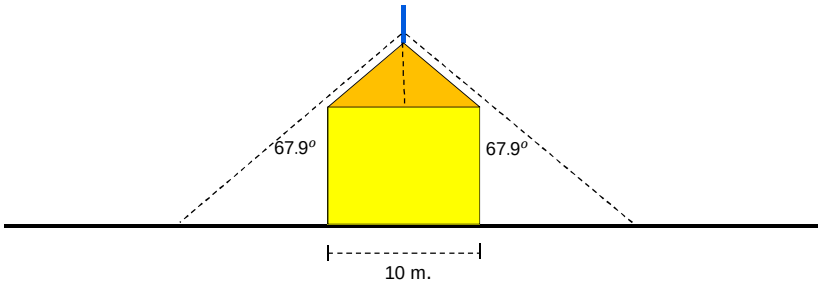


Protective angle method

Example:

Risk Management à Loss of human life less than$1x10^{-5}$ in a year with LPL III

H = 6.1 m. à 67.9 degree



$$s = k_i \times \frac{k_c}{k_m} \times l$$

Where:

- k_i Relates to the appropriate Class of LPS (see Table 4.13)
- k_c Is a partitioning coefficient of the lightning current flowing in the down conductors (see Table 4.14)
- k_m Is a partitioning coefficient relating to the separation medium (see Table 4.15)
- l Is the length in metres along the air termination or down conductor, from the point where the separation distance is to be considered, to the nearest equipotential bonding point

Class of LPS	k_i
I	0.08
II	0.06
III and IV	0.04

Table 4.13: Values of coefficient k_i (BS EN 62305-3 Table 10)

Number of down-conductors n	Detailed values (see Table C.1) k_c
1	1
2	1 … 0.5
4 and more	1 … $1/n$

Table 4.14: Values of coefficient k_c (BS EN 62305-3 Table 11)

Material	k_m
Air	1
Concrete, bricks	0.5

When there are several insulating materials in series, it is good practice to use the lower value for k_m. The use of other insulating materials is under consideration.

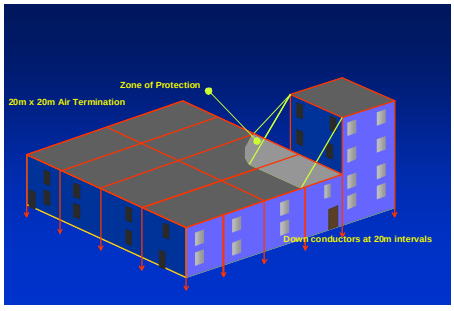
Table 4.15: Values of coefficient k_m (BS EN 62305-3 Table 12)

Air Termination System

Protective methods for determining position of air termination system

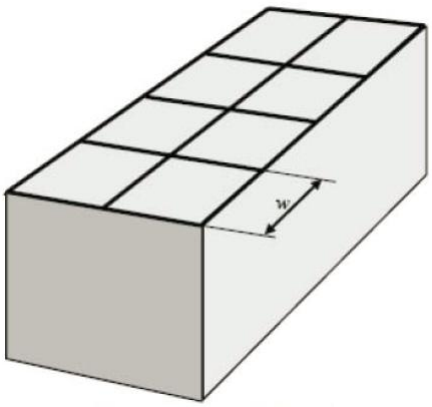
- Mesh method

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



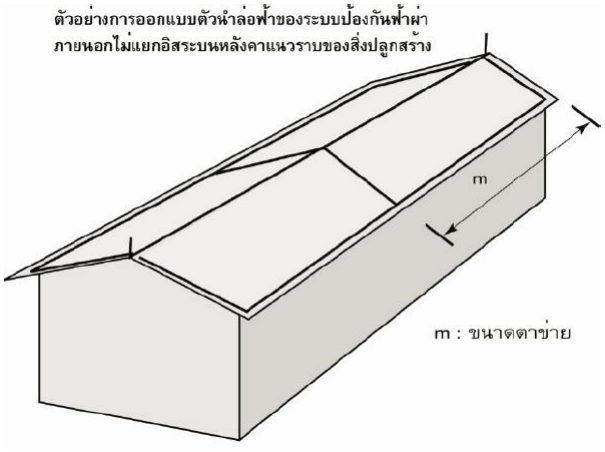
Mesh method

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



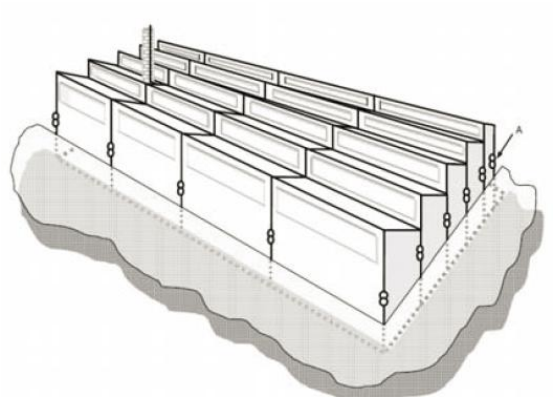
Mesh method

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



Mesh method

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



IEC 62305
General overview

IEC 62305-1	General Principles
IEC 62305-2	Risk Management
IEC 62305-3	Physical damages and life hazard
IEC 62305-4	Electrical & electronic systems

IEC 62561
Lightning protection system components

The IEC/BS EN 62561 series of standards focuses on design and performance of components which are to be installed in an external LPS.

All ABB Furse connection components are designed to conform to the IEC/BS EN 62561 test procedures.

IEC 62561
Lightning protection system components

IEC 62561-1 : Requirements for connection components

IEC 62561-2 : Requirements for conductors and earth electrodes

IEC 62561-3 : Requirements for isolating spark gaps (ISG)

IEC 62561-4 : Requirements for conductor fasteners

IEC 62561-5 : Requirements for earth electrode inspection housings and earth electrode seals

IEC 62561-6 : Requirements for lightning strike counters (LSC)

IEC 62561-7 : Requirements for earthing enhancing compounds

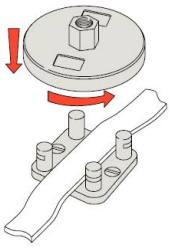
IEC 62561

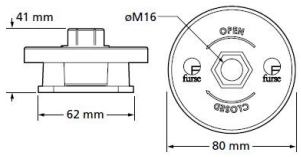
IEC 62561-1 : Requirements for connection components

Standards

IEC/BS EN 62561-1 Class H

UL96 (SD105-H)



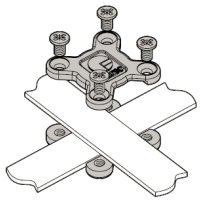


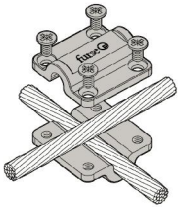
SD307

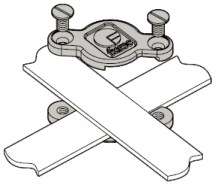
SD305

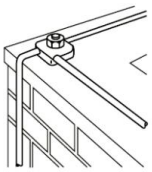
IEC 62561

IEC 62561-1 : Requirements for connection components







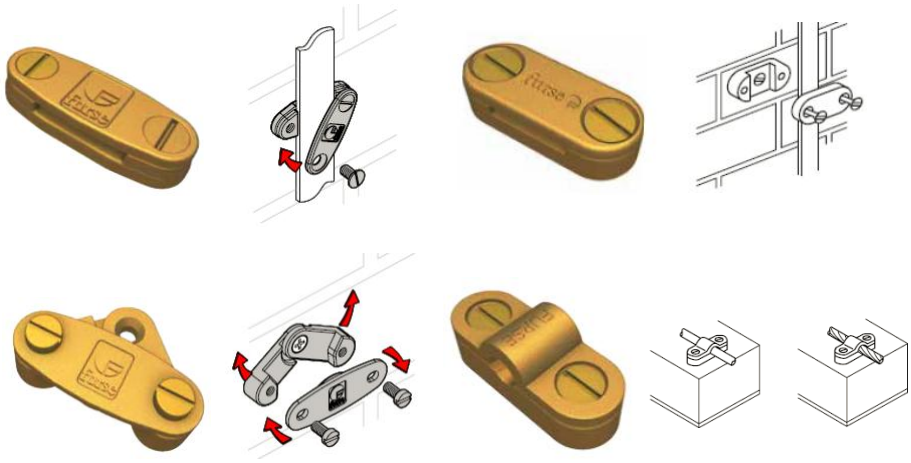


IEC 62561

IEC 62561-2 : Requirements for conductors and earth electrodes

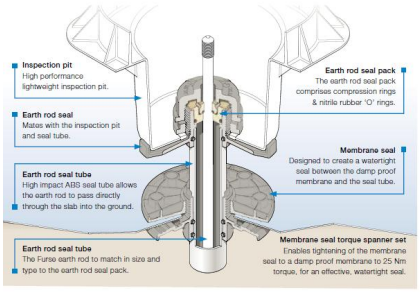
IEC 62561

IEC 62561-4 : Requirements for conductor fasteners



IEC 62561

IEC 62561-5 : Requirements for earth electrode inspection housings and earth electrode seals



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