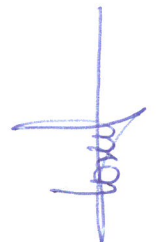




TEST REPORT	
UNE 21186:2011//NF C17-102:2011 Lightning protection: Early streamer emission lightning conductor	
TEST REPORT	IE-ITE-150419/M3/EN
Customer: Address:	Lightning Protection International Pty Ltd Patriarch drive, 49, Hungtingfield Tas, 7055, Australia
Test specification: Standard/s: Test procedure: Deviations: Non-standard test method:	UNE 21186:2011// NF C17-102:2011 PE-ITE-21186 N/A N/A
Sample description: Date of receipt:	Stormaster 60 SS 2015-04-14
Period of tests:	2015-05-19 / 2015-06-10
Issued by: INSTITUTO TECNOLÓGICO DE LA ENERGIA (ITE)	Testing location: <input checked="" type="checkbox"/> Edificio Institutos 8A, U.P.V. Camino de Vera, s/n 46022 Valencia (Spain) <input type="checkbox"/> Parque Tecnológico de Valencia – Av. Juan de la Cierva, 24 – 46980 Paterna (Spain)
Performed by: Jorge Moreno	 Job title: Lab Technician
Reviewed by: Lorena Jiménez	 Job title: High Voltage and Materials Department Manager
The results contained in this report, in accordance with requested tests, refers exclusively to the objects under test identified therein. Tested in the manner and date indicated in this report.	
Reproduction partial of this document is not allowed without permission from ITE. This report cancels and replaces the test report IE-ITE-150419/M2/EN	

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1 General Characteristics

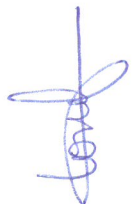
1.1 Guarantees

The Instituto Tecnológico de la Energía (ITE) guarantees the accuracy of the data and results presented in this document obtained from the measurements of the equipment tested on the dates and under the conditions here established.

The ITE guarantees information confidentiality as regards test results. All data related to the tested item and testing procedure will be confidential.

1.2 Important observations

1. Reproduction of this report is only allowed whenever the result be the exact copy from the original and the procedure be fully developed.
2. This report cannot be modified or reproduced partially without the permission of ITE.
3. This test report is only concerned with the specific items under testing, whose code is indicated in this document.
4. This test report only refers to the requested tests that are reflected in this document.
5. This test report, by itself, does not constitute or imply in any way an approval of the product by the ITE, by a certification body or any other body.
6. This test report will not be used either fully or partially by the customer or by anybody authorized by the customer, for promotion or commercial purposes, whenever ITE considers it inappropriate.
7. The accuracy of the data which are referred to in this document as *data provided by customer* will be the customer's own responsibility.
8. The reliability of the Certificates and Specifications presented in this document as *offered by the customer* will be customer's own responsibility.
9. ITE is not responsible for the accuracy of certificates and statements of compliance provided by the customer.



10. Possible test verdict:

Device under test meets the requirements: P (Pass)
Device under test doesn't meet the requirements: F (Fail)
The test doesn't apply to the device under test: N/A

2 Sample data

Early streamer supplied by the customer:

Sample ref.	Name, logo or manufacturer trademark	Product reference	Early streamer efficacy: Δt (in μs)	Serial number
ME-ITE-150419/01	LPI	Stormaster 60 SS	63,1	11147



3 Tests performed

The requested tests are operation assessment tests of an ESE lightning conductor.

Table 1 contains a summary of the tests results.

Annex A contains the results of performed tests and Annex B contains sample drawings.

SECTION OF STANDARD UNE 21186:2011 / NF C17-102 :2011 / NP 4426 :2013 (Annex C)	Test	Verdict	Not performed
C.3.1/-/-	General Tests		
C.3.1.1/-/-	Documentation, information and identification	P	
C.3.1.2/-/-	Marking	P	
C.3.2/-/-	Mechanical tests		
C.3.3/-/-	Environmental testing		
C.3.3.1/-/-	Salt mist test	P	
C.3.3.2/-/-	Humid sulphurus atmosphere test	P	
C.3.4/-/-	Withstand current test		
C.3.5/-/-	Advance time test		
C.3.5.3/C.3.5.2.4/ C.3.5.2.4	Determination of ESE advance time	P	

Table 1

4 Additional information

The expanded uncertainties associated with the results of the measures, are estimated a coverage factor $k = 2$, which means, for a confidence level of approximately 95%. They have been estimated from the contributions set in the corresponding test procedures identified.



ANNEX A. TEST RESULTS



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A.1. General Tests (Par. C.3.1 UNE 21186:2011//NF C17-102:2011)

Test: **Documentation, information and identification (C.3.1.1)**
Test conducted by inspection, through the examination of the information identified in the product.

Acceptance criteria: *The early streamer has passed the test if the information identified in the product is correct.*

Testing date: 2016/06/28

Tested Sample	Test topics			RESULT
ME-ITE-150419/01	Name, logo or manufacturer trademark.	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	<input checked="" type="checkbox"/> Complies <input type="checkbox"/> Non-complying
	Product reference	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	
	ESE lightning conductor efficacy: Δt (in Δs)	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	
	Serial number	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	

Test performed by: Jorge Moreno and Angel Medina
Job title: Lab Technicians

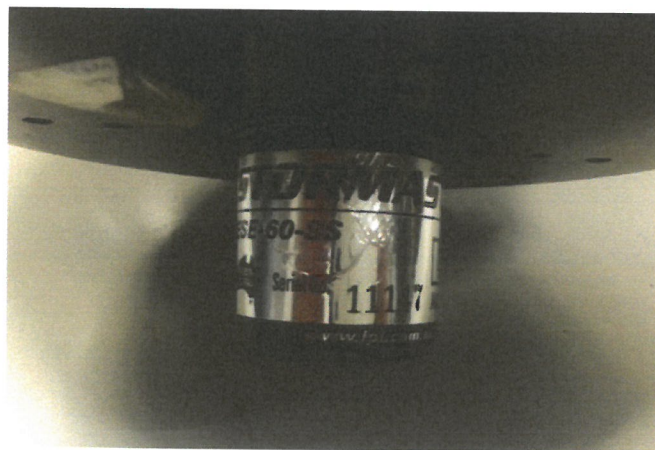


Figure 1. ESE's marking.

Test: **Marking (C.3.1.2)**
Test carried out in, all types of marking except those made by etching or molding, rubbing manually the marks for 15 s with a cloth soaked in water and then for 15 s with a cloth soaked in solvent.

Acceptance criteria: *The early streamer has passed the test if the marking is legible.*

Testing date: 2016/06/28

Tested Sample	Test topics		RESULT
ME-ITE-150419/01	Marking type	Sticker	<input checked="" type="checkbox"/> Complies <input type="checkbox"/> Non-complying
	Test performed	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	



Figure 2. ME-ITE-150419

The ESE's marking is engraved on its body (LPI) and also printed on a sticker in the lower part.

Test performed by: Jorge Moreno and Angel Medina
Job title: Lab Technicians

A.2. Mechanical tests (Par. C.3.2 UNE 21186:2011//NF C17-102:2011)

Test: **Mechanical tests (C.3.2)**
Checking the dimensional tolerances according to the manufacturer's data and drawings.

Acceptance criteria: *The early streamer has passed the test if the measured dimensions are within the range of the dimensions and its tolerances according manufacturer drawings.*

Testing date: 2016/06/28

Tested sample: ME-ITE-150419/01					
Dimensional features of parts of the ESE capturing lightning					
Material	Solid	A (mm²)	A_{min} (mm²)	∅ (mm)	∅_{min} (mm)
-	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	452	200	24	16
Checking of the dimensional characteristics					
Dimension to verify	Draw measurement	Units	Measured result	Dimension ± Tolerance ac./draw	
Tip	85	mm	85	S/T	
ESE body's height	240	mm	240	S/T	
ESE body's maximum width	215	mm	215	S/T	
ESE base's height	-	mm	35	S/T	
Result of test:					
<input checked="" type="checkbox"/> Complies					
<input type="checkbox"/> Non-complying					

S/T: Tolerance not specified

$$S = \pi * r_{pc}^2 = \pi * (24/2)^2 = 452,4 \text{ mm}^2$$

$$S = \pi * (A_{e2} - A_{i2}) = \pi * ((25/2)^2 - (23/2)^2) = 75,39 \text{ mm}^2$$

Test performed by: Jorge Moreno and Angel Medina
Job title: Lab Technicians



A.3. Environmental testing (Par. C.3.3 UNE 21186:2011//NF C17-102:2011)

Test: **Salt mist test (C.3.3.1)**
Test conducted according to the UNE-EN 60068-2-52; except sections 7, 10 and 11 which are not applicable, with a severity degree two (three periods of salt spray of 2 hours each, followed by a storage under humidity conditions of 20 to 22 hours after each of them).

Acceptance criteria: -

Testing date: 2015-05-19 / 2015-05-22

Tested sample	Remarks
ME-ITE-150419/01	<input type="checkbox"/> The sample shows signs of corrosion <input checked="" type="checkbox"/> The sample doesn't show signs of corrosion

Test performed by: Jose Luis Martinez
Job title: Lab Technician



Test: **Humid sulphurus atmosphere test (C.3.3.2)**
Test conducted according to UNE-EN ISO 6988 with 7 cycles and SO2 concentration of 667 ppm (by volume).

Acceptance criteria: -

Testing date: 2015-05-25 / 2015-06-03

Tested sample	Remarks
ME-ITE-150419/01	<input type="checkbox"/> The sample shows signs of corrosion <input checked="" type="checkbox"/> The sample doesn't show signs of corrosion

Test performed by: Jose Luis Martinez
Job title: Lab Technician



A.4. Withstand current test (Par. C.3.4 UNE 21186:2011//NF C17-102:2011)

Test: **Withstand current test (C.3.4)**
Test conducted after environmental preconditioning and without cleaning the sample. Then sample is subjected to the current surge test (I_{imp}).

Acceptance criteria: *The early streamer has passed the test if the registration of the voltage / current and visual inspection does not reveal any indication of damage or perforation of the sample, except for the parts that lead the lightning current where emission lines and surface melting can occur.*

Testing date	Temperature(°C)	Relative Humidity (%)	Barometric pressure (mbar)
05/06/2015			
Start	22,82	46,8	1023,6
End	23,2	45,4	1022,8

Tested sample	Impulse No.	I_{peak} (kA) [100 kA ± 10%]	Q (A.s) [50 A.s ± 20%]	W/R (kJ/Ω) [2500 kJ/Ω ± 35%]
ME-ITE-150419/01	1	91,194	54,9	2566,00
	2	93,734	46,3	2146,00
	3	93,695	40,5	1810,00
Visual Inspection	<input checked="" type="checkbox"/> It reveals no indication of damage or perforation of the sample <input type="checkbox"/> In the parts that lead the lightning, current emission lines and surface melting appears <input type="checkbox"/> Reveals damage or perforation of the sample			
Result	<input checked="" type="checkbox"/> Complies <input type="checkbox"/> Non-complying			

Test performed by: Manuel Martinez and Angel Medina
Job title: Lab Technicians



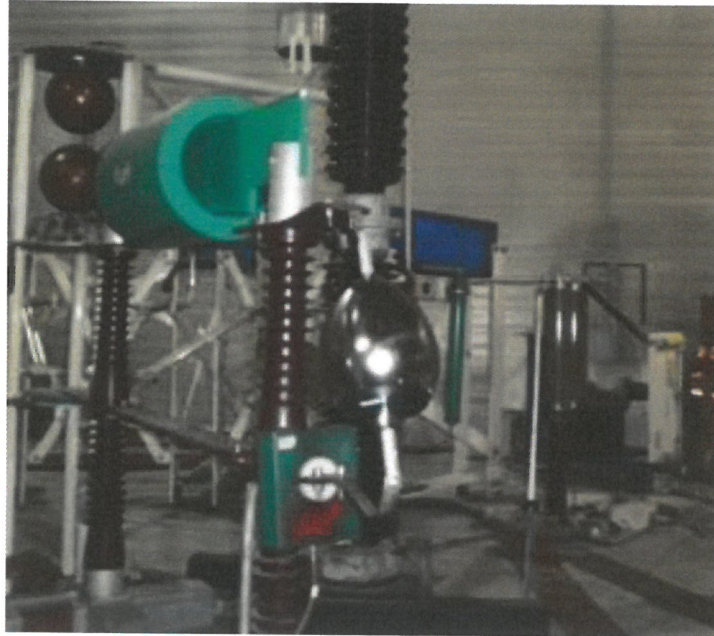


Figure 3. Electric Test.

A.5. Advance time test (Par. C.3.5 UNE 21186:2011//NF C17-102:2011)

Test: **Determination of ESE advance time (C.3.5.3 UNE 21186 :2011 / C.3.5.2.4 NF C17-102 :2011)**

The advance time is determined relative to a reference wave defined by a rise time $T_s = 650$ ms and as defined in the standard.

Acceptance criteria: The tested sample is an early streamer emission lightning rod if:

- $T_{PDC} < T_{PR}$
- $\sigma_{PDC} < 0,8 \sigma_{PR}$
- $T_{PR} - T_{PDC} \geq 10 \mu s$

Testing date	Temperature (°C)	Relative Humidity (%)	Barometric pressure (mbar)
10/06/2015			
Start	24,7	62,4	1017,1
End	25,4	58,1	1016,7

Test voltage to be applied U_{100} (kV) = 521,52

Continuous polarization voltage (kV) = 50



ME-ITE-150419/01				Reference rod (PR)			
Shoot no.	T _{ESE} (μs)	Shoot no.	T _{ESE} (μs)	Shoot no.	T _{PR} (μs)	Shoot no.	T _{PR} (μs)
1	128,94	26	125,44	1	154,54	26	138,50
2	116,81	27	123,44	2	140,54	27	155,07
3	113,74	28	137,64	3	144,51	28	138,24
4	108,95	29	124,51	4	147,11	29	138,17
5	106,74	30	109,02	5	128,32	30	130,77
6	132,18	31	101,57	6	148,20	31	167,47
7	120,41	32	106,27	7	147,27	32	151,44
8	112,80	33	112,74	8	120,57	33	171,24
9	128,44	34	113,91	9	140,17	34	134,21
10	108,96	35	111,84	10	185,13	35	143,87
11	147,74	36	122,64	11	152,51	36	170,87
12	111,34	37	135,41	12	158,34	37	163,67
13	113,47	38	117,40	13	157,47	38	146,74
14	110,30	39	122,14	14	120,60	39	155,74
15	118,87	40	123,87	15	109,31	40	138,80
16	111,70	41	126,87	16	164,74	41	120,67
17	139,04	42	125,95	17	148,00	42	179,44
18	122,20	43	118,24	18	109,77	43	150,60
19	102,12	44	125,28	19	136,20	44	145,10
20	109,44	45	114,77	20	107,37	45	128,74
21	126,84	46	112,74	21	138,37	46	133,14
22	117,51	47	108,88	22	130,58	47	155,01
23	122,84	48	119,18	23	132,37	48	127,68
24	108,10	49	110,40	24	130,87	49	173,77
25	110,04	50	108,76	25	149,57	50	139,47
Average instant of initiation time (T' _{ESE}) μs			118,17	Average instant of initiation time (T' _{PR}) μs			144,02
Deviation (σ _{PDC})			9,887	Deviation (σ _{PR})			17,528
Initiation time (T _{PDC}) μs			328	Initiation time (T _{PR}) μs			391,1
Advance time ΔT (μs):		63,1		Measurement uncertainty (μs):		28,7	
Specified limits:		<ul style="list-style-type: none"> • $T_{PDC} < T_{PR}$ • $\sigma_{PDC} < 0,8 \sigma_{PR}$ • $T_{PR} - T_{PDC} \geq 10 \mu s$ 					
Test result:		<input checked="" type="checkbox"/> Complies		<input type="checkbox"/> Non-complying			

Test performed by: Manuel Martinez and Angel Medina
Job title: Lab Technicians

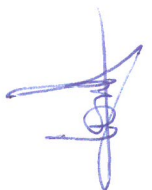




Figure 4. Early Emission Test

ANNEX B. DRAWINGS



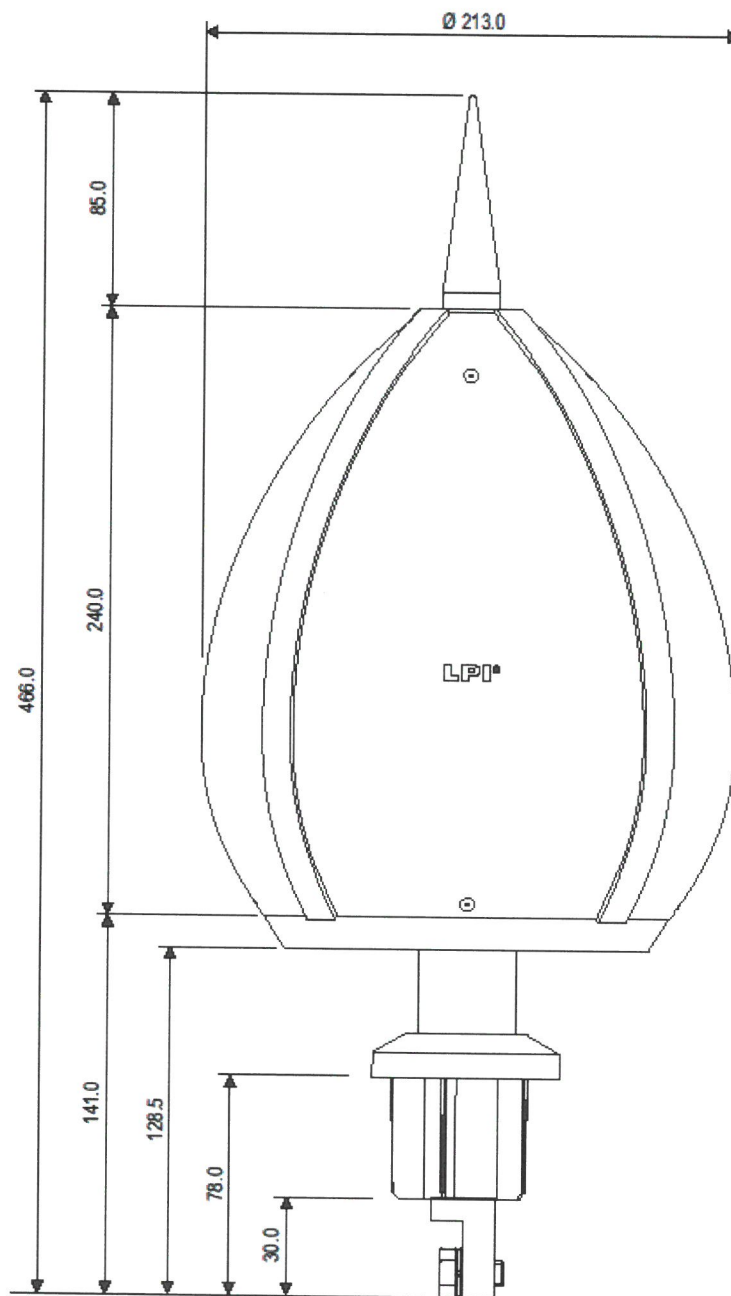


Figure 5. ESE's descriptive drawing.

