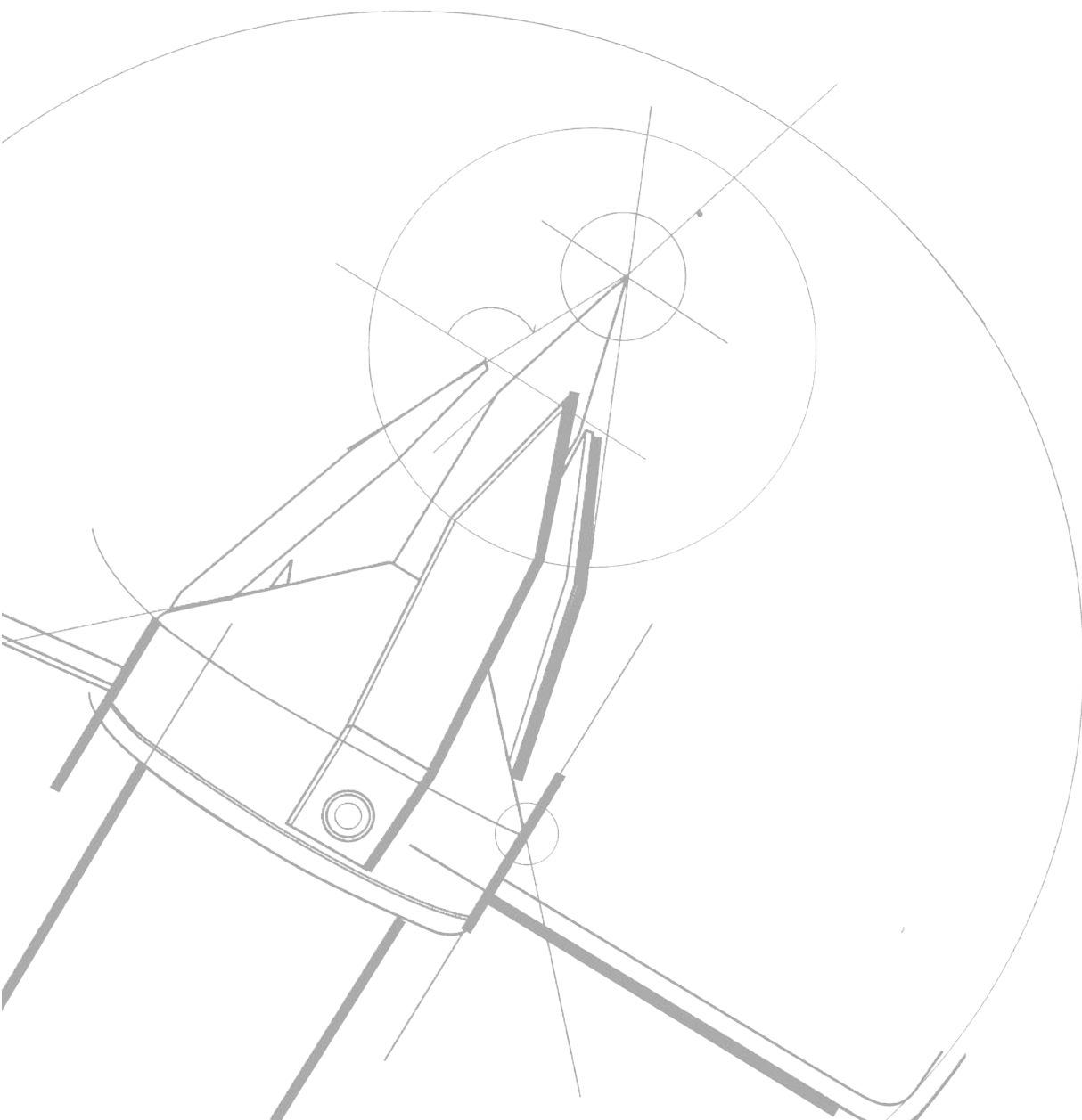


***E.F.* CARRIER SYSTEM OF LIGHTNING PROTECTION**



* E.F.* Lightning Terminal

The worldwide patented *E.F.* Lightning Terminal is the top part of the *E.F.* Carrier System of Lightning Protection. The *E.F.* Lightning Terminal is manufactured with non-radioactive and non-corrosive materials which are resistant to high voltage.

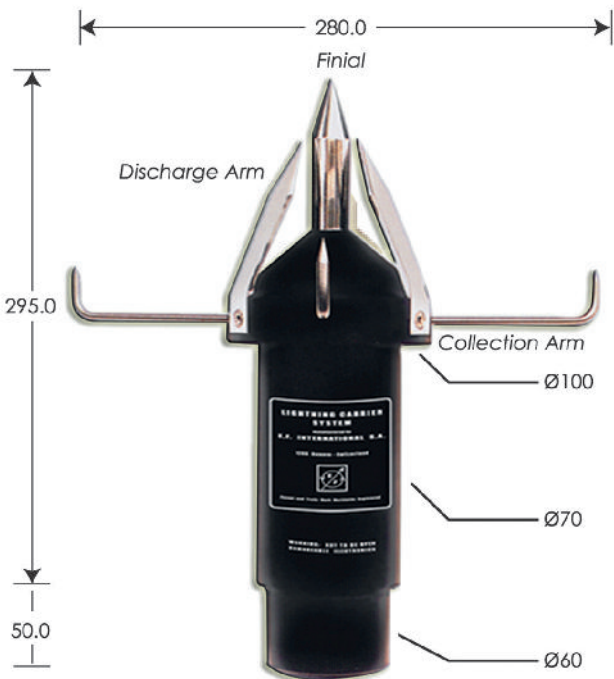
DESIGN

The *E.F.* Lightning Terminal is an Early Streamer Emission air terminal. The protective radii are calculated based on Collection Volume theory with additional parameters to offset interference of ground protrusions.

The protective radii increase with the magnitude of lightning discharge because the effectiveness of the *E.F.* Lightning Terminal is dependent on local electric field strength, which is a function of leader charge and lightning intensity. For general application, conservative protective radii for *E.F.* Lightning Terminal are shown in the chapter "Lightning Protection for Buildings and Structures".

OPERATING PRINCIPLE

When a cumulonimbus is formed, a strong electric field is induced directly below it. A downward leader will develop at the bottom of the cumulonimbus towards the ground. By means of sharp point discharge phenomena, some ionized air molecules transfer their charges to the Collection Arms of the *E.F.* Lightning Terminal and charge up the Discharge Arms as well. However the gap between the Discharge Arm and the Finial are so narrow that the electric field strength of the gap becomes much higher than that of the space. Such high field intensity causes the air in the gap to break down and arcing takes place between the Discharge Arm and the Finial. Arcing virtually produces more ionized particles which then accelerate along the field direction to a high speed and cause more air molecules to be ionized. Thus forming an up streamer. As the cumulonimbus gets closer, the *E.F.* Lightning Terminal powered by strong atmospheric electric field emits 6×10^{12} electrons/sec/ μA of current. This unique feature gives the *E.F.* Lightning Terminal a time advantage in the competition of upward streamer generation and intercepts the lightning discharge. Hence the chances of the occurrence of side strike are greatly reduced.



Specification:

Model	: *E.F.* Lightning Terminal
Ionization power	: 6×10^{12} electrons/sec/ μA
Type	: Early Streamer Emission
Dimension	: 280mm x 295mm
Weight	: 2kg

Lightning Protection for Buildings and Structures

The protection level determines how effectively a structure is shielded from lightning. Higher levels offer stronger protection but cover a smaller area. Select an appropriate level of lightning protection.

- Level 1

 - Best for high-risk sites: Power plants, military bases, hazardous material storage.
 - Highest efficiency, smallest coverage area
- Level 2

 - Ideal for hospitals, data centers, and critical infrastructure.
 - Strong protection with a slightly larger coverage area.
- Level 3

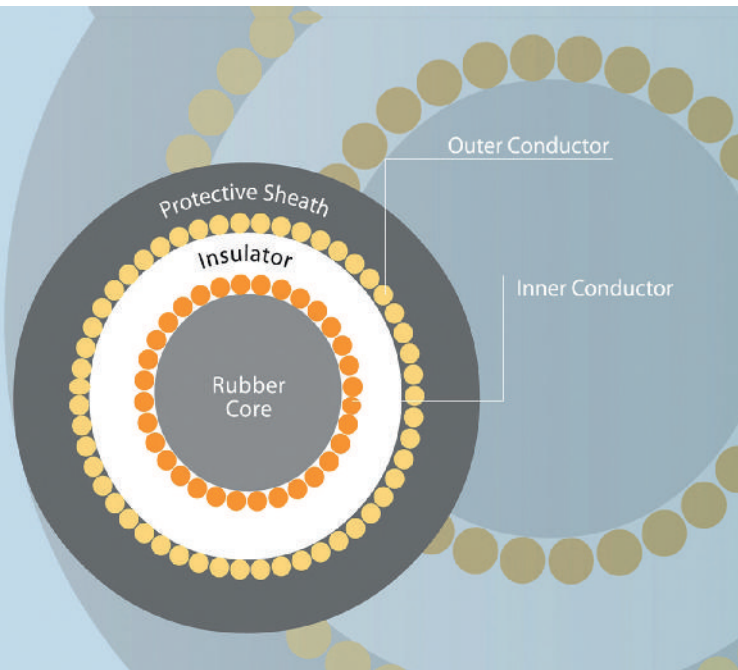
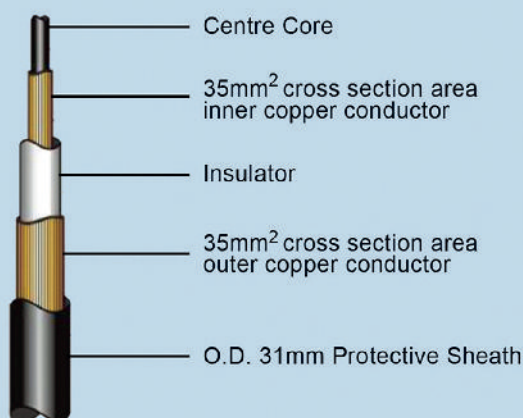
 - Suitable for commercial buildings, factories, and public spaces.
 - Balanced protection with wider coverage.
- Level 4

 - For low-risk areas like homes, small warehouses, and rural sites.
 - Largest coverage area but lower efficiency.
- Choosing the right protection level ensures safety and minimizes damage risks.

2. On a plan view of the structure to be protected, select the location for erecting the *E.F.* Lightning Terminal supporting mast.

3. Using an appropriate radius, draw a circle centred on the *E.F.* Lightning Terminal location.

4. If the circle completely encloses the plan view of the structure, the structure is protected to the nominated risk level. Any part of the structure lying outside the circle is unprotected. The remedy is to reposition the *E.F.* Lightning Terminal location or to use two or more *E.F.* Lightning Terminals.
- ## The Protective Radii of the *E.F.* Lightning Terminal for Building and Structures
- | <i>Δh</i>
<i>Terminal Height</i>
<i>(m)</i> | Protective Radii(meters) | | | |
|--|---|---|--|--|
| | <i>Level I</i>
<i>Maximum Protection</i>
<i>Strike risk reduced by 97%</i> | <i>Level II</i>
<i>High Protection</i>
<i>Strike risk reduced by 95%</i> | <i>Level III</i>
<i>Moderate Protection</i>
<i>Strike risk reduced by 90%</i> | <i>Level IV</i>
<i>Basic Protection</i>
<i>Strike risk reduced by 80%</i> |
| 2 | 32 | 34 | 40 | 44 |
| 3 | 48 | 52 | 59 | 65 |
| 4 | 64 | 69 | 78 | 87 |
| 5 | 79 | 86 | 97 | 107 |
| 10 | 79 | 88 | 99 | 109 |
| 20 | 80 | 89 | 102 | 113 |
| 60 | 80 | 90 | 105 | 120 |
- Based on NFC 17-102 Sept. 2011 with advance Triggering time (ΔT) of 60μs
- This table shows conservative protective radii for *E.F.* Lightning Terminal for general application. For detailed calculation, please refer to our local *E.F.* Authorized Licensee.
- Notes:
1. The *E.F.* Lightning Terminal must be at least 2 meters higher than the highest point of the building, which includes antenna, rail fence, communication equipments, machine room, water tower, air conditioners and other objects that protrude from the roof of the building.
 2. The *E.F.* Lightning Terminal must be installed on top of the FRP Mast.
 3. The table of protective radii is statistically calculated based on empirical data. The field situation is also affected by the proximity of other-pointed project.



*** E.F.* Lightning Carrier**

The worldwide patented *E.F.* Lightning Carrier is the central portion of the self-enclosed *E.F.* Carrier System of Lightning Protection which enables it to have a separate earth.

DESIGN

The function of the *E.F.* Lightning Carrier is to safely conduct the high voltage lightning energy from the *E.F.* Lightning Terminal to earth without side-flashing and electrification of structure. The E.F. Lightning Carrier consists of a rubber filler, stranded inner copper conductor, insulator, stranded outer copper conductor and protective sheath. All concentrically arranged and are insulated from one another and from the structure. This design together with special termination method enables it to reduce self inductance and side flashing. Transient Absorption Technology (TAT) has also been incorporated into *E.F.* Lightning Carrier to further suppress the destructive lightning surge effect by temporarily storing the bulk lightning discharge energy as it travels.

Specification:

Model : *E.F.* LS+HF Lightning Carrier
 Type : Double Concentric Cu 2 x 35mm²
 Inner Conductor Conduction Area : 35mm²
 Outer Conductor Conduction Area : 35mm²
 Insulation Voltage between inner and outer conductor : 250kV @ 1/50μs based on IEC 230 Standard
 Insulation Voltage of sheath : 80kV @ 1/50μs based on IEC 230 Standard
 Insulating & Sheath Material : Flame-retardant, low smoke emission, halogen free, UV rated, non-conductive
 Bending Radius : 0.6 meters
 Size : Outer diameter 31mm
 Weight : 1.5kg/meter

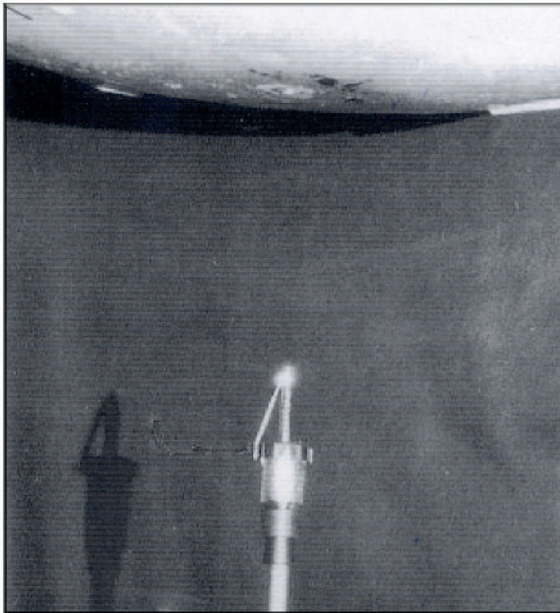
FEATURES

As the possibility of the occurrence of side-flashing is very low, the *E.F.* Lightning Carrier can be installed around building corners and even inside the building. The *E.F.* LS+HF Lightning Carrier is manufactured with Low Smoke, Halogen Free and flame-retardant materials according to IEC 60332 Standard. Its insulation layers has passed the IEC 608112-1 Standard for hot set test. The protective sheath is also non-conductive and UV rated making it very safe and suitable for indoor and outdoor installation.

High Voltage Laboratory Testing

E.F. LIGHTNING TERMINAL

The *E.F.* Lightning Terminal was tested in a high voltage laboratory. When the electric potential of the overhead dome was raised to 80kV, arcing took place between the Discharge Arms and Finial at the rate of 300 times/second. This arcing phenomena give the *E.F.* Lightning Terminal a time advantage over other pointed objects in emitting an upward streamer to intercept a downward leader.



When the overhead electric potential reaches 1500kV, lightning discharge occurs. This test demonstrates that the *E.F.* Lightning Terminal is able to withstand strikes from a large lightning storm.

E.F. LIGHTNING CARRIER

The *E.F.* Lightning Carrier was tested at the Istituto di Elettrotecnica e di Elettronica in Italy. Under identical testing conditions, the traditional copper down-conductor generated arcing between itself and the metal ladder.



The *E.F.* Lightning Carrier safely conducted the lightning energy without causing side flashing to the metal ladder.

E.F. Lightning Counter

The *E.F.* Lightning Counter keeps track of the number of lightning strikes that the "E.F." Carrier System of Lightning Protection intercepts. The *E.F.* Lightning Counter is small, lightweight and waterproof. It can operate normally in extreme climatic conditions. It does not need a battery source to operate nor does it need to be regularly maintained.

Each time a lightning pulse travels down the *E.F.* Lightning Carrier, the local electromagnetic field rises sharply and causes the "E.F." Lightning Counter to advance by one count. The *E.F.* Lightning Counter can record up to 9,999 lightning strikes. The counter is triggered whenever it encounters 1.5 KA impulses current in 1.5 microsecond duration. The counter cannot be reset.

The *E.F.* Lightning Counter provides data, which can be used to analyze the performance of the entire lightning protection system.

For high-rise residential and commercial buildings, transmission and microwave towers, and other civil structures, the *E.F.* Lightning Counter should be installed at the bottom of the lightning protection system. The *E.F.* Lightning Carrier fits through the internal aperture of the *E.F.* Lightning Counter. The *E.F.* Lightning Counter should be placed such that the lightning counter is clearly visible.



Specification:

Model	: *E.F.* Lightning Counter
Type	: Self-powered, Donut type, IP67
Display	: Analogue, 4 Digits
Internal Aperture	: 32mm
Sensitivity	: 1.5kA impulse current at 1.5 microsecond
Dimensions	: 105 x 69 x 70mm
Weight	: 0.8kg

Earthing

A well-prepared earthing system is vital to the function of the lightning protection system.

The earth has a certain level of resistance. The voltage of the earth rises sharply when it receives 500A to 150,000A transients from the downconductor. The electric potential falls exponentially away from the point of lightning reception. This phenomenon is called the step potential, which can cause injury to pedestrians and properties. Normally, the lightning protection earthing system should be situated away from pedestrian sidewalks.

The measured resistance of the earthing at the point of lightning reception should be below 5 ohms. Under no circumstances should the earth resistance exceed 10 ohms.

***E.F.* INTERNATIONAL S.A. AUTHORIZED LICENSEE
FOR PHILIPPINES**



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