

GUIDE FOR THE DESIGN: EARLY STREAMER EMISSION AIR TERMINALS (ESE AIR TERMINALS)

Installation standards

The installation of the LPS using ESE air terminals must follow the relevant standards (NFC 17102, UNE 21186 or similar):

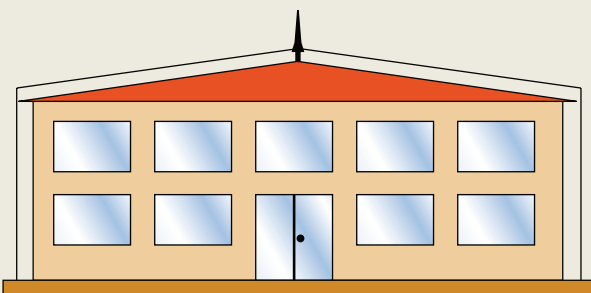
- The radius of protection offered by an ESE lightning conductor is related to its height (h) relative to the area to be protected, to its triggering advance and to the protection level. The following table shows the DAT CONTROLLER® PLUS radii of protection.

| PROTECTION RADIUS (Rp) IN METERS AS CTE SU 8, UNE 21186 and NFC 17102 | | | | | | |
|--|------------------------|----------------------|---------|---------|---------|---------|
| CTE SU 8 | UNE 21186 NFC 17102 | DAT CONTROLLER® PLUS | | | | |
| | | h | AT-1515 | AT-1530 | AT-1545 | AT-1560 |
| Level 4 | Level IV | 2 | 20 | 28 | 36 | 43 |
| | | 4 | 41 | 57 | 72 | 85 |
| | | 6 | 52 | 72 | 90 | 107 |
| | | 8 | 54 | 73 | 91 | 108 |
| | | 10 | 56 | 75 | 92 | 109 |
| Level 3 | Level III | 2 | 18 | 25 | 32 | 39 |
| | | 4 | 36 | 51 | 64 | 78 |
| | | 6 | 46 | 64 | 81 | 97 |
| | | 8 | 47 | 65 | 82 | 98 |
| | | 10 | 49 | 66 | 83 | 99 |
| Level 2 | Level II | 2 | 15 | 22 | 28 | 35 |
| | | 4 | 30 | 44 | 57 | 69 |
| | | 6 | 38 | 55 | 71 | 87 |
| | | 8 | 39 | 56 | 72 | 87 |
| | | 10 | 40 | 57 | 72 | 88 |
| Level 1 | Level I | 2 | 13 | 19 | 25 | 31 |
| | | 4 | 25 | 38 | 51 | 63 |
| | | 6 | 32 | 48 | 63 | 79 |
| | | 8 | 33 | 49 | 64 | 79 |
| | | 10 | 34 | 49 | 64 | 79 |

h: air terminal height over the surface to be protected.

- The air terminal must be installed at least 2 meters higher than any other element within its protected area.

- Each air terminal must be connected to the earthing using two down-conductors that will preferably be placed on different external walls of the structure.



- The 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. Care should also be taken to avoid crossing or running conductors in close proximity to electrical cables.
- When external routing is impracticable, the down-conductor may be internally routed inside an insulating non-flammable duct with a minimum internal cross-sectional area of 2000mm². The project manager must also be aware of the reduced lightning protection system effectiveness, maintenance difficulties, and the risks resulting from the entry of voltage surges into structures.
- The number of fixings is determined considering 3 clips per meter.

Down-conductors should have a cross-section of at least 50mm². Since lightning current is impulsional, flat conductors (tape) are preferable to round conductors because they have a larger surface for the same amount of material. On another side tin-plated copper is recommended due to its physical, mechanical and electrical characteristics (conductivity, malleability, corrosion resistance and so on).

- Down conductors should be protected by installing guard tubes up to a height of 2m above ground level.
- The installation of a Lightning Event Counter over the guard tube is recommended in order to perform the verification and maintenance operations which are essential for any lightning protection system.
- The down-conductor must always be at least 3 meters from external gas pipes.
- Each down-conductor must have an earth termination system.
- Earth terminations should be located externally to the building.
- The connection with the earth termination system must be done directly at the end 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.

The resistance of the earth measured by conventional means must be lower than 10Ω when separated from other conductive elements.

- The inductance of the earthing must be as low as possible. The recommended arrangement is vertical electrodes forming a triangle with a minimum total length of 6m. The vertical electrodes must be bonded with a conductor buried 50cm deep and separated at a greater distance than their length.
- The use of a soil conductivity improver is recommended in high resistivity ground.
- All the earth termination systems should be bonded together and to the general earth system of the building.
- It is recommended to use a spark gap to connect the lightning earth termination system to the general earthing, as well as the lightning air terminal mast to any aerials.
- All elements of the earth termination system must always be at least 5 meters from any buried metallic or electrical service.

Working basis and main materials

The functioning of Early Streamer Emission Air Terminals is based on the electric characteristics of lightning formation. Lightning initiates with a down-conductor, propagating in any direction. Once it approaches a close proximity to objects on the earth surfaces 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): "Average gain in upward leader triggering compared with a reference point having the same geometry. It is obtained by laboratory tests, and is measured in microseconds."

The 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 standards.

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.



AT-1560
AT-011A
AT-056A
AT-023B
AT-052D
AT-060F
AT-020F
AT-028E
AT-094E
AT-001G
AT-060G
AT-010H
AT-020H
AT-050K
AT-052D
AT-025H
AT-010L

Internal Lightning Protection System

- A correct surge protection installation (see Overvoltage Protection catalogue)
- Other measures minimizing the destructive effects of lightning (equipotential bonding, screening, etc.)



Recommended materials for a lightning protection installation using ESE Air Terminals:

| Interception systems | Reference | Page |
|----------------------------|-----------|------|
| ESE lightning air terminal | AT-1560 | 19 |
| Adapting piece | AT-011A | 26 |
| Mast | AT-056A | 30 |
| Anchorage | AT-023B | 30 |
| Earthing | Reference | Page |
| Earth electrode | AT-025H | 256 |
| Ground enhancing product | AT-010L | 263 |
| Earth pit | AT-010H | 264 |
| Bonding bar | AT-020H | 266 |
| Spark gap for earthing | AT-050K | 269 |
| Conductor | AT-052D | 74 |

| Down-conductors | Reference | Page |
|---------------------------|-----------|------|
| Clip | AT-015E | 40 |
| Tile support | AT-094E | 54 |
| Downpipe support | AT-073E | 56 |
| Clamp | AT-020F | 60 |
| Spark gap for aerial mast | AT-060F | 66 |
| Lightning event counter | AT-001G | 67 |
| Guard tube | AT-060G | 68 |
| Conductor | AT-052D | 74 |