



> GUIDE FOR THE DESIGN AND INSTALLATION OF EARLY STREAMER EMISSION AIR TERMINALS (ESE)

Operation of early streamer emission air terminals is based on the electric characteristics of lightning formation. Lightning begins with a down-conductor which spreads in any direction. Once it approaches the objects on the ground, any of them can be struck. The objective of an external lightning protection system is to control the lightning strike point and provide the lightning current with a path to earth avoiding damage to the structure.

The main feature of Early Streamer Emission (ESE) air terminals is the generation of the continuous upward leader before any other object within its protected area. The standards define this characteristic using a parameter called **advance time (ΔT)**: "Difference expressed in microseconds between the emission time of an early streamer emission air terminal and a simple rod air terminal measured in a laboratory under the conditions defined in the reference standard."

This advance time determines the protection radius of each air terminal. If the triggering occurs earlier, then the distance at which the downward leader is intercepted increases, thus avoiding a lightning strike in a wider area. The advance time must be measured in a high voltage laboratory, following the test procedure described in the ESE lightning protection regulations.

The components for a lightning protection system using ESE air terminals are as follows:

EXTERNAL LIGHTNING PROTECTION SYSTEM

- One or more air terminals.
- Two or more down-conductors.
- An earth termination system.

INTERNAL LIGHTNING PROTECTION SYSTEM

- A suitable surge protection installation.
- Other measures minimizing the destructive effects of lightning (equipotential bonding, screening etc.).

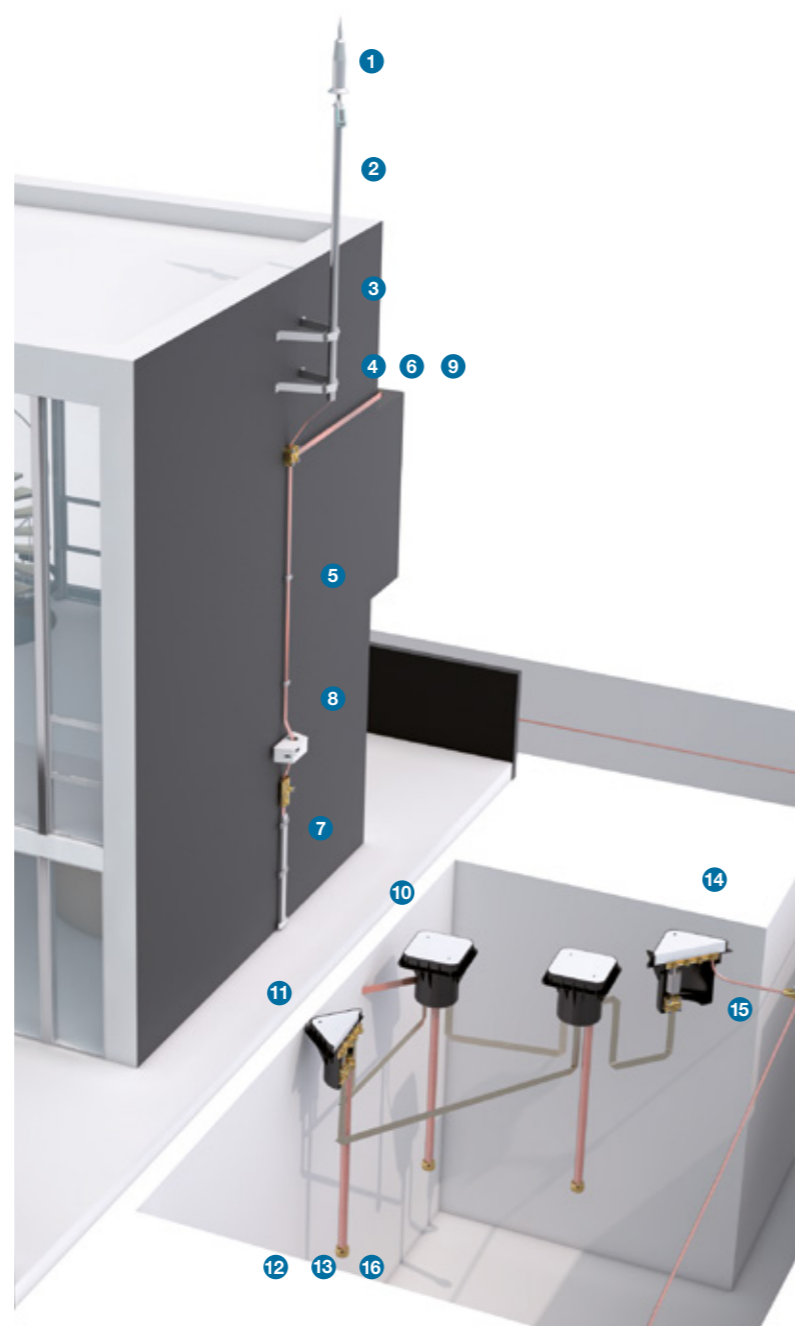
The **installation** of the LPS using ESE air terminals must follow the relevant standards (NF C 17-102, UNE 21186 or similar):

> PROTECTION RADIUS (R_p)

Calculated according to UNE 21186:2011, NF C 17-102:2011 and NP 4426:2013

Ref. →	PROTECTION LEVEL I (D=20 m)				PROTECTION LEVEL II (D=30 m)				PROTECTION LEVEL III (D=45 m)				PROTECTION LEVEL IV (D=60 m)			
	AT-1515 AT-2515	AT-1530 AT-2530	AT-1545 AT-2545	AT-1560 AT-2560	AT-1515 AT-2515	AT-1530 AT-2530	AT-1545 AT-2545	AT-1560 AT-2560	AT-1515 AT-2515	AT-1530 AT-2530	AT-1545 AT-2545	AT-1560 AT-2560	AT-1515 AT-2515	AT-1530 AT-2530	AT-1545 AT-2545	AT-1560 AT-2560
2	13	19	25	31	15	22	28	35	18	25	32	39	20	28	36	43
4	25	38	51	63	30	44	57	69	36	51	64	78	41	57	72	85
6	32	48	63	79	38	55	71	87	46	64	81	97	52	72	90	107
8	33	49	64	79	39	56	72	87	47	65	82	98	54	73	91	108
10	34	49	64	79	40	57	72	88	49	66	83	99	56	75	92	109
20	35	50	65	80	44	59	74	89	55	71	86	102	63	81	97	113
60	35	50	65	80	45	60	75	90	60	75	90	105	75	90	105	120

h (m): Height of the air terminal over the element to be protected (in metres).
D (m): Rolling sphere radius (in metres).



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> BASIC RECOMMENDED MATERIALS

INTERCEPTION	DENOMINATION	REF.	TABLE
<p>1 The radius of protection offered by an ESE lightning conductor depends on its height (h) in relation to the area to be protected, its triggering advance ΔT and the protection level.</p> <p>2 The air terminal must be installed at least 2 metres higher than any other element within its radius of protection.</p>	ESE air terminals	AT-1560	1, 2
	Adapting piece	AT-011A	15
	Mast	AT-056A	30
	Anchorage	AT-023B	31

DOWN-CONDUCTORS	DENOMINATION	REF.	TABLE
<p>3 Each air terminal must be earthed using two down-conductors located outside the structure. They will preferably be on different external walls of the building.</p> <p>4 Each down-conductor should be installed such that its routing is as straight as possible and takes the shortest path to earth without sharp bends or upward sections.</p> <p>Care should also be taken to avoid crossing or running conductors in close proximity to electrical cables.</p> <p>When external routing is impracticable, the down-conductor may be internally routed. However, this is not recommended as it reduces the effectiveness of the lightning protection system, makes maintenance difficult and increases the risk of voltage surges.</p> <p>5 The number of down-conductor fixings is determined by considering 3 clips per metre as a reference.</p>	Clip	AT-240E	46
	Clamp	AT-020F	90
<p>6 Down-conductors should have a cross-section of at least 50 mm². Since lightning current needs to be driven, flat conductors (tape) are preferable to round conductors as they have a larger exterior surface area for the same amount of material. Tin-plated copper is recommended due to its physical, mechanical and electrical characteristics (conductivity, malleability, corrosion resistance and so on).</p> <p>7 Down-conductors should be protected by installing guard tubes up to a height of 2 m above ground level.</p> <p>8 The installation of a lightning event counter over the guard tube is recommended in order to carry out verification and maintenance operations which are essential for any lightning protection system.</p> <p>9 It is recommended that the down-conductor be kept at a distance of at least 5 metres from the external gas pipes.</p>	Lightning event counter	AT-034G	106
	Guard tube	AT-060G	107
<p>10 Each down-conductor must have an earth termination system. Earth termination systems should be located outside the building, except where this is absolutely impossible.</p> <p>11 The resistance of the earth termination system measured by conventional means must be lower than 10 Ω, when separated from other conductive elements.</p> <p>Connection with the earth termination system must be made directly at the bottom of each down-conductor, using a device that allows the disconnection of the earth electrode and should be placed inside an inspection pit marked with the earth symbol.</p> <p>12 The inductance of the earth termination system must be as low as possible. The recommended arrangement is vertical electrodes forming a triangle with a minimum</p>	Conductor	AT-052D	121
	Earth Electrode	AT-025H	133
<p>13 The use of a soil conductivity improver is recommended in high resistivity ground.</p> <p>14 All earth termination systems should be bonded together and to the general earthing system of the building.</p> <p>15 It is recommended to use a spark gap to connect the lightning earth termination system to the general earth system, as well as the lightning air terminal mast to any aerials.</p> <p>16 All elements of the lightning rod earth termination system must always be at least 5 m from any buried metal or electrical pipes.</p>	Earth pit	AT-010H	144
	Bonding bar	AT-020H	148
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