ECS

ENERGY CONTROL SYSTEMS

Protec ESE

EARLY STREAMER EMISSION TERMINAL

Installation Guide

Pro ESE Terminal Installation Guide

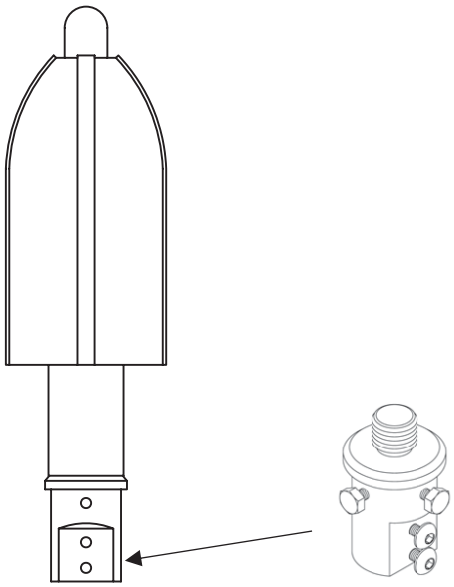
Table of Contents

Warranty

The warranty is limited to the cost of replacement of equipment providing it has been installed and/or certified by Protec Power Solutions Inc. or its authorized distributor. Protec Power Solution Inc. shall in no event be responsible for any loss of business or profits, downtime or delay, labor, repair or material costs or any similar or dissimilar consequential loss or damage incurred by the buyer. All other costs such as: insurance premiums, freight charges, loss of profit, and reinstallation of equipment are not included. Also specifically excluded from the warranty is any responsibility for other direct or indirect damages or death.

NOTE: *Protec Power Solutions Inc. shall in no event be responsible if the products have not been stored or used in accordance with its specifications and recommended procedures.*

Supplied Items



ProESE Terminal **Adaptor**

On Line Warranty Registration

www.protec-power.com

Model No. _____	Date of Installation:
Serial No. _____	ESE Tester Installed: Yes/No
Owner of the system _____	Strike Counter Installed: Yes/No
Electrical Engineer for the project ____	Earth system resistance: .....Ohms
Installation Contractor _____	Isolation Spark Gap Installed: Yes/No
Material purchased from _____	Power Line SPD Installed: Yes/No
Address of the project _____	Communication Line SPD Installed: Yes/No
Contact E-mail of facility manager ____	Data Line SPD Installed: Yes/No
Name _____	Coaxial SPD Installed: Yes/No
Email ID _____	Lightning Detector Installed: Yes/No

Warranty

Protec Power Solutions Inc or it's authorized reseller will not be responsible for any loss of business or profits, downtime or delay, repair or maintenance cost incurred due to direct or indirect affects of lightning strike. The warranty for the product is limited to the cost of replacement of the product only. The product is warrantied against manufacturing defects only for 5 years. The product must have been procured through Protec Power Solutions Inc or their authorized distributor and installed by a Protec Protec Power Solutions Inc authorized lightning protection installation contractor. All other costs such as damages incurred by the buyer, shipping and custom duties, re-installation of equipment and death of personal are excluded from this warranty.

Protec Power Solutions Inc shall not be responsible if the product has not been installed as per specifications or recommended procedures. Online registration should be complete within 60 days of installation. Records of two year inspection by authorized installation contractor records must be kept.

Warranty Registration

Quality Certificate

Date: _____	**Models**
Serial Number: _____	Pro ESE20, Pro ESE40, Pro ESE60

Test Certificate

Test report No. 8/4-1 from 28.02.2011

Applicant Protec Power Solution Inc.

Address One Commerce Center, 1201 Orange St., #600 Wilmington, New Castle, DE 19899, USA

Product EARLY STREAMER EMISSION TERMINAL

M/N Pro ESE Series

Applied Standards: NF C 17-102-1995 (Appendix C)

Brand Name Protec

The products have been tested by us in conformity with a procedure required by NF C 17-102-1995 (Appendix C). The ESE Terminal Pro ESE Series confirm such resultates:

ESE Type	Average time-to-breakdown for the ESE arrester, T_{ESE}, μs	Average time-to-breakdown for the reference arrester T_{LR}, T_{LR}, μs	Difference between the average times $T_{LR} - T_{ESE}$, μs	Triggering advance of the ESE, μs
Pro ESE 60	571,1	631,8	60,7	60,0
Pro ESE 40	589,9		41,9	41,0
Pro ESE 20	609,7		22,1	22,0

Note: Uncertainty associated to results ± 5 μs

Director R&D Institute "Molniya", Professor V. Kravchenko

Date: February, 28, 2011

The statement is based on an evaluation of three samples of above mentioned products. It does not imply an assessment of the whole production and does not permit the use of the Test laboratory logo.

Ministry of Science and Education of Ukraine
National Technical University "Kharkiv Polytechnic Institute"
Research & Design Institute "Molniya"
47, Shevchenko Street, Kharkiv, 61013, Ukraine

Protec Power Solutions Inc. certifies that the above noted product model with noted serial number has passed company internal quality control standards. The product has been tested by an independent authorized hi-voltage laboratory in accordance to the standards of NFC 17-102 & UNE 21186 and has also passed the 40kA multiple strike test.

Head of Quality Control
Protec Power Solutions Inc.

Quality Certificate

Protec ESE
Early Streamer Emission (ESE) Terminal

The principle of operation for ESE terminals is to create an upward propagating streamer earlier than conventional air terminals or other objects on the earth. Protec ESE does this by collecting and storing ground charge during the initial phase of a thunderstorm development and emits strong and consistent upwards streamers to intercept leaders.

Features

- Meets NFC 17-102 & UNE 21186 standards
- Tested to withstand multiple 40kA impulses
- High quality anti-corrosive and conductive coating
- Low wind resistance and light weight
- 5 years replacement warranty

Lightning Protection of Structures

As a general rule for protection, the object to be protected shall be in a LPZ whose electromagnetic characteristics are compatible with the capability of the object to withstand stress causing the damage to be reduced (physical damage, failure of electrical and electronic systems due to over-voltages).

Protection to reduce physical damage and life hazard :

The functions of the external LPS are

- to intercept a lightning flash to the structure (with an air-termination system),
- to conduct the lightning current safely to earth (with a down-conductor system),
- to disperse it into the earth (with an earth-termination system) and equalize potential between other earth-termination systems on site (with an isolation spark gap)

Four classes of LPS (I, II, III, IV) are defined as a set of construction rules.

Protection to reduce the failure of internal systems:

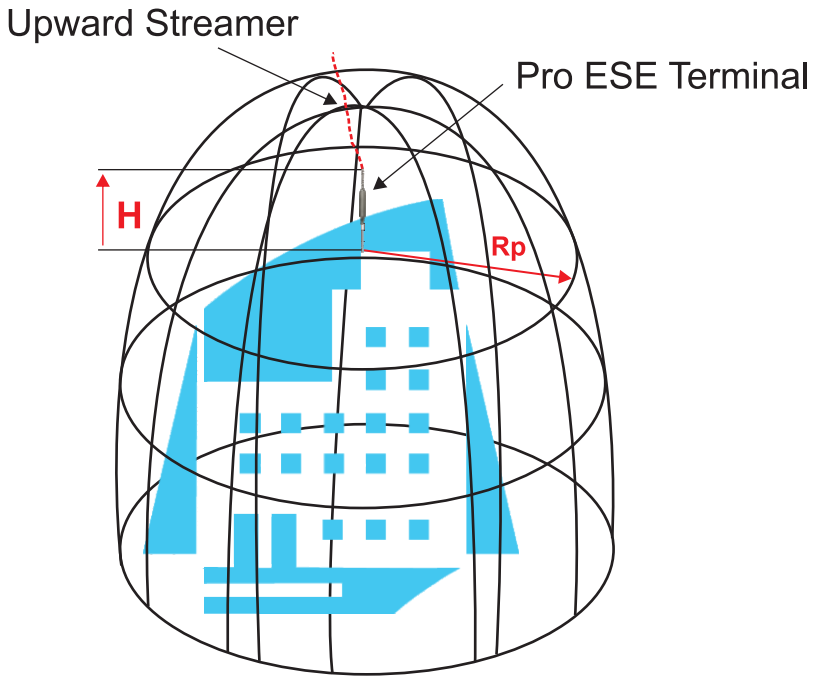
The protection against LEMP to reduce the risk of failure of internal systems shall limit:

- over-voltages due to lightning flashes to the structure resulting from resistive and inductive coupling;
- over-voltages due to lightning flashes near the structure resulting from inductive coupling;
- over-voltages transmitted by lines connected to the structure due to flashes to or near the lines;
- magnetic field directly coupling with internal systems

Effective protection against over-voltages, causing failures of internal systems, may be achieved by means of a "coordinated SPD protection", limiting over-voltages below the rated impulse withstand voltage of the system to be protected.

Radius of Protection

Radius of Protection (Rp) in Metres				
Protection Level	H (m)	Pro ESE 20 Rp	Pro ESE 40 Rp	Pro ESE 60 Rp
Level - I (R = 20)	2	13	25	31
	4	25	51	63
	6	32	63	79
	8	33	64	79
	10	34	64	79
Level - II (R = 30)	2	15	28	35
	4	30	57	69
	6	38	71	87
	8	39	72	87
	10	40	72	88
Level - III (R = 45)	2	18	32	39
	4	36	64	78
	6	46	81	97
	8	47	82	98
	10	49	83	99
Level - IV (R = 60)	2	20	36	43
	4	41	72	85
	6	52	90	107
	8	54	91	108
	10	56	92	109



Positioning & Height of ESE Terminal

The ESE Terminal tip should be at least 2 meters higher than the area that it protects, including antennae, cooling towers, roofs, tanks, etc. as per standard NFC 17-102. If the external installation for a given structure comprises several ESE Terminals these are to be interconnected by a suitable conductor, unless it has to be routed over a structural obstacle (cornice, parapet wall) with a positive or negative level difference in excess of 1.50m (see Fig. A).

When ESE Terminals protect open areas such as playing fields, golf courses, swimming pools, camping sites, etc., they should be installed on specific supports such as lightning poles, pylons, or any other nearby structures which enable the ESE Terminal to cover the area to be protected.

The ESE Terminal height may be increased by means of an elevated mast. If the ESE Terminal is steadied by conductive guy lines, these should be connected at the bottom attaching points to the down conductors by means of suitable conductors.

Preferred Installation Point

The architectural features favorable to the ESE Terminal installation should be taken into account during the lightning protection system design. Usually, these features are high structural points, such as:

- equipment rooms on flat roofs
- gables
- metal or masonry chimneys

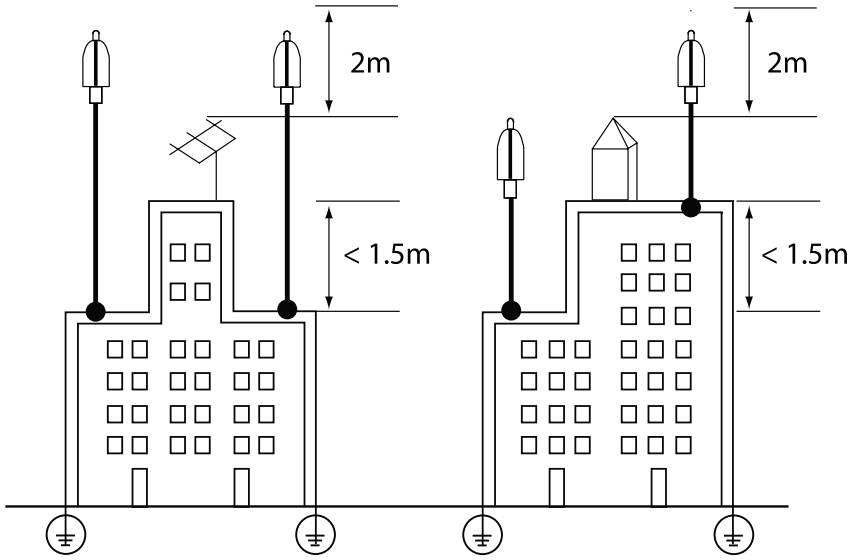


Fig. A

Pre-Installation Checklist

- ✶ Determine the best location for ESE Terminal(s), then the mounting method (tower, mast, structure, etc.) and the optimum routing of down conductor(s).
- ✶ Locate area(s) for grounding system installation and determine where the new system will be connected to any existing grounding system and metal bodies of conductance, etc.
- ✶ Verify that all parts and system components are compatible (dissimilar metals not allowed) and in good condition.
- ✶ Review installation plans, structural drawings, site drawings and mast erection instructions.
- ✶ Read this Installation Guide and familiarize yourself with all of the system components and functions.
- ✶ Be sure that all tools and equipment required for system installation are available and in good working order.
- ✶ Follow all industry guidelines and local/site requirements for safety and safety equipment.

Important Safety and Other Considerations

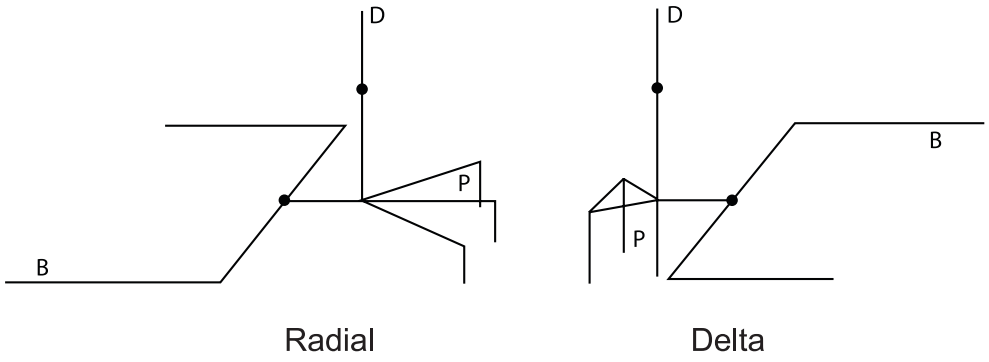
- ➢ If the ESE Terminal needs to be erected prior to connection to the grounding system, or immediate connection is not possible, connect the lower end of the down conductor to structural steel reinforcing or other suitable grounding point.
- ➢ Before installation of the grounding system, consult site drawings of underground services so that these are not damaged during installation of the grounding system.
- ➢ Where separate grounding systems exist, i.e.: structure, power, communications and/or lightning protection, they need to be bonded together to form an equipotential ground plane. This will help prevent ground loops and ground potential differences arising under transient conditions.
- ➢ Before service ground bonding takes place make sure proper authorization is obtained.
- ➢ Bonding cable must be 70sqmm (2/0AWG) minimum, depending on local standards. It may be necessary to use a grounding bus bar which bonds all grounds to the same potential under transient conditions.
- ➢ All local applicable standards, regulations and requirements necessarily apply.
- ➢ It is the responsibility of the customer/installer to label inspection/test wells or grounding systems to local requirements.

Stay clear of any overhead power lines.

Ground System Configurations

A ground resistance of less than10 Ohms is required for successful operation of the ESE Terminal. If, due to space constraints or high soil resistivity, it is not possible to readily install a grounding system as recommended, consult Protec Power Solutions Inc. for further advice. In order to meet safety and grounding system resistance requirements, Protec Power Solutions Inc. recommends the installation of a purpose designed and installed grounding system such as the radial (crow's foot) design or Delta design shown in Fig. B. Other configurations and materials are allowed, and may be required due to local conditions.

NOTE: Alternate grounding methods and designs are allowed by NF C 17- 102, and Protec Power Solutions Inc. is capable of designing a grounding system to meet any resistance goal in any type of soil.



D: Down-conductor
B: Building foundation loop ground
P: Grounding system

Fig. B - Recommended Grounding Configurations

1. Installation of the Grounding System

- Each radial should consist of a trench (approx. 50cm deep x 20cm wide x 10ft) length).
- A ground rod should be driven at the end of each radial.
- The use of copper conductor is recommended, with a cross sectional area of not less than 50mm^2. Tin-plated copper is recommended for its corrosion resistance.
- All rods should be interconnected through the use of at least 25mm x 2mm copper tape and ground rod clamps.
- The application of Protec ASEM soil enhancement material aids in the reduction of soil resistivity to the recommended level of less than 10 Ohms.

- A ground inspection/test well should be installed where the end of the down conductor terminates to the grounding system. This gives an access point for disconnection and future testing.

- Each down conductor should be provided with a means of disconnect for testing. These disconnect/test terminals may be located 2m above ground level and should be marked "Lightning Conductor" and the symbol:

Down Conductor Routing Guidelines

Copper tape is recommended for use as the down conductor, although building steel and alternate materials are also allowed. NF C 17-102 requirements should be strictly adhered to as regards materials and design requirements for number and placement of ESE Terminals and down conductors.

- The route of the down conductor should be as set out in the original design. Ensure no structural changes such as new antenna, mast installations, air conditioning towers or ducting has been installed.

- DO NOT double the down conductor back against itself after changes of direction (i.e. 180° bend).

- The down conductor may be installed internally or externally on the structure; however internal routing may reduce effectiveness and induce voltage surges into structures.

- The down conductor should be installed as close (flush) as possible to the structure.

- Minimize the number of bends and use the most direct route to the ground possible.

- Ensure recommended bend radius is maintained, never less than 20cm.

- If the down conductor has to cross other services make sure it crosses at right angles using a conduit that extends at least 1m past either side of the existing service.

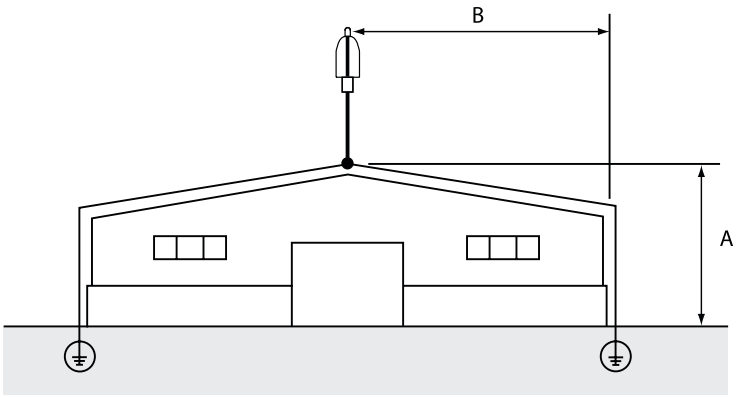
- The down conductor should be protected from damage at the lower end by installing a protective tube / conduit / guard pipe up to 2m from ground level.

- Provide adequate separation between down conductors, preferably opposite building corners.

Number of Down Conductors and Grounds

The number of down conductors is dictated by the height and width of the structure to be protected. Typically, structures of a height greater than 28 meters require two down conductors, as do structures where the height is less than the distance from the roof edge to the center of the structure where the terminal is to be located. See Figure C, below.

Protec Power Solutions highly recommends that when an ESE Terminal is located more than 2 meters from a structure edge, 2 down conductors are to be installed regardless of building height.



A > 28m or A<B = 2 down conductors

A: Vertical projection of down conductor
B: Horizontal projection of down conductor

Fig. C - Number of Down Conductors

Adaptor

Down conductors should be attached to the ESE Terminal using through adaptor as per Fig. D. This adaptor is integrated with ESE Terminal and as recommended in sections following.

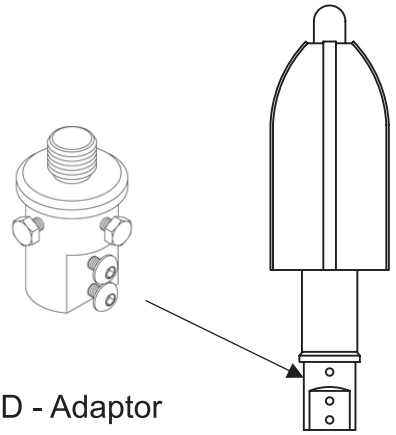


Fig. D - Adaptor

2. Down Conductor Installation

- ☐ The most direct path to ground is recommended, avoiding sharp bends.
- ☐ Down conductors should be installed around the outside walls of the structure.
- ☐ Any extended metal running vertically through the structure should be bonded to the down conductor at the top and bottom of the structure.

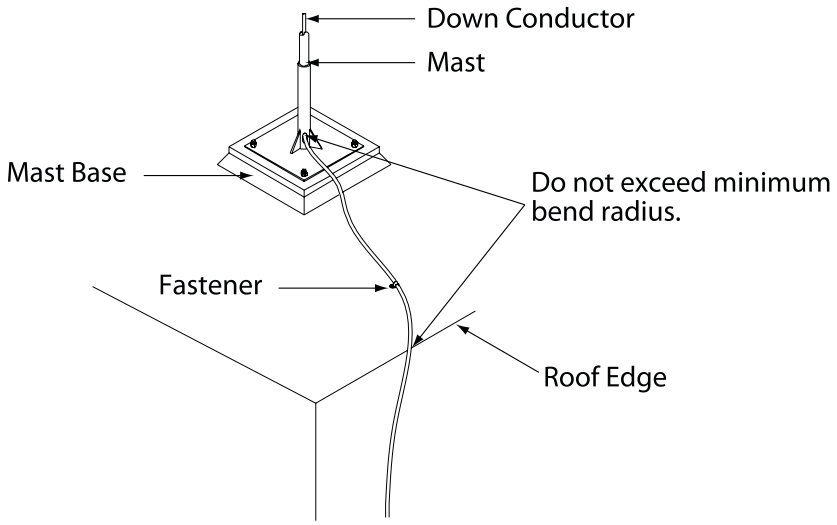


Fig. E - Down Conductor Routing Detail

- ☐ Each down conductor should be connected to the grounding system.
- ☐ Where practical all structural steel and metallic reinforcement in the structure should be bonded to the down conductor system.
- ☐ The use of copper conductor is recommended, with a cross sectional area of not less than 50mm^2. Tin-plated copper is recommended for its corrosion resistance.
- ☐ Recommended copper conductor size is 30mm x 2mm.
- ☐ The copper should be of a grade normally used for commercial electrical work. Do not use insulated coaxial cable.
- ☐ Suitably sized PVC insulated copper, bare aluminum and stainless steel may be used as down conductors (Please refer to NF C 17-102 standard for minimum material requirements).
- ☐ Suitable fasteners should be installed to secure all down conductors.
- ☐ Down conductors should be fastened on the basis of three points per meter (per NF C 17-102). Avoid trip hazards.

3. Termination of the Down Conductor

Lower End

Down conductor(s) should be directly connected to the grounding system through the use of a suitable ground rod clamp or by using exothermic welding.

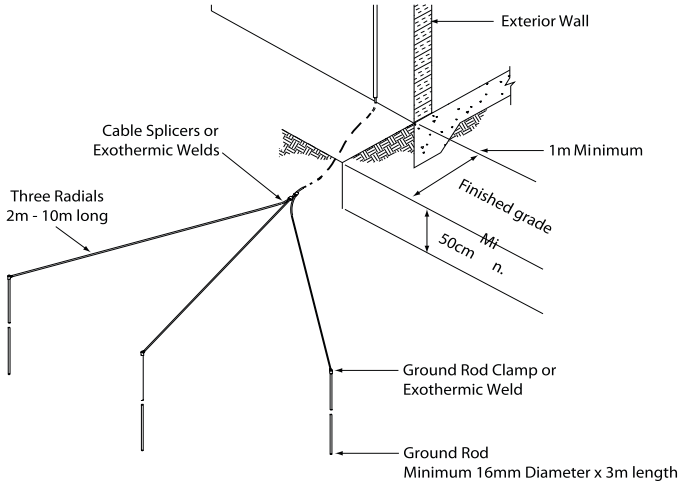


Fig. F - Down Conductor Lower End

Upper End

Each ESE Terminal comes supplied with the adaptor (Fig. G). This adaptor accepts either flat copper strip, or stranded copper wire.

- Flat copper strip attaches to the external "flat" side of the adaptor.
- Round/stranded copper wire is inserted into the hole in the base of the adaptor and secured with the two screws provide

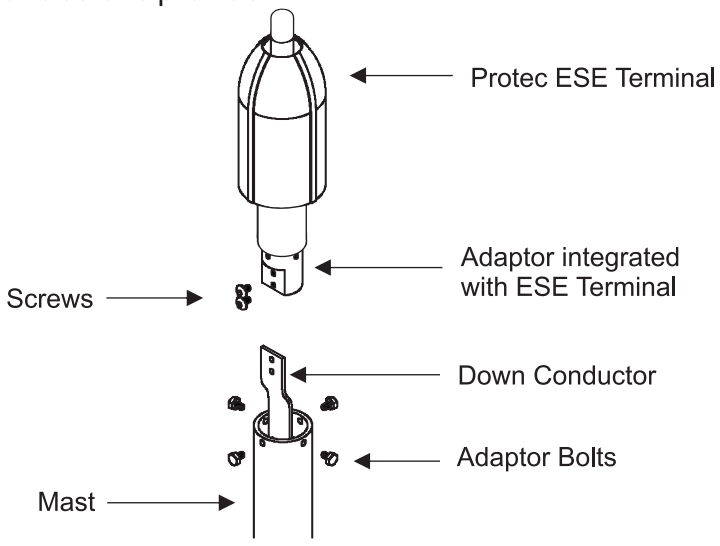


Fig. G - Down Conductor Upper End

4. ProESE Terminal Installation

Stay clear of any overhead power lines or electrical sources.

When installing the ESE Terminal, Protec Power Solutions Incorporation provides for two main configuration types.

Guyed FRP Masts

- When installing the ESE Terminal with an Protec Power Solutions Incorporation FRP mast, refer to the supplied FRP Mast Installation Guide for assembly and installation instructions. Other important items to remember include:

- Using a crane or other suitable equipment is recommended for any installation over 6 meters in height, or for hazardous areas such as unsafe heights without appropriate safety railings.

- It is very important to keep the mast straight during the lift to avoid damaging the mast.

- The ESE Terminal must NOT be used as a slinging point.

- When lifting masts, ensure that the slings or ropes do not damage the ESE Terminal.

- When lifting the mast, the down conductor must be tied off to the mast to remove any strain on the down conductor's termination to the ESE Terminal and/or supplied adaptor.

- The ESE Terminal tip must be at least 2m above any aerial, equipment or structure on the roof. Please refer to NF C 17-102 standard or Protec Power Solutions design for specific mast/ESE height requirements.

- Guy wires must be tight, but also consider roof load limitations (e.g. tighten guying grips to no more than 7 Nm of torque).

Installation Examples Using Guyed FRP Mast

- Ground Installation

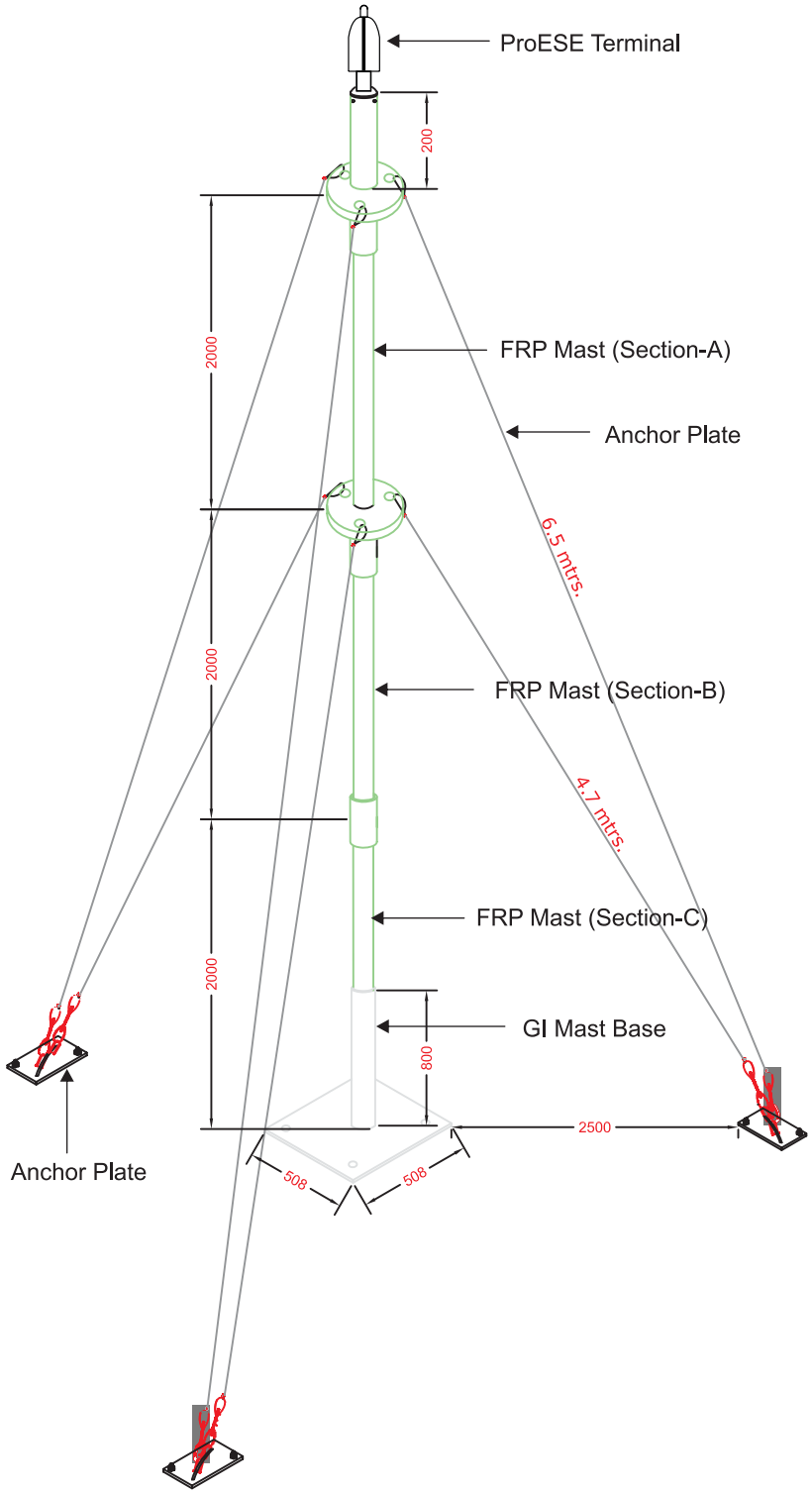


Fig. H - Ground Installation

- Roof Top Installation

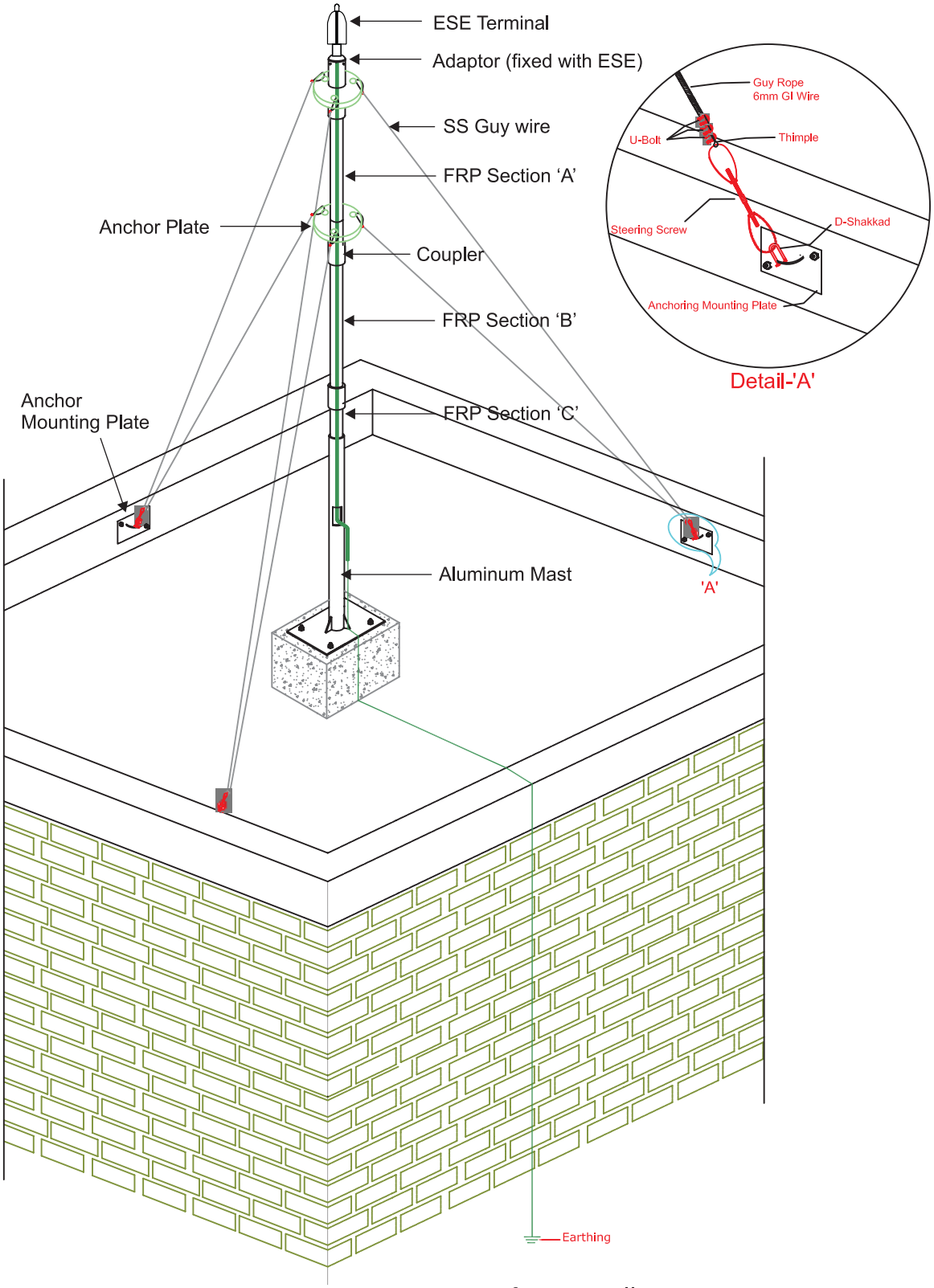


Fig. I - Roof Top Installation

- Side wall Installation

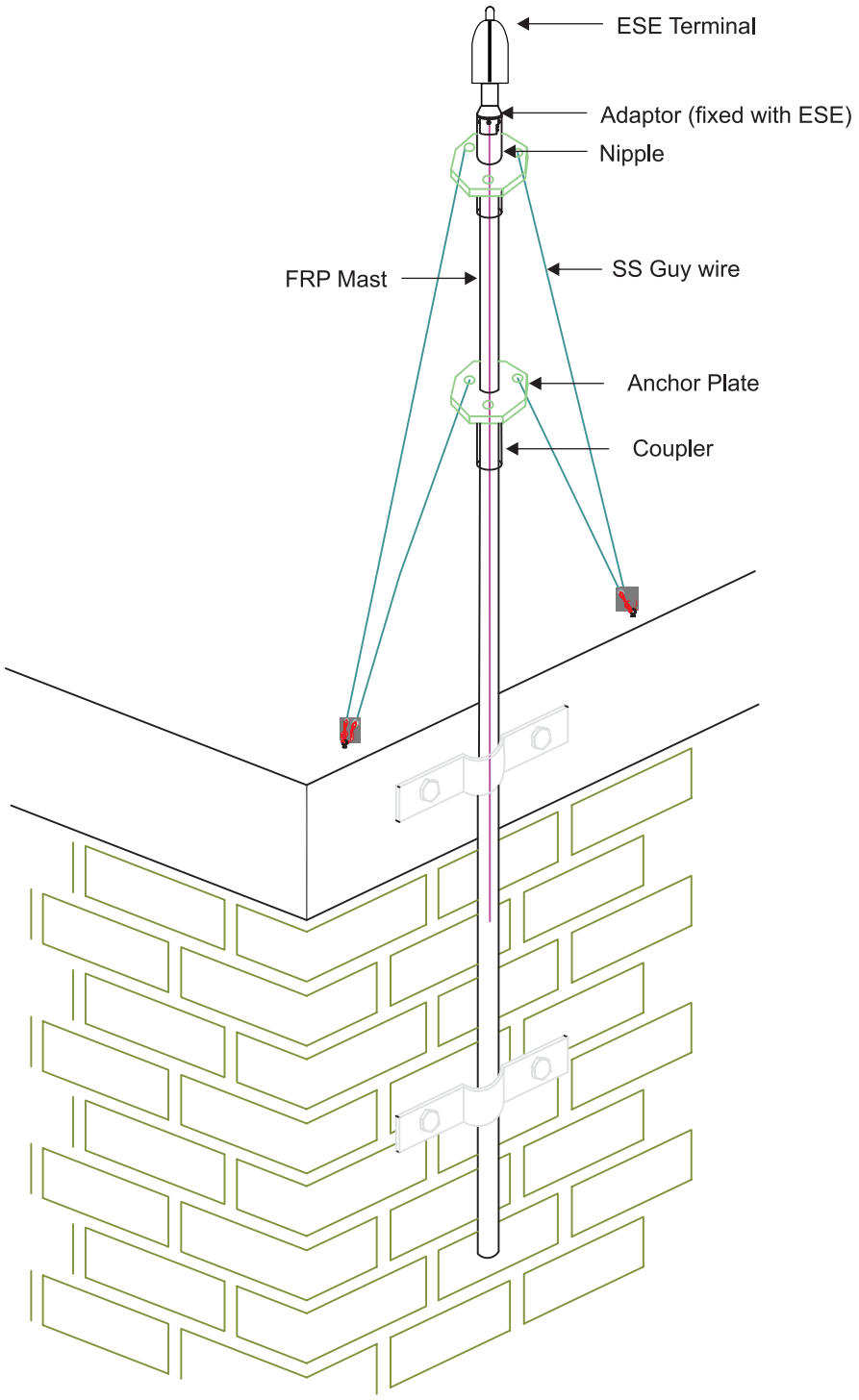


Fig. J - Side Wall Installation

Metallic Masts

- Following installation of the ESE Terminal to a metallic mast, it will be necessary to connect the metallic mast to a down conductor in order to convey the lightning energy to the grounding system.

- The connection between the metallic mast and the appropriately sized down conductor should be completed by approved mechanical means or by exothermically welding the down conductor at a practical point somewhere along the length of the mast.

- Particular care should be taken to ensure that compatible metals are used when connecting the down conductor to metallic masts (e.g. aluminum to copper connections require an approved bimetallic connector).

- It is important that a minimum of one third of the mast height in case of Metallic and one sixth in case of FRP be securely fixed to the structure to which the mast is mounted.

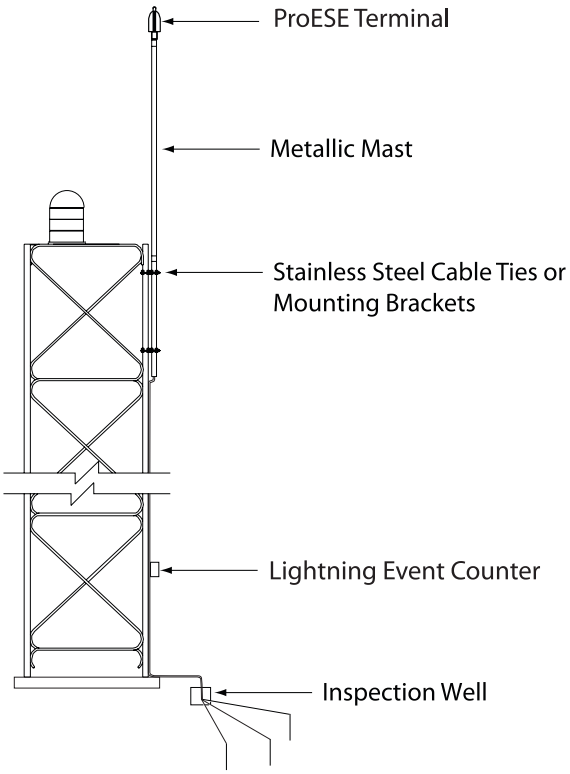


Fig. K - Tower Top Location

5. Lightning Event Counter Installation

- The Lightning Strike Counter should be installed at a position along the down conductor length where it can be accessed easily for inspection.
- Typically the strike counter should be installed approximately 2m from ground level.
- The strike counter should be mounted away from areas where damage/loss may occur due to theft, vandalism or damage from nearby operations.
- The strike counter can be enclosed in a security enclosure but the display should be kept visible to allow for the checking of recorded strikes.

6. Final Installation Verification

The following should be checked for quality of workmanship and compliance to recommended installation instructions and NF C 17-102 requirements:

- Correct ESE Terminal and placement for proper zone of protection.
- Correct mast and any associated brackets and fastenings have been used for installation.
- Guying, anchor points and fastenings.
- Down conductor routing and attachment points
- Connection of down conductor to grounding system
- Grounding system
- Labeling

7. Inspection/Maintenance

Protec Power Solutions recommends inspection and any required maintenance to be performed regularly and as listed below:

Schedule

- After each known lightning strike to the terminal.
- Once every twelve months minimum.
- If changes have been made to the structure.

Checklist

- ☐ Check for any damage to the ESE system.
- ☐ Check ESE Terminal body and tip for excessive pitting or other damage.
- ☐ Inspect the ESE Terminal and ensure that no dirt or other matter is embedded in the air gap between the center tip and the surrounding panel edges.
- ☐ Verify that the structure to be protected has not been modified or expanded since the last maintenance check.
- ☐ Make sure that the electrical continuity of all visible conductors is correct, and that no conductors or other parts have been weakened by corrosion.
- ☐ Check that all rigging, mast mounts, and conductor fixings are secure and tight.
- ☐ Check that all down conductors and equipotential bonds remain correctly positioned and that they are securely attached and no damage or theft has occurred.
- ☐ All warning labels must still be in place and visible.
- ☐ Check the strike counter for secure installation and record the number of strikes, if any.

Disclaimer

"As in the case with anything related to the natural elements, lightning protection systems, designed and installed in accordance with the standard **NF C 17-102**, cannot guarantee absolute protection to structures, persons or objects: however, applying this standard will significantly reduce the risk of protected structures being damaged by lightning."**NF C 17-102**.

No ESE Terminal or any other lightning protection system to our knowledge can provide 100% protection from lightning. In order to provide the most effective Early Streamer Emission (ESE) Air Terminal technology available today, Protec ESE Terminals are tested and certified to meet **NF C 17-102** and **UNE 21 186** standards. In addition, these modern standards have provided the applicable information contained in this Installation Guide to correctly implement a proper ESE system.

The **NF C 17-102** and **UNE 21 186** standards are "applicable to lightning protection using early streamer emission lightning conductors of common structures of less than 60m high and of open areas."**It is recommended that any ESE installation strictly adhere to the general and detailed contents of the latest editions of the NF C 17-102 and UNE 21 186 standards.**

ECS

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