Guardian System 5

INSTALLATION MANUAL

LIGHTNING PROTECTION INTERNATIONAL PTY LTD
www.lpi.com.au
ABN 11 099 190 897

GUARDIAN SYSTEM 5 INSTALLATION MANUAL

As a result of continuing research and product development in the area of lightning and lightning protection, LPI reserves the right to alter any detail contained within at any time without notice.

Prior to installation of the Guardian System 5, installers should check with LPI or an authorised distributor to confirm they have the most recent version of the Guardian System 5 Installation manual.

It should be noted that 100% (100 percent) protection level for direct lightning strikes is not possible and cannot be provided due to the lightning discharge process being a natural atmospheric event.

Guardian System 5 Lightning Protection System

System Owner:_____

Date Installed:_____

Installation Contractor:_____

Supplied by:_____

Location of Installation:_____

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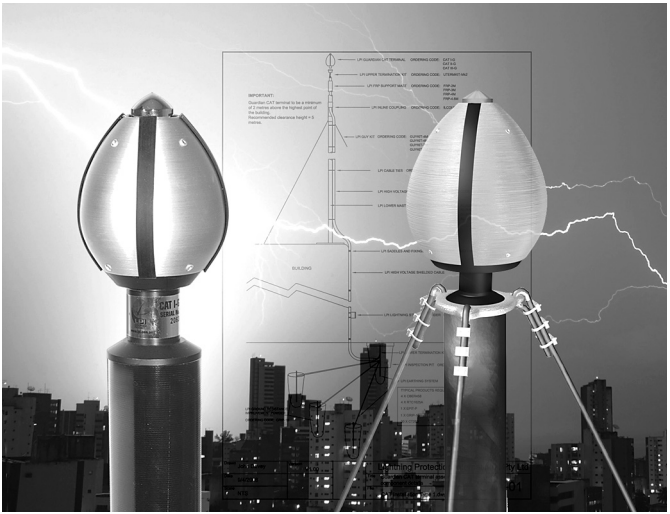
Guardian System 5
INSTALLATION MANUAL



Lightning Protection International Pty Ltd

Contents

Warranty

LPI's Guardian System 5 Lightning Protection System is guaranteed against defects in materials and workmanship for a period of 5 years from the original sales date when it was purchased from LPI or one of its authorised distributors.

The warranty is limited to the ex factory cost of replacement of equipment providing it has been installed and or certified by LPI or its distributor. All other costs such as freight, re-installation, loss of profit, insurance premiums are not included.

Responsibility for other direct or indirect damages or death is also specifically excluded from the warranty.

The range of Guardian CAT terminals (or to our knowledge any other lightning protection system) cannot provide 100% protection and therefore it is not inferred.

As confirmation of the above paragraph we refer to Australian Standard AS 1768 (2007).

Lightning Protection

Comments on the Australian Standard AS 1768 (2007).

We refer to the standard where it states that it provides authoritative guidance of a general nature only and it is not intended to become a mandatory set of regulations.

In general, it is not economically possible to provide total protection against all the possible damaging effects for lightning, but the recommendations in this standard will reduce the probability of damage to a calculated acceptable level and will minimise any lightning damage that does occur.

Thunderstorms are natural phenomena and there are no proven devices and methods capable of preventing lightning flashes. Direct and nearby cloud-to-ground lightning discharges can be hazardous to persons, structures, installations and many other things in or on them. Consideration should always be given to the application of lightning protection measures.

Users are warned that direct strike lightning protection is only one aspect of the overall protection strategy required for comprehensive structural, personnel and equipment safety. Correctly designed and installed low impedance earthing, elimination of earth loops, systems engineering, surge protection on power lines and transient protection of communications, data and telephone lines are also essential.

The LPI Guardian CAT Terminal should only be installed during storm free periods.

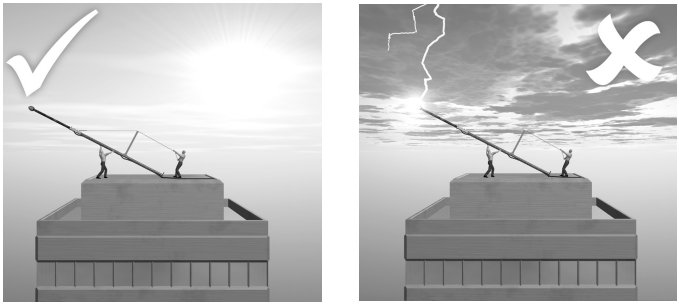


Figure 1.

General Safety Guidelines

- Ensure safe working environments and practices to local codes.
- Use of personal protective equipment during installation.
- Use mechanical methods of raising and installing masts over 6m.
- Cordon off area below installation point.
- Check for overhead powerlines or any other obstructions before lifting or raising.
- Ensure enough man power to safely conduct all aspects of installation.
- The installation must conform to all relevant local standards and regulations.

Recommended Installation Method

To assist in the installation of the Guardian CAT terminal and accessories, refer to drawings CTA-01, CTA-02, CTA-03, CTA-04, CTA-05, CTA-06 and HVC-1 as illustrated on pages 5 to 11.

1. Installation of the lightning earth.
2. Installation of the HVSC Downconductor.
3. Lower termination of the HVSC Downconductor and connection to the lightning earth.
4. Upper termination of the HVSC Downconductor and connection to the Guardian CAT terminal.
5. Preparation and raising of the mast into position.

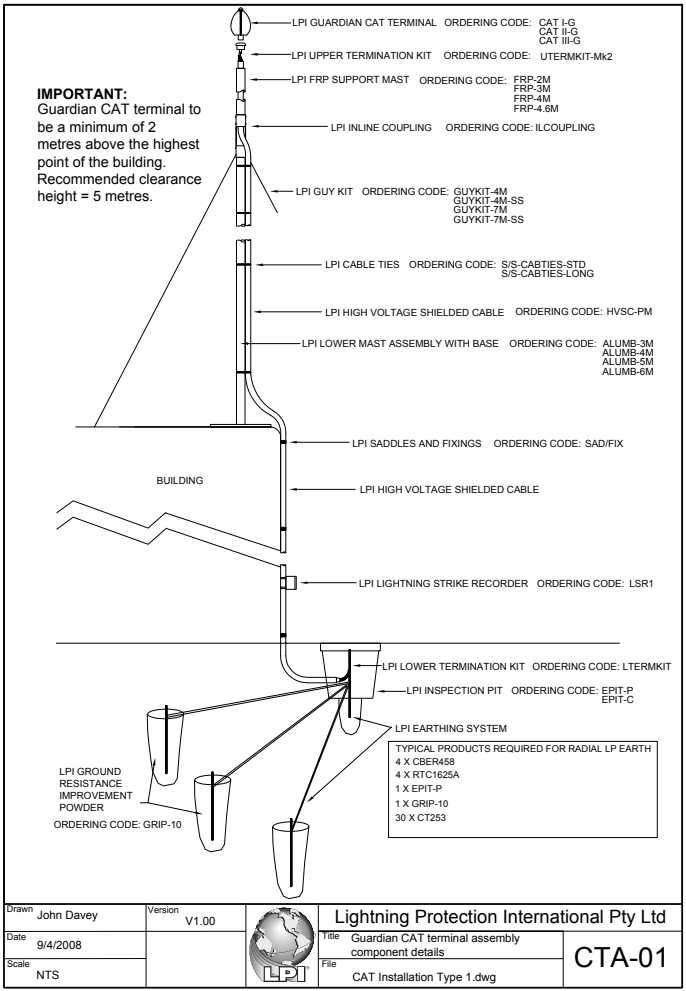


Figure 2.

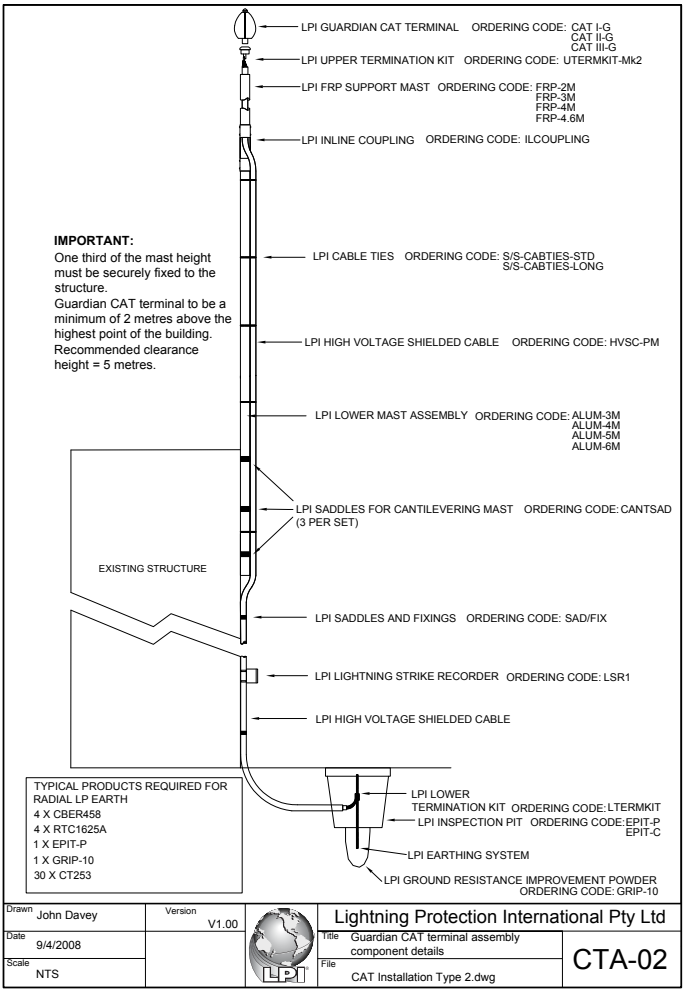


Figure 3.

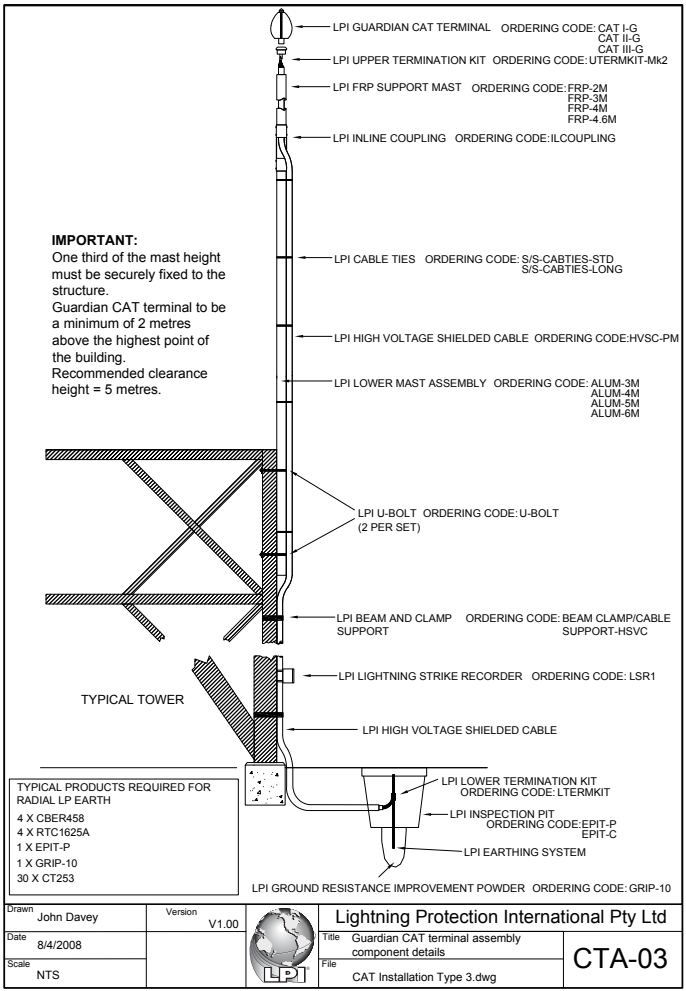


Figure 4.

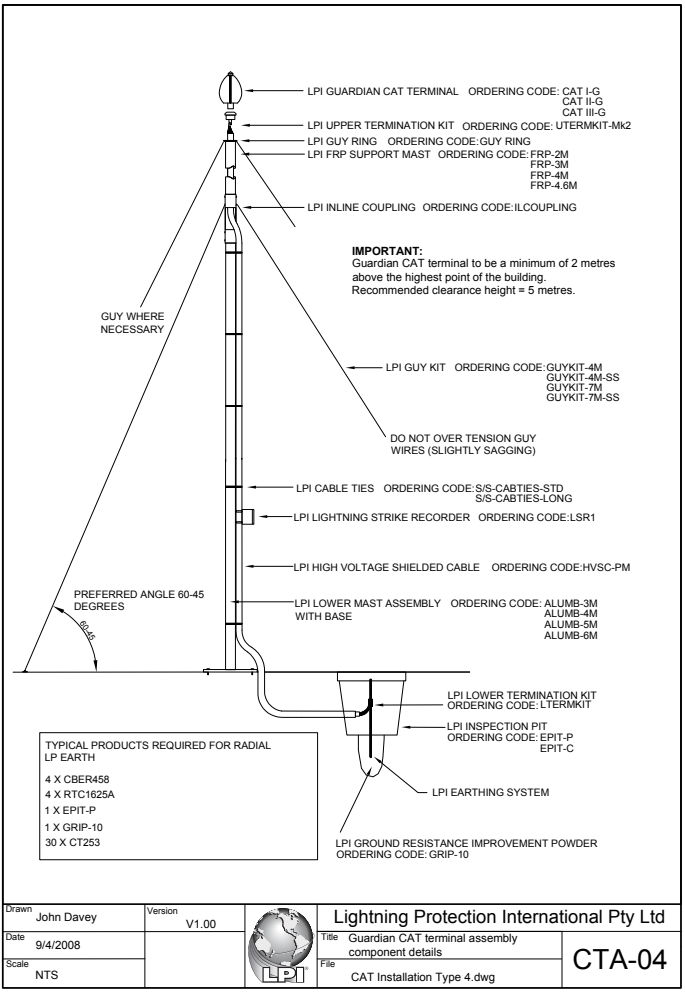

LPI GUARDIAN CAT TERMINAL ORDERING CODE: CAT I-G
CAT II-G
CAT III-G
LPI UPPER TERMINATION KIT ORDERING CODE: UTERMKIT-Mk2
LPI GUY RING ORDERING CODE:GUY RING
LPI FRP SUPPORT MAST ORDERING CODE: FRP-2M
FRP-3M
FRP-4M
FRP-4.6M
LPI INLINE COUPLING ORDERING CODE:ILCOUPLING
IMPORTANT:
Guardian CAT terminal to be a minimum of 2 metres above the highest point of the building.
Recommended clearance height = 5 metres.
GUY WHERE NECESSARY
LPI GUY KIT ORDERING CODE: GUYKIT-4M
GUYKIT-4M-SS
GUYKIT-7M
GUYKIT-7M-SS
DO NOT OVER TENSION GUY WIRES (SLIGHTLY SAGGING)
LPI CABLE TIES ORDERING CODE: S/S-CABTIES-STD
S/S-CABTIES-LONG
LPI LIGHTNING STRIKE RECORDER ORDERING CODE:LSR1
LPI HIGH VOLTAGE SHIELDED CABLE ORDERING CODE:HVSC-PM
PREFERRED ANGLE 60-45 DEGREES
60-45
LPI LOWER MAST ASSEMBLY WITH BASE ORDERING CODE: ALUMB-3M
ALUMB-4M
ALUMB-5M
ALUMB-6M
LPI LOWER TERMINATION KIT ORDERING CODE: LTERMKIT
LPI INSPECTION PIT ORDERING CODE: EPIT-P
EPIT-C
LPI EARTHING SYSTEM
LPI GROUND RESISTANCE IMPROVEMENT POWDER ORDERING CODE: GRIP-10
TYPICAL PRODUCTS REQUIRED FOR RADIAL LP EARTH
4 X CBER458
4 X RTC1625A
1 X EPIT-P
1 X GRIP-10
30 X CT253
Drawn John Davey
Version V1.00
Date 9/4/2008
Scale NTS
Lightning Protection International Pty Ltd
Title Guardian CAT terminal assembly component details
File CAT Installation Type 4.dwg
CTA-04

Figure 5.

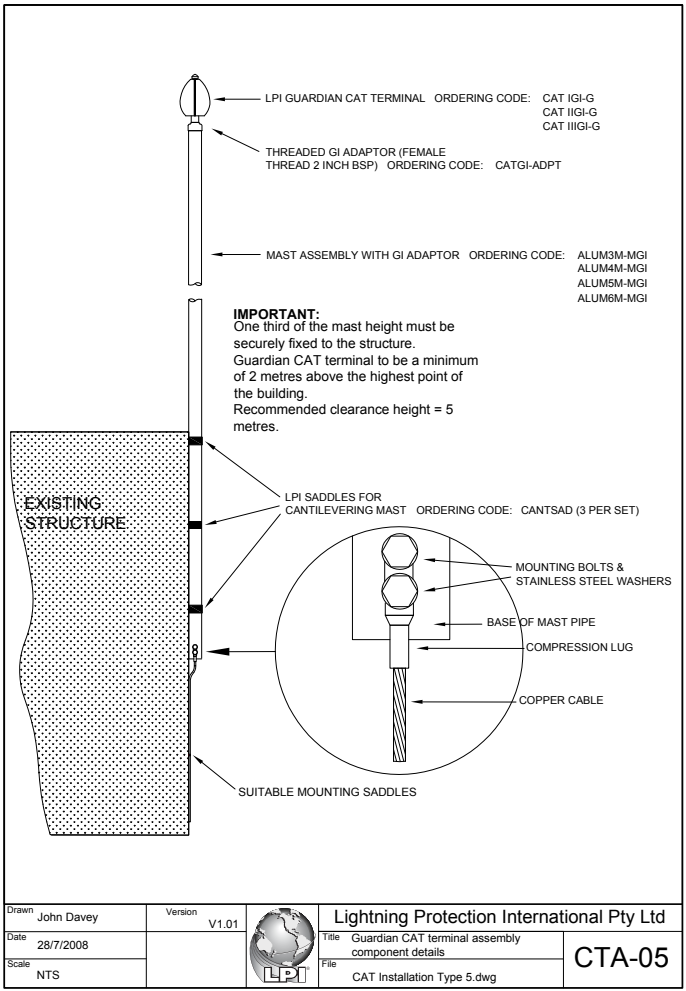


Figure 6.

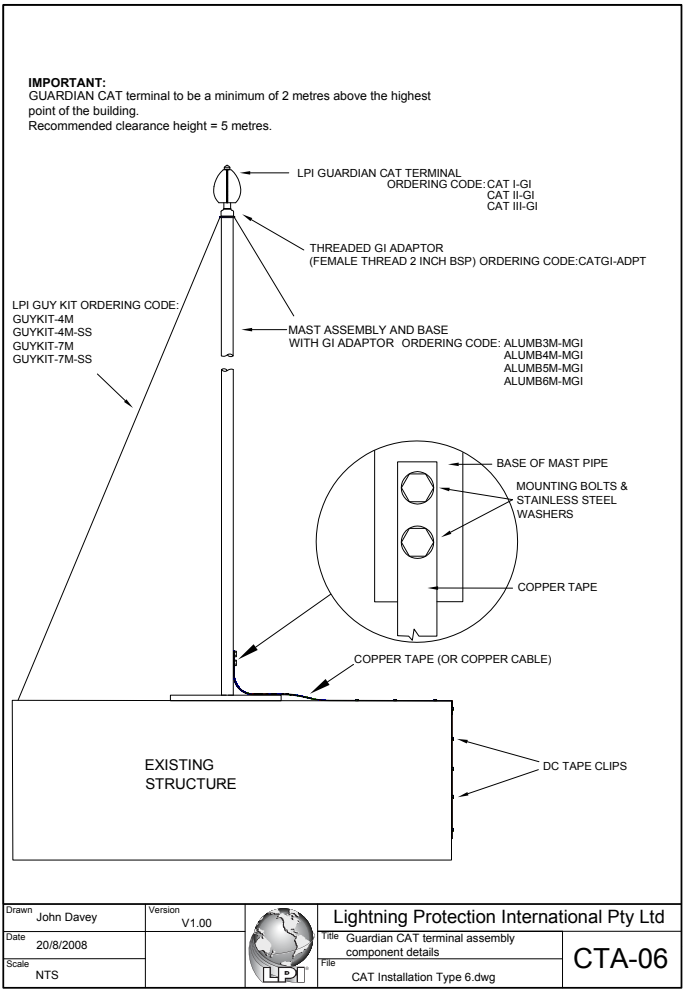


Figure 7.

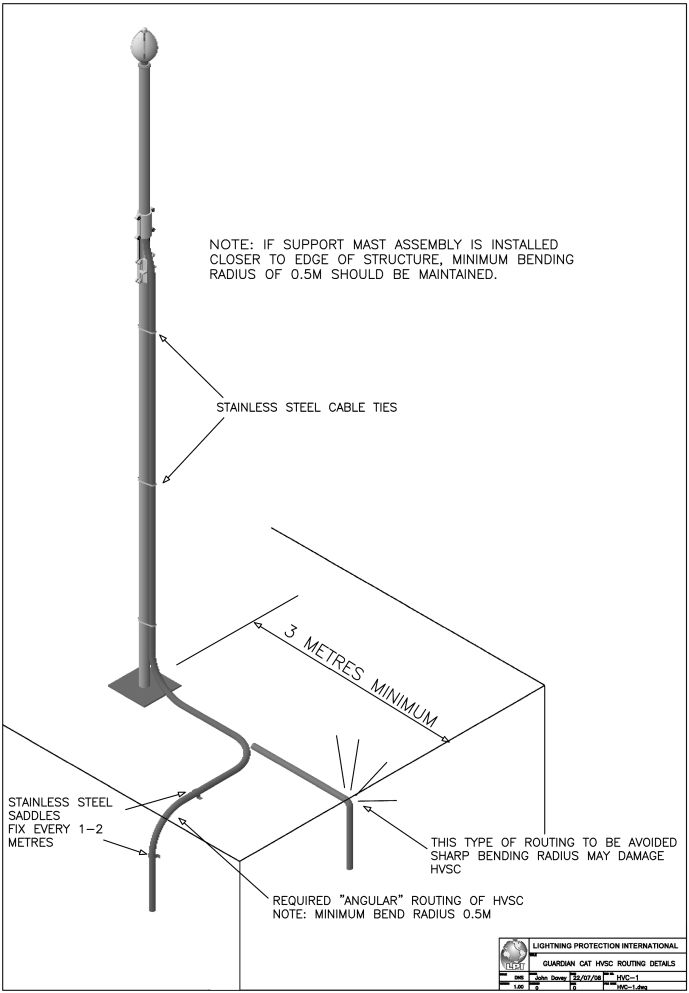


Figure 8.

Checking Lightning Protection Components Supplied

The Guardian System 5 components received should be checked against the "Bill of materials" for loss during shipping and for damage.

Check the following:

Terminal (s)

- Terminals have not been dented or damaged in any way during transit.
- Instructions, Warning Labels, Warranty, Test Certificate and relevant mast base components supplied.

Downconductor(s)

- The HVSC cable drum (if supplied) is not damaged.
- The correct HVSC length(s) have been supplied.
- No obvious damage to the HVSC cable.
- If a factory completed upper termination is supplied, check to see that the termination is not damaged and confirm inside or outside termination(s).
- Order of lengths and quantities of HVSC (if multiple lengths on one drum), will be shown on the side of the Cable Drum(s).

LPI Guardian System 5 Installation

All site and safety requirements must be followed during the installation of the LPI Guardian System 5.

The correct order of installation is as follows:

1. Installation of the lightning earth.
2. Installation of the HVSC downconductor.
3. Lower termination of the HVSC downconductor and connection to the lightning earth.
4. Upper termination the HVSC downconductor and connection to the Guardian CAT terminal.
5. Preparation and raising of the mast into position.

LPI Guardian System 5 should only be installed during storm-free periods.

If the Guardian CAT terminal needs to be raised prior to connection to the lightning earth or immediate connection is not possible then connect the lower end of the downconductor to structural steel reinforcing or other suitable earth point.

Installation of the Lightning Earth

Before installation of the lightning protection earth, consult site drawings of underground services so that these are not damaged during installation of the earthing system.

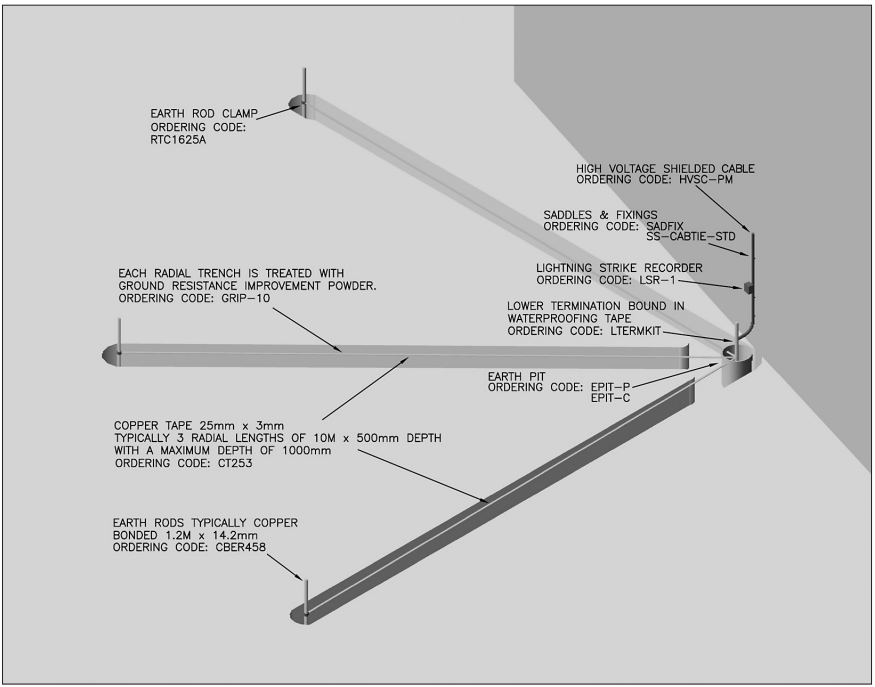


Figure 9.

Earth DC resistance (typically ‹10 ohms) and impedance (typically ‹30 ohms) is required for successful operation of LPI Guardian System 5.

LPI recommends the installation of a radial lightning earth as shown in figure 9.

- Recommended to install a 3 x 10 metre length radial trench.
- Each radial should consist of a trench (Approx: 500mm Deep x 200mm wide x 10m length).
- An earth rod should be driven at the end of each trench.
- All rods should be interconnected through the use of 25mm x 3mm copper tape. The use of earth rod clamps to fix the tape to rods is recommended.
- Use waterproofing mastic on all mechanical connections.
- The application of earth enhancing compounds such as LPI RESLO and GRIP assists to reduce soil resistivity to the recommended level of less than 10 ohms.
- An earth pit should be installed where the end of the downconductor terminates to the lightning earth as shown in figure 9. This gives an access point for disconnection and future testing.
- Do not lower terminate (connect) the downconductor to the earthing system at this point in time.

Note: If due to space constraints it is not possible to install a radial earth as recommended, consult with LPI or an authorised distributor for further advice.

When using earth rods:

- Use driving heads to prevent mushrooming on top of rod.
- Use driving heads when using coupled rods.
- Use a post or picket driver.

Recommendations for bonding the earthing system components are listed below:

- The use of the EXOWELD exothermic welding process is a safe and efficient way of providing a permanent connection between conductors. EXOWELD connections will not corrode or rust with age.
- DO NOT use aluminium lugs or couplings.

Ground Resistance Lowering Compounds

- Ground resistance lowering compounds (such as LPI RESLO and GRIP) are supplied when the existing soil mass has a high resistivity.
- Using the compounds can lower earth resistance/impedance.
- Compounds will require water and a mixing container.
- Follow all installation and safety instructions as supplied with products when applying the compounds.

Bonding the Lightning Earth

Where separate earths exist eg. Structure, Power, Communications and Lightning Protection, they need to be bonded to form an equipotential ground plane. This will stop ground loops and potential differences arising under transient conditions.

Before bonding of these earths takes place, make sure proper authorisation is gained.

Bonding cable must be 70mm^2 (2/0 AWG) minimum depending on local standards. It may be necessary to use a Transient Earth Clamp (TEC 100) which bonds all earths to the same potential under transient conditions.

For further information, it is advisable that local applicable standards are used, ie. IEC 61024-1, BS 6551, AS1768-2007, NFPA 780, C22.1-98 and NEC.

Labelling

It is the responsibility of the customer/installer to label earth pits or earthing systems to local requirements.

Installation of the HVSC Downconductor

If installing LPI HVSC, the HVSC downconductors(s) may have had the upper terminations completed at a pre-specified end of the cable by the LPI factory before being shipped.

When removing HVSC downconductor packaging, do not use a knife or cut in any way as this can damage the outer layer of termination.

LPI's HVSC has an outer layer which is approximately 2mm (1/16in.) thick. Be careful not to damage this layer.

Hauling the HVSC Downconductor

Place the HVSC downconductor cable drum close to where it is to be installed.

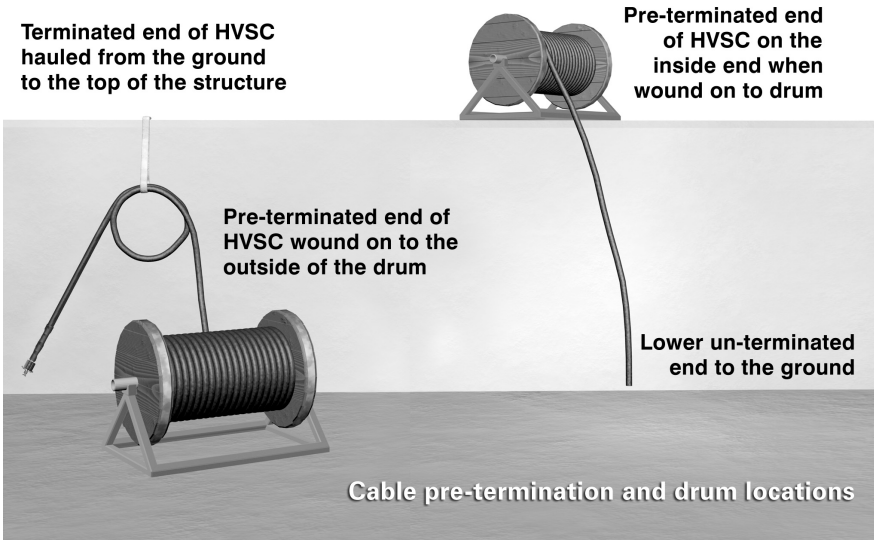


Figure 10.

- Make sure that the cable drum is in a servicable condition.
- Check that the correct length of HVSC downconductor has been supplied. The length of HVSC will be marked on the drum.
- If the HVSC downconductor has been upper terminated on the outside of the drum, then the HVSC downconductor will need to be hauled up the structure with the drum staying on the ground.

- If the HVSC downconductor has been upper terminated on the inside of the drum, then the drum has to be taken to the top or near the top of the structure, then the HVSC downconductor can be hauled downwards from the drum to the ground.
- Any lifting slings or ropes must be securely attached.
- DO NOT haul the HVSC downconductor from the termination, see Figure 11.
- Protect the HVSC downconductor at all times when it is being moved.

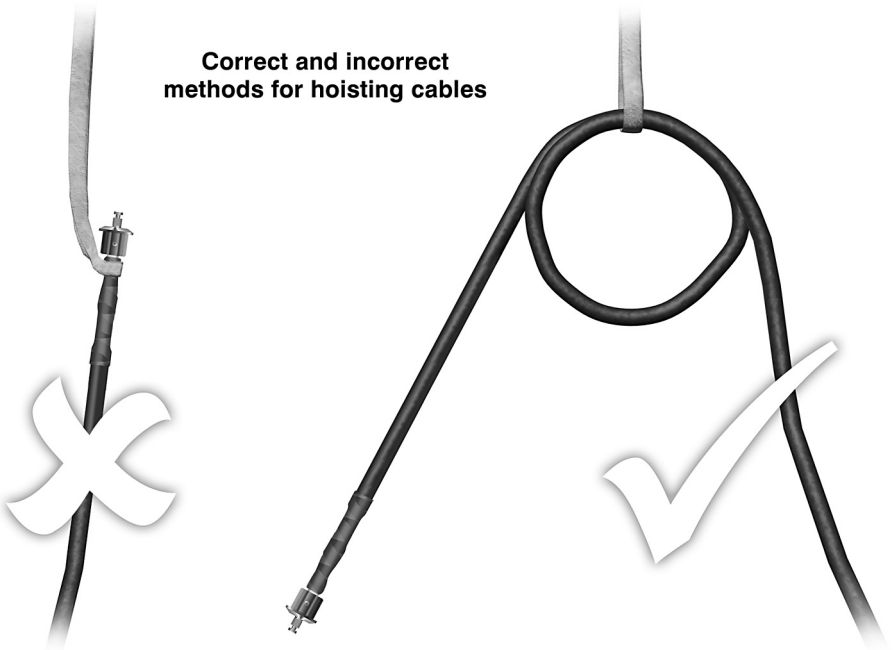


Figure 11.

HVSC Downconductor clearance holes

Before running the HVSC downconductor through any clearance holes, ensure that:

- A minimum hole diameter of 60mm (2 3/8") is used.
- Enough protection is provided so that the HVSC downconductor is not damaged during or after installation.
- A waterproofing sealant or sealing gland should be used if the hole needs to be weatherproof.

Routing

The routing of the HVSC downconductor needs to follow these guidelines:

- The route of the HVSC downconductor should be as set out in the original design. Ensure no structural changes such as new antenna or mast installations, air conditioning towers or ducting has been installed.
- DO NOT double the HVSC downconductor back against itself after changes of direction, ie. 180°.
- The HVSC downconductor may be installed internally or externally on the structure.
- The HVSC downconductor should be installed as close (flush) as possible to the structure.
- Minimise the number of bends and use the most direct route to ground.
- Minimise strain on the HVSC downconductor.
- Ensure minimum bend radius maintained ›500mm (20in.).
- Parallel routing with other services – Minimum separation = 2m. See Figure 12 on page 19.
- If the HVSC downconductor 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 lower end of the HVSC downconductor must terminate close to the initial injection point of the lightning earth.
- Be sure to allow for enough slack in the HVSC at the top end for connection to the Guardian CAT Terminal and the raising of the mast.

- If it is necessary to isolate the HVSC downconductor from the structure, run the cable in an insulating conduit with a minimum wall thickness of 3mm (1/8in.). The maximum length isolated from the structure should be 2.5m (9ft). The entire length of the HVSC downconductor cannot be run in insulated conduit.
- HVSC Downconductor should be protected from damage at the lower end by installing a "Top Hat" surface mount cover of no more than 2m from ground level.

The HVSC downconductor must be checked by an LPI representative if it is damaged during installation to see if the damage will affect performance.

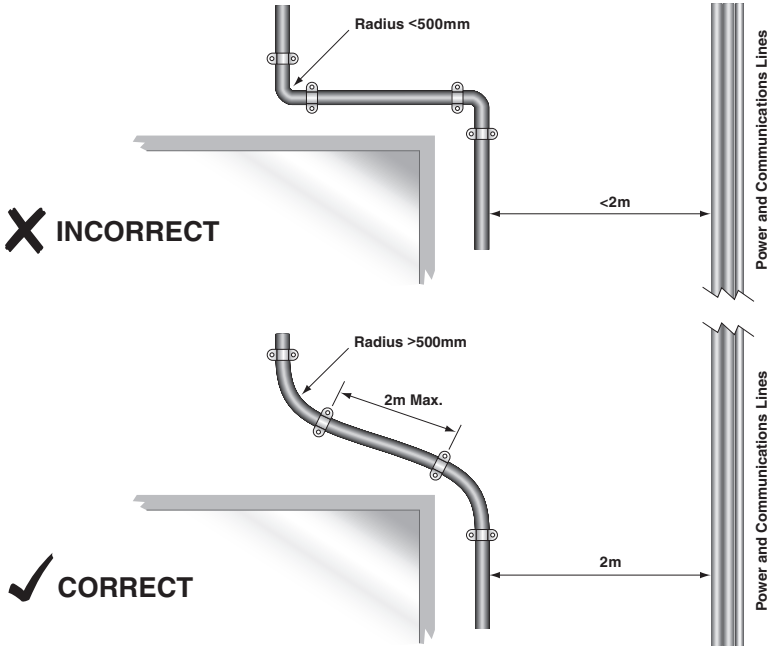


Figure 12.

Fixing of the HVSC Downconductor

Using non LPI saddles can damage the downconductor outer sheath.

- The HVSC downconductor should be fixed to the structure every 2m for the entire length of the run.
- For masonry walls or roofs, use the LPI saddles provided. These can be used with masonry anchors, suitable fastenings for wood, fibreglass and metallic surfaces or self tapping screws.
- Use cable ties when fixing to round sections, such as pipes, tower legs, masts, etc.
- If the HVSC downconductor is to be routed above a false ceiling, ensure that it is fixed to the underside of the concrete floor slab.
- Do not use explosive fastening methods on LPI saddles or HVSC downconductors.

Installation of Conventional Downconductors

In some installations the use of copper tape or insulated stranded copper cable may be installed as the downconductor. In such cases it may be necessary to install multiple downconductors in compliance with local standards and/or international standards. (NFC 17-102, AS1768-2007, BS6651, IEC 62305). See the following dot points for further information.

The Guardian CAT Terminal provides a bolt for the lug connection to the lower finial connector of the mast butt adaptor. All conventional downconductors should be lugged and fixed to the terminal as per figure 13.

The following are recommendations and points that should be considered when installing conventional downconductors.

- Downconductors should be installed at each external corner of the building and additional downconductors installed at spacing not exceeding 20m.
- The most direct path to ground is recommended, avoiding sharp bends.
- Downconductors should be installed around the outside walls of the structure. It is not recommended to install downconductors internally to the structure.
- It is not recommended to locate downconductors in areas where personnel are liable to congregate.

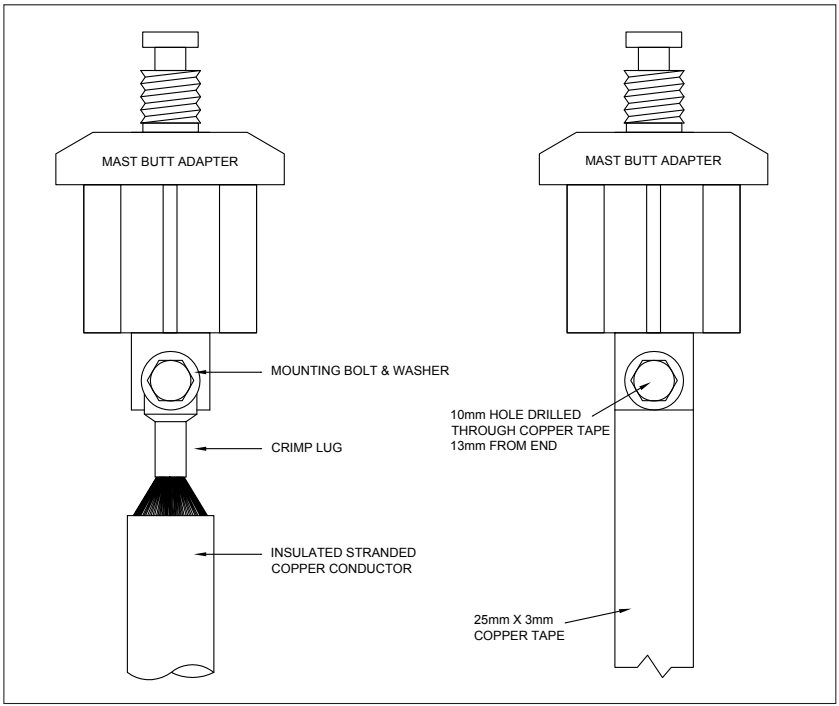


Figure 13.

- Any extended metal running vertically through the structure should be bonded to the lightning downconductor at the top and bottom of the structure.
- Each downconductor should be connected to the earthing system.
- Where practical, all structural steel and metallic reinforcement in the structure should be bonded to the downconductor system at recommended intervals as per international standards.

- The use of copper conductors are recommended and should have a cross sectional area of not less than 35mm^2. In addition, the use of PVC copper, bare aluminium and stainless steel as downconductors is permitted in compliance to most international standards.
- Recommended copper conductor size is 25mm x 3mm.
- The copper should be of a grade normally used for commercial electrical work.
- Suitable fasteners should be installed to adequately secure all downconductors.
- Downconductors should be fastened at spacings not exceeding 1.0m on horizontal runs and not exceeding 2m on vertical runs.

Installation of Guardian CAT GI Terminal to threaded pipe

LPI offers within its range of Guardian CAT terminals, a GI version which is designed for a threaded connection to a 2 inch GI pipe. Please refer to drawing CTA-05 on page 9 and figure 14 (page 23) for further details.

The Guardian CAT GI terminal is supplied with a threaded coupler (female thread) fixed to the terminal and designed for connection to a 2 inch BSP pipe (Male thread).

- Following installation of the Guardian CAT GI terminal to the threaded pipe as per drawing CTA-05 and figure 14, it will be necessary to connect the metallic pipe to a conventional downconductor in order to convey the lightning energy to the earthing system.
- Ideally the connection between the metallic pipe and the conventional downconductor should be completed by lugging or exothermically welding (LPI EXOWELD) the downconductor at a practical point somewhere along the length of the pipe.
- Particular care should be taken to ensure that compatible metals are used when connecting the downconductor to the metallic pipe.
- For installation details of the conventional downconductor please review instructions and comments as detailed under the heading Installation of Conventional Downconductors on page 20.

Figure 15.

GUARDIAN CAT GI TERMINAL

THREADED GI ADAPTOR (FEMALE THREAD 2" BSP)

THREADED PIPE WITH MALE THREAD (2" BSP)

INSTALLATION STEPS FOR GUARDIAN CAT GI TERMINAL

1. ENSURE THAT THE THREADED GI ADAPTOR IS FIRMLY SCREWED INTO THE BASE OF THE GUARDIAN CAT TERMINAL.
2. ENSURE THAT BOTH THE MALE AND FEMALE THREADS ARE FREE FROM PAINT, GREASE AND DIRT AND THAT THE MALE THREAD IS NOT DAMAGED.
3. SCREW THE FEMALE THREAD OF THE GI ADAPTOR ONTO THE 2" BSP MALE THREAD OF THE PIPE.
4. ENSURE THAT THE GI ADAPTOR IS FIRMLY SCREWED INTO PLACE ON THE PIPE, AND THAT THE CONNECTION BETWEEN THE GI ADAPTOR AND THE TERMINAL IS STILL SECURELY FIXED.

Drawn: John Davey	Version: V1.00		Lightning Protection International Pty Ltd	
Date: 15/7/2008			Title: GUARDIAN CAT GI TERMINAL ASSEMBLY	SA-2
Scale: NTS			File: SA-2.dwg	

Figure 14.

Termination of the HVSC Lower End

Tools required for the completion of the HVSC Lower Termination include:

- Compression or Mechanical Crimping Tool (for 95mm^2 crimp lug).
- Sharp Knife.
- 2 x screwdrivers (used as friction cutting tool handles).
- Shifting Spanner.
- Tape Measure (cm).

Lower Termination Kit Consists of

1 x Roll Waterproofing Tape.
1 x 95mm Crimp Lug.
2 x Warning Stickers.
1 x Earth Clamp.
1 x Insulation Friction Cutting Tool.

The following steps outline the termination of the lower end of the High Voltage Shielded Cable to the lightning earth.

The inner screen copper conductors and the outer screen copper conductors should be connected to the earthing system.

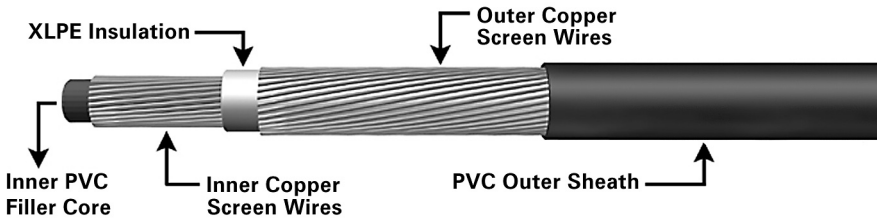


Figure 16.

1. Remove the outer sheath for a length of 15cm from the lower end of the HVSC by cutting radially around HVSC cable with the supplied insulation friction cutting tool. (This is less likely to damage individual copper conductors than by cutting radially with a knife). The lengthwise cut can be completed with a knife.

2. Remove the clear binder tape (2nd layer) for a length of 15cm from the end of the HVSC, this will expose the outer screen copper conductors as shown in Figure 17.

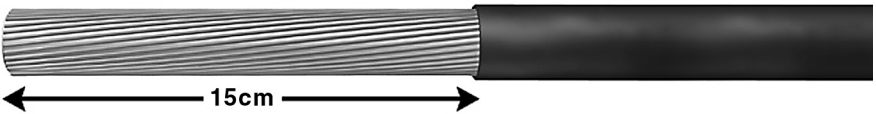


Figure 17.

3. Bend outer screen conductors back without damaging them. For a length of 5cm from the end of the HVSC, remove XLPE insulation (4th layer) and inner binding tape (5th layer) to expose inner screen copper conductors. Be sure not to remove outer screen conductors in this step. It is recommended to use the insulation friction cutting tool in this step.

4. Bend inner screen conductors back without damaging them. For a length of 5cm from the end of the HVSC, remove the inner PVC Filler Core under the inner screen copper conductor leaving the inner screen copper conductor in place.

Remove XLPE insulation and inner binding tape to expose inner screen copper conductors

Figure 18.

5. Bunch together both inner and outer screen conductors. If connecting directly to the earth system as per figure 21, the bunched conductors should be connected to the earth rod clamp and the clamp tightened holding the conductors firmly in place. To avoid oxidisation of this connection, seal it using the waterproofing tape as provided in the kit.

Bunch together both inner and outer screen conductors, crimp them together in the crimp lug provided using a compression or mechanical crimping tool

Figure 19.

6. If terminating the lower end of the HVSC to a bus bar, bunch together both inner and outer screen conductors, crimp them together in the 95mm² crimp lug provided using a compression or mechanical crimping tool and connect the bus bar as per Figure 20.

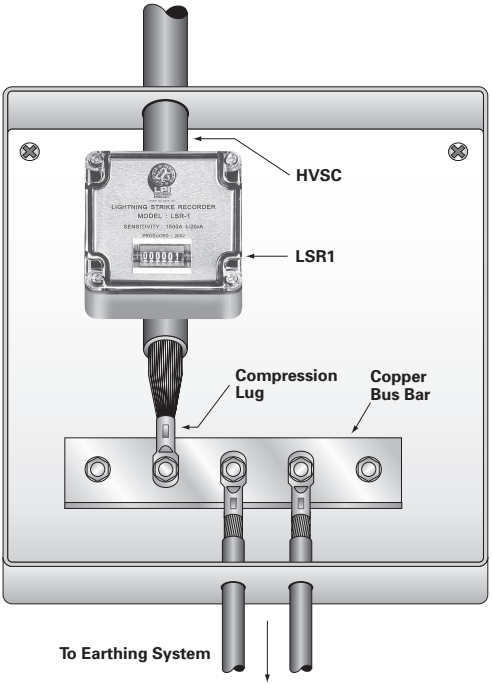


Figure 20.

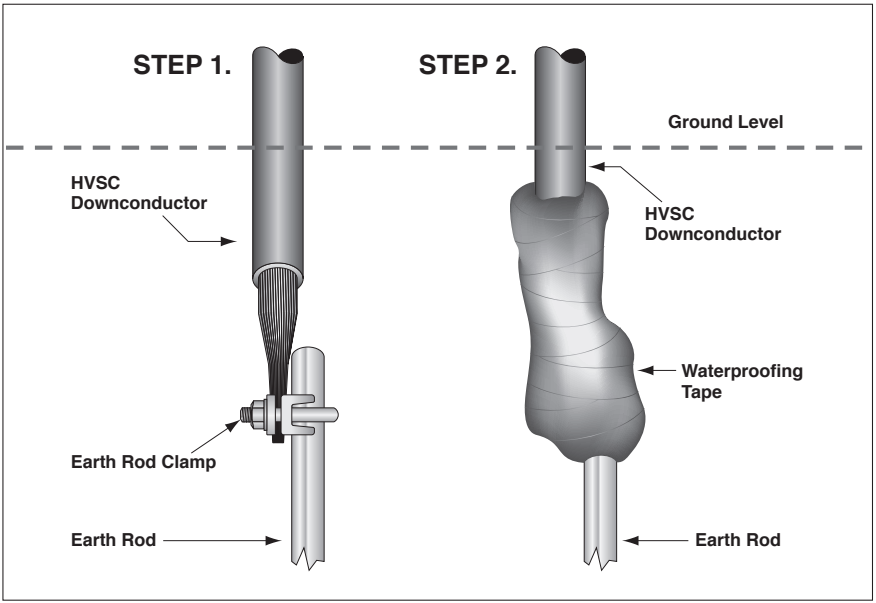


Figure 21.

Lower Termination of Conventional Downconductor to the Lightning Earth

- If installing stranded copper cable as a downconductor then the lower end should be connected to the lightning earth through the use of an earth rod clamp and then wrapped with waterproofing tape to avoid oxidisation.
- If installing copper tape (25mm x 3mm) as a downconductor then the lower end should be directly connected to the lightning earth through the use of a suitable earth rod clamp and then wrapped with waterproofing tape to avoid oxidisation.

Termination of the HVSC Upper End

Tools and parts required for the completion of the HVSC Upper Termination include:

- Compression or mechanical crimping tool (for 50mm² crimp lug).
- Sharp knife.
- Phillips Head Screwdriver.
- Shifting spanner (or 14mm spanner/socket).
- 2 x screwdrivers (used as friction cutting tool handles).
- Heat gun or Gas Torch (LPG).
- Tape measure (cm).
- Marker or pen.
- Combination Pliers/Cutters.
- Terminal Base Assembly (supplied with the Guardian CAT Terminal).

Upper Termination Kit consists of:

- Instructions.
- 1 x roll of Semi-Conductive Tape.
- 1 x 50mm² Crimp Lug.
- 1.5 x Heatshrink Tubes (1 x 1200 & 1 x 600mm lengths).
- Insulation Friction Cutting Tool.
- Insulation Tape (1 x roll).

Upper Termination Instructions For UTERMKIT-Mk2 (Heatshrink)

The diagram on the following page (Figure 22) shows the different layers of the HVSC cable and indicates their names as referred to in the following instructions:

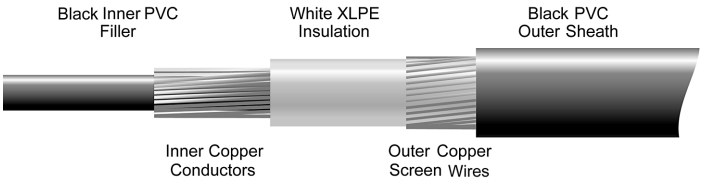


Figure 22.

1. First, remove the Black PVC Outer Sheath for a length of 165cm by cutting radially round the HVSC cable with the supplied insulation friction cutting tool (this is less likely to damage individual copper conductors than by cutting with a knife). The lengthwise cut can be completed with a knife, but take great care not to score the White XLPE Insulation. Also remove the clear plastic lining over the copper.
2. Measure and mark the outer copper screen wires at 3 cm above the end of the Black PVC Outer Sheath. (Figure 23) With the cutters, carefully cut and remove the wires, again without damaging the White XLPE Insulation below.

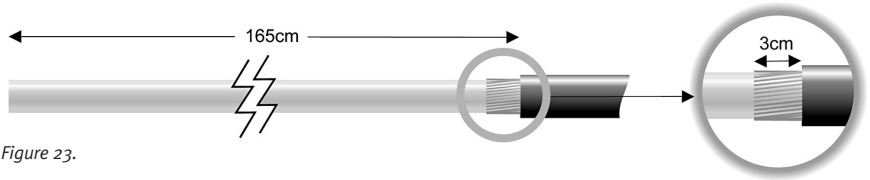


Figure 23.

3. Using the insulation friction cutting tool, remove the White XLPE Insulation to expose the Inner Copper Conductors for a length of 5cm from the top end of the HVSC (Figure 24). Also remove the clear plastic lining over the copper conductors.
4. Remove the Black Inner PVC Filler core under the Inner Copper Conductors by folding back the Inner Copper Conductors to expose the Filler core, then cut and remove with a knife. Return the Inner Copper Conductors to their original position. (Figure 24)

Figure 24.

5. Straighten the cable back to the Black PVC Outer Sheath as much as possible then crimp the Inner Copper Conductors into the supplied 50mm² crimp lug using a suitable compression or mechanical crimping tool. (Figure 25)

Figure 25.

6. Connect the crimp lug to the Guardian CAT Terminal Base Assembly using the bolt and washers as supplied with the assembly. Ensure the connection is aligned correctly and tightly secured using a 14mm spanner, socket or shifting spanner. (Figure 26)

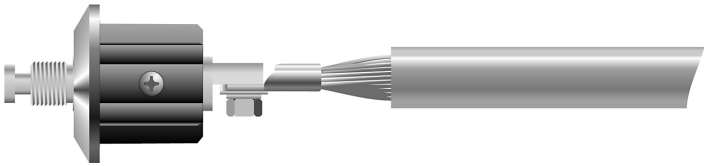


Figure 26.

7. Use a marker or pen to mark 30cm intervals on the White XLPE Insulation between the end of the Outer Copper Screen Wires and the Crimp - this will act as a guide to wrapping the semiconductive tape towards the Crimp in a coarse spiral. (Figure 27)

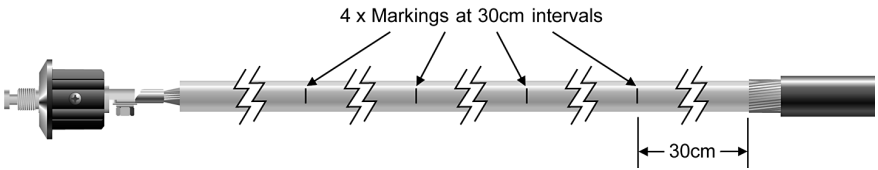


Figure 27.

8. Using the Semi-Conductive Tape provided, starting 2cm in front of the end of the Outer Copper Screen Wires (or 5cm in front of the Black PVC Outer Sheath), stretch and wrap the tape back over the wires and 3cm over the Black PVC with 50% overlap, securing the Outer Copper Screen Wires in place. This should use approx 50cm of the tape. (Figure 28)

Note: DO NOT cut the tape at this stage.

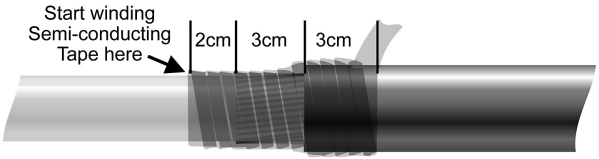


Figure 28.

9. Over wrap back towards the Crimp end of the cable, again stretching the tape and with 50% overlap, leaving 5cm covering the Outer Copper Screen Wires and White XLPE Insulation and 3cm covering the Black PVC Outer Sheath. This should use approx another 50cm of the tape. Again, do not cut the tape. (Figure 29)

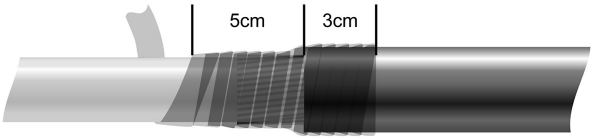


Figure 29.

10. Using the 30cm markings as a guide, continue to wrap the tape around the White XLPE Insulation in a coarse spiral, (5 Turns from the outer-Copper screen wires to crimp), with only slight tension, ensuring that the tape is not too loose. Note: The spiral needs to be applied with even pitch to achieve best performance. (Figure 30)

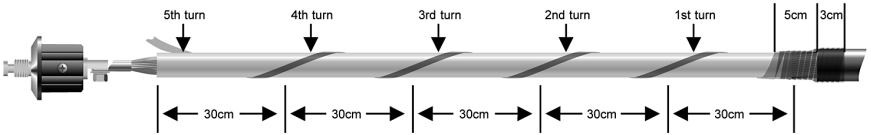


Figure 30.

11. Once the tape has reached the crimp, start to stretch the remaining tape and using 50% overlap, cover the last 3cm of the White XLPE Insulation, over the brass lower connector and up to the black plastic section of the Terminal Base Assembly in multiple layers, completely covering the crimp and achieving as smooth and level a surface as possible, removing all sharp edges. (Figure 31)

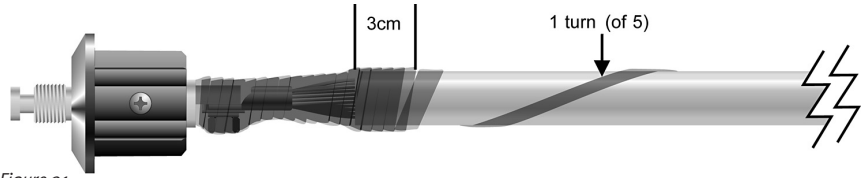


Figure 31.

12. Using the supplied Insulation Tape (or 50mm packing tape), cover the coarse spiral section of the Semi-Conductive Tape to ensure that it stays in place during the application of the Heatshrink tubes. Do this first by covering the left half of the tape, then using a second length to cover the right half of the tape for the full length of the spiral. (Figure 32)

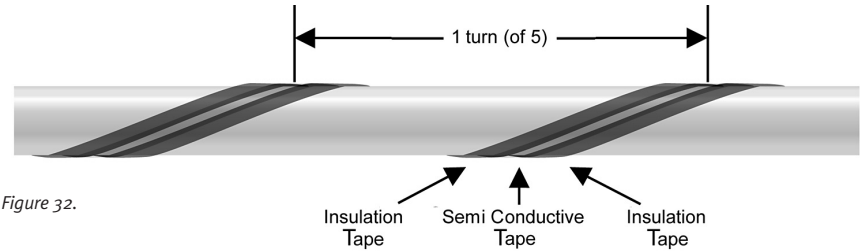


Figure 32.

13. Remove the plastic Mast Butt Adaptor section of the Terminal Base Assembly by unscrewing the M6 Phillips head screw on the side. Again, straighten the cable as much as possible and carefully slip the first 1.2m length of Heatshrink over the cable ensuring that the Semi-Conducting Tape is not effected, until the end of the Heatshrink tube covers and overlaps the Semi-Conductive Tape (over the Black PVC Outer Sheath) by 3cm (Figure 33). Using a Gas torch or heat gun, shrink the lower end into the correct position and gradually work up towards the top of the Heatshrink.

Note: Ensure that the Heat gun or Gas torch is not pointed in the same area for too long as this will burn the Heatshrink, also be careful around the ends of the tube as too much heat will damage the Black PVC Outer Sheath, Semi-Conductive Tape and White XLPE Insulation.

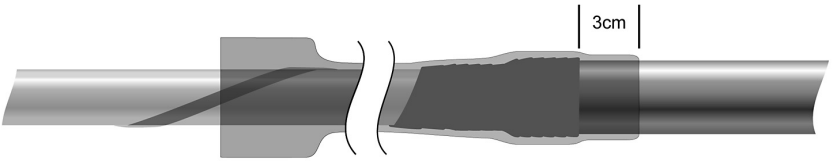


Figure 33.

14. Place the 2nd 600mm Heatshrink tube into place over the cable, again ensuring that the Semi-Conductive tape is not damaged, overlapping the previous Heatshrink tube by at least 3cm. Shrink about 7cm of the upper end of the Heatshrink into place so that it will sit flush with the base of the Plastic Mast Butt Adaptor when fitted back into place.

    Shrink the rest of the Heatshrink, ensuring that it overlaps the previous piece of Heatshrink by at Least 3cm. (Figure 34) Ensure the rest of the Heatshrink has a smooth overall finish. Note: If required, feed the cable through the mast sections & guying ring. Replace the plastic Mast Butt Adaptor section of the Terminal Base Assembly back onto the brass connector and ensure that the M6 Phillips Head screw is tight and secure.

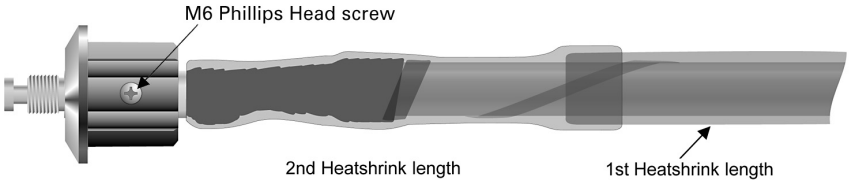


Figure 34.

15. The lugged HVSC is now ready to be connected to the base of the Guardian CAT terminal. Screw the terminal onto the completed Terminal Base Assembly and secure with the supplied M6 locking grub screw.

Connection of Factory Pre-Terminated HVSC (Upper End) to Guardian CAT Terminal

Tools required for the installation of the factory completed upper termination include:

- Sharp Knife.
- Medium size Phillips head screw driver.

1. Firstly remove the protective packaging from the cable and upper terminated end section taking care not to cut cable or associated upper termination parts in the process.
2. Using a Phillips Head screwdriver, remove the M6 Phillips Head screw holding the mast butt adaptor (if fitted) to the lower connector and retain both screw and mast butt adaptor.
3. Feed the HVSC cable through the FRP support mast.
4. Slide the black plastic mast butt adaptor back onto the brass lower connector, line up holes and screw the Phillips Head screw into position tightly. Now screw the mast butt adaptor into the Guardian CAT terminal and tighten the M6 Grub Screw at the base of the terminal to lock the assembly.

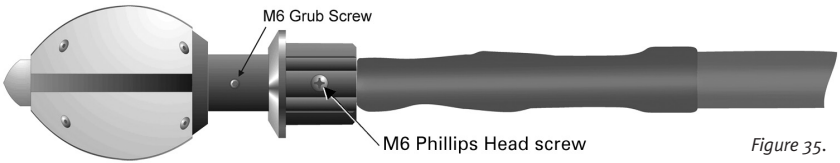


Figure 35.

Labelling

Warning Labels are supplied with all Guardian CAT terminals and should be installed as per the following:

- In locations where personnel may be in close proximity to the HVSC Downconductor.
- Where the HVSC downconductor connects to the earthing system.
- At the base of the support mast.

There are 2 Warning Labels supplied in the front cover of this manual and also 2 supplied in the lower termination kit. If more labels are required, contact your nearest LPI supplier or Distributor.

The mast chosen for the application must:

- Raise the terminal to a height of at least 2 metres (81 in.) higher than the structure. (Minimum accepted).
- Have an FRP mast section of at least 2 metres (81 in.) used below the air terminal if using LPI HVSC.
- Be suitable for local weather conditions. Seek guidance from a local civil engineer.
- Be guyed and securely attached to the dedicated mounting points (if required).

Types of Mast Configurations

When mounting a Guardian CAT terminal, there are generally three types of mast configurations that can be used.

Cantilevered

Typically used for mounting to a tower or the side wall of a plant room when a mast and base are not suitable. See drawings CTA-02, CTA-03, CTA-05 and Figure 36.

- 1/3 of the overall mast height must be fixed to the structure for adequate mechanical strength.
- Cantilevered masts can be guyed for additional strength. If guying, the use of a guy ring and/or the eyelets provided on the inline coupling can be utilized.

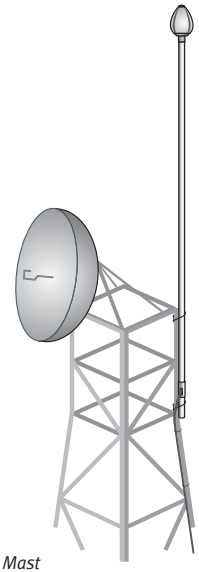


Figure 36. Cantilevered Mast

Guyed

When mounting a Guardian CAT terminal, a typical guyed configuration would involve the following. See drawing CTA-04 and Figure 37.

- Two sections of mast (Aluminium mast & FRP mast) coupled together with an inline coupling. Securing of guy wires is completed at the eyelets as provided on the inline coupling.
- Alternatively or in addition, a guy ring can be supplied which is installed at the neck of the mast in between the Guardian CAT terminal and the top section of the FRP. The guy ring provides eyelets for connection of the guy wires.

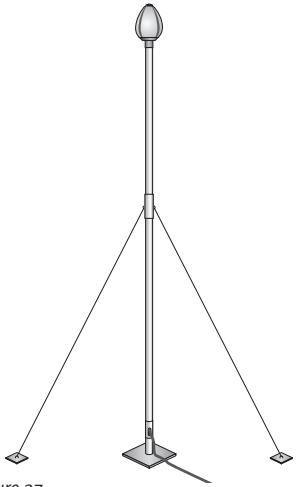


Figure 37. Guyed Mast

Freestanding

A freestanding mast configuration is typically used in situations where protection by isolation is required. For example a Guardian CAT terminal is installed 5 metres or more away from a fuel storage tank.

Prior to installing the freestanding mast, ensure that:

- A spigot has been supplied with the freestanding mast which allows for external or internal mounting of the FRP mast.
- The downconductor can exit through the base of the freestanding mast if run internally.
- Adequate information is provided for mast foundation requirements.

Figure 38. Freestanding Mast

Mast Bases

LPI supplies a mast base welded directly onto the required length of aluminium mast.

Mast Couplings and Guying Points

There are two methods of coupling two sections of mast:

1. The U-Bolt set uses two stainless steel U-Bolts to clamp the two masts together. (Figure 39)
2. The inline coupling fixes the upper and lower mast sections together and provides guying points and an exit point for the HVSC downconductor.

U-Bolts and Inline Couplings nuts must be tightened to no more than 55kg/cm (45in.lb).

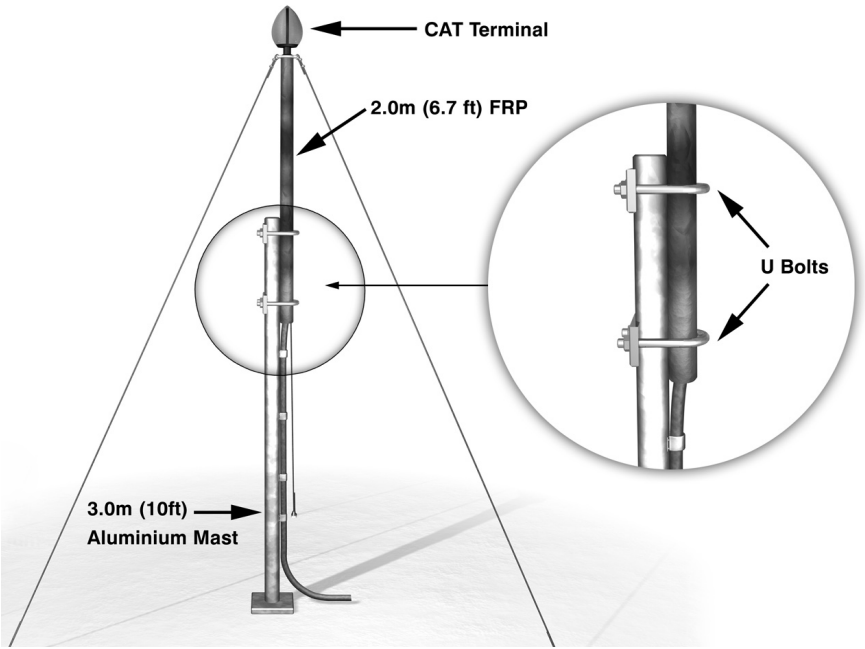


Figure 39.

A Guying Ring is supplied for guy points for any two piece masts that require double guying. This fits on the terminals mast butt adaptor between the Guardian CAT terminal and the top of the mast. See Figure 40

Guying

LPI offers a standard 4m (13 ft) and 7m (22.7 ft) guy kit made up of light weight plastic coated fibreglass, non-conductive cable. The LPI GUYKIT-4M and GUYKIT-7M are both non-conductive guying kits. They are designed to be installed with the use of a Guy Ring at the top section of the FRP Mast as illustrated in Figure 40. When guying from the LPI Inline Coupling, the use of stainless steel Guy Wire Kits (GUYKIT-4M-SS + GUYKIT-7M-SS) is recommended.

Important Recommendations:

- The guying angle must be no greater than 60° from horizontal.
- The inline coupling couples the upper and lower mast sections and provides guying points and an exit point for the HVSC downconductor.
- Minimum of 3 guying grips per guy end.
- Guying grips spaced at a minimum of 25mm (1 in.).
- Grips are correctly orientated
  - saddle on the longer length side of the guy and U-bolt over the tail side of the guy.
- Tighten grips to no more than 60cN.m (5lbf.in) of torque.
- Customised guy kits can be supplied upon request.

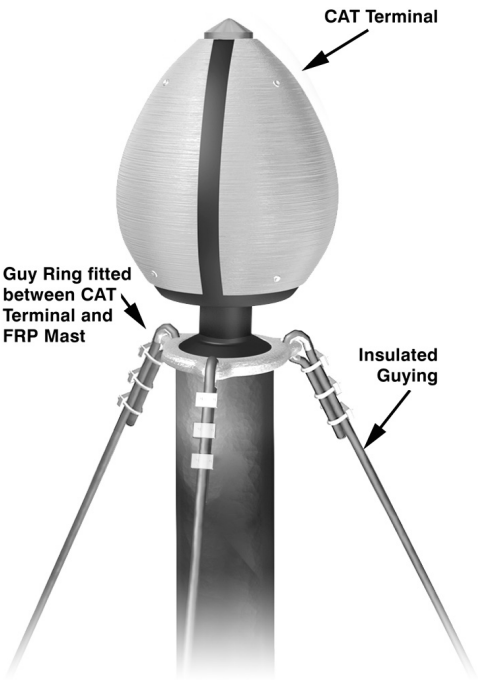


Figure 40.

Preparation for raising of the mast into position

- With the upper termination of the HVSC completed and the FRP mast in position it is now time to finalise the mounting arrangement so that the mast can be raised and secured into position.
- If using the recommended installation methods as per drawings CTA-01, CTA-02, CTA-03 and CTA-04, (on pages 5, 6, 7 and 8) fit the inline coupling to the lower mast material.
- If required, fit the HVSC downconductor through the centre of the Inline Coupling and through the FRP mast. Refer to Figure 42 on page 41.
- Feed the upper termination through the Guying Ring if required.
- Carefully fit the mast adaptor of the Guardian CAT terminal into the top of the FRP.
- It may be necessary to pull back any slack of HVSC downconductor through the FRP support mast to achieve a tight fit for the Guardian CAT terminal. This should be completed carefully so as to not damage the upper termination.
- Fix the FRP support mast firmly into the inline coupling and tighten the coupling so that the FRP mast and the lower mast are secured firmly in position, with no more than 55kg/cm (45lb/in).
- If a guy kit is to be installed, the guys should be securely fixed to the eyelets as provided on the inline coupling and or the guy ring. See text and graphics as detailed under the heading Guying for more information.

Raising of Mast

When raising the mast, ensure:

- Guys to inline coupling and/or guy ring are properly secured.
- Guys are not twisted, kinked or damaged.
- Guys are able to be easily secured at the lower guy anchoring points when the mast has been raised.

Turnbuckles or Rigging Screws are recommended at the base anchor points of the guys.

Other guying methods such as conductive stainless steel can be used only on aluminium masts or inline couplings below an FRP section.

Using a crane is recommended (or other suitable equipment) for anything over 6 metres (20ft.) in height, or for hazardous or high areas.

- It is very important to keep the mast straight during the lift to avoid damaging the mast.
- The Guardian CAT terminal must NOT be used as a slinging point.
- When lifting the mast, ensure that the slings or ropes cannot damage the Guardian CAT terminal, see Figure 41.
- When lifting the mast, the HVSC downconductor must be tied off to the mast to remove any strain on the HVSC downconductor termination to the Guardian CAT terminal.

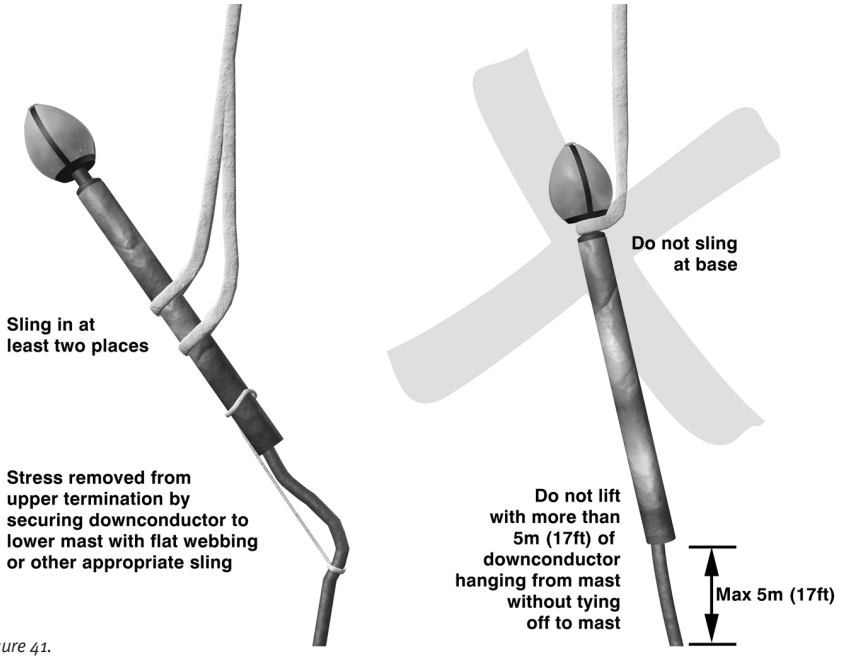


Figure 41.

- Protect the HVSC downconductor at the base of the mast when lifting, maintain a minimum bending radius of 500mm (20 in.) and ensure it does not drag over rough or sharp surfaces.

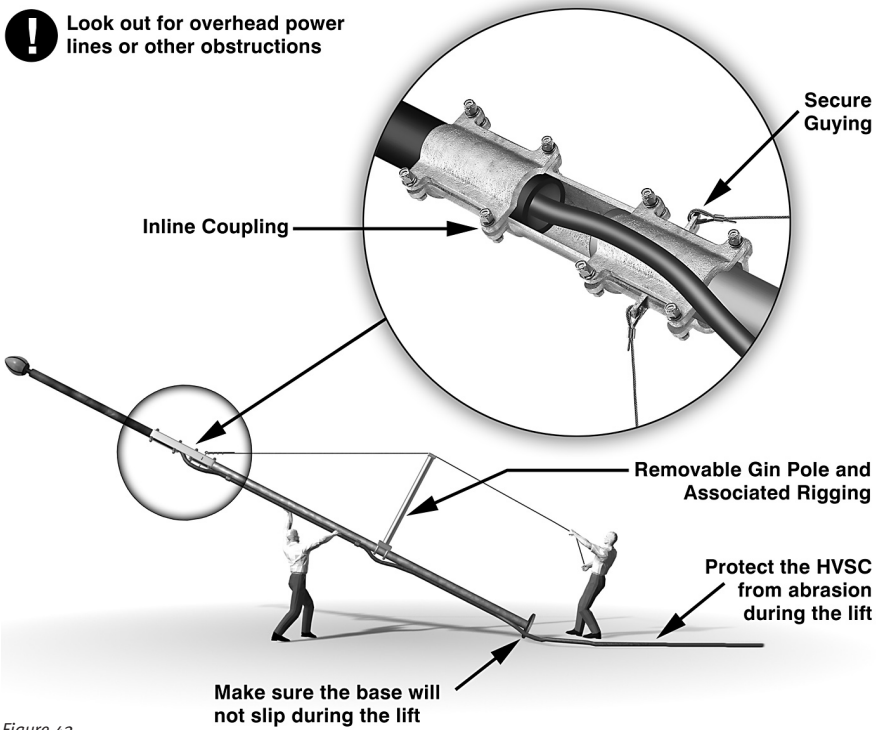


Figure 42.

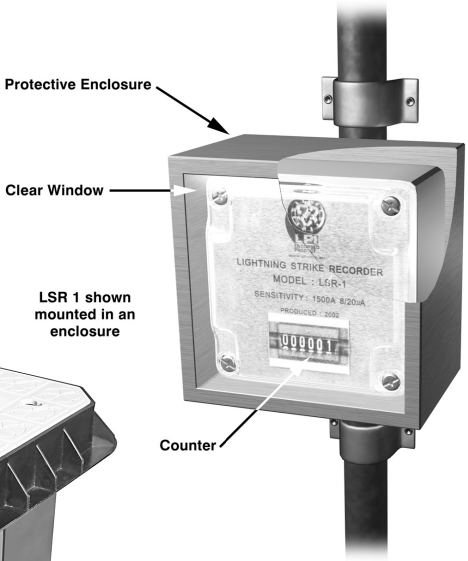
Lightning Strike Recorder (LSR1)

The Lightning Strike Recorder (LSR1) should be installed at a position along the downconductor length where it can be accessed easily for inspection. Typically the LSR1 should be installed approximately 1.5m from ground level or alternatively within the earth pit at the lower termination point of the HVSC.

When installing the LSR1 the following should be considered:

- The LSR1 should be mounted away from areas where damage may occur due to theft, vandalism or from nearby operations.
- The LSR1 can be enclosed in a security enclosure but the display should be kept visible to allow for the checking of recorded strikes.

Figure 43.
Lightning Strike Recorder installed on HVSC Downconductor.



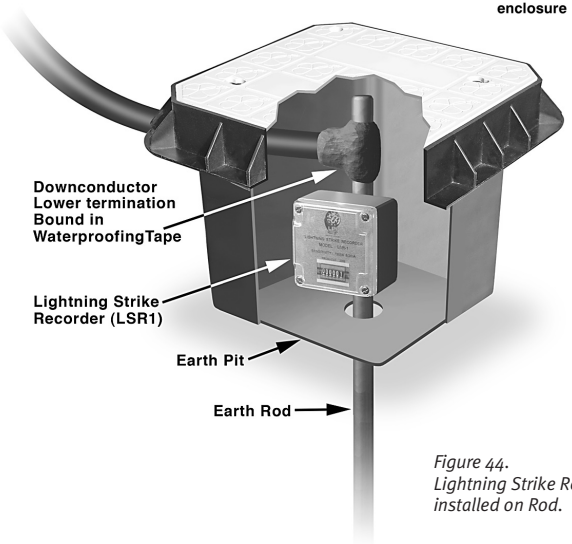


Figure 44.
Lightning Strike Recorder installed on Rod.

Certification

The certification of the LPI Guardian System 5 installation should be performed by an authorised LPI representative.

A certificate of compliance and warranty registration is provided with the installation manual. This certificate should be completed in full following the successful inspection and certification of the installation.

The following should be checked for quality of workmanship and compliance to recommended installation instructions.

Certification checklist

- Correct mast and any associated brackets and fastenings have been used for installation.
- Guying, anchor points and fastenings.
- HVSC Downconductor routing, fixing and weatherproofing.
- Lower termination of HVSC Downconductor.
- Earthing System.
- Labelling.

Operation and Maintenance

The LPI Guardian System 5 Lightning Protection System is designed to react to the rise in electric field which is present in approaching thunder storms. The Guardian CAT Terminal becomes active only during storm activity.

- The system operates without the need for external power supply or spare parts for standard operation.
- To keep the LPI Guardian System 5 Lightning Protection System operating at optimum levels it needs to be regularly checked.

Maintenance checks must be done:

- After each known lightning strike to the terminal.

- Once every twelve months.
- If changes have been made to the structure.

Checks to be conducted in standard maintenance inspection:

- Is there any damage to Guardian System 5?
- Has the structure to be protected been modified since the last maintenance check?
- Check finial tip for excessive pitting.
- Check all rigging, mast mounts, saddles and conductor fixings are secure and tight.
- Ensure that no dirt or other matter is sitting in the air gap between the finial tip and the surrounding panel edges.
- If conventional downconductors are used, check that all conductors are securely fixed and not damaged.
- Check for damage to the LPI HVSC. The downconductor should not be able to be accessed by non authorised people or machinery.
- All warning labels must still be in place.
- Check LSR1 for secure installation and record number of strikes.

Testing the Guardian CAT Terminal

Tools required to complete operational test of Guardian CAT terminal

A Standard Insulation Tester such as a Megger will be required to complete testing of the Guardian CAT terminal. The insulation tester to be used must have a meg ohm scale that provides for a voltage of between 500V and 1500V to be applied.

Steps for testing Guardian CAT terminal

1. The Guardian CAT terminal can be tested once installed or prior to mounting.
2. Ensure that the Guardian CAT terminal is dry prior to testing the terminal. If moisture is visible wipe dry with a clean cloth.
3. If the terminal is not yet installed and moisture is visible complete step 2. As an additional

measure shake the Guardian CAT terminal gently to allow all moisture to escape through the drainage holes at the base of the terminal.

4. One lead of the tester is connected to the rivet on each panel, whilst the other lead is placed on the finial tip.
5. The same test should be applied for each of the four panels (4 tests in total).
6. The result for each panel should be greater than 2 mega ohms.
7. If one or more tests does not meet the 2 mega ohms requirements as detailed in step 6, the Guardian CAT terminal should be removed and washed thoroughly with clean water removing all dirt and debris.

   Be sure to thoroughly dry the terminal as detailed in step 3 prior to re-testing. The terminal can be tested while removed from the mast.
8. If the terminal still fails the test, please contact LPI or an authorised LPI agent for further instructions.

The LPI Guardian System 5 lightning Protection System may not operate at full efficiency in all environmental conditions ie. under ice or snow or on chimneys or exhaust stacks releasing gasses or pollutants. For advice on dealing with these specific environments contact your local LPI Distributor.

Testing the Lightning Earth and the HVSC Downconductor

Use the table on page 47 to record the results following completion of the following steps.

1. Remove the waterproofing tape from the lower termination.
2. Disconnect the HVSC downconductor from the lightning earth.
3. Disconnect the structure earth bonding cable from the earth system.
4. Measure the earth resistance of the lightning earth system and record in column 3 under the heading Earth Resistance Readings in the table provided on page 47.
5. Measure the earth resistance of the structure and record in column 4.

6. Reconnect the structure earth bonding cable to the lightning earth and measure and record in column 5 the earth resistance reading.
7. Use a multimeter to measure the continuity between the inner and outer conductors of the HVSC downconductor. The measurement should exceed 10,000 ohms.
8. Reconnect the HVSC lower termination to the lightning earth and re-seal the termination using waterproofing tape to ensure that it is waterproof.
9. Report any problems arising from the above tests to your local LPI distributor for further advice.

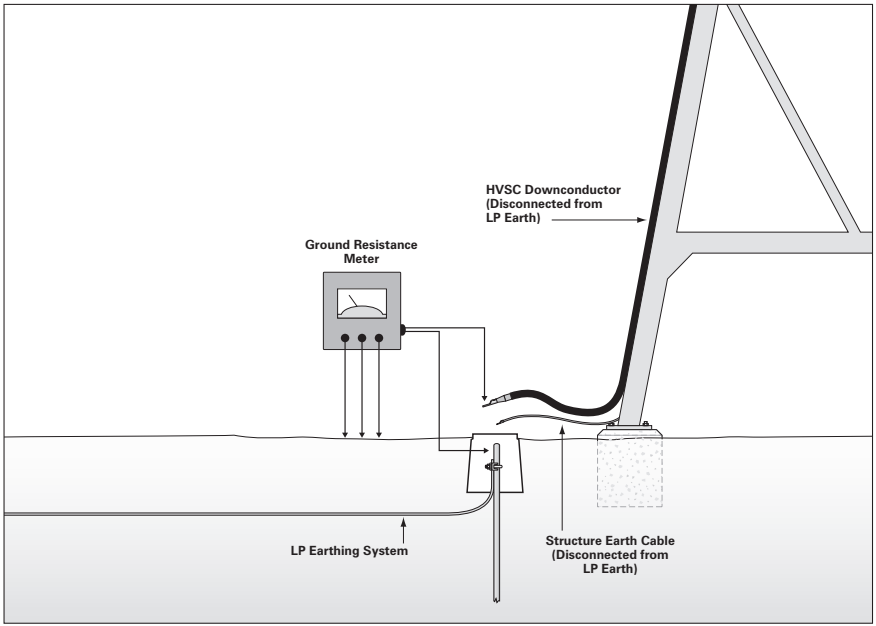


Figure 45.

Date of Inspection	Inspected by:	Earth Resistance Reading #1	Earth Resistance Reading #2	Earth Resistance Reading #3	LSR Reading	Comments

Installation Notes

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