FOREND®

LIGHTNING PROTECTION & EARTHING SYSTEMS

BROCHURE


#THINKLIGHTNINGPROTECTION









ABOUT US

Founded in 2003 in Istanbul, Turkey, Forend has combined almost 60 years of sectoral experience.

Until today, the company has exported to over 50 countries, which makes us committed to helping our customers achieve their goals.

Our business is to protect lives and properties from hazard of lightning, offering high quality and efficient solutions.

We work with professionalism, transparency, creativity and full dedication to our customers.

Seriousness Quickness Accuracy Efficiency Satisfaction

The lightning phenomenon

The cumulonimbus thunder cloud is the main source of lightning. Its upper part is made up of positively charged ice crystals, and its lower part of negatively charged water droplets.

This separation is due to atmospheric turbulence in which a very strong electric field is created. Once the disruptive limit has been achieved, this electric field causes one or more electrical discharges, either between clouds or zones of clouds (lightning flash), or between the cloud and the ground (lightning strike).

In fine weather, the electric field at ground level is around -100 V/m: when a storm belt arrives (negative storm), it usually gets reversed and can become as high as 10 to 25 kv/m. The potential difference between the cloud and the ground is then several tens of mega volts.

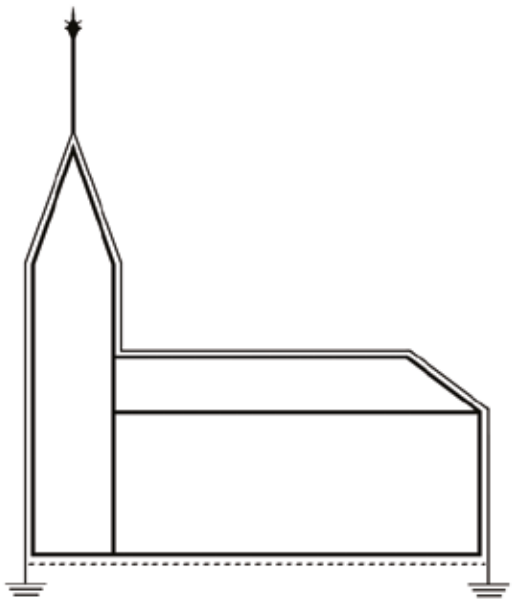
Lightning protection:

The principle consists of creating one or more preferred impact points for a lightning strike using low impedance conductor elements. These then conduct and dissipate the lightning current into the ground.

This coherent system enables the lightning to be captured and dissipated whilst providing protection to the structure.

There are four types of lightning conductor for protecting structures against lightning:

- Lightning rod
- Mesh method
- Catenary wire lightning conductor
- Early streamer emission type rod



E.S.E. lightning conductors

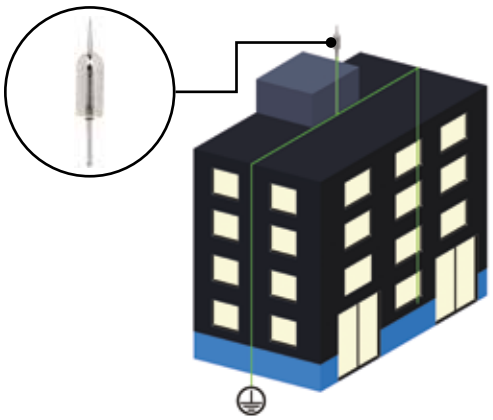
Forend Early Streamer Emission (ESE) lightning conductors use active ionization system to capture atmospheric electrical discharges and conduct them to the ground.
This system is characterized by its efficiency ΔT which is proved in the evaluation test (according to NFC 17-102:2011, Annexe C) and the area protected is determined according to its efficiency.
The maximum value for ΔT, whatever are the test results, is 60 µs.

The lightning rods are placed on the highest spot of the construction to be protected and are connected with the ground along the shortest route. The protection area they provide varies depending on the location of the installation and height of such location compared to the surrounding constructions.
The electro-geometrical model method based on warning distance enables the safe calculation of protection level.

The installation of an ESE lightning conductor should follow standards for Early Streamer Emission Lightning Protection Systems such as **NFC 17-102:2011** and **UNE 21186:2011**.

Advantages of Forend ESE lightning conductors:

- Cost-effective
- Provides an active protection to the whole building
- Protects surrounding areas
- Requires less conductors and earthing accessories
- Easy to install and maintain, requiring less workforce

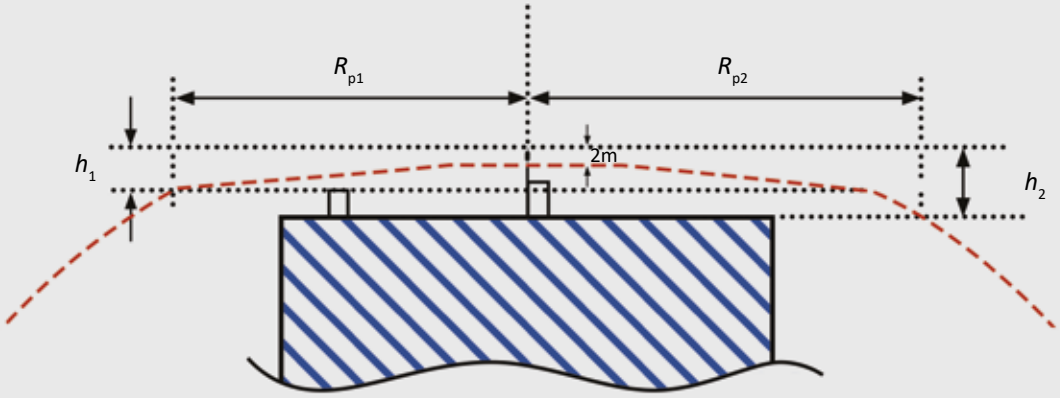


Example of Forend ESE lightning rod and earthing system as shown in the picture above.

Illustration of area protected by Forend ESE lightning rod.

Protected area:

The protected area is delineated by a surface of revolution defined by the protection radius corresponding to the different considered heights h and which axis is the same as the one of the air terminal (see figure below).

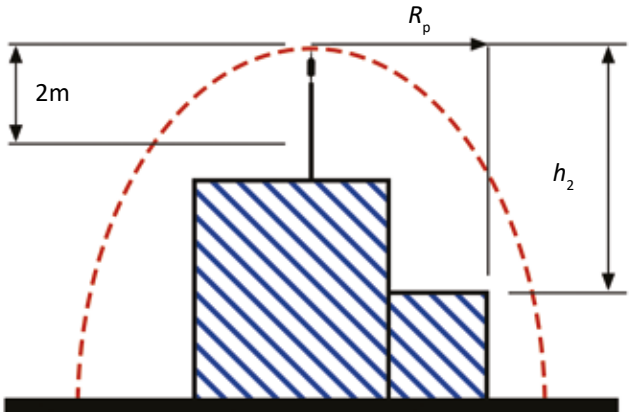


h_n is the height of the ESE rod tip over the horizontal plane through the furthest point of the object to be protected

R_{pn} is the ESE rod protection radius to the considered height h_n.

Protection radius:

The protection radius of an ESE lightning rod is related to its height (*h*) relative to the surface to be protected, to its efficiency and to the selected protection level:



R_p Protection radius at a given height *h*

h Height of the ESE rod tip over the horizontal plane through the furthest point of the object to be protected

r (m) 20m for protection level I
30m for protection level II
45m for protection level III
60m for protection level IV

Δ (m) $\Delta = \Delta T \times 10^6$
Field experience has proved that Δ is equal to the efficiency obtained during the ESE lightning conductor evaluation tests

Protection Radius

$$R_p(h) = \sqrt{2rh - h^2 + \Delta(2r + \Delta)} \quad \text{for} \quad h \geq 5\ \text{m}$$

and

$$R_p = h \times R_p(5)/5 \quad \text{for} \quad 2\ \text{m} \leq h \leq 5\ \text{m}$$

Calculation is based on NFC 17.102:2011 and UNE 21.186: 2011 standards. Please view the norms for complete technical details.

- For buildings higher than 60m, the requirements in NFC 17-102:2011; Section 5.2.3.4 should be applied.

Choosing the model

For the installation of each lightning protection system, a risk analysis must be made in order to determine the minimum required lightning protection level. After specifying the protection level, you can choose the appropriate model of Forend ESE lightning conductor using the following protection radius (R_p) table.

Additionally, the level of protection can be specified by entering the required details in the Lightning Risk Assessment program, available in Forend website:

- https://forend.com.tr/risk-assesment-program/giris.php

Protecion Radius Table

	FOREND PETEX-S ΔT: 30µs				FOREND EU-M / PETEX-M ΔT: 45µs				FOREND EU / PETEX-L ΔT: 60µs			
h (m)	LEVEL I	LEVEL II	LEVEL III	LEVEL IV	LEVEL I	LEVEL II	LEVEL III	LEVEL IV	LEVEL I	LEVEL II	LEVEL III	LEVEL IV
2	19	22	25	28	25	28	32	36	31	35	39	43
3	29	33	38	43	38	43	49	53	47	52	58	64
4	38	44	51	57	51	57	64	72	63	69	78	85
5	48	55	63	71	63	71	81	90	79	86	97	107
6	**48**	**55**	**64**	**72**	**63**	**71**	**81**	**90**	**79**	**87**	**97**	**107**
8	49	56	65	73	64	72	82	91	79	87	98	108
10	49	57	66	75	64	72	83	92	79	88	99	109
20	50	59	71	81	65	74	86	97	80	89	102	113
30	50	60	73	85	65	75	89	101	80	90	104	116
60	50	60	75	90	65	75	90	105	80	90	105	120

INDEX

ΔT: Early streamer emission of an ESE lightning rod, determined by laboratory tests.
LEVEL: Level of protection required by a particular building, depending on the operations carried out and various other factors.
h (m): Distance between the lightning rod and the roof level, optimal: 6 meters.

- The first column of the table *R*p (m) indicates the elevation of the ESE lightning rod above the highest point of the structure within the protection zone.
- To obtain elevation, a mast, pole, tower, or part of the structure (such as chimney, antenna, etc.) must be used.
- The minimum elevation should be 2 meters. The optimal level of elevation is 5 or 6 meters, because below that level the radius of protection decreases rapidly and above that level, the increase is very limited.
- It is recommended to install the ESE lightning rod at one point to cover the maximum area. To specify the installation point, the top plane of the building roof can be used.

Laboratory tests issued:

1. Early Streamer Emission tests (reference NFC 17.102-2011 Anex C; UNE 21186-2011 Anex C).
2. Environmental conditioning test (reference NFC 17.102-2011 Anex C.3.1.1, C.3.1.2; UNE 21186-2011 Anex C; IEC 600682-52/1996; SR EN ISO 6988/1997):
   2.1. Cyclic salt mist conditioning
   2.2. Humid sulphurous atmosphere treatment

3. Mechanical test (reference NFC 17.102-2011, Anex C.3.1.1).
4. Lightning impulse current withstand test: 100 kA of 10/350µs waveform (reference UNE-EN 62561-1 Paragraph 6.3; UNE 21.186 December 2011 Paragraph C.3.4; NFC 17.102:2011).

Forend ESE lightning conductors

Characteristics:

Internal ion generator
Body made of stainless steel AISI 316L
IP65 enclosure
Expected lifespan of 25 years
Working temperature: -40°C to + 120°C
Standard coupling: M18 Thread

Standards:

- NFC 17.102-2011
- UNE 21.186-2011
- FD C17-108

Certifications:

- ISO 9001:2015
- NFC 17.102-2011
- UNE 21.186-2011

PETEX-S
ΔT: 30µs

Code: F10120
Net weight: 2,20 Kg
Height: 47cm

PETEX-M
ΔT: 45µs

Code: F10117
Net weight: 2,25 Kg
Height: 47cm

PETEX-L
ΔT: 60µs

Code: F10115
Net weight: 2,30 Kg
Height: 47cm

PETEX-L GOLDEN
ΔT: 60µs

Code: F10115-G
Net weight: 2,30 Kg
Height: 47cm

GOLDEN

FOREND EU-M
ΔT: 45µs

Code: F10105
Net weight: 4,40 Kg
Height: 58cm

FOREND EU
ΔT: 60µs

Code: F10110
Net weight: 4,50 Kg
Height: 58cm

FOREND EU GOLDEN
ΔT: 60µs

Code: F10110-G
Net weight: 4,50 Kg
Height: 58cm

GOLDEN

Forend lightning strike counter

A lightning strike counter is used to register the number of strikes, it should be placed at the most direct down-conductor. Forend counters work with an inductive effect of the lightning strike current, containing a high frequency transformer.
The events can be easily monitored on a display.

Characteristics:

Detects currents from 1 to 100 kA
Does not require an external power source
Dimensions: 11.3 x 6.4 x 5.5 cm
Operating temperature (˚C): -40˚ to + 60˚
Easy to install
Tested and certified

Standards:

- NFC 17.102-2011
- UNE 21.186-2011
- IEC 62561-6

Certifications:

- ISO 9001:2015
- NFC 17.102-2011
- UNE 21.186-2011

Technical specifications:

FDLSC-10 Digital Strike Counter

6-digit digital counter
IP68 certified
Does not require an external power source
3 functions: test; reboot and turn on the screen (requires external 9V battery)
Resettable
Contains internal battery
Weight: 0.46 Kg

FLSC-10 Analog Strike Counter

6-digit mechanical counter
IP68 certified
Does not require an external power source
Not resettable
Weight: 0.62 Kg

Forend Tester

Forend Tester lets you check the status of your ESE lightning conductor.
With this device, you are able to check if there is a short circuit or a fault in the ion generator immediately by simply connecting the cable to the ESE conductor and pressing the button.

GREEN LED indicates full functionality
RED LED indicates the the device is not properly connected
YELLOW LED indicates there is a short circuit

- In order to avoid incorrect information, please do not touch the ESE lightning conductor during the test

Remote Solar Tester:

Test your lightning conductor remotely. The testing device stores energy to operate for 24 hours by a daily exposition of 5-7 hours of sun light.

Characteristics:

The device is turned on by pressing the power switch to the “I” position on the main unit.

- In order to avoid incorrect information, please do not touch the ESE lightning conductor during the test
- While holding the TEST button on the controller, the system performs a test. The LED next to the power switch flashes to indicate that there is communication between the controller and the test unit during the test
- The RF range in the open area is 100 m
- The system can be supplied from both solar and grid. It is recommended to charge with adapter for 5-6 hours before installation
- The energy inside the unit is 4.8 V, 800 mA (4 pcs. 1.2 V, 800 mA, AAA type recharge accumulator)
- When not in use, it must be charged once in 6 months
- The charging adapter DC 12 V is 1000 mA

Items and accessories:

Remote controller included

Mounting clamp

ESE & RF main unite cable, 1 m

Charging adapter

Down conductors

Each ESE lightning conductor should be connected to the earth termination system by at least one down conductor. Two or more down conductors are required when:

- The horizontal projection of the conductor is larger than its vertical projection
- External lightning protection is installed on any structures higher than 28 m

The down conductors should be installed on two different walls in such a way that its path is as direct as possible.
The routing of the down conductor should be as straight as possible, following the shortest path, avoiding sharp bends or upward sections.
The bend radius should not be less than 20 cm and bends formed edgewise should preferably be used (NFC 17-102:2011; 5.3.3).

Standard conductors

Available in different dimensions, shapes and materials such as copper, aluminium and steel, Forend conductors meet IEC 62305-3 standard.

Copper Clad Aluminium (CCA) Conductors

This conductor has the benefits of low weight and corrosion resistance. It's tested according to IEC 62305-3 and IEC 62561-2 standards.

Test joint:

Each down-conductor should be provided with a test joint in order to disconnect the earth termination system for enabling measurements.

Test clamps are usually installed at the bottom of the down conductors. When down conductors are installed on metal walls or when ESE terminals are not provided with specific down conductors, test joints will be inserted between each earthing system and the metallic item to which the earth termination system is connected. The test joints are then installed inside inspection pits (complying with IEC 62561-5) showing the earth termination symbol.

LICON

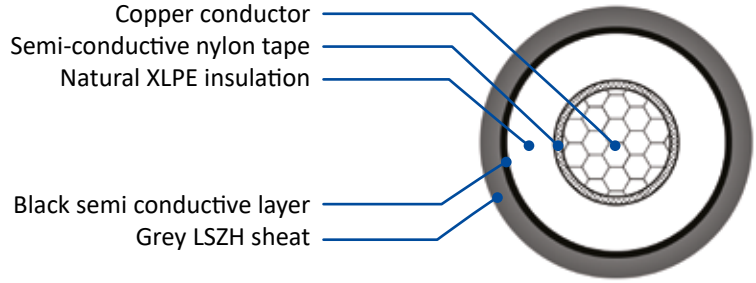
LICON Special Down Conductors are high conductivity insulated cables that provide low impedance, safety and resistance for use above ground level.
They are tested certified according to UNE-EN 62561-8, UNE 21.186 and TS EN 60332-1-2 standards.

Technical specifications:

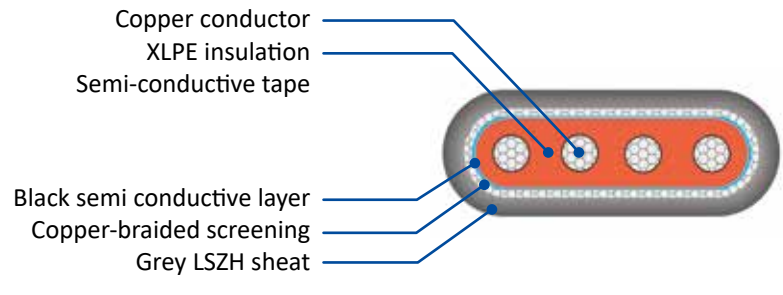
	FLF-35	FLR-50
Colour	Grey	
Dimension	35 mm²	50 mm²
Diameter / Approx. size	27 x 15 mm	23,50 mm
Weight (Kg/m)	0,570	0,815

FLR-50	Equivalent separation distance, air ≤ 900 mm
	Equivalent separation distance, solid ≤ 1500 mm

FLR-50



FLF-35

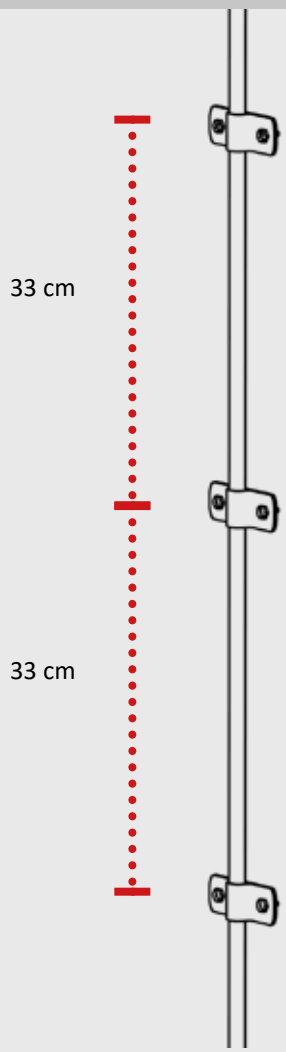


Accessories:

Licon cables are compatible with a variety of connection holders and terminals.

Wall clamps

According to NFC 17.102, the fixings of the down conductors should be attached on the basis of three fixings per meter (every 33 cm).



Copper

Galvanized steel

Fixing clamps, holders and much more:

Available in brass, galvanized steel, copper or other materials, Forend has a wide range of models suitable for different surfaces and types of conductors. We offer complete solutions in lightning protection accessories.

Forend earthing systems

Forend has complete solutions for earthing systems with high quality materials. There is a wide range of products and accessories for different needs.

Items and accessories:

Clamps

Earth pits

Earth rods

TAM / TAM PLUS
Earth resistivity material

250 µm Copperbonded earth rods:

Using copperbond earth rods is the most economical method of achieving a low earth resistance. 99,95% pure copper is applied electrolytically to a high tensile strength, low carbon steel core and forms a metallurgical bond between the steel core and the copper. This combination provides lasting resistance to corrosion and makes the deep driving easy. The threads are formed by a cold rolling process which makes the threads stronger than cutthreads. The molecularly bonded copper covers along the full length of the threads. The copper thickness is 0,254 mm (254 µm). The rods are extensible by a coupler made of bronze or brass.

LED warning lights

LED warning lights are used to provide safety to aviation, giving visibility to tall structures such as high-rise buildings, towers, windmills, chimneys, etc.

Characteristics:

Complies with ICAO & FAA regulation
Smash proof, heat resistant glass cover
Electrostatic powder coated aluminium frame
LED heat sink
IP 65 protection class
Anti-static protection coated circuit
Inbuilt photo sensor
Failure signal relay contacts
LED light source ensures long lifetime and low power consumption
Available in flashing mode or continuous mode

Standards:

- ICAO Annex 14, Eighth Edition, July 2018
- ICAO low intensity, type B
- FAA AC No: 150/5345-43J, 2019
- FAA type L810

Technical specifications:

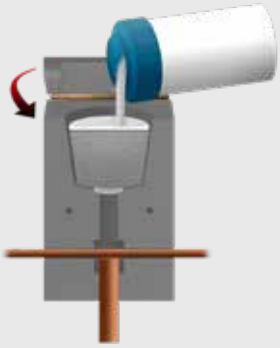
FLB 10 S

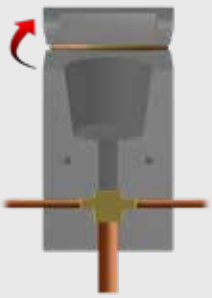
The single LED Warning Light module has an electrostatic powder coated aluminium body and contains 6 units of power LED placed in the device.

FLB 10 D

The dual system has a backup lamp that is activated when the main one fails.
The spare LED light is activated after 10 seconds.

	FLB 10 S	FLB 10 D
	LIGHT OUTPUT	
Effective Intensity	>32 Candela	>32 Candela
Vertical Divergence	10 Degree	
Horizontal	360 Degree	
LED colour	RED	
LED lifespan	100.000 Hours	
	POWER SUPPLY (OPTIONAL)	
Input voltage	220VAC ; 110VAC ; 48VDC ; 24VDC ; 12VDC	
Power Consumption	6-8W	16-18W
	MECHANICAL STRUCTURE	
Lens	Glass, UV Stabilized	
Protection standard	IP65	
Weight (Packing)	1,45 Kg	5,50 Kg
Mounting Size	Non-Threaded 5/4'' (43mm) bottom hub	
Temperature Range	-40C° ~ +85C°	
Relative Humidity	100% with condensation	
Wind speed	Up to 150mph (240kph)	





Forweld exothermic welding

Exothermic welding is fusion reaction that allows to join conductors with a permanent molecular bonding

The benefits of exothermic welding are:

- Resistance to corrosion and oxidation
- High electrical conductivity
- Low resistivity path to earth

Standards:

- IEC 62561-1

Forweld products:

Graphite moulds

Forweld exothermic powder

Remote ignitor

Handle clamps

Flint gun

Cleaning accessories

Technical Additive Material

TAM and TAM PLUS are produced to reduce the earth resistance, improve the grounding effectiveness and impedance measurements with its non-corrosive, high conductive carbon based structure. They contain natural cements and becomes highly conductive, long-lasting concrete when it is dried.

PRODUCT SELECTION CHART

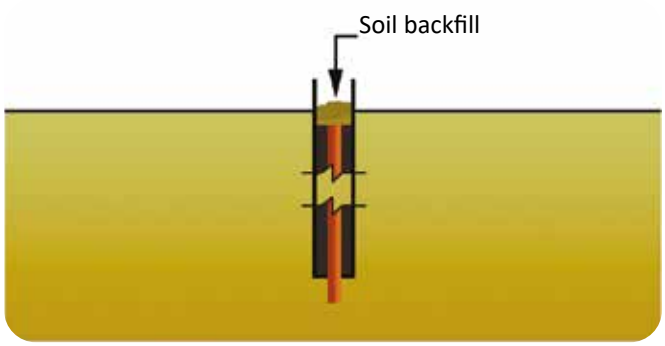
	Material	Weight
TAM	Bentonite	10 Kg
TAM PLUS	Carbon based	11 Kg

Standards:

- IEC 62561-7

Advantages:

- It helps reducing earth resistance up to 1 ohm depending on soil conditions of grounding.
- Resistivity is < 1,5ohm/cm as powder, ≤ 15 ohm/cm as cured.
- Performs in all soil conditions even during dry spells.
- Does not require periodic irrigating, restoration, maintenance or replacement.
- Is not dissolved, decomposed.
- Easy to use and fully cured in 15 days



Diameter of hole	DEPTH OF HOLE						
	183 cm/6 ft	213 cm/7ft	244 cm/8 ft	274 cm/9 ft	518 cm/17 ft	579 cm/19 ft	610 cm/20 ft
7,6 cm (3 in)	2	2	2	2	4	4	4
10 cm (4 in)	2	3	3	3	6	7	7
12,7 cm (5 in)	3	4	4	5	9	10	10
15,2 cm (6 in)	5	5	6	7	13	14	15
17,8 cm (7 in)	6	7	8	9	17	19	20
17,8 cm (7 in)	8	9	11	12	22	25	26
22,8 cm (9 in)	10	12	13	15	28	31	32
25,4 cm (10 in)	12	14	16	18	34	38	40

Forend surge arresters

FBC-25M 3P+FBC-100G1.5+NPE

Surge suppressors are used to protect electronic components in field equipment from being damaged.

IEC divides SPDs into 3 types: Type 1 (class I), Type 2 (or class II) and Type 3 (or class III).
The classification depends on the intended use area and the corresponding magnitude of the transient suppression capability.
Please check Forend full catalog for more technical details.

Standards:

Complies with EN 61643-11/IEC 61643-11 standards

Forend electrical insulating mats

Characteristics:

Made of thermoplastic elastomer (TPE) which is resistant to various oils and solvents.

Area of usage

Substations, power stations, test laboratories, in front of machinery & electrical boards and all electrically risky areas.

Tests

Electrical resistance tests are carried out according to TS 5119, EN 60243-1 and TS EN 61111 standards.

PRODUCT SELECTION CHART

PATTERN	kV	THICKNESS
Honeycomb	1 kV 10 kV	2 mm
Honeycomb	20 kV	3 mm
Honeycomb	36 Kv	5 mm
Coin	50 kV	4 mm

Forend products are manufactured under strict quality control and are tested and certified in renowned laboratories.
We have a warranty policy for our products in order to promote customer satisfaction. Please contact us for our full list of certificates and laboratory tests.

Project references:


Uruguay

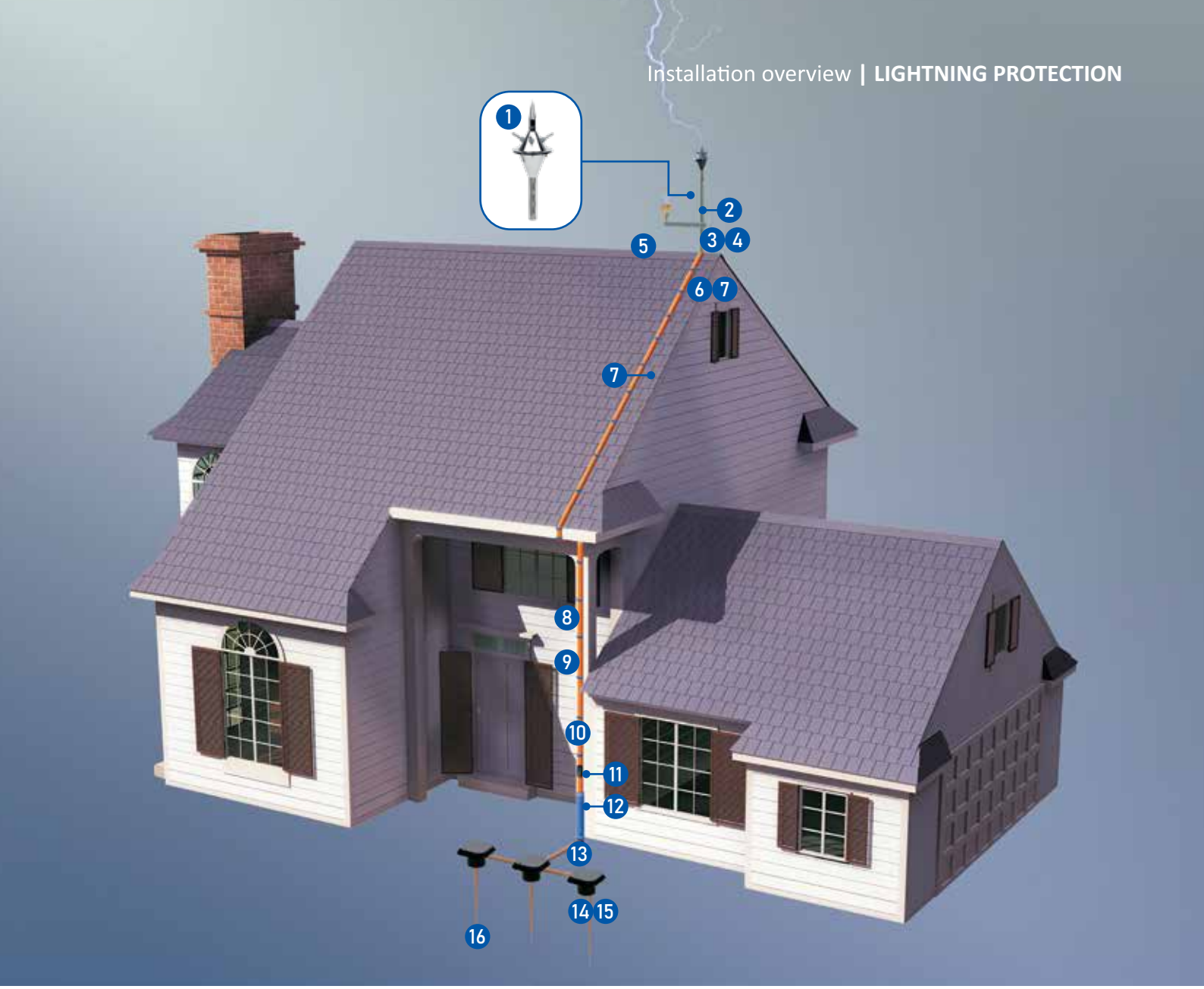

USA


Mexico

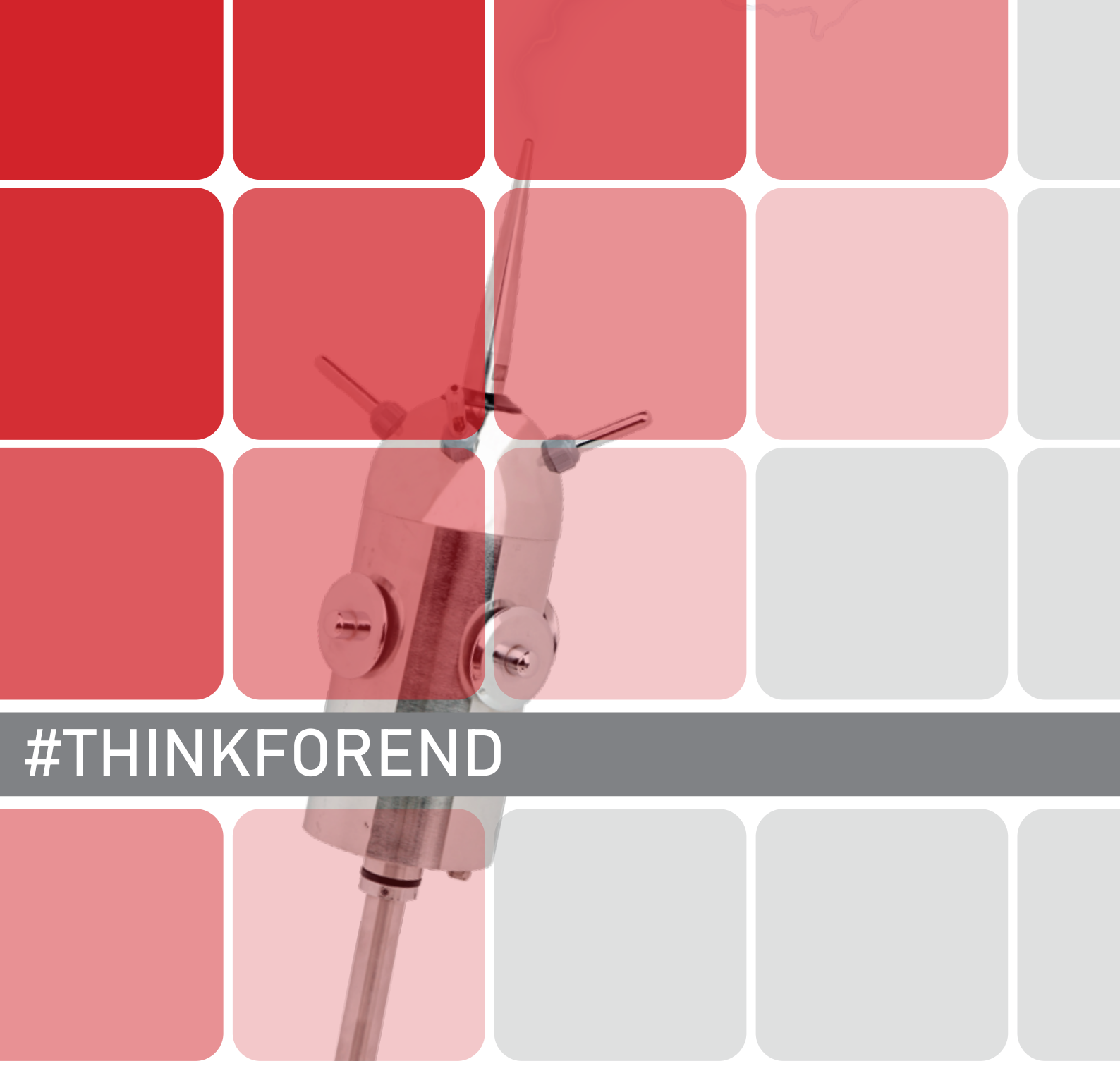

Senegal


Tunisia


Bulgaria



1. Forend ESE lightning cundoctor
2. Mast adaptor
3. Galvanized mast
4. Conductor fixing mast clamp
5. LED warning light
6. Mast base
7. Isolated PVC holder for roof
8. Isolated PVC holder for wall
9. Conductor fixing wall clamp
10. Down conductor
11. Forend lightning strike counter
12. Test joint/clamp
13. Protection pipe
14. Earth rod clamp
15. Inspection pit
16. Earth rod



#THINKFOREND

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