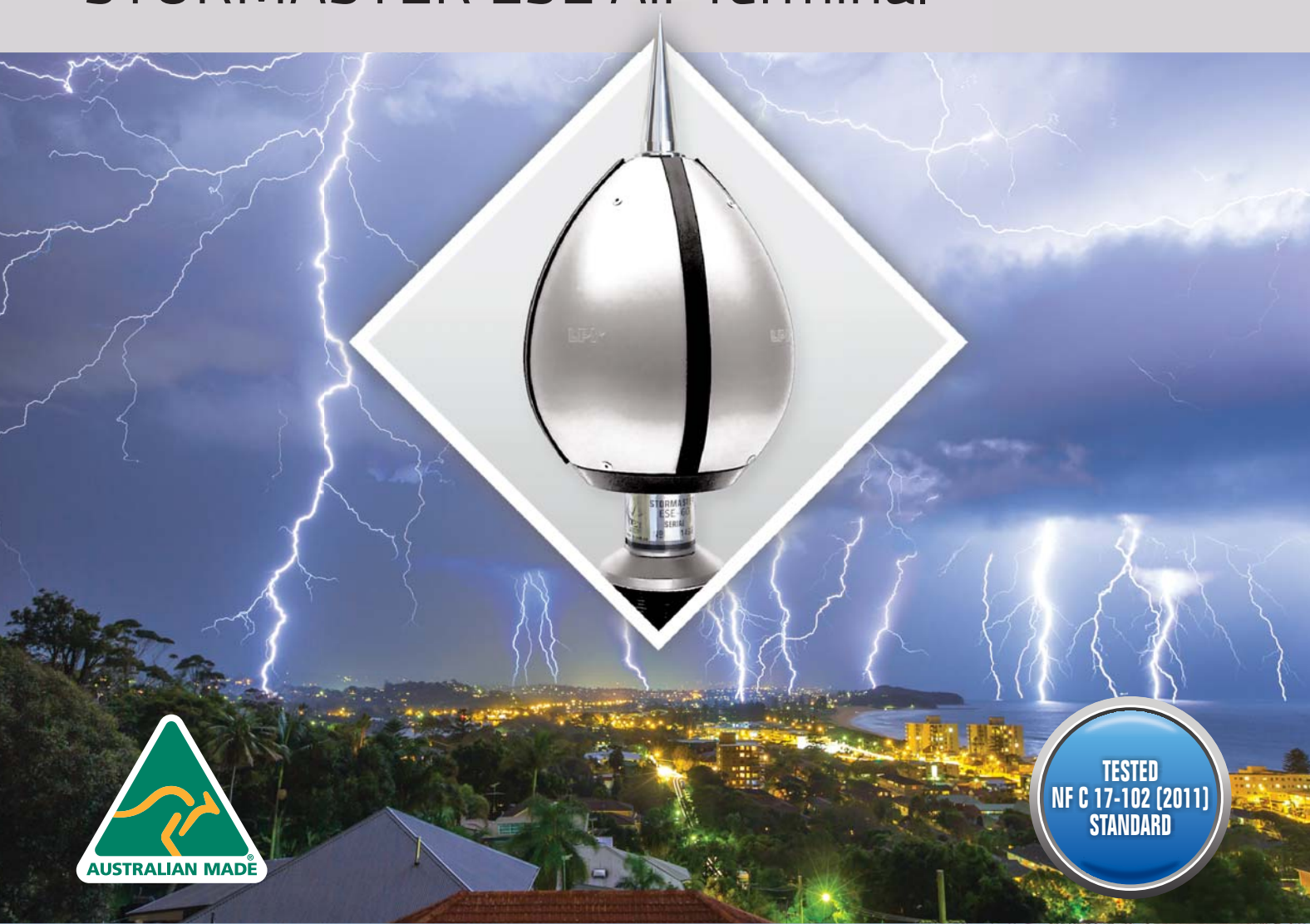
LIGHTNING PROTECTION INTERNATIONAL PTY LTD

# STORMASTER ESE Air Terminal



AUSTRALIAN MADE

TESTED
NF C 17-102 (2011)
STANDARD

LPS Installer

APS


## The LPI story

Lightning Protection International Pty Ltd (LPI) is a fully Australian owned manufacturer and supplier of direct strike lightning protection, transient voltage surge suppression, and earthing / grounding solutions.

For many years, LPI have been providing specialist lightning protection advice to customers in some of the most lightning prone areas of the world. Our personnel have extensive experience in risk management, system design, training, installation, certification, and commissioning of systems in a wide variety of industry groups.

LPI maintains a third party Quality Management System to AS/NZS

ISO 9001:2008.

LPI's range of products and services are exported from its head office and research facility (in Tasmania, Australia) and via regional offices worldwide.

The company has been recognised within Australia for its outstanding export successes and has been awarded several prestigious export awards.

### Our system design approach includes:

1. Definition and provision of area protection
2. Creation of a bonded earthing system
3. Protection of mains power lines
4. Protection of signal, data and communication lines

## LPI's 4-Step Approach to Lightning Protection

It is the strategic aim of our company to be able to provide a complete packaged solution. LPI has identified 4 key steps when considering the complete approach to lightning protection, ask for our LPI 4 Step approach to lightning protection.

EXPORT AWARD WINNER

Australian Standard

ISO 9001 Quality Management

Approvals: IEEE IEC

## Lightning & the need of safety

Lightning is one of the most devastating natural phenomena. There are many discharges during lightning storms and some of them can even reach hundreds of kilo amperes. The electrical discharges are a great hazard to people, animal, buildings and electronic equipments. The economic consequences of lightning are also very important; it can cause fire, stop production of a factory or interrupt critical processes. A direct lightning discharge lasts a very short time but the intensity is enough to provoke electrocution resulting in heart failure and causing burns of different degrees to the human beings. Lightning is a constant hazard where the buildings and equipments are becoming more complex and sensitive every day. One lightning strike discharge can damage the buildings and cause failures to the electronic devices inside the building and sometimes it may even results in fire and important economical losses.

Until now, there is no device that can prevent lightning formation or lightning strikes. However, it is possible to create a path (divert) for the lightning discharge to the ground which will minimise the damage to the environment through a well designed Lightning Protection System (LPS). The lightning protection should be considered preferably during the initial stage of the building/structure design which has 4 basic objectives:

1. Capture lightning.
2. Conduct lightning current to earth avoiding damage.
3. Disperse lightning current in the ground quickly and safely.
4. Avoid the secondary effects of lightning (surge/temperory overvoltages)

## The phenomena of lightning

During the formation of a cumulonimbus (cloud forming a towering mass with a flat base at fairly low altitude and often a flat top, as in thunderstorms), there is an increase of ionisation and a potential difference is generated between the thunder cloud and the ground, which gives rise to small discharges.

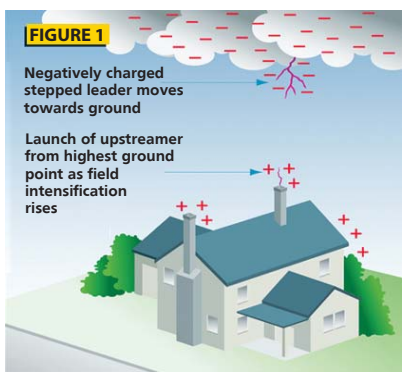
As the electric field gains in strength, the descending leader breaks up the dielectric field in the air.

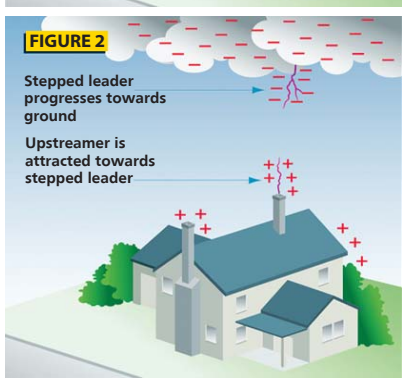
Ultimately, this may break through the layers of dielectric field in the air and strike the surface via the upward propagating tracer from the surface.

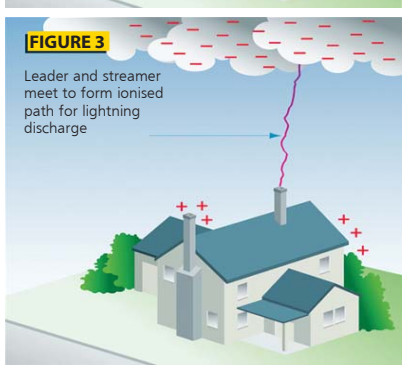
In normal conditions there is a balance between positive and negative charges in the atmosphere, where the ground is more negatively charged than the air and the elements placed on the ground.

However, the formation of storm clouds creates a charge polarization; usually, the lower part of the cloud is charged negatively, inducing then a positive charge at the ground and other elements on it. The electric field at the atmosphere can reach kilovolts in a short span of time.

When the electric field is high enough, the cloud starts discharging towards the ground. The path formed by this discharge is called "downward leader" and produces a very sharp variation of the electric field, causing the corona effect. One of these objects/structure will be forming the upward leader, which will move towards the downward leader thus forming the discharge path between the cloud and the ground. This object/structure will be hit with the lightning strike. The cloud charge will try to find the straightest/shortest path to earth and if this path is not controlled, damages can be severe.




Electrical effects: Damages/destruction to the electrical & electronic equipments. Abnormal rise in ground voltage and surges/transients can damage all the equipment connected to the electrical network.

Electrodynamical effects: Structure/building damages. The conductors & equipments which falls within the vicinity of the flow of lightning current are submitted to mechanical strengths due to the magnetic field originated. This may cause deformations and rupture the conductors & equipments.

Thermal effects: Lightning strikes can lead to fires. Heat dissipation by the Joule effect can even cause fires.

Effects on living beings: Electrocutions and burns. Currents passing through during a short lapse are enough for electrocution risk by respiratory or cardiac arrest. Further burn risk appears.

Induction effects: Within a variable electromagnetic field, induced currents appear in every conductor.

The consequences of all these effects are important economical losses because of the damages in buildings and equipment due to lightning strike. Lightning can cause service interruptions, stops production processes or force to switch off and on again the utility machinery if the control equipment is affected by lightning.

## LPI's Stormaster ESE

The LPI Stormaster (Early Streamer Emission) range of terminals provides a safe and efficient system for the protection of your facility from direct lightning strikes. The LPI Stormaster ESE terminal captures the lightning energy at a preferred point.

## How does the LPI Stormaster ESE Terminal work?

The Stormaster ESE air terminal uses the naturally occurring electrical field to complete the timely release of an upward streamer. This process provides for a safe and efficient method of controlling dangerous lightning energy at a preferred point.

As a thunderstorm gathers overhead, the ambient electrical field surrounding the Stormaster ESE begins to rise in voltage. Upon the approach of a downward leader towards the protected area, there is a rapid increase in the electric field which initiates the triggering of an upward streamer from the Stormaster ESE terminal. The early initiaton allows for a larger or enhanced area of protection to be provided by the Stormaster ESE in comparison to a conventional rod, in accordance with NF C 17-102 (2011).

With the release of the upward streamer from the finial tip earlier than other competing structural points, the Stormaster ESE terminal becomes a preferred point for the capture of the lightning discharge within the protected area.

## The Stormaster ESE range

LPI Early Streamer Emission (ESE) air terminals in both **Anodised Aluminium** and **Stainless Steel.**

**Ordering Code:**

STORMASTER ESE-**XX-YY-ZZ**

**XX:** Available in 15, 30, 50 and 60

**YY:** Blank for Gold (anodised aluminium) model, **SS** for stainless steel model

**ZZ:** Blank for standard model (to FRP Mast), **GI** for 2 inch BSP GI pipe adaptor

**Stormaster ESE Tester:**

Ordering Code: Stormaster-ESE-Tester

## Certified Performance

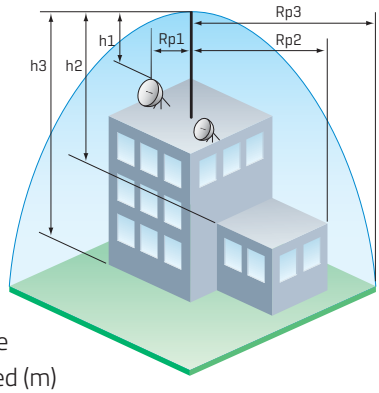
As one of the leading companies in the field of lightning protection, LPI has invested heavily in field and laboratory testing as part of its ongoing commitment to research and development.

Throughout the product development of the Stormaster ESE, the proto-type models were subjected to intense testing under high voltage conditions. Following further refinements, the Stormaster terminals were subjected to final testing by an independently accredited test laboratory which completed testing in full compliance with the French National Standard NF C 17-102 (2011). The final testing of Stormaster ESE terminals showed effective performance as defined in this Standard.


**All Stormaster terminals tested by the ITE HV laboratory in Europe, which has national (ENAC) and international (ILAC / ISO IEC) accreditation.**

## Protection Performance

The protection radius (Rp) of a Stormaster ESE terminal is calculated using the following formula as defined in NF C 17-102 (September 2011), namely:




$Rp(h) = \sqrt{2rh - h^2 + \Delta(2r + \Delta)}$ **for h ≥ 5 m**

and

$Rp = h \times Rp_5 / 5$ **for 2 ≤ h < 5 m**

where **h** = Stormaster height relative to the area being protected (m)

**$Rp_5$** = value of Rp from Eqn. (1) when h = 5 m

**r** = 20 m for protection level I (Very High protection)
30 m for protection level II (High protection)
45 m for protection level III (Medium protection)
60 m for protection level IV (Standard protection)

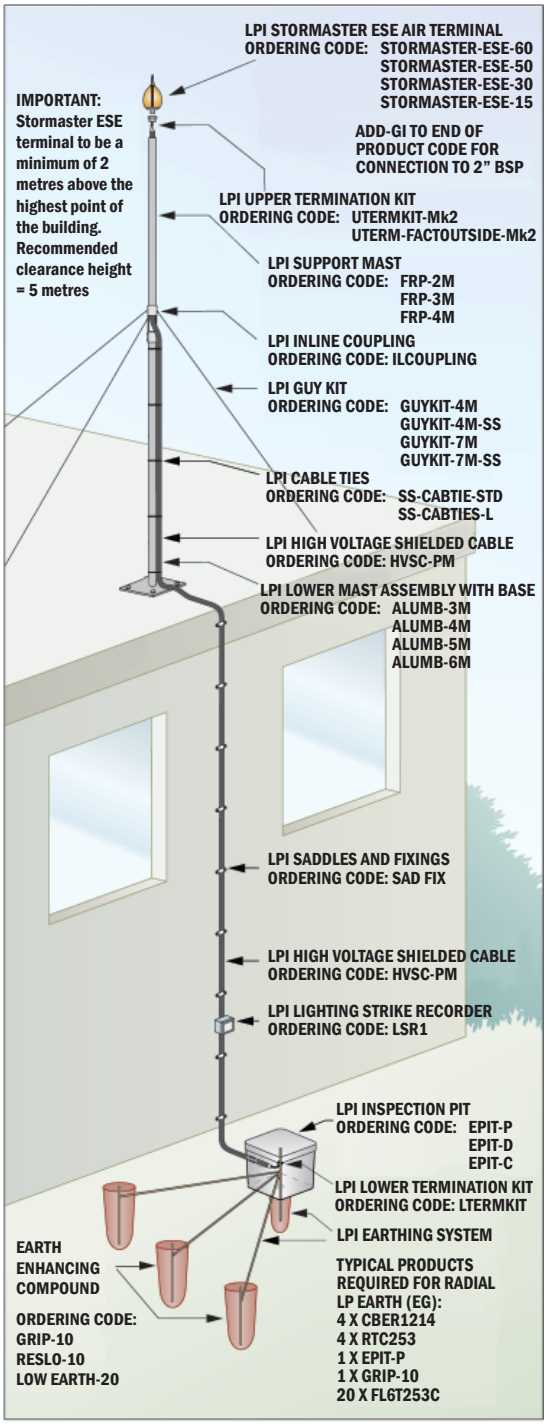
and $\Delta$ = Stormaster time and height advantage according to the Stormaster model installed:

Choices: Stormaster ESE 15 SS: $\Delta$ = 15 µs
Stormaster ESE 30 SS: $\Delta$ = 30 µs
Stormaster ESE 50 SS: $\Delta$ = 50 µs
Stormaster ESE 60 SS: $\Delta$ = 60 µs

**PROTECTION RADIUS $R_P$(m)**

| h = height of Stormaster ESE terminal above the area to be protected (m) | 2 | 4 | 5 | 6 | 10 | 15 | 20 | 45 | 60 | 80 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Protection Level I (Very High) | | | | | | | | | | | |
| Stormaster ESE 15 SS | 13 | 25 | 32 | 32 | 34 | 35 | 35 | 35 | 35 | 35 | 35 |
| Stormaster ESE 30 SS | 19 | 38 | 48 | 48 | 49 | 50 | 50 | 50 | 50 | 50 | 50 |
| Stormaster ESE 50 SS | 27 | 55 | 68 | 69 | 69 | 70 | 70 | 70 | 70 | 70 | 70 |
| Stormaster ESE 60 SS | 31 | 63 | 79 | 79 | 79 | 80 | 80 | 80 | 80 | 80 | 80 |
| Protection Level II (High) | | | | | | | | | | | |
| Stormaster ESE 15 SS | 15 | 30 | 37 | 38 | 40 | 42 | 44 | 44 | 44 | 44 | 44 |
| Stormaster ESE 30 SS | 22 | 44 | 55 | 55 | 57 | 58 | 59 | 59 | 59 | 59 | 59 |
| Stormaster ESE 50 SS | 30 | 61 | 76 | 76 | 77 | 79 | 79 | 79 | 79 | 79 | 79 |
| Stormaster ESE 60 SS | 35 | 69 | 86 | 87 | 88 | 89 | 89 | 89 | 89 | 89 | 89 |
| Protection Level III (Medium) | | | | | | | | | | | |
| Stormaster ESE 15 SS | 18 | 36 | 45 | 46 | 49 | 52 | 55 | 60 | 60 | 60 | 60 |
| Stormaster ESE 30 SS | 25 | 51 | 63 | 64 | 66 | 69 | 71 | 75 | 75 | 75 | 75 |
| Stormaster ESE 50 SS | 35 | 69 | 86 | 87 | 88 | 90 | 92 | 95 | 95 | 95 | 95 |
| Stormaster ESE 60 SS | 39 | 78 | 97 | 97 | 99 | 101 | 102 | 105 | 105 | 105 | 105 |
| Protection Level IV (Standard) | | | | | | | | | | | |
| Stormaster ESE 15 SS | 20 | 41 | 51 | 52 | 56 | 60 | 63 | 73 | 75 | 75 | 75 |
| Stormaster ESE 30 SS | 29 | 57 | 71 | 72 | 75 | 78 | 81 | 89 | 90 | 90 | 90 |
| Stormaster ESE 50 SS | 38 | 76 | 95 | 96 | 98 | 100 | 102 | 109 | 110 | 110 | 110 |
| Stormaster ESE 60 SS | 43 | 85 | 107 | 107 | 109 | 111 | 113 | 119 | 120 | 120 | 120 |

## Stormaster Installation




### Disclaimer

- LPI maintains a policy of on-going product development, specifications are subject to change without notice.
- Application detail, illustrations and schematic drawings are representative only and should be used as guides.
- It should be noted that 100% protection for direct strike lightning, lightning detection and surge and transient protection equipment is not possible and cannot be provided due to the lightning discharge process being a natural atmospheric event.

## LPI HVSC Plus

Figure 1. : Construction of the HVSC Plus

LPI's "High Voltage Shielded Cable" (HVSC Plus) is a purpose-designed, high-integrity, low-impedance cable that is used to safely convey lightning currents to earth with minimal risk of side flashing or structure electrification. The design of the HVSC incorporates carefully selected dielectric components to ensure optimum performance under the impulse or "transient" voltages and currents imposed by lightning discharges.

- Double the voltage withstand performance of past versions;
- 35% reduction in the mass per unit length of the cable;
- Improved manufacturing consistency via a "triple extrusion" process;
- Reduced voltage stress via thin, semi conductive screen layers; and
- Improved material parameters and performance.

The design of the cable is based on the optimisation of all of the key parameters associated with dealing with lightning discharges and the subsequent voltage and current transients, including impedance, inductance, capacitance, insulation thickness (withstand voltage) and all of the relevant lightning statistics, plus practical aspects such as size, flexibility and mass.

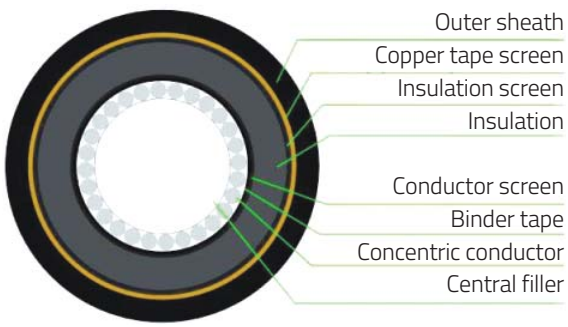



Figure 1 : Construction of HVSC Plus

| Product Ordering Code: | HVSCPLUS-PM or HVSCPLUS-500 |
|---|---|

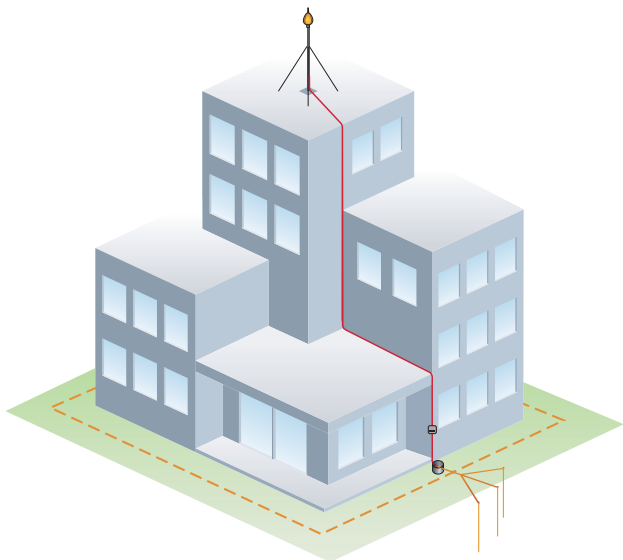
**Physical Specifications:**

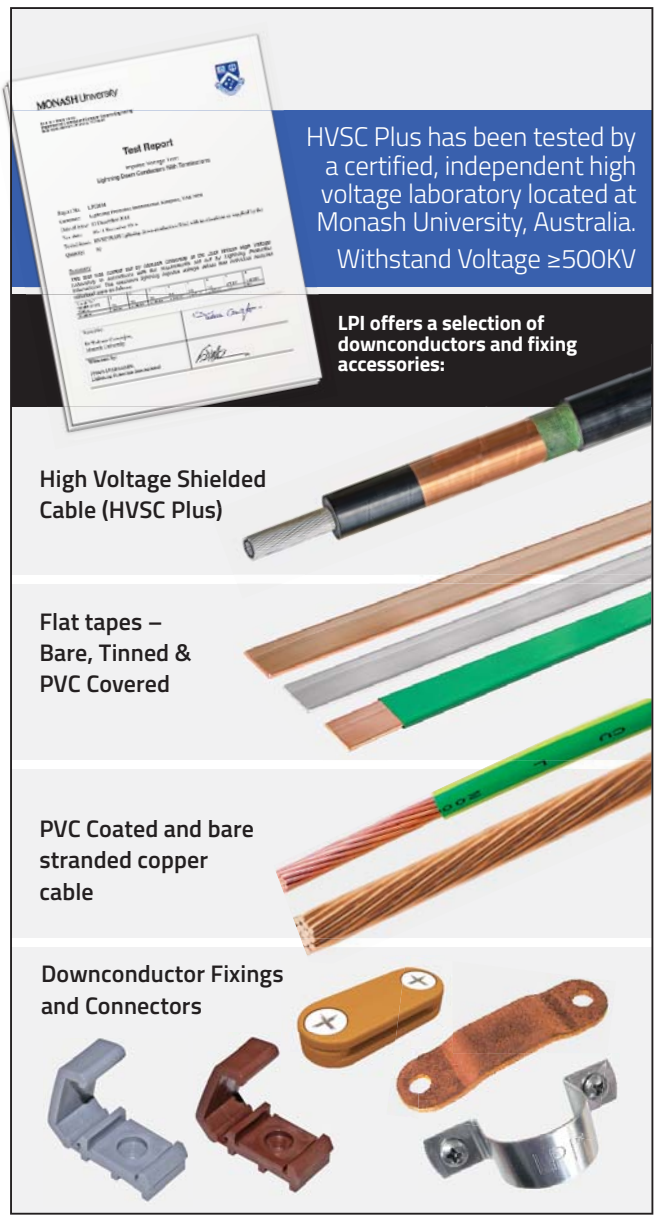
| | |
|---|---|
| Mass per unit length | 1.34 kg/m |
| Construction | Triple Extruded |
| Concentric Conductor Material | Aluminium |
| Concentric Conductor XSA | ≥ 70 mm² |
| Insulation | 5 mm (nominal) of XLPE |
| Metallic Screen | Copper Tape |
| Outer Sheath | 3 mm (nominal) of PVC |
| Cable Diameter | 36 mm |
| Min. bending radius before installation | 430 mm |
| Min. bending radius after installation | 358 mm |

**Electrical Specifications:**

| | |
|---|---|
| Conductor DC resistance @ 20°C | 0.641 Ω/km |
| Conductor DC resistance @ 90°C | 0.821 Ω/km |
| Insulation Resistance @ 20°C | 5000 MΩ |
| Inductance | 93 nH/m |
| Capacitance | 285 pF/m |
| Impedance | 18 Ω |
| Withstand Voltage (1.2/50 μs impulse) | ≥ 500 kV |

## Downconductors





## LPI FRP Mast

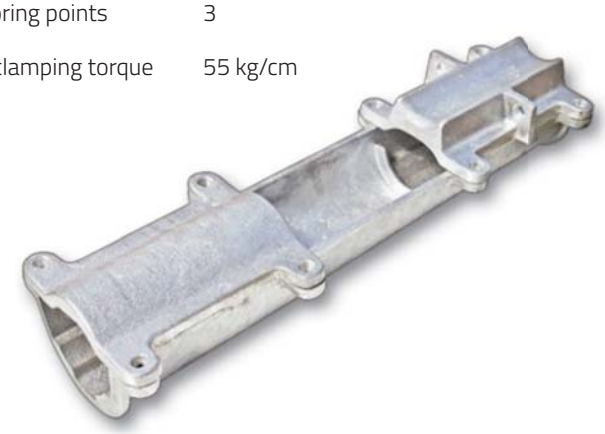
LPI Fibreglass Reinforced Plastic (FRP) mast is an insulated and water resistant mounting pole which is designed to provide the necessary electrical isolation and mounting strength at the position where the high voltage upper termination between the HVSC Plus downconductor and LPI Stormaster terminal is completed.

| **Description** | **Fibreglass Reinforced Pole (FRP)** |
|---|---|
| Color | Black |
| Material | Fibreglass |
| Construction type | Pre-impregnated reinforced epoxy resin laminate (flame retardant) |
| Resin tensile strength | 70 MPa |
| Resin tensile modulus | 2.0 GPa |
| Resin tensile strain | 2.7% |
| Resin poisson ratio | 0.35 |

## LPI Inline Coupling

LPI Inline coupling is a purpose-designed coupling which enables clamping of the FRP mast to the aluminium lower mast. The inline coupling provides 3 guy anchoring points and provides an exit point for the HVSC Plus.

| **Ordering code** | **ILCOUPLING** |
|---|---|
| Description | Inline Coupling |
| Material | Cast aluminium |
| Dimension | 550 mm x 150 mm x 120 mm |
| Weight | 2.7 kgs |
| Anchoring points | 3 |
| Max. clamping torque | 55 kg/cm |



## Lightning Strike Recorder (LSR1)


LPI Lightning Strike Recorder (LSR1) is a lightning strike counter. The LSR1 is simply mounted at any location along the downconductor route. Its purpose is to record the number of strikes captured and conveyed by the downconductor.

When the lightning rod receive an impact of the lightning strike, discharge counter detects the energy dissipated by the down conductor, thereby incrementing the number.

The LSR1 operates by sensing current by means of an inductive pick up loop. With the voltage impulse detected by the current transformer (CT) a trigger to the pulse counter then turns the counter to register the lightning event.

The equipment does not require either external or internal power supply, as it is electromechanical and uses the power of the induced current dissipated through the down conductor.

**Features**

- 7 Digits
- IP 67 enclosure
- Up to 9,999,999 counts
- Testable using LSR-Tester

| **Ordering Code** | **LSR1** |
|---|---|
| Description | Lightning strike recorder |
| Current sensitivity | 1500 A 8/20 μs impulse |
| Operating range | Min. 1500 A and Max. 220 kA 8/20 μs |
| Display | Mechanical 7 digits display (not re-settable) |
| Dimension | 100 mm (B) x 100 mm (H) x 55 mm (D) |
| Weight | 0.57 kg |
| Mounting | Releasable UV resistant plastic cable ties suitable for up to ø40 mm cable or 50 x 5 mm flat tape |
| Construction | Polycarbonate enclosure |
| Colour | Light grey & blue |
| Environment | IP 67 (IEC 529) |
| Operating temperature | -15°C to + 85°C |

# Earth Termination System

One earth termination per downconductor and two electrodes per termination. Earth resistance should be less the 10 Ω. Avoid a single excessively long horizontal or vertical component (>20 m) in order to minimise the inductive voltage drop. Hence, deep vertical electrodes are discouraged unless the surface resisttivity is very high. Direct electrodes outwards / away from the structure. For average soils, electrodes should be at least 2 m from any buried metal pipe or electrical conduit. For soils with resistivity over 500 Ωm, the minimum distance should be 5.

Two types of earthing systems are prescribed:

**TYPE A**

- Crows foot buried to a minimum depth of 50 cm
- Set of vertical rods with a minumum (total) length of 6 m buried at least 50 cm, with rod seperation of at least the buried depth.

**TYPE B**

- Ring earth around the structure which is in contact with the soil for at least 80% of its length.
- Foundation earth electrode (on basis of at least 50 $mm^2$ cross-sectional area)
- Base of each downconductor must also have a $\geq$ 4 m radial or $\geq$ 2 m rod

For difficult earthing conditions, the following suggestions are made:

- Use an earth enhancing material in accordance with EN 50164-7
- Add rods to the crow's foot arrangement.

## Earth Rods

Copper bonded (threaded or unthreaded), Solid Copper or Stainless Steel. Copper bonded earth rods are made from high-tensile low-carbon steel and each rod is manufactured by molecularly bonding 99.9% pure electrolytic copper to the low-carbon steel core in accordance with national and international standards such as BS651, BS7430 and UL467. Threads are rolled onto the rod, ensuring an even copper covering which eliminates the risk of chipping whilst driving.

## LPI RESLO


The requirement for a low resistance is extremely important with the installation of any earthing system. LPI's RESLO provides the ability to dramatically reduce soil resistivity even in soils with average electrical conductivity. LPI RESLO is supplied in 10 Kgs packaged bags to suit the site application.

RESLO comprises specifically selected compounds, which possess excellent electrical conductivity. When RESLO is mixed with water and poured around the earthing system and surrounding soil, the powder and water react to form a hardened mass within an earthing system. RESLO will not wash away under seasonal conditions and therefore provides a permanent presence in working to improve and maintain the integrity of an earthing system. Given that RESLO does not wash away the requirement to re-treat the soil as is the case with other enhancing compounds is eliminated.

## LPI GRIP


The requirement for a low resistance is extremely important with the installation of any earthing system. LPI's GRIP provides the ability to substantially reduce soil resistivity in soils of the poorest electrical conductivity such as rocky ground or sandy soils. LPI GRIP is supplied in two kit sizes -

A 10 Kgs kit comprises two 5 Kg containers; one 5 Kg kit contains a copper compound whilst the other 5 Kg kit holds a mix of compounds which assist in the mixing process (Hardener). When GRIP is mixed with water and poured around the earthing system and surrounding soil, the powder and water react to form a gelatinous hygroscopic mass which forms an integral part of an earthing system, this effectively increases the surface area of the earthing system in contact with the surrounding soil.

GRIP will not wash away under seasonal conditions and therefore provides a permanent presence in working to improve and maintain the integrity of an earthing system. Given that GRIP does not wash away the requirement to re-treat the soil is eliminated.

## Advantages of the Stormaster ESE Terminal

A typical Stormaster ESE installation consists of a single Stormaster ESE terminal with an enhanced area of protection and downconductors connected to a dedicated earthing system designed to have a low impedance to lightning.

- LPI's Stormaster ESE system is simple to install and requires no special maintenance.
- LPI's Stormaster ESE system is a cost- effective lightning protection solution whilst providing superior safety.
- The Stormaster ESE range of terminals have been fully tested in accordance with NF C 17-102 (2011) in a high voltage laboratory, under high current impulses and environmental chambers.

## NF C 17-102 (2011) The New Standard

NF C 17-102 is written specifically to ensure compliance with regard to the testing, application and installation of ESE terminals. The new standard, issued in 2011, is deemed to be applicable to structures of any height and for the protection of open areas. The previous version of the standard, first published in 1995, has been cancelled by the French standards organisation UTE and conformity with that version ceased in September 2012.

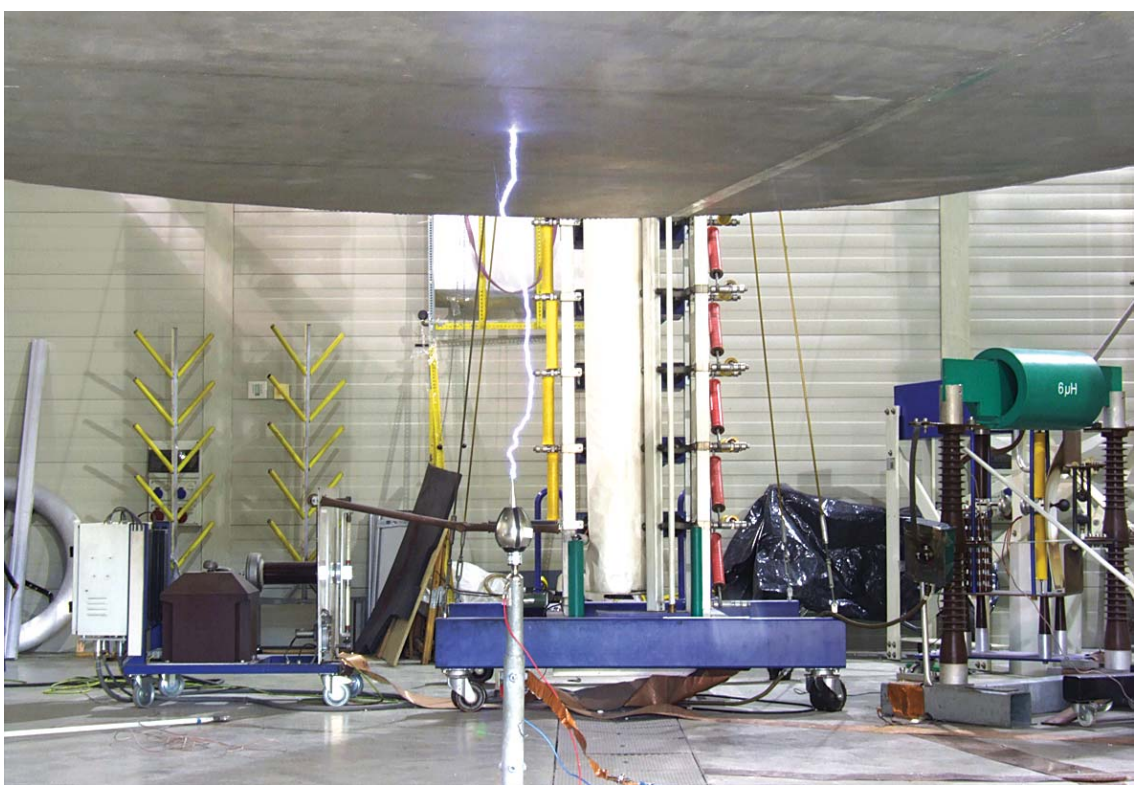
NF C 17-102 (2011) includes much more stringent requirements when compared to the 1995 version. The main differences are as follows:

- There are now four protection levels rather than the previous three levels.
- There are two new enhanced sub-levels for protection level I (levels I+ and I++).
- Protection of structures taller than 60 metres is now allowed and there are special rules with regard to strike interception and downconductors. The top 20% of tall buildings needs to be protected.
- Some simple rules regarding downconductors, commonly two, are needed, but one of them can be the natural components of the structure.
- The earlier ban on coaxial insulated downconductors has been removed, but any use of insulated conductors has to follow the separation distance requirements per the IEC 62305 standards.

## Research and Development

LPI has an ongoing commitment to Research and Development.

LPI personnel and its associates have been involved in a number of field trials in the most lightning prone regions of the world. This experience has extended throughout such countries as Australia, India, Indonesia, Sri Lanka, the USA and South Korea.




Testing of the Stormaster Terminal: ITE HV Laboratory, Spain (Europe)

# HIGH VOLTAGE TESTING REQUIREMENTS

**French Standard NF C 17-102**
**September 2011**
**Early Streamer Emission Lightning Protection Systems**

## Introduction

Early Streamer Emission or "ESE" air terminals (hereafter simply abbreviated "ESEAT") were conceived by French manufacturers in the 1980's to generate an upward streamer earlier than a traditional lightning conductor, or "Franklin Rod" (FR). This "time advance" characterises the effectiveness of such equipment according to French standard NF C 17-102. The time advance can be measured relatively easily in a high voltage laboratory against a specific test procedure.

The effectiveness of an ESEAT is defined by its "radius of protection". The radius of protection depends on a number of factors, described below. From a practical or market viewpoint, a study report published by INERIS by INERIS in October 2001 notes that:

- Certain claimed ESEAT's are not tested in a HV laboratory although the manufacturer claims conformity with NF C17-102;
- Certain models of ESEAT have never been tested to ensure they can handle large lightning currents;
- The effectiveness of protection claimed by certain manufacturers, who refer to standard NFC 17-102, has never been verified on actual installations; and
- The capacity of the ESEAT to capture lightning is claimed, but superiority in the radius of protection compared to a Franklin rod is not specified.

### Scope

NF C17-102 is specifically written on the testing, application and installation of ESE terminals. Since the release of the 2011 version of this standard, ESEAT protection is now deemed to be applicable to structures of any height and for the protection of open areas. Note that the previous version of the standard, first published in 1995, has been cancelled by the French standards organization UTE. Technical and legal conformity with that version ceased in September 2012.

### ESEAT Efficiency

The efficiency of an ESEAT is characterised by its time advance, ΔT, the magnitude of which is established in well-defined test procedure carried out in a high voltage laboratory. According to the standard, the maximum value allowable for ΔT, regardless of the best test results, is 60 µs. Protection of structures taller than 60 metres. Following IEC standard guidelines, NF C 17-102 requires additional protection for the top 20% of the structure for buildings greater than 60 m, or indeed any point above 120 m.

### Additional rules:

- ESEAT's or conventional protection means must be implemented at each façade wall according to a valid standard.
- A minimum of four downconductors, interconnected by a ring conductor when applicable, shall be used, distributed along the perimeter and if possible at each angle of the building.

## Main Ways to Identify Parties Making False Claims

- Check to make sure that the test laboratory is accredited (national authority) and that all test and measurement equipment is calibrated according to international standards.
- Check to make sure that all of the test report requirements have been met.
  a. **See Annex A for a checklist.**
- Check to make sure that all of the fixed test parameters are correct.

- Reference Franklin rod tip must have a 28 mm diameter, a tip radius of 1 mm and a tip length 90 mm;
- Air terminal height must be ≥ 1 metre with a measurement error of 1%;
- Plate-to-ground distance must be ≥ 2 metres;
- Smallest horizontal size of the upper plate is the distance between the plate and ground;
- Applied background electric field must be between -20 and -25 kV/m;
- Check to make sure that the breakdown voltage of the air gap (technically termed the "U100") has been determined correctly for the prevailing environmental conditions.
- The U100 must be obtained from U50 + 3 , where U50 is obtained via the procedure in IEC60060-1 and is the standard deviation of the U50 measurements;
- The prevailing environmental parameters (temperature, pressure and humidity) must also be recorded in the report, and shown not to vary by more than 10°C, 2% and 20% respectively.
- Check to make sure that all of the time advance (ΔT) test specifications have been satisfied, namely that the:
  - ΔT value must be obtained from a set of at least 50 impulses, where ΔT is referenced to a 650 μs waveform;
  - Standard deviation of the time-to-breakdown results must be less than 80% of that measured for the Franklin rod, i.e., $\sigma ESEAT < 0.8\ \sigma_{FR}$;
- Null (invalid) results have been excluded from the data set, i.e., Clause C.3.5.2.2 of NFC 17-102 (2011) states *"The waveform slope when the upward streamer initiates should be between 2 x $10^8$ and 2 x $10^9$ V/m/s".* Any data that shows breakdown occurred at a point on the waveform where the slope is outside this range must be excluded.
- Check that all other tests have been completed and the ESEAT has passed them.
- 100 kA (±10%) current withstand test using 10/350 μs waveform
- Environmental (salt spray and sulphide atmospheres) test
- Q 50 As (±20%) and W/R 2.5 MJ/Ω (±30%)

## *Annex A: Test Report Checklist*

NF C 17-102 (2011) imposes mandatory reporting requirements for the ESE test. Few listed as follows:

- Report Identification;
- A title or subject of the report;
- Name, address and telephone number of the test laboratory;
- Name, address and telephone number of the sub test laboratory where the test was carried out if different from company which has been assigned to perform the test;
- Unique identification number (or serial number) of the test report;
- Name and address of the vendor/manufacturer;
- Report shall be paginated and the total number of pages indicated;
- Date of issue of report;
- Date(s) of performance of test(s);
- Sample Description;
- Photographs, drawings or any other visual documentation, if available;
- Standards and References;
- Identification of the test standard used and the date of issue of the standard;
- Description of equipment used for every test conducted i.e. generator etc.;
- The measured, observed or derived results shall be clearly identified;
- The above shall be presented by tables, graphs, drawings, photographs or other documentation of visual observations as appropriate; and
- A statement of pass/fail identifying the part of the test for which the specimen has failed and also a description of the failure. This shall be illustrated by drawings, photographs or other documentation of visual observations as appropriate.

## *Conclusions*

- In order for any manufacturer to claim compliance with NF C 17-102 (2011) and hence legitimately sell an ESE air terminal, ALL of the above criteria must be met.
- It is well known in the market place that some or all of these criteria are not met for many of the ESEAT products being sold, in which case they cannot be claimed to comply with NFC 17-102 (2011)

# OUR CLIENTS LIST



## LIGHTNING PROTECTION INTERNATIONAL PTY LTD.

ABN 11 099 190 897

PO BOX 379 Kingston, Tasmania, Australia 7051
49 Patriarch Drive, Huntingfield, Tasmania, Australia 7055

- Telephone: *Australia:* 03 6281 2477
  *International:* +61 3 6281 2480
- Facsimile: +61 3 6229 1900
- Email: info@lpi.com.au
- Web: ***www.lpi.com.au***




*Distributed by:*


## ALLIED POWER SOLUTIONS

(ISO 9001:2008 & UL listed LPS installer)
T - 4, 5 & 6, 3rd Floor, Pankaj Plaza - 3
I.P. Extn., Patparganj, Delhi - 110 092
**t:** +91 11 2224 7322
**e:** info@alliedpowersolutions.com
**w:** www.alliedpowersolutions.org

**BENGALURU**
**m:** +91 98869 63195, 98860 08218

**KOLKATA**
**m:** +91 83348 95599