LIGHTNING PROTECTION

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Contents:

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- Discharge phenomenon
- Lightning arrester system
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- Surge voltage protection system

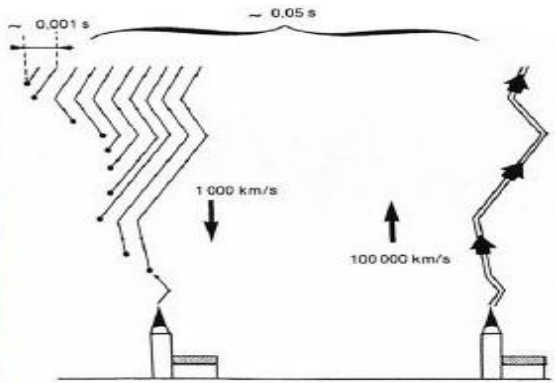
Lightning

"Lightning is an important event which no one can avoid from its danger, but also it can be observed easily. It possesses millions of volts, capable of shattering insulating obstacles, but flows through small diameter conductors. Since it is curious during its descent to explore neigbouring metal structures and conductors, where, rightly or wrongly, it hopes to find an easier outlet, it is wiser to pyave its way with appropriate interconnections than to bar its way with obstacles that are ineffective".

"Lightning explores the surronding space supplies to a sort of sensitivity that it procuses from the electrical field that it propagates, and this same field means of breaking through inslator by applying its electrical force. The essential idea behind every protection system is to avoid situations in which these forces can be brought into play".

Lightning is produced by cumulo-nimbus storm clouds. The upper part of the cloud is made up of positively charged ice crystals, while the base contains negatively charged water droplets. This separation of charges is caused by atmospheric turbulence. A highly intense electrical field is created between the charges, and when this field reaches its breakdown point, an electrical discharge occurs, either as lightning flashes between clouds or cloud zones or as lightning between the cloud and the ground.

During fine weather, the electrical field on the ground is around 100V/m. As the storm (negative storm) approaches, this becomes a positive value possibly reaching 10 to 25 kV/m. The potantial difference between the cloud and the ground is then of some several tens of megavolts (see diagram).



Discharge phenomenon

From the cloud base, generally charged, a low-luminosity discharge known as the tracer, is released. This makes its way to the ground in leaps of some tens of meters. It is in fact series of discharges each taking the route ionized by the previous discharge with an interruption of 40 to 100 us (average speed of progression of 0.5 to 1 m/us).

As it approaches the ground, the highly charged tip of the tracer causes the electric field vertically below it to increase considerably, possibly eaching values of 400 to 500 kV/m. When the ionization threshold of the atmospheric air is reached (30kV/cm) at points highly prone to lightning (tree tops, chimneys, lightning conductors, etc.) jets are released. Where the field values are the highest, this jet with the best triggering characteristics, or which travels most quickly, will reach the leader. This forms an ionized channel providing the perfect electrical junction between the storm cloud and the ground.

There is a return stroke from ground to the cloud by which it neutralizes its own charge. Within the space of 0.2 to 1 seconds, several lightning strokes may be exchanged in continuous progression and at a very high propagation speed.

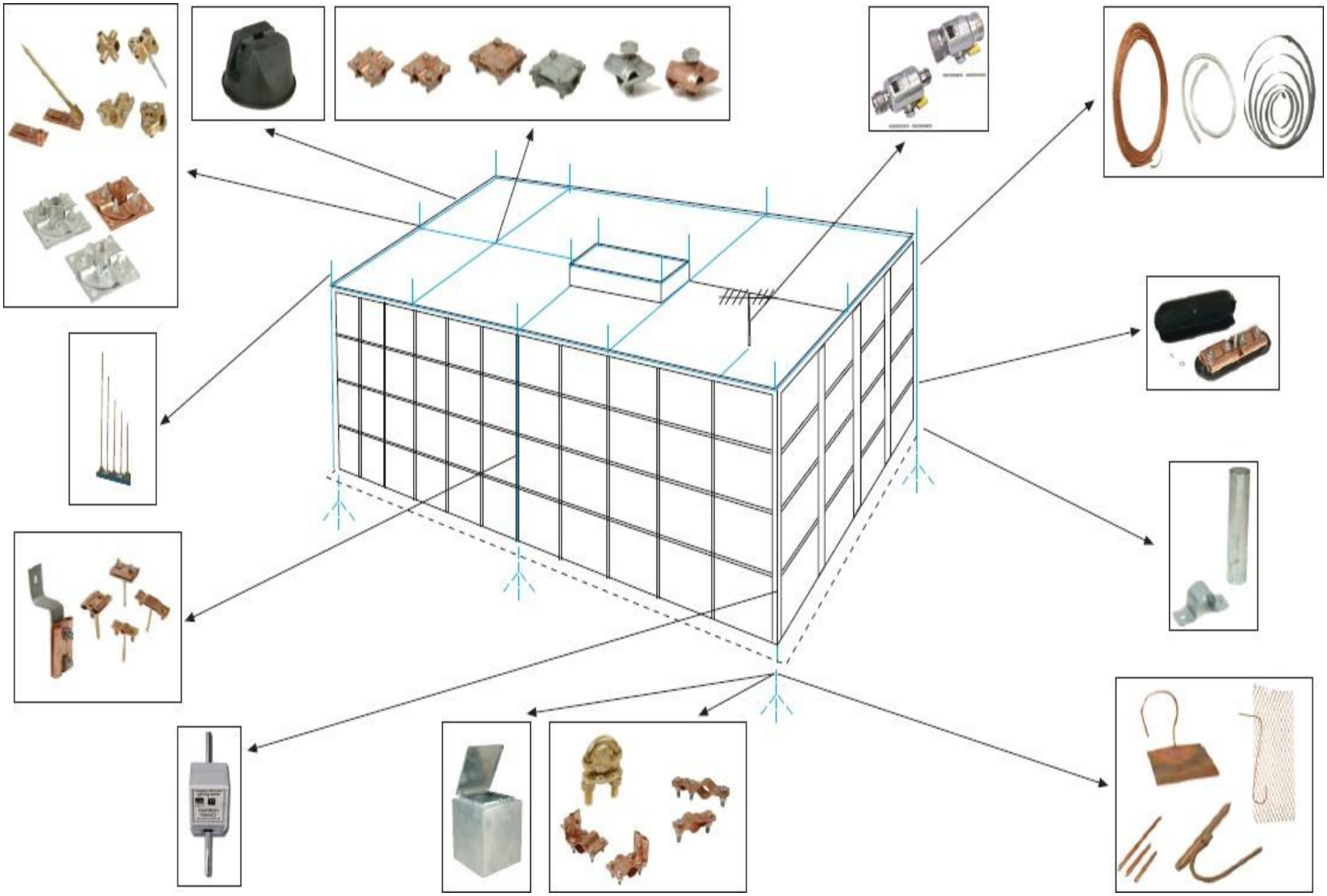
Lightning Protection Systems

Until recent years, people thought that the installation of a lightning conductor provided a building sufficient protection against lightning. This partial protection is now supplemented by a set of compatible devices designed to : - protect against direct strikes - avoid dangerous differences of potential between neighbour points of the building, - prevent induction effects on switch gear and electrical conductors and suppress overvoltages conveyed on network lines.

There are two types of lightning protection system:

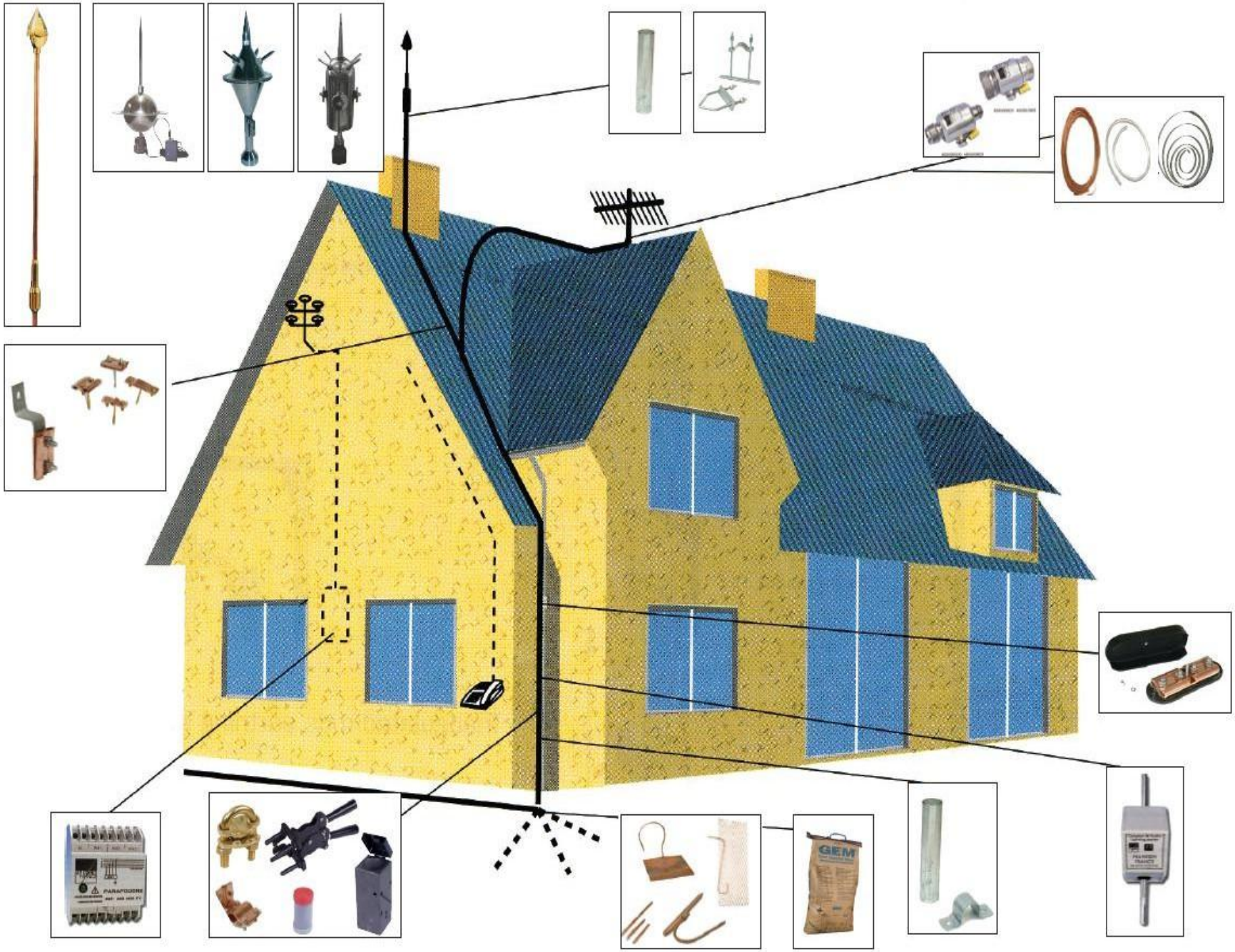
1-meshed cage system

Protection by mesh method involves installing a large-mesh Faraday cage on the top of a building and connected to the ground. Small rods (0.50 m) called "strike points" are installed at all emerging points around the roof meshes (chimneys, roof top structures, etc.).



2-Early streamer emission (ESE) system

For these systems, tapered rods are placed at the highest point of the buildings to be protected. The rods are connected to the ground via the shortest way. The protection they provide depends on their installation point and height above surrounding structures.


GEM

Franklin France - Saint Elmo E.S.E. Piezoelectric Active Lightning Conductor

Ref No	Model Model	Max Koruma Çapı Protected Diameter h= 6m	△L	Ölçüler Measures	Ağırlık Weight
AE 10101	SE 6	104 m	15 m	1,98 m	8,2
AE 10103	SE 9	144 m	30 m	1,98 m	8,2
AE 10106	SE 12	180 m	45 m	1,98 m	8,2
AE 10107	SE 15	214 m	60 m	1,98 m	8,2

Rp (m)	SE 6 △L= 15 m			SE 9 △L= 30 m			SE 12 △L= 45 m			SE 15 △L= 60 m		
N p / h(m)	I	II	III	I	II	III	I	II	III	I	II	III
2	13	18	20	19	25	28	25	32	36	31	39	43
4	25	36	41	38	51	57	51	65	72	63	78	85
6	32	46	52	48	64	72	63	81	90	79	97	107
8	33	47	54	49	65	73	64	82	91	79	98	108
10	34	49	56	49	66	75	64	83	92	79	99	109
20	35	55	63	50	71	81	65	86	97	80	102	113
30	35	58	69	50	73	85	65	89	101	80	104	116
60	35	60	75	50	75	90	65	90	105	80	105	120

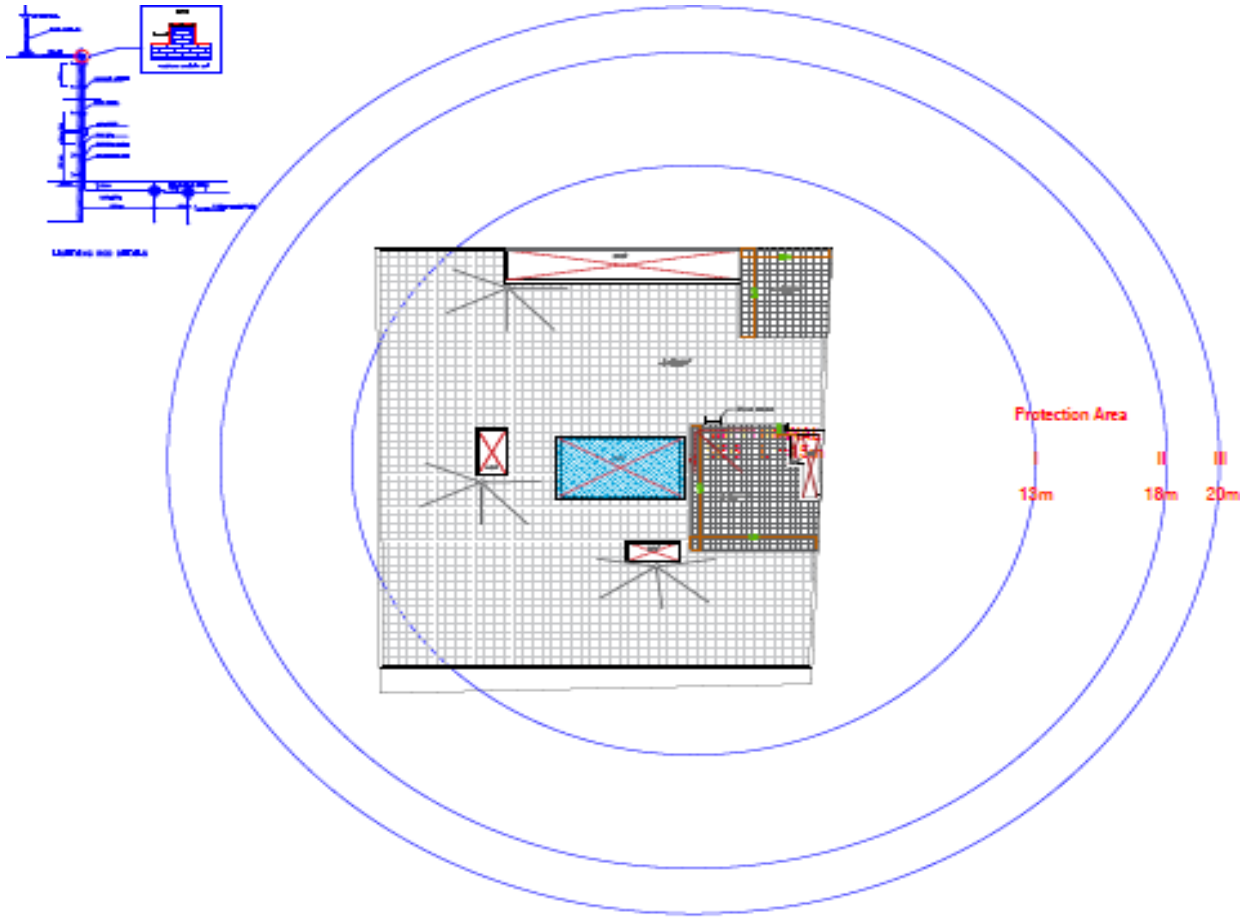


Table 2 The Protection Radius of Franklin France

Rp (m)	SE 6 ΔL=15m.			SE 9 ΔL=30m.			SE 12 ΔL=45m.			SE 15 ΔL=60m.		
h(m) \ Np	I	II	III	I	II	III	I	II	III	I	II	III
2	13	18	20	19	25	28	25	32	36	31	39	43
4	25	36	41	38	51	57	51	65	72	63	78	85
6	32	46	52	48	64	72	63	81	90	79	97	107
8	33	47	54	49	65	73	64	82	91	79	98	108
10	34	49	56	49	66	75	64	83	92	79	99	109

Tesla ST E.S.E. Active Lightning Conductor

Ref No	Model Model	△L	Max Koruma Çapı Protected Diameter (h=6M)	Ölçüler Measures	Ağırlık Weight
AE 10351	Tesla ST	60 m	214 m	0,85 m	9,36

- ISO 9001:2000 belgeli / *Certificated ISO 9001:2000*
- NF C 17 - 102 'ye uygunluk test belgeli / *Test certificated of confarmity in* NF C 17-102 (Icmet Laboratory , TEIK of Kalamata laboratory)
- TGMC - TEXAS test belgeli / *Test certificated TGMC -TEXAS*
- BET Lab. Test belgeli / *Test certificated BET laboratory guaranteed.*
- T.C. Sanayi Bakanlığından 25 yıl garantili / *25 Years of guaranteed by ministry of industry and commerce of Turkish Republic.*

Ortalama Uyarım Yolu *Mean Triggering Distance*		(NF C 17 - 102 ye göre) △L = 60 m. *According to NF C 17 - 102*			Laboratuar ölçüm sonuçlarına göre △ L= 65,8 m. *According to measurement results in laboratory.*		
Koruma Seviyesi *Protection Level*		I	II	III	I	II	III
Koruma Yarıçapı *Protection Radius*	h= 6m.	79	97	107	85	104	114
	h= 60m.	80	105	120	95	124	138

Tesla ST Test Cihazı / *Tesla ST Tester*

Ref No	Model Model	Boyutlar Dimensions mm	Ağırlık Weight
AE 10361	ST - Test - 01	75 x 37 x 111	0,13

Tesla ST Test Kablosu / *Tesla ST Test Cable*

Ref No	Model Model	Boyutlar Dimensions m	Ağırlık Weight
AE 10371	ST - Test - 5M	5	0,3
AE 10373	ST - Test - 10M	10	0,6

Not: Paratoner test kablosunun ilk tesisat anında monte edilmesi daha sonraki yıllarda yapılacak bakımlarda kolaylık sağlayacaktır.

Forend E.S.E. Aktif Paratoner / *Forend E.S.E. Active Lightning Conductors*

Ref No	Model Model	Max Koruma Çapı Protected Diameter (h=6M)	△L	Boyutlar Dimensions	Ağırlık Weight
AE 10401	FOREND PETEX	214 m	60 m	0,5 m	3
AE 10421	FOREND S	214 m	60 m	0,58 m	4,5
AE 10431	FOREND EU	214 m	60 m	0,58 m	5,5

Forend EU

h(m)	(Rp) Koruma Yarıçapı (m) (△L= 60 m) *(Rp) Protection Radius (m)* Yıldırımdan Korunma Seviyesi *Lightning Protection Level*		
	I	II	III
6	79	97	107
10	79	99	109
20	80	102	113
30	80	104	116
60	80	105	120

Forend S

Forend Petex

- ISO 9001:2000 belgeli / *Certificated ISO 9001:2000*
- NF C 17 - 102 'ye uygunluk test belgeli / *Test certificated of conformity in NF C 17-102 (ICMET Laboratory)*
- 20/25 yıl garantili (EU-25, PETEX-20) *20/25 years of guarantee*
- BET Labarotuvar test belgeli (EU) / *Test certificated by BET laboratory*

Forend Test Cihazı / *Forend Tester*

Ref No	Model Model	Boyutlar Dimensions mm	Ağırlık Weight
AE 10441	Forend Test - 01	75 x 37 x 111	0,13

Forend Test Kablosu / *Forend Test Cable*

Ref No	Model Model	Boyutlar Dimensions m	Ağırlık Weight
AE 10461 AE 10471	Forend Test - 5m Forend - Test - 10m	5 10	0,3 0,6

Plastik Kapaklı Bakır Test Klemensi / *Copper Test Clamp With Plastic Covering*

Ref No	Malzeme Material	İletken Conductor	Ağırlık Weight
AE 12401	Yuvarlak İletken İçin For Round Conductor	1 x 25 mm^2	0,35
AE 12403		1 x 50 mm^2	0,40
AE 12405		2 x 50 mm^2	0,40
AE 12411	Şerit İletken İçin For Flat Strip Conductor	20 x 3 mm	0,40
AE 12413		25 x 3 mm	0,40
AE 12415		30 x 3 mm	0,42
AE 12425	Aluminyum Test Klemensi Aluminium Test Clamp	2 x 50 mm	0,35

Som Bakır İletken
Solid Copper Conductor

Standart Çap *Diameter* mm	Standart Kesit *Cross Section* (20) mm^2	Ağırlık- *Weight* kg/100 m Yoğunluk- *Density* 8.9 kg/dm^3	200C°'de DC Akım Direnci Nominal Değerler/m *DC Current Resistance*
1.45	1.651	14.7	0.0162
1.5	1.767	15.7	0.00993
1.6	2.011	17.9	0.00873
1.7	2.270	20.2	0.00773
1.9	2.835	25.2	0.00619
2	3.142	28.0	0.00558
2.1	3.464	30.8	0.00507
2.2	3.801	33.8	0.004615
2.4	4.524	40.3	0.003878
2.5	4.909	43.7	0.003574
3	7.069	62.9	0.002482
3.5	9.621	85.6	0.001823
3.8	11.34	101	0.001547
4	12.57	112	0.001396
4.5	15.90	142	0.001103
4.8	18.10	161	0.000970
5	19.64	175	0.000894
5.2	21.24	189	0.000826
5.5	23.76	211	0.000738
6	28.27	252	0.000621
6.5	33.18	295	0.000529
7	38.48	342	0.000456
7.5	44.18	393	0.000397
8	50.27	447	0.000348
8.5	56.75	505	0.000309
9	63.62	566	0.000276
9.5	70.88	630	0.000248
10	78.85	701	0.000222

Örgülü Bakır İletken
Stranded Copper Conductor

Kesit Cross Section mm^2	Tel Adedi Wire Unit	Tel Çapı Wire Diameter	Ortalama Ağırlık Avg. Weight
10	7	1.32	87
16	7	1.70	144
25	7	2.12	224
35	7	2.50	311
50	7	3.00	448
70	19	2.12	611
95	19	2.50	849
120	19	2.80	1065
125	19	2.90	1130

Bakır Bara / *Copper Bar*		
20x3 mm	Bakır lama (bara)	1mt=540 gr
20x5 mm	Bakır lama (bara)	1mt=900 gr
30x3 mm	Bakır lama (bara)	1mt=810 gr
30x5 mm	Bakır lama (bara)	1mt=1350 gr
40x3 mm	Bakır lama (bara)	1mt=1080 gr
40x5 mm	Bakır lama (bara)	1mt=1800 gr
50x5 mm	Bakır lama (bara)	1mt=2250 gr
50x10 mm	Bakır lama (bara)	1mt=4500gr
60x5 mm	Bakır lama (bara)	1mt=2700 gr
80x5 mm	Bakır lama (bara)	1mt=3600 gr
80x10 mm	Bakır lama (bara)	1mt=7200 gr
100x5 mm	Bakır lama (bara)	1mt=4500 gr
100x10 mm	Bakır lama (bara)	1mt=9000 gr

Toprak Elektrodu
Earth Rod

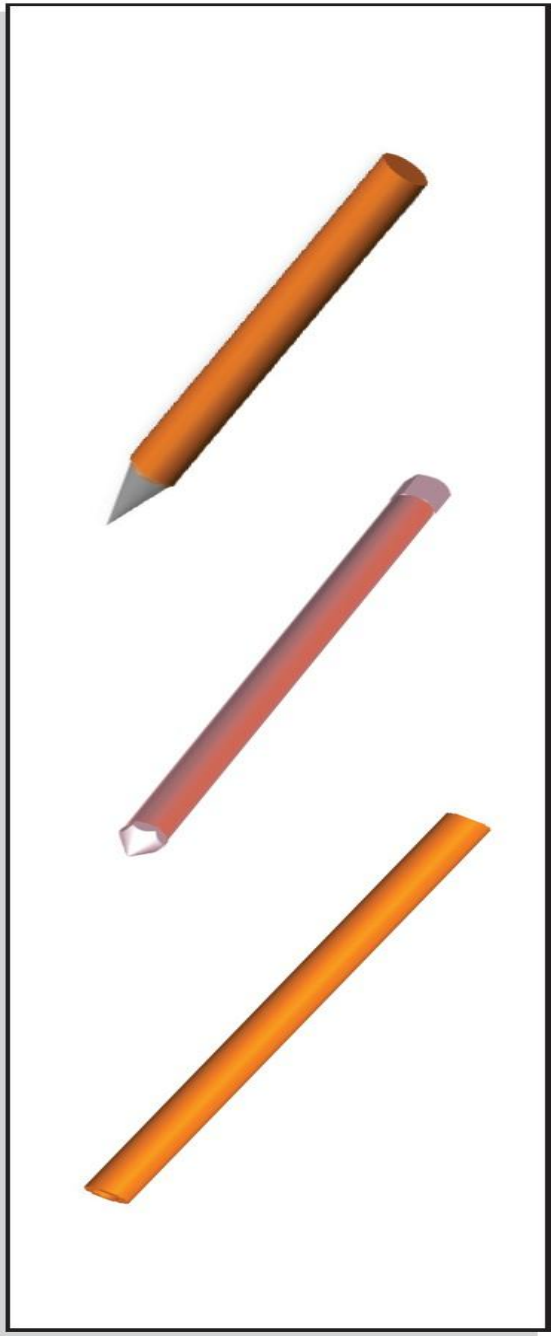
Çap / *Diameter* mm	Kg/m
8	0.448
9	0.567
10	0.700
12	1.008
15	1.575
18	2.268
20	2.800
22	3.388
25	4.275
28	5.488
30	6.300
32	7.168
35	8.575
40	11.200
42	12.348
45	14.175
48	16.128
50	17.500
55	21.128
60	25.132

Earthing:

Standards NF C 17-100 and NF C 17-102 stipulate that each down conductor must have a specific earthing with different dimensions for cages and rods. The electrical ground or the existing belt is connected to them to provide equipotentiality. Finally, it is important to keep down conductor's earthings well away (3 to 5 meters) from any buried metal pipe of electrical conduct and to ensure that ohmic value does not exceed 10 Ohms with a low wave impedance.

Bakır Topraklama Çubuğu / *Copper Earth Rod*

Ref No	Malzeme Material	Elektrod Rod mm	Boyutlar Dimensions m	Ağırlık Weight kg / (m)
AE 30503	Som Bakır Solid Copper	Ø 16	1.00	1.800
AE 30505		Ø 16	1.50	2.700
AE 30507		Ø 16	1.75	3.150
AE 30515		Ø 18	1.00	2.200
AE 30519		Ø 18	1.50	3.300
AE 30523		Ø 18	1.75	3.850
AE 30527		Ø 18	2.00	4.400
AE 30529		Ø 18	3.00	6.600
AE 30531		Ø 18	3.50	7.700
AE 30545		Ø 20	0.75	2.100
AE 30547		Ø 20	1.00	2.800
AE 30551		Ø 20	1.50	4.200
AE 30555		Ø 20	1.75	4.900
AE 30559		Ø 20	2.00	5.600
AE 30561		Ø 20	2.50	7.000
AE 30563		Ø 20	3.00	8.400
AE 30565		Ø 20	3.30	9.240
AE 30567		Ø 20	3.50	9.800
AE 30569		Ø 20	6.00	16.800
AE 30575		Ø 30	1.50	9.450
AE 30577		Ø 30	1.75	11.025
AE 30583		Ø 40	1.50	12.600
AE 30585		Ø 40	1.75	14.700



Çubuk Çakma Ucu / *Rod Driving Stud*

Ref No	Malzeme Material	Çap Diameter mm	Ağırlık Weight kg
AE 31801	Çelik / *Steel*	Ø 16	0.028
AE 31803		Ø 18	0.034
AE 31805		Ø 20	0.046
AE 31807		Ø 22	0.052
AE 31809		Ø 40	0.200

Çubuk İrtibat Civatası / *Rod Coupling Dowell*

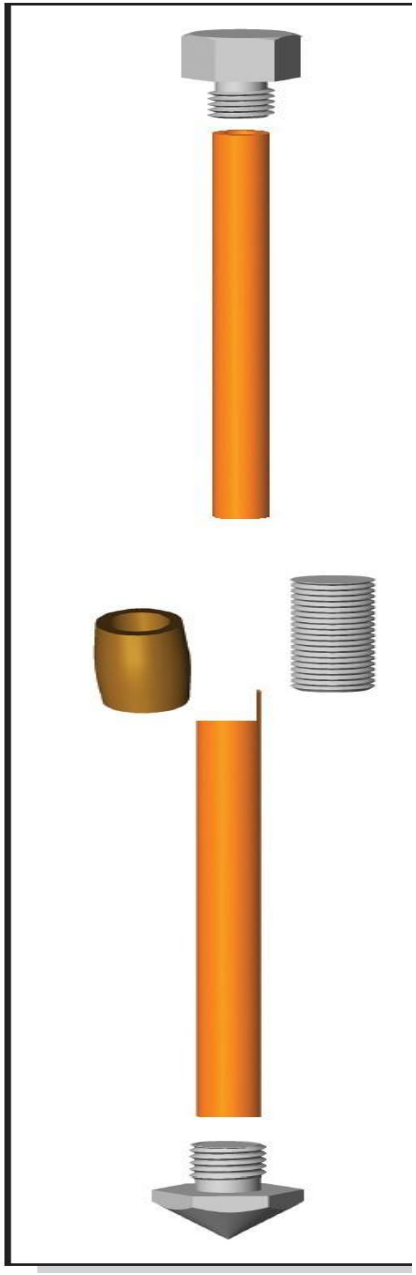
Ref No	Malzeme Material	Çap Diameter mm	Ağırlık Weight kg
AE 31851	Çelik / *Steel*	Ø 16	0.030
AE 31853		Ø 18	0.030
AE 31855		Ø 20	0.030
AE 31857		Ø 22	0.030
AE 31859		Ø 40	0.030

Manşon / *Coupling Dowell*

Ref No	Malzeme Material	Çap Diameter mm	Ağırlık Weight kg
AE 31903	Bronz / *Bronze*	16	0.116
AE 31905		18	0.116
AE 31907		20	0.116

Çubuk Sivri Ucu / *Rod Spike*

Ref No	Malzeme Material	Çap Diameter mm	Ağırlık Weight kg
AE 31951	Çelik / *Steel*	Ø 16	0.020
AE 31953		Ø 18	0.022
AE 31955		Ø 20	0.026
AE 31957		Ø 22	0.034
AE 31959		Ø 40	0.110



Advantages of Exothermic Welding Connections

- *It isn't needed an external heat source.*
- *Material can be welded in a couple of seconds.*
- *A mould with dimensions 16-20 cm and the welding powder are enough for welding.*
- *Welding connections materialize molecular.*

For this reason;

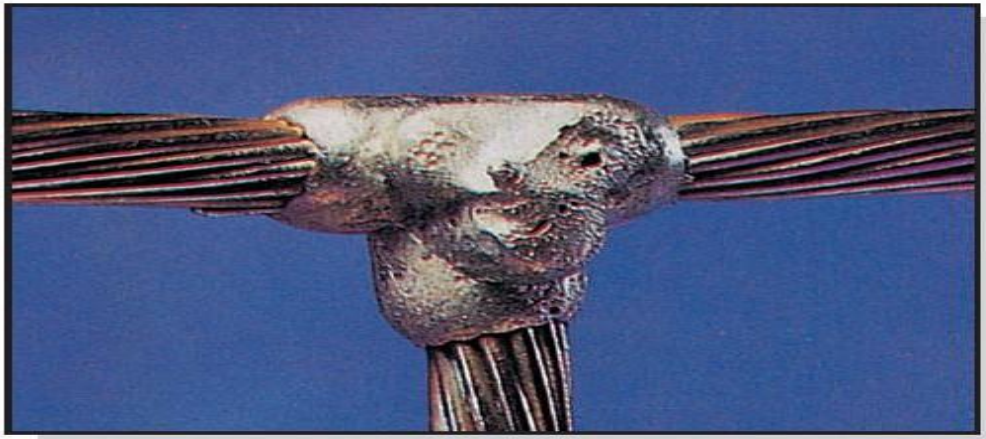
-There won't be a voltage drop at the welding point to the contrary mechanical connections.

-The over current carrying capacity is equal to the conductor which welded less.

-There won't be a slackness or corrosion likewise mechanical connections.

DON'T FORGET!!!

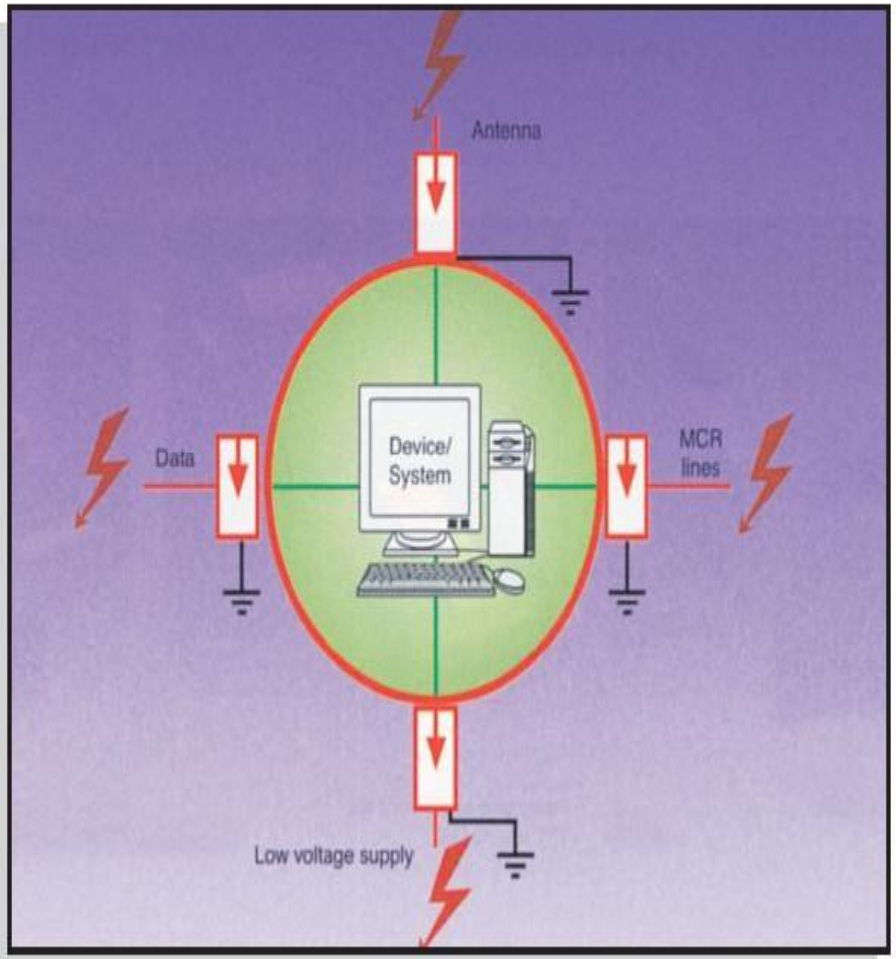
Fixing with clips may have drawbacks because of corrosion effect. Exothermic welding is the most effective way for a modern and a problem-free solution.



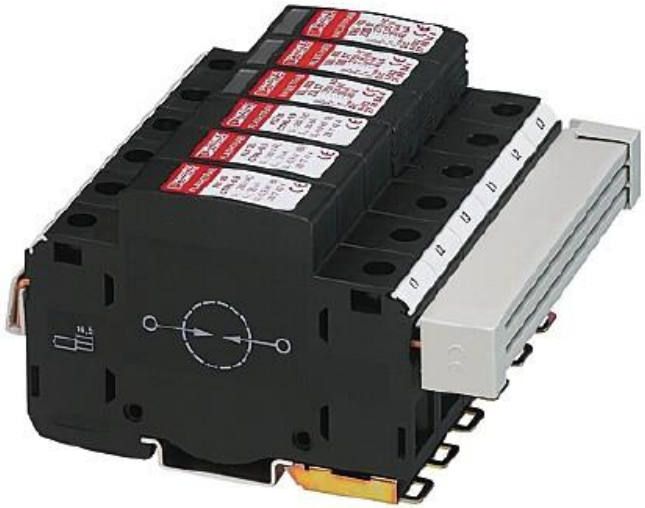
Surge Voltage Protection

Transient surge voltage arise as a result of lightning discharge, switching operations in electric systems and electrostatic discharge. Without protective measures including lightning current and surge voltage arresters, the power involved in lightning discharge is top much for even the sturdily built low voltage power supply of a building or industrial plant. The surge voltages occur only briefly in the range of a millionth of a second. In spite of this, most very high voltages are capable of destroying electronic circuits or the insulation between printed circuits.

Even if electric or electronic equipment has passed the voltage resistance test in acc. with IEC 1000-4-5 necessary for granting the CE-mark, it is still not capable of resisting all environmental influences with respect to EMC without damage.



In order to prevent surge voltages from destroying electrical systems, all the interfaces risk, such as signal inputs and power supplies, must be connected to surge voltage protection devices. Despending on the application, components such as spark gaps, gas filled surge voltage arresters, varistors and suppressor diodes are arranged individually or combined in protective circuits since the components differ in their arresting and discharging data.



TRABTECH

By "Efficent Protective Circuit" we mean complete protection againist surge voltages.
The first step toward planning such a protection concept is to list all the devices and areas of the system that need to be protected. This is followed by an eavaluation of the level of protection required for all the devices registered. The different types of circuits are differentaited between in the following areas:

- Power supply,
- Measurement and control technology (MCR)
- Data processing systems
- Telecommunications
- Transceiver systems.

One must think of the system or device to be protected as being in a protected zone, see illustraion. At all the intersections "Line Protective Circuit" surge voltage protective devices are to be installed to match the nominal data of the particular type of circuit or interface of the device to be protected. The area within the protective circuit is thus so safe that surge voltage coupling from outside is not possible.

POWERSET

POWERSET

POWERSET CP 3C

POWERSET CP 3S

Powerset (B + C)

Thank you

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