



FRANCE[®]
PAR TONNERRES

OUR RELIABILITY IS YOUR FIRST INSURANCE



IONIFLASH MACH[®]

Early Streamer Emission Air Terminal

 International patent, French technology and production



40 years of experience for advising you

in your projects of prevention and protection against lightning and electrical damages



THE QUALITY OF THE CONTACT AND THE REACTIVITY OF A TEAM LISTENING TO YOU

- A technical support dedicated to our customers
- Reliable and reactive answers given within 24 to 48 hours
- Shipment of the material within 24 to 48 hours

AN ECO-RESPONSIBLE COMPANY

- Carbon impact results

PERIMETER	Results IONIFLASH MACH (T eq CO ₂)	Results IONIFLASH MACH + accessories (T eq CO ₂)
Restricted	99.2	115.2
Life cycle	93.6	109.6
Global	151.2	167.2

- Results per ESE air terminal

PERIMETER	Results IONIFLASH MACH (kg eq CO ₂ /unit)	Results IONIFLASH MACH + accessories (kg eq CO ₂ /unit)
Restricted	33	38
Life cycle	31	37
Global	50	58

Data collected within the framework of the Carbon Assessment 2008/2009 of France Paratonnerres



MACH NG15



MACH NG25

RELIABILITY OF THE IONIFLASH MACH[®]

Five solutions adapted to all your projects

- Higher efficiency demonstrated (High Voltage Laboratories results on request)
- Double security thanks to the two spark gaps dimensioned to have an operating range adapted to the frequential spectrum of the lightning (0 to 10 MHz)
- Electrical and physical continuity from the IONIFLASH tip to the earth
- Reliable and autonomous device even in extreme climatic conditions
- Support tools for study and installation (software IONEXPERT 3000[®], operational tests devices IONICHECK[®], IONICOUNT[®] impulse counter)
- 7 years guarantee. Lifetime of 25 years : all material in stainless steel 316L, protective fairing
- Lowest carbon impact 33 kg eq. Co₂ / unit
- Tested in accordance to the Standards NFC 17-102 Edition 2011, EN 50164-1, IEC 60060-1, UNE 21186, production conformed to NF EN ISO 9001 : 2008 Standard (Certification N° FR003277-2)

For working steps of the IONIFLASH MACH[®], see technical data sheet.



MACH NG30

MACH NG45

MACH NG60

France Paratonnerres is a world-wide company recognized for its expertise,

and the quality of its products since more than 40 years. Inventor and producer of a technology of the latest generation, the Early Streamer Emission Air Terminal **IONIFLASH MACH®**.

POLE of RESEARCH

- Applied research
- In situ tests
- Incident expertise

RESEARCH DEPARTMENT

- Lightning Risk Analysis
- Lightning Technical Studies
- Checkings of lightning installations
- Training sessions (governmental authorization)

POLE of DEVELOPMENT

- Member of the Standard Committees (AFNOR-UTE/CENELEC/CEI)
- Actor in the scientific research world
- International conferences, workshops, scientific reviews
- Partnerships with Laboratories

PRODUCTION and TECHNICAL DEPARTMENT

- Studies and production of specific solutions adapted to complex problems
- Removal, dismantling, storage of radioactive early streamer emission air terminals

COMMERCIAL DEPARTMENT

- Trilingual team
- Rigour, reliability of service
- Reactivity

QUALITY

- ISO 9001 version 2008
- Qualifoudre (Level C) N° 1223131658121
- French Nuclear Safety Authority (ASN)
- Oseo Excellence

INTERNATIONAL REPRESENTATION

- in more than **50** countries

THE FIRST WORLD TECHNOLOGY WITH PATENTED SPHERICAL OPTIMIZATION

LIGHTNING : A NATURAL PHENOMENON

Lightning is a natural phenomenon which occurs in a violent and unpredictable way with a recurrence increased in certain areas of the globe. It contributes to the electric stability of the earth.



The **IONIFLASH MACH®** is the first Early Streamer Emission Air Terminal in the history of the lightning protection which transposes the last research results and tests in real conditions of lightning. Long research studies [1] have highlighted the superiority of the performance of a rounded tip compared to a sharp rod, both positioned in the same conditions, in laboratory [2] and in real conditions of lightning [3,4].

The rounded tip shows a much higher efficiency.

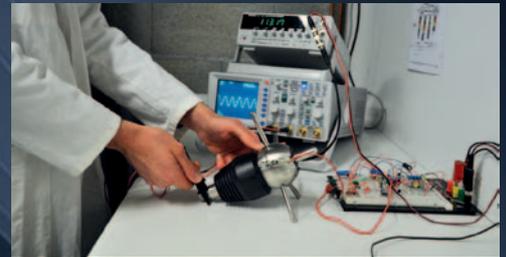
Thanks to the design of the **IONIFLASH MACH®**, the concentration and the electric field lines control at the top of the air terminal amplify and regulate [2] considerably the ionization, starting factor of the propagation of the upward leader.

The connection process of the upward leader with the downward leader becomes intensified, synchronically supplied by the principal spark gap and the auxiliary spark gap.

The **IONIFLASH MACH®** tip in ellipsoid of revolution and the conception of the spark gaps working in extreme climatic conditions demonstrate [4,5] the precursory and regular character of the propagation of the **IONIFLASH MACH®** upward leader, connecting and ensuring the capture of the downward leader to the earth.

Indeed, for a level of electric field given, the sharp rods produce too many charges compared to the rounded tips.

This surplus bound in a plasma then will contribute to mask the sharp rod from the downward leader effects and will reduce strongly the connection process and the capture of the downward leader. Thus, the superiority of the spherical tip of the **IONIFLASH MACH®** is shown.



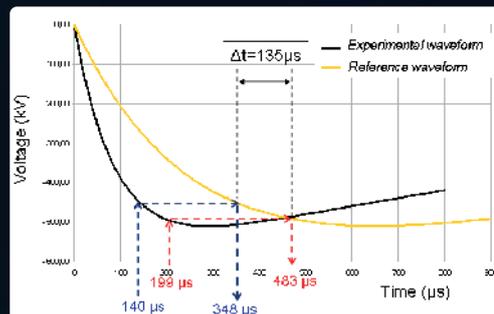
CONSEQUENCES

Besides the fact that lightning causes many deaths, it represents billion euros of losses for the economy of the countries.



SOLUTION

The **IONIFLASH®**: the efforts of the R&D Department made it possible to develop and to improve the performances of its technology with the achievement of the **IONIFLASH MACH®** (registered patent).



Results of Laboratory tests NFC 17-102

- [1] International Patents France Paratonnerres (1987, 2009)
- [2] National Center of Research Laboratory – Tests under new standard NFC 17-102 2011 (M. Troubat)
- [3] Institute of Mining and Technology New Mexico C.B. Moore, William Rison, James Mathis and Graydon Autich “Lightning rod Improvement studies”
- [4] France TELECOM – Tests in real conditions on hertzian pylon of 70 meters – Alt. 819 m. “Contribution au débat sur l’efficacité des paratonnerres ionisants” (Eng. M. Damour)
- [5] SAS France Paratonnerres – In situ tests of IONIFLASH at SUPERBESSE (A. Mottin)

Contribution au débat sur l'efficacité des paratonnerres ionisants

Michel DAMOUR
Centre de Recherches et de Développement Technologique

Un nouveau type de paratonnerre ionisant, utilisé pour la première fois pendant le séisme de l'été 2003, a permis de protéger un bâtiment en béton armé sans provoquer de dommages matériels. Après une analyse approfondie de la protection par paratonnerres ionisants, il est conclu que ce type de protection est plus efficace que les conclusions que l'on peut en tirer.

Les paratonnerres ionisants ont la particularité de créer une zone de protection autour de la pointe de l'air terminal, ce qui permet de protéger les éléments situés à proximité de la pointe. Il est donc possible de protéger des éléments situés à proximité de la pointe de l'air terminal sans provoquer de dommages matériels. Cette zone de protection est plus étendue que celle des paratonnerres classiques.

Altitude (m)	15	25	50	75	100	150
1000	15	25	50	75	100	150
1500	25	50	100	150	200	300

Si l'on considère un bâtiment de 100 mètres de hauteur, on peut conclure que la protection par paratonnerres ionisants est plus efficace que celle des paratonnerres classiques.

Approche de la protection par paratonnerres

Il est possible de protéger un bâtiment de 100 mètres de hauteur sans provoquer de dommages matériels. Cette zone de protection est plus étendue que celle des paratonnerres classiques.

Annulation de l'efficacité d'un paratonnerre

Tout bâtiment qui favorise la création d'un champ électrique est susceptible d'être touché par la foudre.

117 808 37 596 2006 031

Results published in IEEE

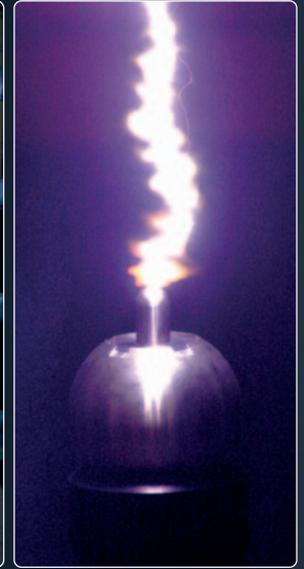
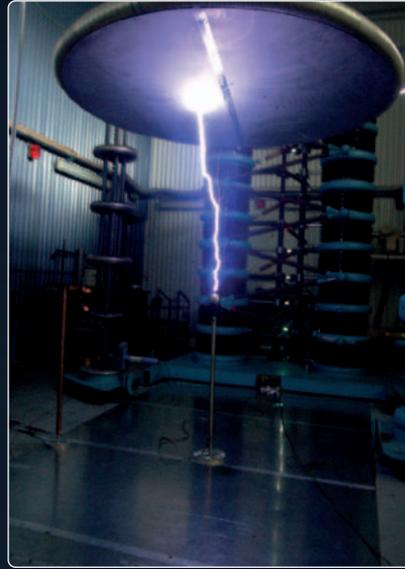
LABORATORIES TESTS

MAIN TESTS

The first ESE air terminal which presents the double performance of conformity to all the tests of the NFC 17-102 Edition 2011 Standard and IEC tests.

- The NFC 17-102 Edition 2011 is the European Standard used as the reference for the prescription and installation of the ESE air terminals.
- The appendix C of the NFC 17-102 Standard requires a complete sequence of consecutive tests carried out with the same ESE air terminal, in conformity in particular with the Standards EN 50164, EN 62305.
- The electrical Standard IEC 60060-1 prescribes the test of insulation in rain conditions, applied to high voltage equipments.

These tests were defined out of France Paratonnerres company, in independent, governmental or accredited COFRAC Laboratories.



TESTS SEQUENCE

According to NFC 17-102 Edition 2011 (Appendix C)

GENERAL TESTS

- Documentary information and identification
- Marking tests

MECHANICAL TESTS

- Inspection of the dimensional characteristics

ENVIRONMENTAL TESTS

- Salt Mist Treatment
- Humid sulphurous atmosphere treatment

ELECTRICAL TESTS

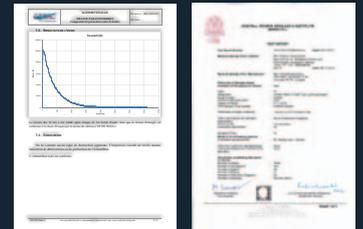
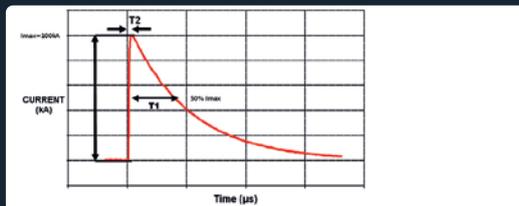
- Withstand voltage to impacts

EFFICIENCY TESTS

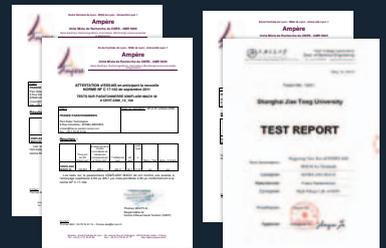
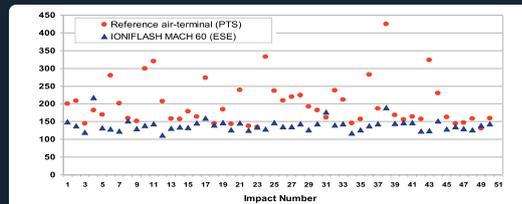
- Experimental assembly
- Recording of the climatic parameters
- Measure of the efficiency

RESULTS AND TEST REPORTS

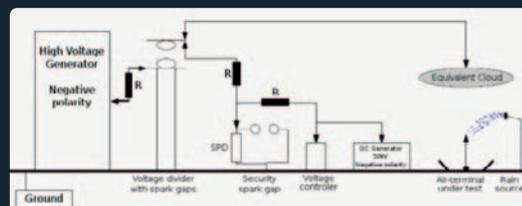
Test according to EN 50164-1, prescribed by NFC 17-102 ed.2011 High current test 100 kA (waveform 10/350)



Early streamer emission test according to EN 61180-1, prescribed by NFC 17-102 ed. 2011



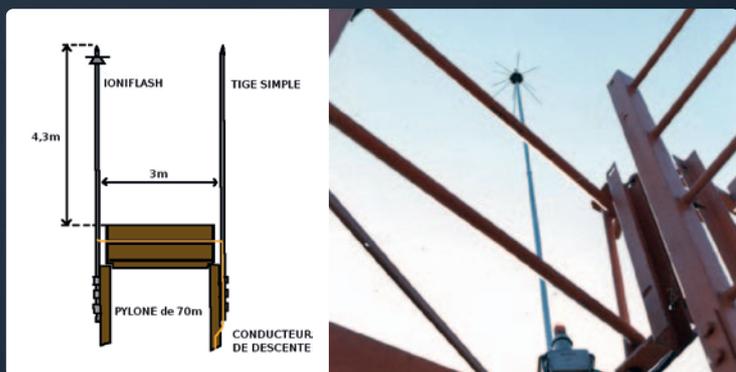
Insulation test according to IEC 60060-1



EXPERIENCE FEEDBACKS

IN SITU TESTS – Tests in real conditions of lightning

Several test campaigns were carried out between 1988 and 2011 in France and abroad. Two of them still continue. The results of the first tests (below) on the IONIFLASH were published and are available at the IEEE.



ESE air terminal compared with simple rod

IN SITU TEST - FRANCE TELECOM

PUYBEAUBIER SITE (FRANCE) – ALT. 879 METERS – JUNE 1988

Hertzian pylon of 70 meters – very struck by lightning. Installation of the IONIFLASH® ESE air terminal and a simple rod at 3 meters away from one another, common height of 4.30 meters at the top of the pylon.

Results recorded by France Telecom : **several impacts on the IONIFLASH® – 0 impact on the simple rod**



ESE air terminal in extreme climatic conditions

IN SITU TEST - HIGH MOUNTAIN RESORT

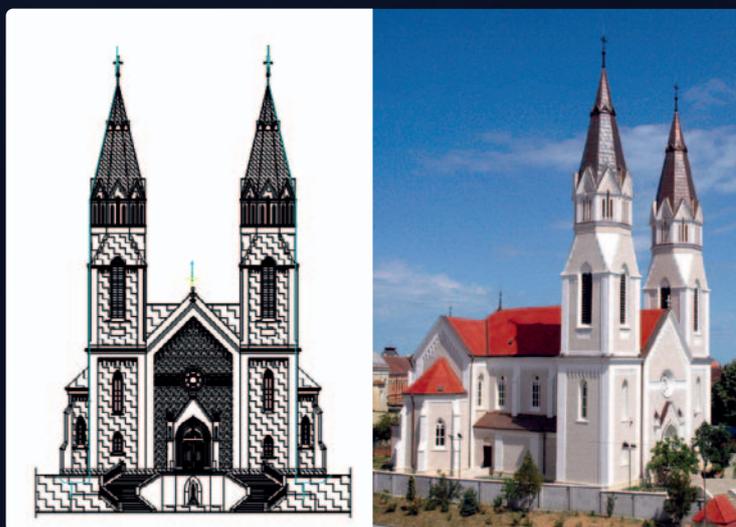
SUPERBESSE SITE (FRANCE) – ALT. 1804 METERS – APRIL 2009

The target : to validate the performance of the materials used, as well as the behaviour of the IONIFLASH MACH® in extreme climatic conditions :

- Winds > 150 km/h
- Temperatures : - 35°C / + 40°C
- Installation on pylon of radiotelecommunication – height of 15 meters

The mechanical resistance and in temperature of materials of the IONIFLASH MACH® in extreme climatic conditions is perfect.

The lightning strike counter IONICOUNT® records the events.



ESE air terminal compared with simple rod

IN SITU TEST

SATU MARE CHURCH (ROMANIA) – JUNE 2011

The target : to observe the early streamer emission of the IONIFLASH MACH® facing a simple rod both installed in the same conditions.

The church has two spires : the IONIFLASH MACH® is installed with equidistance of the simple rod (dimensioned such as defined in the NFC 17-102 Standard).

The lightning strike counter IONICOUNT® records the events.

INSTALLATION STANDARDS



PROTECTION RADIUS IONIFLASH MACH®

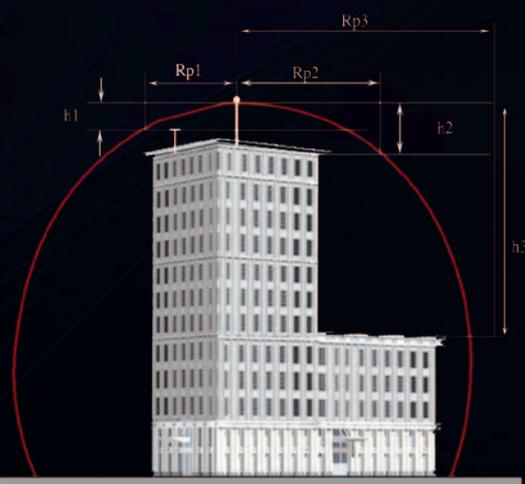
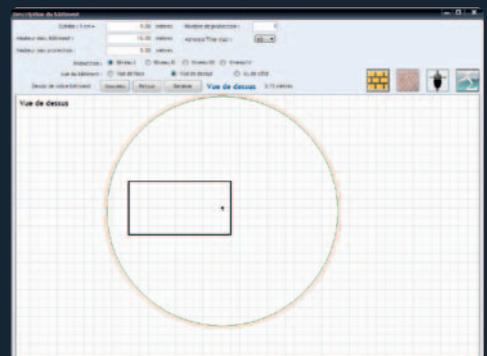
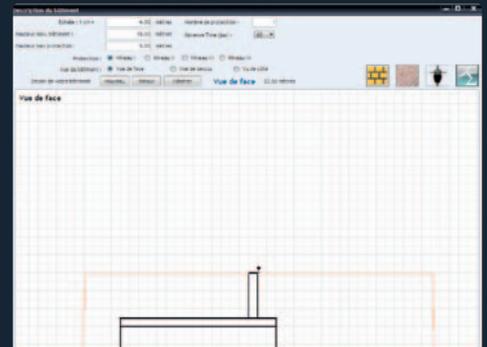
The protection radius (Rp) of a ESE air terminal depends of the height of its installation in relation to the surface to be protected, its early streamer emission (Δt) and the level of protection chosen.

Height in meters		Security %	2	3	4	5	6	10	15	20	30	45	60	
Level I	MODELS													
	IONIFLASH MACH NG15	73%	13	19	25	32	32	34	35	35	34	24		
	IONIFLASH MACH NG25	68%	17	25	34	42	43	44	45	45	44	37	21	
	IONIFLASH MACH NG30	66%	19	29	38	48	48	49	50	50	49	43	30	
	IONIFLASH MACH NG45	61%	25	38	51	63	63	64	65	65	64	60	51	
	IONIFLASH MACH NG60	56%	31	47	63	79	79	79	80	80	79	76	69	
Level II	MODELS													
	IONIFLASH MACH NG15	73%	15	22	30	37	38	40	42	44	45	42	34	
	IONIFLASH MACH NG25	68%	20	29	39	49	49	51	53	54	55	53	46	
	IONIFLASH MACH NG30	66%	22	33	44	55	55	57	58	59	60	58	52	
	IONIFLASH MACH NG45	61%	28	42	57	71	71	72	73	74	75	73	69	
	IONIFLASH MACH NG60	56%	35	52	69	86	87	88	89	89	90	89	85	
Level III	MODELS													
	IONIFLASH MACH NG15	73%	18	27	36	45	46	49	52	55	58	60	58	
	IONIFLASH MACH NG25	68%	23	34	46	57	58	61	63	65	68	70	68	
	IONIFLASH MACH NG30	66%	25	38	51	63	64	66	69	71	73	75	73	
	IONIFLASH MACH NG45	61%	32	48	64	81	81	83	85	86	89	90	89	
	IONIFLASH MACH NG60	56%	39	58	78	97	97	99	101	102	104	105	104	
Level IV	MODELS													
	IONIFLASH MACH NG15	73%	20	31	41	51	52	56	60	63	69	73	75	
	IONIFLASH MACH NG25	68%	26	39	52	65	66	69	72	75	80	84	85	
	IONIFLASH MACH NG30	66%	28	43	57	71	72	75	78	81	85	89	90	
	IONIFLASH MACH NG45	61%	36	54	72	89	90	92	95	97	101	104	105	
	IONIFLASH MACH NG60	56%	43	64	85	107	107	109	111	113	116	119	120	

The level of protection is given using the NFC 17-102 Edition 2011, EN 62305-2 or UTE 17-108 guide. If the site presents a risk for the environment, the protection radius must be reduced of 40%.

IONEXPERT 3000® SOFTWARE

The IONEXPERT 3000® software developed by France Paratonnerres enables you to carry out the lightning risk analysis and the installation of protection devices.



For $2m \leq h \leq 5m$

$$R_p(h) = h \times \frac{R_p(5)}{5}$$

For $h \geq 5m$

$$R_p(h) = \sqrt{h(2r - h) + \Delta(2r + \Delta)}$$

where :

$R_p(h)$ (m) corresponds to the protection radius for a stated height (h). h (m) corresponds to the height of the tip of the ESE air terminal in relation to the horizontal point passing through the top of the element 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

The experience shows that Δ is equal to the efficiency obtained during the evaluation tests of the ESE air terminal.

$$\Delta (m) = \Delta T(\mu s) \times 10^6$$

ΔT = Early streamer emission time of the ESE air terminal obtained with laboratories tests.



OUR REFERENCES

40 YEARS OF EXPERIENCE WITH PRESTIGIOUS REFERENCES

More than 20 000 protected sites



Cathedral Notre Dame de Paris – France



Photovoltaic Central – France



Amman Airport – Jordania



Ariane 5 space rocket launch pad – Kourou - Guyana



Beijing Forbidden City – China



Cable ship – Atlantic

FRANCE PARATONNERRES, A WORLD-WIDE COMPANY

GEOGRAPHIC LOCATION



France Paratonnerres is located in Limoges (87) at 1 hour from Paris by plane and 3 hours from Paris by train

France Paratonnerres has its own Research and Development Department and devotes a significant budget to the innovation through strong partnerships with Scientific Laboratories and Research Centers.



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