Early Streamer Emission Lightning Conductors

Prevectron®2 Millenium

NF C 17-102 compliant

Indelec
lightning protection

INDELEC's reputation in the field of lightning protection dates back almost fifty years.
Since 1986, the company has invested heavily in the manufacture of its PREVECTRON® Early Streamer Emission Lightning Conductor. This has involved both fundamental research into the physical phenomena associated with lightning, as well as extensive product development.
The latest PREVECTRON®2 series provides optimal protection against the direct effects of lightning.

Operation

The PREVECTRON®2
is operating in three stages:

- **The ionization device is charged** via the lower electrodes using the ambient electrical field (several million volts/meter when storms are prevalent). This means the PREVECTRON®2 is a fully autonomous system requiring no external power supply.

- **The ionization phenomenon is controlled** by a device which detects the appearance of a downward leader: the local electrical field increases rapidly when a discharge is imminent.
  The PREVECTRON®2 detects changes within the field, making it the only E.S.E. air terminal to react at the precise moment the downward leader develops from the cloud to the ground.

- **Early triggering of the upward leader** using a system of spark ionization between the upper electrodes and the central tip.
  The PREVECTRON®2's ability to trigger an upward leader ahead of any other protruding point within the protected area ensures it will be the preferential point of impact for the lightning discharge.

Protection areas

French Standard NFC 17-102 requires that every ESE Lightning Conductor first undergo a series of high-voltage laboratory tests to determine the gain in triggering time in comparison to a simple rod. The value obtained - referred to as Δt - equals the average trigger time over a run of 100 electrical discharges in the laboratory, minus a 35% safety margin. This figure is then used to calculate each conductor's protection area according to the standardized formula.
From the outset, INDELEC subjected the PREVECTRON®2 to independent testing in laboratories across France (EDF facility at Renardières & Cediver Laboratory at Bazet) and internationally (Louvain University in Belgium, IREQ in Canada & KERI in South Korea). The tests highlighted the advantages of the PREVECTRON®2's early triggering system compared to a passive rod and allowed each model's average Δt value to be measured. The results of the tests have all been approved by the CNRS and are available on request.

Installation

Installation procedure for the PREVECTRON®2 is governed by French standard NFC 17-102 and follows a series of simple rules catering for all types of structure:

- the tip should be positioned at least 2m above the structure to be protected;
- with heights less than 28m, a single down conductor is sufficient (as long as the conductor's horizontal projection is less than its vertical projection);
- the resistance of the grounding system should be less than 10Ω;
- PREVECTRON®2 activity can be recorded by installing a lightning strike counter;
- the PREVECTRON®2 has been designed for the most extreme climatic conditions (see the results of our real-life lightning tests). INDELEC also markets a tester allowing clients to regularly check the air terminal on-site.

TS 2.25 TS 3.40 S 3.40

TS SERIES

Prevectron® 2 MILLENIUM

Ø 100 mm / H = 330 mm

Key benefits

The skills of INDELEC's engineers, the variety of tests carried out in both high-voltage laboratories and real-life lightning conditions, and the experience gained from the thousands of PREVECTRON®2 installations around the world, have allowed us to develop a complete range of lightning conductors offering a host of key benefits:

- 5-MODEL RANGE OFFERING CUSTOMIZED SOLUTIONS FOR EACH PROJECT (EASTHETIC CONSTRAINTS, REQUIRED PROTECTION AREA, ETC.);
- FULLY AUTONOMOUS OPERATION;
- TOTAL RELIABILITY, EVEN IN EXTREME CLIMATIC CONDITIONS;
- PROVEN, ROBUST DESIGN ABLE TO WITHSTAND MULTIPLE LIGHTNING STRIKES;
- LIGHTNING CONDUCTOR ONLY BECOMES ACTIVE WHEN ELECTRICAL FIELD INTENSITY RISES (LIGHTNING DISCHARGE LIKELY), THE PREVECTRON®2 PRESENTS NO DANGER TO THE SITE;
- STRAIGHTFORWARD INSTALLATION & MAINTENANCE USING TOOLS SPECIALLY DEVELOPED BY INDELEC, INCLUDING PROTECTION CALCULATION SOFTWARE, STRIKE COUNTER AND PREVECTRON® TESTER;
- HIGH-VOLTAGE LABORATORY TEST RESULTS AVAILABLE ON REQUEST;
- REAL-LIFE TEST RESULTS & SCIENTIFIC REPORTS AVAILABLE ON REQUEST;
- ULTRA-SAFE CAPTURE TIP THANKS TO FULL ELECTRICAL CONTINUITY BETWEEN THE TIP AND THE EARTH POINT;
- ISO 9001-2000 MANUFACTURING PROCESS (CERTIFICATE #116884).

S 4.50

S 6.60

S SERIES

Prevectron® 2 MILLENIUM

Ø 185 mm / H = 385 mm

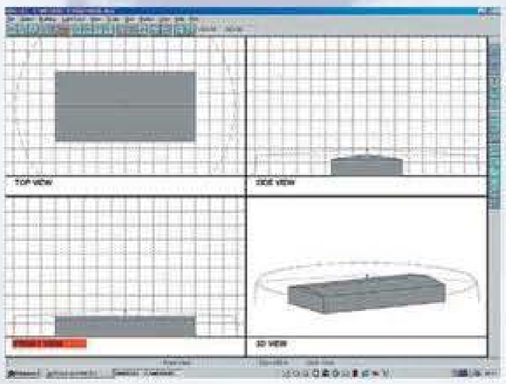
Protection area

The protection area Rp of a PREVECTRON®2 lightning conductor is calculated according to French Standard NF C 17-102, thus:

$R_p = \sqrt{h\,(2D-h) + \Delta L\,(2D + \Delta L)}$

The protection area depends on a number of factors:

- Gain in triggering time ΔT of the chosen PREVECTRON®2 (see Technical Guide: high-voltage laboratory PREVECTRON® test results), which allows the ΔL value to be determined according to the formula ΔL (m) = V(m/_s) .ΔT(_s);
- D = 20, 45, or 60, depending on the protection level required (I, II, or III) on a given site, according to the lightning risk assessment guide (NFC 17-102 appendix B);
- the actual height of the lightning air terminal above the surface to be protected: h (where h < 5m, see table below).



Calculating the protection area using Indelec's **Protec** ***2001***® software

PROTECTION RADII

Level I : D = 20m
high protection

h (m)	2	3	4	5	10
S 6.60	31	47	63	**79**	79
S 4.50	27	41	55	**68**	69
S 3.40	23	35	46	**58**	59
TS 3.40	23	35	46	**58**	59
TS 2.25	17	25	34	**42**	44

Level II : D = 45m
medium protection

h (m)	2	3	4	5	10
S 6.60	39	58	78	**97**	99
S 4.50	34	52	69	**86**	88
S 3.40	30	45	60	**75**	77
TS 3.40	30	45	60	**75**	77
TS 2.25	23	34	46	**57**	61

Level III : D = 60m
standard protection

h (m)	2	3	4	5	10
S 6.60	43	64	85	**107**	109
S 4.50	38	57	76	**95**	98
S 3.40	33	50	67	**84**	87
TS 3.40	33	50	67	**84**	87
TS 2.25	26	39	52	**65**	69

Real lightning condition test campaigns

The decision to go ahead with real lightning tests was based on a simple premise: laboratory testing cannot reproduce the complete parameters and constraints of a real lightning discharge. In addition to the extensive tests carried out in the laboratory in pursuance of French Standard NFC 17-102, INDELEC is one of the only lightning rod manufacturers to actively pursue real-life testing.

The test campaigns were originally developed in close cooperation with a team of engineers from the Atomic Energy Commission (C.E.A.) in Grenoble. As work progressed, other companies, universities and scientists joined in the test campaigns, providing a wealth of experience in the field of lightning phenomena.

In order to gather as many data as possible, the tests were performed in America, Europe and Asia, with each site offering very different lightning conditions. The first tests were carried out in 1993 at Camp Blanding in Florida, since when experimentation has moved on to Cachoeira Paulista in Brazil and Nadachi in Japan.

Each test campaign has provided invaluable results, including:

- highlighting the performance of the PREVECTRON®2 through measuring and comparing electrical activity at the tips of various lightning rods;
- operation of the PREVECTRON®2's triggering system;
- confirmation of the PREVECTRON®2's robust design by exposing it to repeated strikes;
- total reliability provided by the PREVECTRON®2 in a wide range of situations representative of all types of lightning conditions, including upward & downward lightning strikes and tropical & winter storms.

A number of scientific reports have been produced in relation to this research, which has also allowed the PREVECTRON® to be continuously developed from the initial design through to the latest Millenium model.