

# \*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.

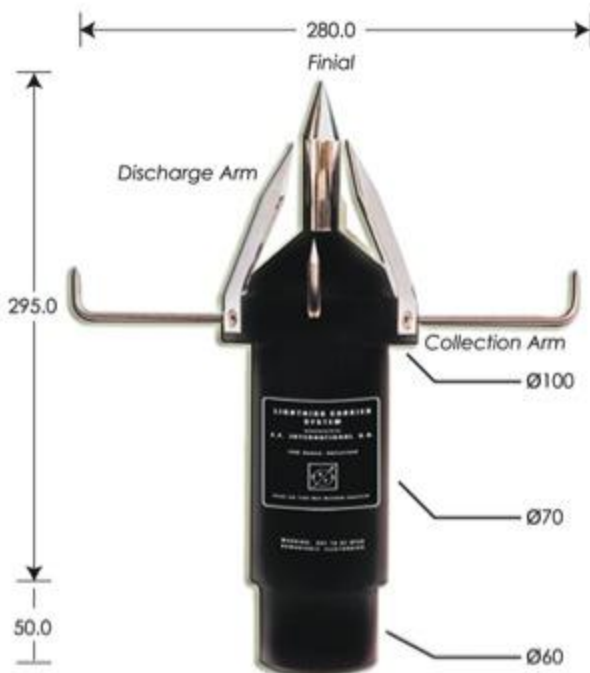
## DESIGN

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".

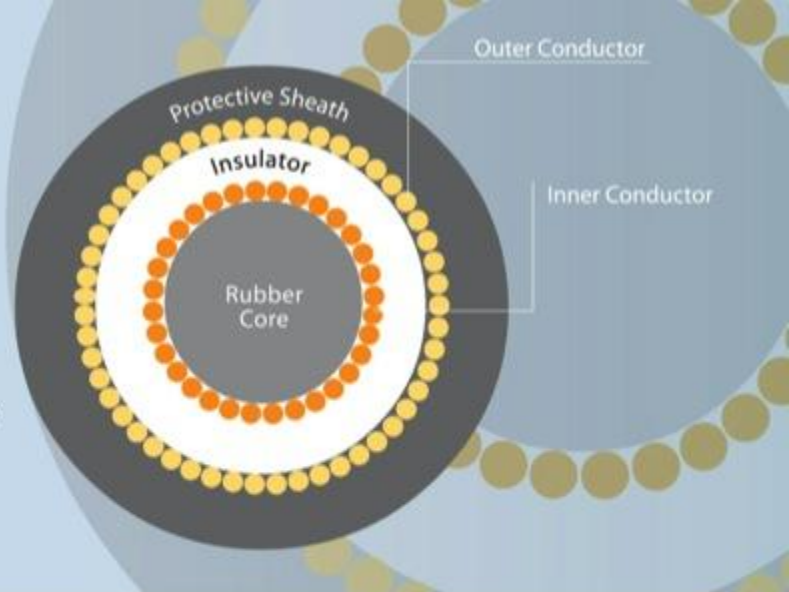
## OPERATING PRINCIPLE

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  $6 \times 10^{12}$  electrons/sec/ $\mu\text{A}$  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	: $6 \times 10^{12}$ electrons/sec/ $\mu\text{A}$
Type	: Early Streamer Emission
Dimension	: 280mm x 295mm
Weight	: 2kg



## \* 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 35mm<sup>2</sup>  
 Inner Conductor Conduction Area : 35mm<sup>2</sup>  
 Outer Conductor Conduction Area : 35mm<sup>2</sup>  
 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

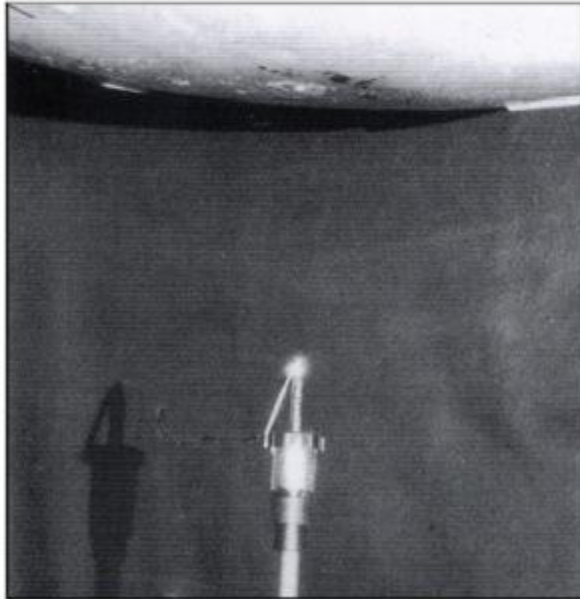
### FEATURES

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

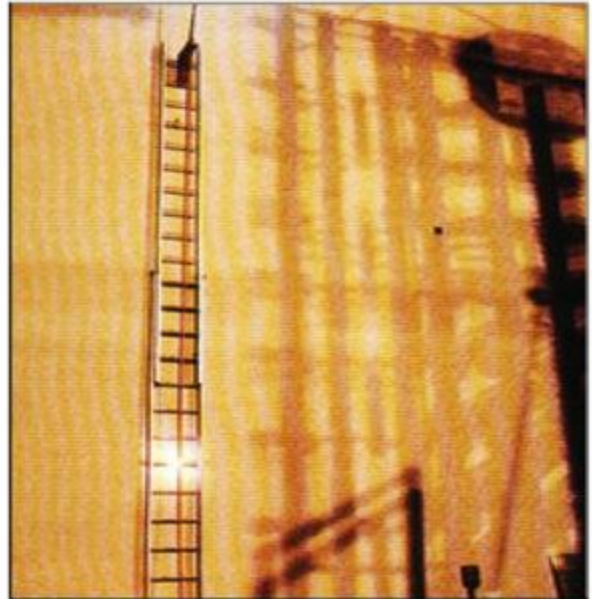
The \*E.F.\* Lightning Terminal was tested in a high voltage laboratory. When the electric potential of the overhead dome was raised to 80kV, arcing took place between the Discharge Arms and Finial at the rate of 300 times/second. This arcing phenomena give the \*E.F.\* Lightning Terminal a time advantage 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.

# Lightning Protection for Buildings and Structures

1. Select an appropriate level of lightning protection.

(a) Level I

Best level of protection which is suitable for structures containing vital communications and computers, or for hospitals, key airport facilities, and military installations.

(b) Level II

High level of protection which is suitable for most factories and plants.

(c) Level III

Standard level of protection which is suitable for most commercial buildings and other structures.

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.

5. The \*E.F.\* Lightning Terminal should be at least 10 metres higher than the ground level at all times and at least 3 meters above any protruded object.

## The Protective Radii of the \*E.F.\* Lightning Terminal for Building and Structures

Terminal Height from ground (meters)	Protective Radii (meters)		
	Level I (Best) - 98% Protection, 3kA	Level II (High) - 95% Protection, 10kA	Level III (Standard) - 80% Protection, 25kA
10	33	43	100
20	41	53	110
30	48	65	120
40	53	70	130
50	54	75	140
60	55	77	150
70	54	79	160
80	53	80	170
90	52	82	180
100	49	81	190
110	48	81	200
120	47	80	200
130	46	79	200
140	45	78	200
150	44	77	200

**Above 150**

*Enquire Local \*E.F.\* Authorized Licensee*

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 3 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 object.

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is registered worldwide.

\*E.F.\* INTERNATIONAL S.A. reserves the right to modify the specifications in this catalogue without prior notice.

Lightning storm is a natural phenomenon. From the past to the present, lightning has occurred everywhere on earth, causing enormous damages. Due to scientific research in lightning, lightning protection technology has made significant advancements in the past decades. However, many questions remain to be answered.

It is impossible to provide a guaranteed lightning protection system. Around the world, all the codes of lightning protection reflect this reality. \*E.F.\* International S.A. has spent the past few decades in developing the components of the \*E.F.\* Carrier System of Lightning Protection providing a reliable and cost effective lightning protection for building and structures.

If material defect is found and proven in components of the \*E.F.\* Carrier System of Lightning Protection within one year from the date of purchase, the manufacturer will replace the defective components without charge. The manufacturer or the supplier are not responsible for the cost of shipping, insurance, storage, handling or testing, or any related expenses.

After installation of the \*E.F.\* Carrier System of Lightning Protection or any portion thereof, the manufacturer or the supplier are not responsible for any damages due to unusual large lightning discharge to any portion of the \*E.F.\* Carrier System of Lightning Protection or the structures intended to be protected.

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



**Leah Construction and Development Corporation**

Rm 207 Jovan Condominium 600 Shaw Blvd., Mandaluyong City, Philippines  
Tel. Nos.: 8533-1656, 8533-3431, 8570-9891 Fax No.: (632)8533-0328  
Email Address: [info@leahconstruction.com](mailto:info@leahconstruction.com) ; [sales@leahconstruction.com](mailto:sales@leahconstruction.com)  
[www.leahconstruction.com](http://www.leahconstruction.com)

**\*E.F.\* INTERNATIONAL S.A.**  
6,Rte du Signal, CH - 1350 Orbe - Switzerland

[www.ef-international.ch](http://www.ef-international.ch)

**Tel: +41 24 441 00 30**

**Fax: +41 24 441 00 31**