ATEG

Lighting & Earthing Protection Partner

External Lightning Protection System
Earth Termination System

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Authorized

* Any other types & sizes are available upon request. Kindly to contact with our technical person.


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Namecard Holder
Size: 8.8cm x 5.3cm

Content Page

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Introduction

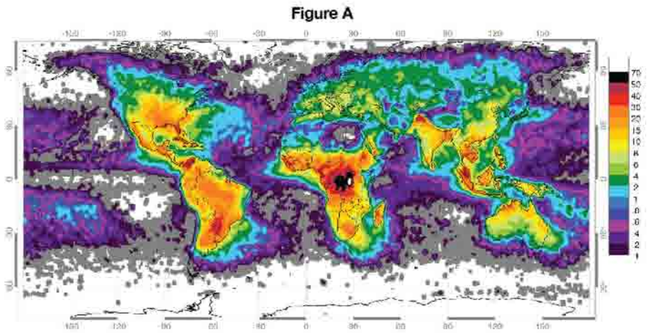
Lightning is a transient discharge of static electricity that serves to re-establish electrostatic electricity that serves to re-establish electrostatic equilibrium usually within a storm environment. From eye-view, lightning can occur within cloud, cloud-to-cloud, and between cloud-to-ground.

Lightning can provide a spectacular display of light on a dark night. However, this awesome show of nature can bring fierce destruction than many other natural disastrous. The destruction can either bring direct effects or indirect effects. The direct effects are from resistive (ohmic) heating, arcing and burning. Whereas, the indirect effects are more probable, which include capacitive, inductive and magnetic behaviour. Lightning can induce fires, damage electrical installations and more importantly it kills.

Southeast Asia - Tropical Climate

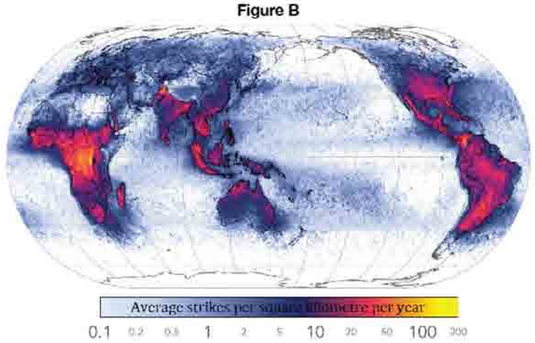
The climate in Southeast Asia is mainly tropical-hot and humid all year round with plentiful rainfall. Incidents caused by lightning strikes is always being heard as this piece of lands is oppose to 80-140 thunderstorm days per year (Refer to Figure A); which approximate equivalent to average 10-50 strikes per kilometre square per year (Refer to Figure B). Therefore, it would be a need for us to install a proper lightning protection system because lightning strikes all exposed things on the ground, such as buildings, storage tanks, trees, hilltops or even human beings.

Figure A



Lightning is a transient discharge of static electricity that serves to re-establish electrostatic

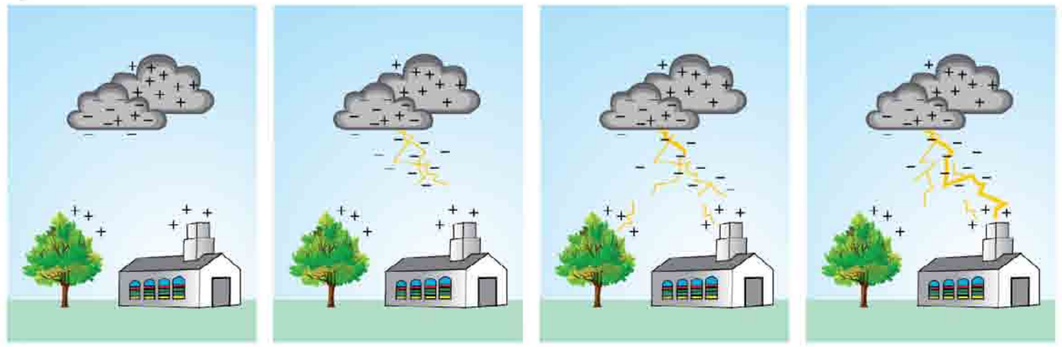
Figure B



Structural (Primary) Protection

Cloud-to-ground lightning occurs when the potential difference becomes great enough between cloud and earth to cause ionization, an avalanche breakdown in the cloud as electrons jump from air molecule to air molecule forming a negatively charged "stepped leader" (Refer to Figure C). As the leader descends it is really not being attracted to any single object on the ground, but rather the overall attraction of the opposite charge at ground level. Therefore a structural (primary) lightning protection system has to be installed to create a path to conceive the lightning current to disperse into the ground. At the same time, the path must be very low in impedance in order to reduce the lead time to disperse the lightning current.

Figure C



Lightning Protection Levels (LPL)

According to IEC 62305-1, four LPL are introduced in order to identify the optimal technical along with economic scale of class of Lightning Protection System (LPS) to cope with lightning interference. In essence, the site with greater LPL requires higher Class of LPS installed. The required Class of LPS is defined by the result of risk assessment calculation in IEC 62305-2.

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

Table: Class of LPS indentified in corresponding LPL

In the case of where the structure is constructed of combustible or flammable material, the external LPS is typically to be isolated in the consideration of the effect of thermal and explosive caused by lightning strikes.

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A. AIR TERMINAL FIXINGS
A1. Multiple Taper Pointed Air Rod
A2. Taper Pointed Air Rod
A3. Air Terminal Base
A4. Ridge Saddle

B. ROOFING CONDUCTOR FIXING
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B2. Clip On Roof Support
B3. Slip-In Roof Support
B4. Clamp On Roof Support

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F12. Earth Bars
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F14. Copper Link
F15. Earthing Improvement Compound

H. SUPPORTING ACCESSORIES
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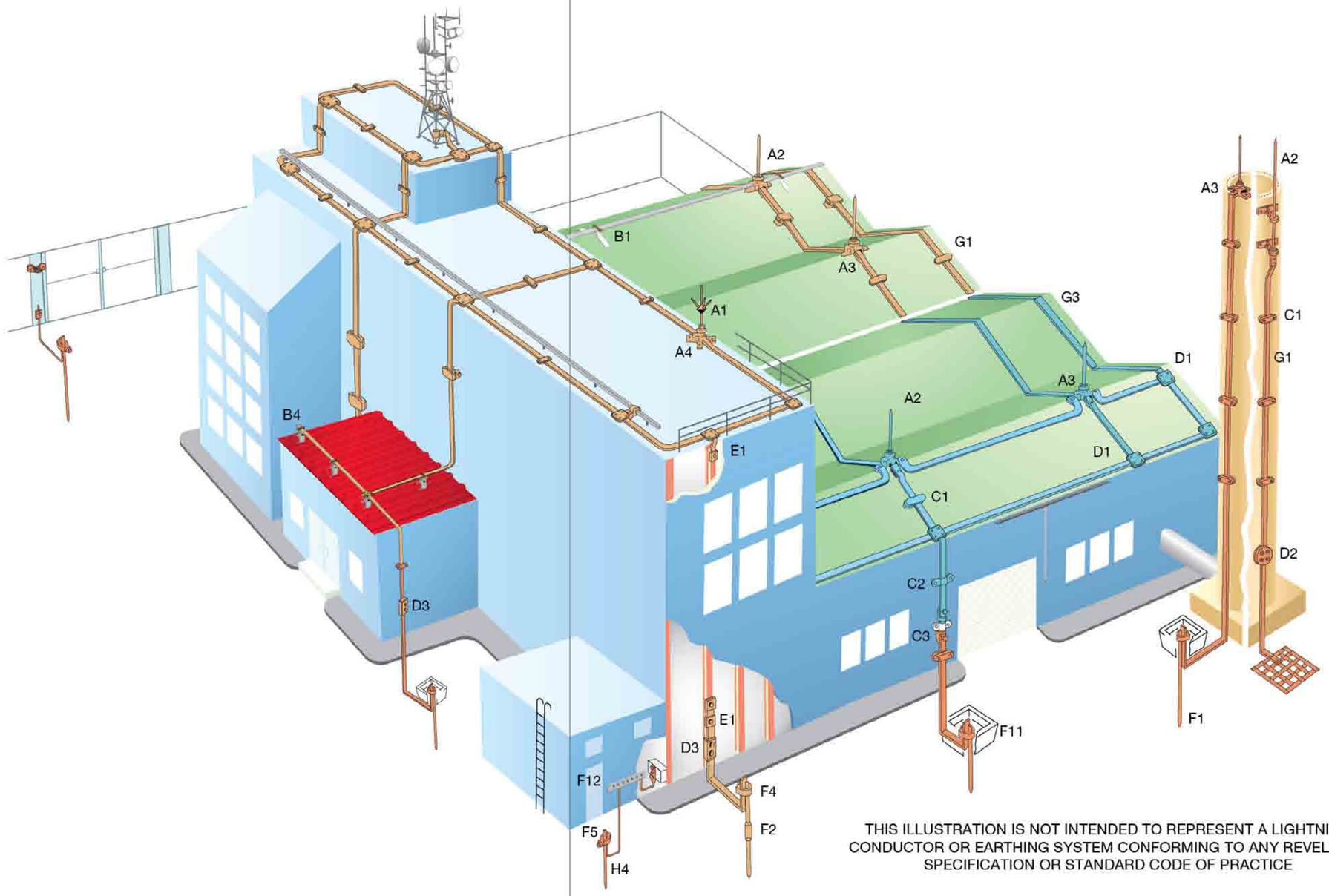
H2. Cable Lug
H3. Grounding Cable (Green/Yellow or Green)
H4. Bare Galvanized Steel Wire
H5. Flexible Copper Bare Braid Conductor Size

G. CONDUCTORS
G1. Bare Copper Tape
G2. Tinted Bare Copper Tape
G3. Bare Aluminum Tape



THIS ILLUSTRATION IS NOT INTENDED TO REPRESENT A LIGHTNING CONDUCTOR OR EARTHING SYSTEM CONFORMING TO ANY REVELVANT SPECIFICATION OR STANDARD CODE OF PRACTICE

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External Lightning Protection System Design Consideration

An external LPS is mainly consists of air termination system, down conductor system and earth termination system.

Air Termination System

The role of air termination is to reduce the tendency of the lightning strikes to the structure. In other words, air termination system establish a prefer point for lightning to strike to, so the current can be directed to the ground and dispersed via down conductor and earth termination system. With such a way, the losses and damages to the structure incurred by lightning are to be minimized by the LPS.

According to IEC 62305-3, either alone or combination of multiple types of air terminal is feasible to all structure. These are air rods, catenary conductors or meshed conductor network.

The optimal positions of the air terminal to be installed are corners of the structure, exposed points and edges. The standard provides guide way in determining the position of the air termination system. There are 3 methods to determine the position of the air termination system.

- **Rolling Sphere Method**
- **Protective Angle Method**
- **Meshed Method**

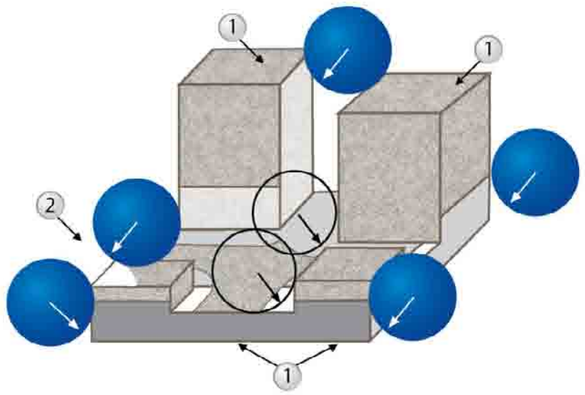
Rolling Sphere Method

The radius of rolling sphere is derived from the minimum current based on each LPL. Rolling sphere can be explained as the interception point of lightning current. All points touched the areas in the rolling sphere are potentially to be stroke by lightning. The radii of the rolling sphere are corresponding to the relevant LPL.

LPL	Rolling Sphere radius (m)
I	20
II	30
III	45
IV	60

Table: Rolling Sphere radius correspond to the LPL

This method is suitable for complex geometry structure to prevent part of the structure stack in the area of rolling sphere. Moreover, it is a determinant of optimum cost for lightning protection system installation in reducing overlapped protection.



Mesh Method

The method is suitable for plane surface structure. It can be a replacement for mounted air finial (air rod) if the user found the mounted rod at attic is inconspicuous in sight. The mesh size differs corresponding to the relative LPL.

LPL	Mesh Size
I	5m x 5m
II	10m x 10cm
III	15m x 15cm
IV	20m x 20cm

Table: Mesh Size

The position of the conductor must be as close to the edges as possible, as edge has a greater tendency to be stroke by lightning as proven by previous study. For ridge roof building, the conductor must be positioned at roof edge lines and roof ridge lines if the roof gradient exceeds 1/10.

Protective Angle Method

This method is a simpler method derived from rolling sphere. This is usually applied to simple design structure. The starting point of the angle of protection initiates from the vertical top end of air terminal project down to area to be protected. The protective angle varied with the height of the air terminal with respect to the corresponding LPL as depicted in Figure - Protective angle ranging . The protection of the structure only fully situated in the area of the cone.

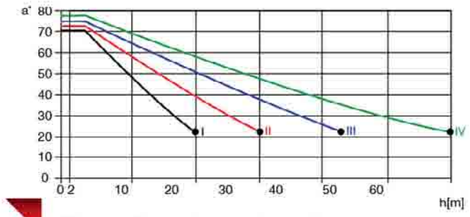
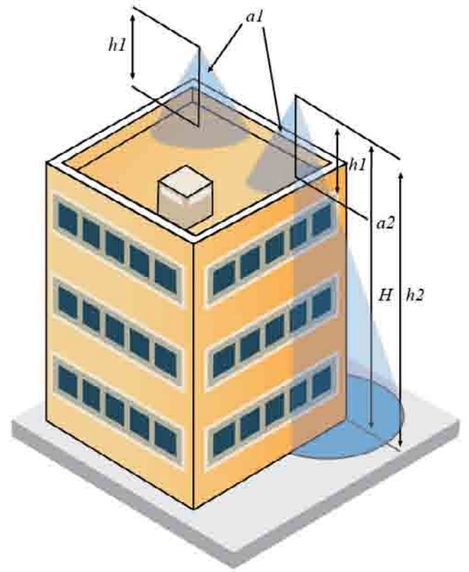


Figure - Protective angle ranging



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A. AIR TERMINAL FIXINGS

A1. Multiple Taper Pointed Air Rod

Rod Length	Thread Diameter	Material	Catalogue No
500mm	16mm	Copper	MATG 050
1000mm	16mm	Copper	MATG 100

A2. Taper Pointed Air Rod

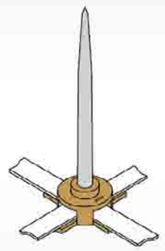
Rod Length	Thread Diameter	Material	Catalogue No
500mm	16mm	Copper	ATG 050
1000mm	16mm	Copper	ATG 100

Rod Length	Thread Diameter	Material	Catalogue No
500mm	16mm	Aluminum	LATG 050

A3. Air Terminal Base

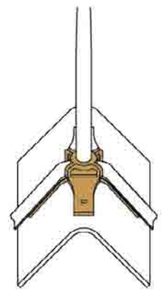
Rod Length	Maximum Conductor Width	Material	Catalogue No
16mm	25mm	Copper	ATBG 160

Rod Length	Maximum Conductor Width	Material	Catalogue No
16mm	25mm	Aluminum	LATBG 160

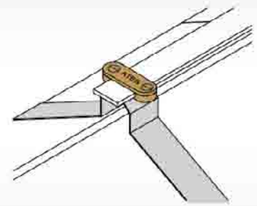


A4. Ridge Saddle

Rod Length	Maximum Conductor Width	Material	Catalogue No
16mm	31mm	Copper	RSGB 160

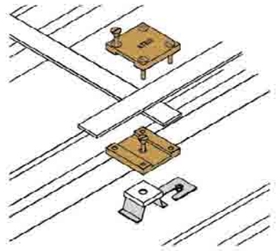


B. ROOFING CONDUCTOR FIXING



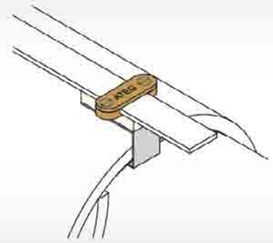
B1. Curve Type Roofing Support Hook

Width	Length	Thickness	Material	Catalogue No
25mm	420mm	1mm	Stainless Steel	RCTG 302



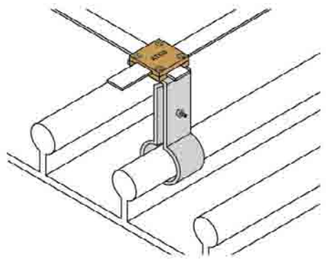
B2. Clip On Roof Support

Width	Length	Thickness	Material	Catalogue No
25mm	80mm	1mm	Stainless Steel	RCLG 252



B3. Slip-In Roof Support

Width	Length	Thickness	Material	Catalogue No
25mm	160mm	1mm	Stainless Steel	RSIG 252



B4. Clamp On Roof Support

Width	Length	Thickness	Material	Catalogue No
30mm	70mm	1mm	Stainless Steel	RCOG 302

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Down Conductor System

In order to reduce damage inflicted by lightning current flowing through the lightning protection conductor path, with essence of at least two down conductor interconnecting air terminal system and grounding system in a single structure. Greater number of down conductors possesses better ability to split lightning current. The down conductor routes should be as direct as possible to reduce unnecessary loops from the air terminal to earth terminal. A conductor holder or clip is fixed in between the distance of one meter away. Equipotential bonding to all down conductor parts of the structure to further enhance protection. The minimum spacing of the down conductors is given in the Table: Distance Between Down Conductor. A test clamp is placed in each of the down conductor at ground level for convenience of periodic disconnection testing.

LPL	Typical Distance
I	5m or 10m
II	10m
III	15m
IV	20m

Table: Distance Between Down Conductor

Separation Distance

- Isolation of the external Lightning Protection System

During lightning strike event, surge current flow through external lightning protection system generates high potential difference which leads to the flashover between lightning protection system with metallic in structure. Metal installation within the structure and the external lightning protection system is essentially requires a separation distance to minimize probability of flashovers in between. The least distance of metal installation must be equal or greater than the separation distance. The formula in determining the separation distance in meter, s:

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

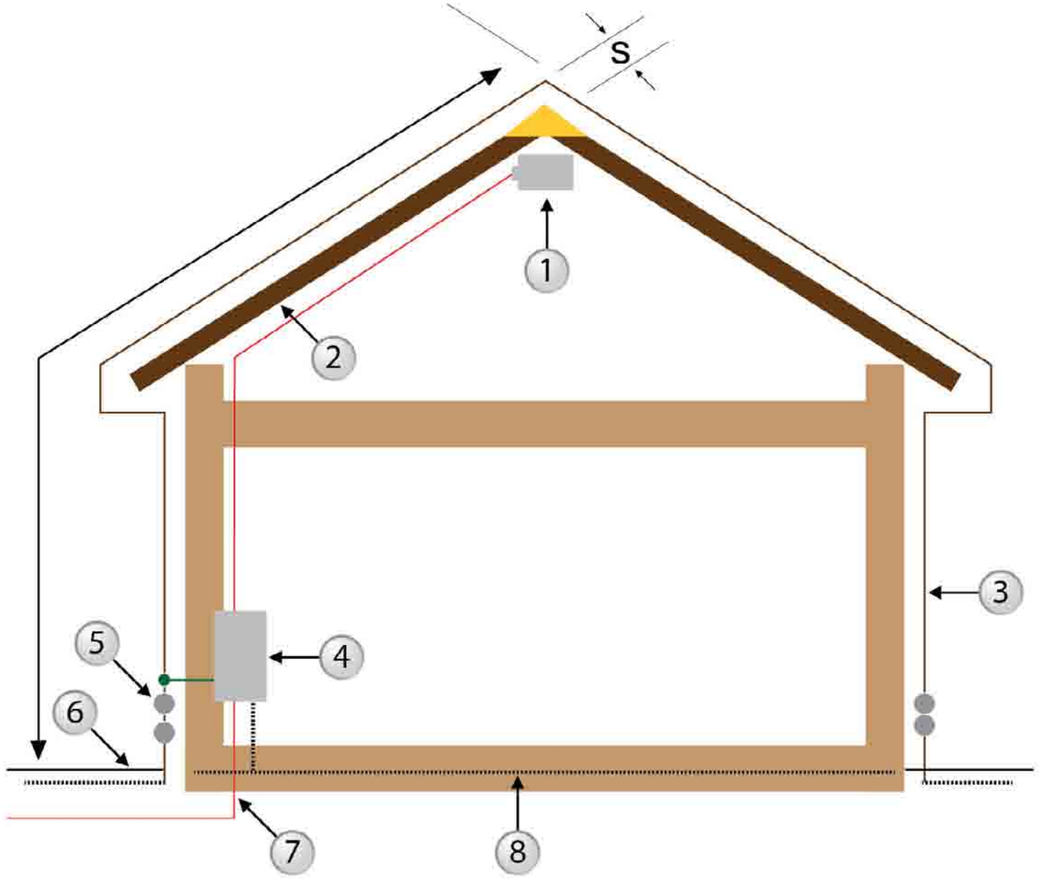
l, is the length in meter of the external lightning protection system from the point of equipotential to the next point of structural metal required separation distance. k_i is the factor of class of lightning protection system used, k_c is the coefficient of current splitting, k_m is the factor of material used in the gap.

LPL	K_i
I	0.08
II	0.06
III & IV	0.04

Number of down conductor, n	K_c
1	1
2	1-0.5
4 & more	1-1/n

Material in the distance	K_m*
Air	1
Concrete or brick	0.5

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



1) Electric Equipment
2) Electric Conductors
3) LPS Conductors
4) Main Electric Power Distribution Box with SPD
5) Test Joint
6) Earth-termination System
7) Electric Power Cable
8) Foundation Earth Electrode
s) Separation Distance According to 6.3
l) Length for the Evaluation of the separation Distance s

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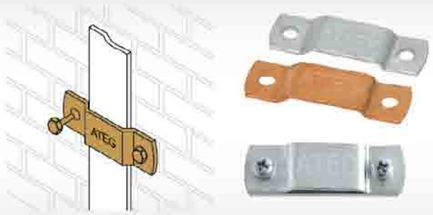
C. CONDUCTOR FIXINGS

C1. DC Tape Clip

Conductor Size	Material	Catalogue No.
25 x 3 mm	Copper	DCG 253
25 x 6 mm	Copper	DCG 256
50 x 3 mm	Copper	DCG 503
50 x 6 mm	Copper	DCG 506
25 x 3 mm	Aluminum	ADCG 253

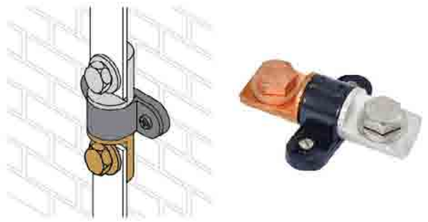
C2. Tape Clip

Conductor Size	Material	Base	Catalogue No.
25 x 3 mm	Copper	No	TCG 253
25 x 3 mm	Copper	Yes	TCBG 253
25 x 3 mm	Aluminum	No	ALTG 253
25 x 3 mm	Aluminum	Yes	ALBG 253



C3. Bi – Metallic Connector

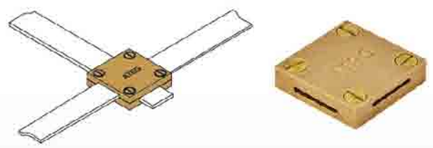
Conductor Size	Material	Catalogue No.
25 x 3 mm	Copper & Aluminium	BMG 253

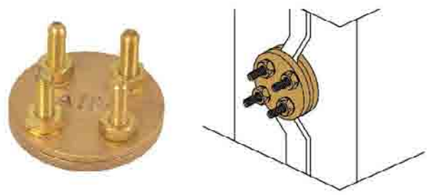


D. CLAMPS FIXINGS.

D1. Square Tape Clamp

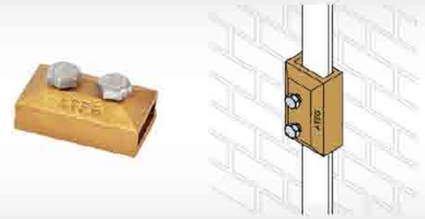
Conductor Size	Material	Catalogue No.
25 x 3 mm	Copper	STG 253
25 x 6 mm	Copper	STG 256
50 x 3 mm	Copper	STG 503
25 x 3 mm	Aluminum	ASTG 253





D2. Plate Type Test Clamp

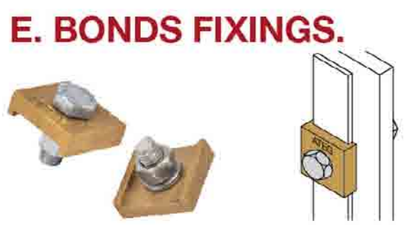
Conductor Size	Catalogue No.
26 x 12 mm	PTCG 2612



D3. Oblong Test Clamp

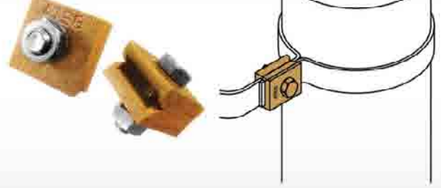
Conductor Size	Catalogue No.
26 x 8 mm	OTBG 2608

E. BONDS FIXINGS.



E1. B Bond

Max Tape Width	Bolt Size	Material	Product Code
26 mm	M 10	Copper	BBCG 2610



E2. RWP Bond

Max Tape Width	Bolt Size	Material	Product Code
26 mm	M 10	Copper	RWPG 2610

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Earth Termination System

The earth termination system functions as dispersion of the lightning current harmlessly into ground. In design phase, the LPS designer should select suitable types of earth electrodes and locate at safe distance from entrances and exits of a structure and away from the external conductive parts in the soil. Meanwhile, the LPS designer should take consideration of the protection against step voltages in the vicinity of the earth termination if installed in areas accessible to the public. The lightning current discharges are high in frequency; while the measurements of the earth termination system are measured at low frequency. However, the earthing resistance is recommended to be as low as 10Ω or lower in standard. The standard recommends a single integrated earth termination system with equipotential bonding all the metallic part in the ground. There are two basic types of earth electrode arrangement provided:-

Type A arrangement

The radial earth electrode to be connected to the terminal of each down-conductor in type A arrangement, this may consist of horizontal or vertical earth electrode by appropriate design. Electrode should be installed at a depth of 0.5m depth from ground level. It is often necessary to employ deep-driven vertical earth electrode to meet the required resistivity.

Type B arrangement

This is preferred for meshed air-terminal systems and for lightning protection system with several down-conductors. This type of arrangement comprises either a ring earth electrode external to the structure in contact with the soil for at least 80% of its total length or a foundation earth electrode. For bare solid rock condition, only B arrangement with foundation earth electrodes is recommended.

Foundation Earth Electrodes

A foundation earth electrodes comprises meshed conductors are installed in the foundation of structure below ground. Foundation earth electrodes are covered by concrete by at least 50mm in depth, so they are reasonably protected against corrosion. Electrochemical corrosion due to galvanic currents flow issue must take into account, the earth electrode in soil should be copper or stainless steel to connect to reinforcing steel embedded in concrete to minimise the electrochemical corrosion effects.

Besides this, an earth chamber is placed to the depth driven electrode for ease of earth resistance measurement. The interconnection between the conductor metal joints must be capable to withstand the high currents with no deterioration; exothermic welding joining method is recommended as it is a molecular bonded with maintenance free and better conductivity than mechanical clamp.

The embedded earth electrode conductivity varies from the dimension of electrode and grounding design. The LPS designer should choose the most appropriate design. The length or the number of electrode shall increase if the permissible resistance cannot be achieved. For structures with sensitive electronic systems or high risk of combustible material, a foundation earth electrode such as meshed electrodes is essential.

At the embedded depth of earth electrode, the designer should take consideration of the effects of corrosion, soil drying and freezing and thereby stabilize the efficiency of the lightning protection system.

Equipotential

In event of lightning strikes, external lightning protection system at a great different voltage potential to the internal metallic installation or structure. In order to avoid the occurrence of dangerous sparking within the structure, equipotential bonding joining all of metallic part to provide no different in voltage potential and thus sparking or flash over is nullified.

	Bonding bar to earth termination system	Metal installation to bonding bar
Material	Cross-section mm2	Cross-section mm2
Copper	14	5
Aluminum	22	8
Steel	50	16

Table: Equipotential bonding minimum dimension reference table

The minimum size of the cross section area of the bonding conductors as interconnection between bonding bars to earth termination system and internal metal installations to the bonding bar is refer to Table: Equipotential bonding minimum dimension reference table.

A lightning surge protective device (SPD) is used where direct connection bonding conductors is not feasible, normally connection to electrical supply and electronic equipment.

Single structure facilities usually come with separated grounding system for mains power, communications and lightning protection system. MS IEC-62305-3 recommended the overall grounding to be equipotential bonded to form integrated grounding in order to prevent earth loops and voltage transient underneath ground.

Hazardous Effect due to Touch and Step Voltages

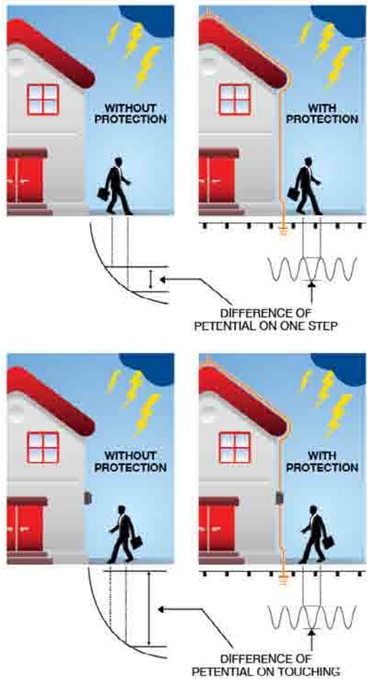
Hazard still present even though lightning protection system has well designed according to standard, especially in the vicinity of the down conductors. Such hazard is inflicted by current flows through a person in contact with the gradient of voltage potential. Human body is a good conductor and thus lead a current flow through from the point of potential difference. Mainly are step voltage and touch voltage has to be aware.

Touch voltage is a person's hand in touch with conductor with his feet on the earthing ground, the difference of potential on touching leads current pass through the person; whilst step current is the voltage difference between a person taking a step on the ground surface of earthing area, the current can be bridged through the body from one foot to another.

The following measures advocated by MS IEC standard can reduce the risk of touch and step voltages:

- Down conductors are set in the area where the probability of persons approach or duration of presence and distance to the conductor is low. Or physical restriction and/or warning noticed to minimize the accessibility in down conductor area.
- Exposed down conductor in vicinity is sheathed in insulating material of at least 3 mm cross-linked polyethylene which able to withstand 100kV 1.2/50μs.
- Increase the number of down conductor and meshed network to interconnect all conductors to reduce the partitioning current to minimum.
- The resistivity of the surface layer of the soil in the distance of 3 meter around the down conductor must not less than 3kΩm, or a layer of asphalt with a thickness of 5cm.

Figure: Step Voltage and Touch Voltage



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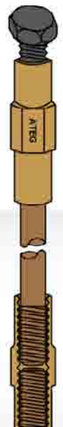
F. EARTHING ACCESSORIES

F1. Copper Bond Rod

Nominal Diameter	Dimensions Length	Thread Diameter 'X'	Shank Diameter 'Y'	Product Code
5/8"	1200 mm	5/8"	14.2 mm	CRG 1612
5/8"	1500 mm	5/8"	14.2 mm	CRG 1615
5/8"	1800 mm	5/8"	14.2 mm	CRG 1618
3/4"	1200 mm	3/4"	17.2 mm	CRG 2012
3/4"	1500 mm	3/4"	17.2 mm	CRG 2015



F2. Coupling

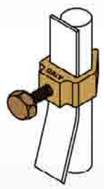
Nominal Rod Diameter	Product Code
5/8"	CPG 062
3/4"	CPG 075

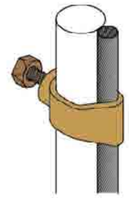
F3. Driving Stud

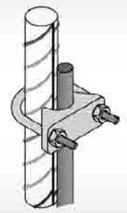
Nominal Rod Diameter	Product Code
5/8"	DSG 062
3/4"	DSG 075

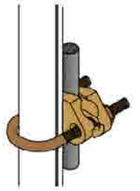
F4. Earth Rod To Tape Clamp (Type A)

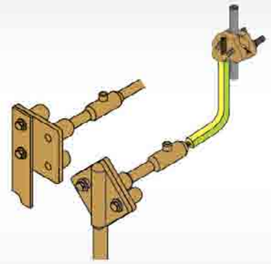
Nominal Rod Diameter	Conductor Size	Product Code
5/8"	25 mm	ERG 1625
5/8"	50 mm	ERG 1650
3/4"	25 mm	ERG 2025
3/4"	50 mm	ERG 2050











F5. Earth Rod To Cable Clamp (Type G)

Nominal Rod Diameter	Conductor Size	Product Code
5/8" (16 mm)	16-70 mm²	ERCG 1670

F6. Galvanised Steel Wire To Rebar Clamp

Conductor Size	Conductor Size	Product Code
50-70mm	Y16 – Y22	ERRG 1622

F7. GUV Type Rod To Cable Clamp

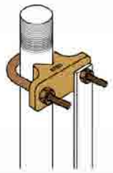
Nominal Rod Diameter	Conductor Size	Product Code
5/8"	16-95 mm²	GUVG 1637
3/4"	16-70 mm²	GUVG 2037

F8. Earth Bonding Points

No. Of Holes	Conductor At Font Plate	Cover Plate	Product Code
4	70 mm²	No	EPG 004
2	70 mm²	Yes	EPG 002

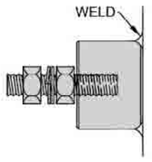
F9. E Type U Bolt Rod Clamp

Nominal Rod Diameter	Hole Centres	Tape Width	Product Code
5/8"	25 mm	-	UBG 1637
5/8"	50 mm	25 mm	UBG 1637a
3/4"	25 mm	-	UBG 2037



F10. Earth Boss

Length	Diameter	Thread Size	Product Code
30 mm	40 mm	M10	EBG 4030



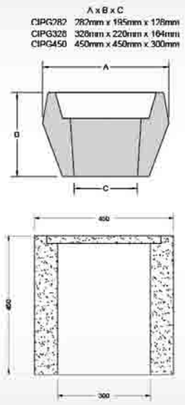
F11. Concrete Earth Chamber

Overall Dimensions	Product Code
328 x 328 x 220(H) mm	CIPG 328
282 x 282 x 195(H) mm	CIPG 282

Concrete Manhole

Overall Dimensions	Product Code
450 x 450 x 400 (H) mm	CIPG 450

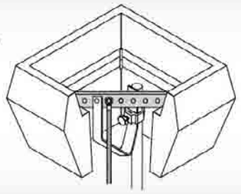
* Other sizes also available upon request.



F12. Earth Bars

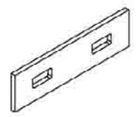
Nominal Rod Diameter	Size (mm)	No Of Disc Links	Product Code
6	40(H) x 6(T) x 350(L)	-	EBBG 006
8	40(H) x 6(T) x 350(L)	-	EBBG 008
10	40(H) x 6(T) x 460(L)	-	EBBG 010
6	40(H) x 6(T) x 420(L)	1	EBBG 061
6	40(H) x 6(T) x 460(L)	2	EBBG 062
8	40(H) x 6(T) x 420(L)	1	EBBG 081
8	40(H) x 6(T) x 460(L)	2	EBBG 082
6	40(H) x 6(T) x 350(L)	-	EBTG 006
8	40(H) x 6(T) x 350(L)	-	EBTG 008

* Other sizes also available upon request.



F13. Chamber Earth Bar

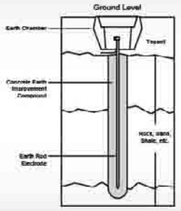
Overall Dimensions	Product Code
25 x 6 x 320mm (5 Hole)	EBG 005



F14. Copper Link

Dimensions	Bolt Size	Product Code
25 x 3mm	M10	CUL253

* length upon request



F15. Earthing Improvement Compound

Weight (Kg)	Product Code
20	EMIX-20
25	EMIX-25

Lightning & Earthing Protection ATEG

G. CONDUCTORS

G1. Bare Copper Tape

Conductor Size	Product Code
19 x 1.5 mm	BCG 191
25 x 3 mm	BCG 253
25 x 6 mm	BCG 256
50 x 3 mm	BCG 503
50 x 6 mm	BCG 506

* Other sizes also available upon request.

G2. Tinted Bare Copper Tape

Conductor Size	Product Code
19 x 1.5 mm	TBCG 191
25 x 3 mm	TBCG 253
25 x 6 mm	TBCG 256
50 x 3 mm	TBCG 503
50 x 6 mm	TBCG 506

* Other sizes also available upon request.

G3. Bare Aluminum Tape

Conductor Size	Product Code
25 x 3 mm	BAG 253

H. SUPPORTING ACCESSORIES

H1. C Tap Connector

Cable Size	Product Code
35 mm² : 4-25 mm²	Copper
50-70 mm² : 16-35 mm²	Copper
50-70 mm² : 35-70 mm²	Copper
95 mm² : 95 mm²	Copper

* Other sizes also available upon request.

H2. Cable Lug

Cable Size
50mm² x M8
50mm² x M10
50mm² x M12
70mm² x M8
70mm² x M10
70mm² x M12
95mm² x M8
95mm² x M10
95mm² x M12

* Other sizes also available upon request.

H3. Grounding Cable (Green/Yellow or Green)

Cable Size
1C x 25 mm²
1C x 50 mm²
1C x 70 mm²
1C x 120 mm²

* Other sizes also available upon request.

H4. Bare Galvanized Steel Wire

Nominal Strand Diameter (mm)	Stranding No/mm²
6.00	7/2.00
7.95	7/2.65
9.75	7/3.25
12.00	7/4.00

* Other sizes also available upon request.

H5. Flexible Bare Copper Braid

Conductor Size
6 x 1 mm
12 x 1.5 mm
16 x 2 mm
25 x 2 mm
35 x 3 mm

* Other sizes also available upon request.