CONNECT AND PROTECT

Telecommunications Facility Protection Solutions

nVent

ERICO

NOTE: Product application information given in this document is of a general nature. Installers of the product are cautioned to ensure product is always installed in accordance with any applicable National Standards, Codes, and Practices.

Table of Contents

Indoor Bonding Arrangement

Grounding, bonding, lightning and surge protection are critical parts of a telecommunications facility installation. nVent ERICO has complete telecommunication application solution to help protect the facility against electrical noise, lightning induced surges and transients caused by switching components in the power systems.

nVent ERICO solutions include ground rods, ground mats, nVent ERICO GEM (GEM) and nVent Quickfil (Quickfill) ground enhancing material, ground bars, nVent ERICO Cadweld connections, lightning protection systems and power, signal and communication surge protection.

To make the application of these products simpler, the grounding, lightning protection and surge protection system at a telecommunications facility is divided into five components.

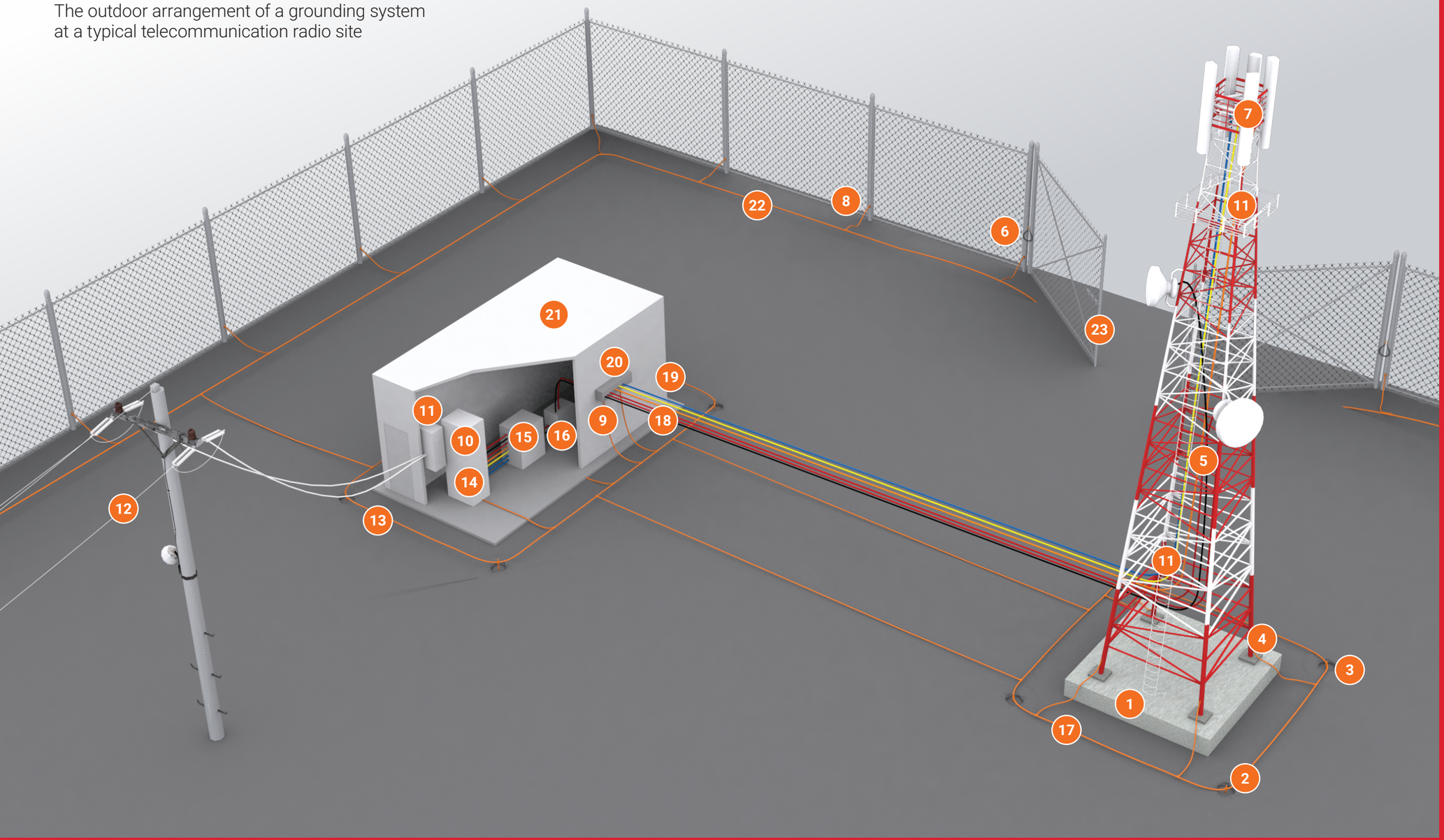
- Indoor bonding arrangement
- Outdoor grounding arrangement
- Surge protection for AC and DC power lines
- Bonding surge protection for coaxial & communication lines
- Direct strike lightning protection

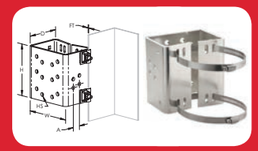
Ground bars can be used to achieve the ideal indoor grounding arrangement as required at the telecommunications facility.

1 Bonding Lugs
2 Equipotential Ground Bar
3 Ground Bonding Braids
4 AC Power Surge Protection
5 Network Surge Protector
6 Mechanical Mesh Bonding
7 Signal Reference Grid

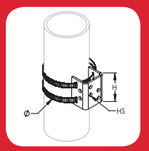
Outdoor Grounding and Protection Arrangement

The outdoor arrangement of a grounding system at a typical telecommunication radio site

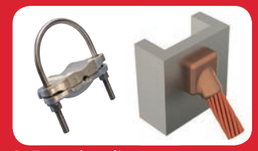




7. Tower mount bond, ETMAG



7. Tower mount bond, ETMAG



8. Fence bonding

9. DC surge protection

10. Surge reduction filter, SRF range

10. DIN mounted surge protection, DT/EDT range

10. AC surge protection, TDX range

11. Equipotential equipment ground bar

12. AC power line

13. Telecom ground electrode

14. AC main switch board & Surge protection

15. Rectifier

16. DC surge protection remote radio feed

17. Tower ground electrode

18. DC, alarm, other copper cables

19. Fiber, Coaxial & Waveguide feeders

20. Point of entry grounding

21. Telecom shelter or cabinet

22. Fence grounding

23. Gate grounding

1. Copper tape

1. Copper bonded steel conductor, CBSC

1. Theft deterrent composite cable, TDCC

2. Ground enhancement material, GEM or Quickfill

3. Ground rod

3. Cadweld connections

3. Mechanical connector, REC16120

3. Mechanical connector, GUV16070

3. nVent ERICO Hammerlock

3. Mechanical connector, SP58

4. Cadweld tower bond

5. Tower mount ground bar

6. Gate bonding

Ground Rods, Connections and Accessories

GROUND RODS

nVent ERICO offers a range of ground rods for telecommunications applications to suit the needs and preferences of the carriers. The most common of these are copper bonded steel ground rods, due to their versatility in varied soil conditions and compatibility with various common metals used underground.

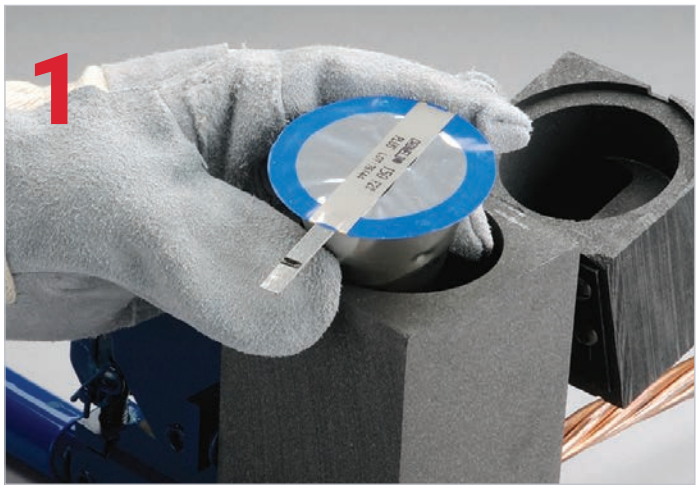
The copper-bonded ground rod has an electrolytic coating of copper deposited over a layer of nickel. This process helps ensure a long lasting, molecular bond between the copper layer and the steel core. nVent ERICO recommends copper-bonded ground rods because the copper coating will not slip or tear when driven, nor will it crack if the rod is bent. The tough, carbon steel core has good characteristics for deep driving. Copper-bonded ground rods have a high resistance to corrosion and provide a low resistance path to ground.

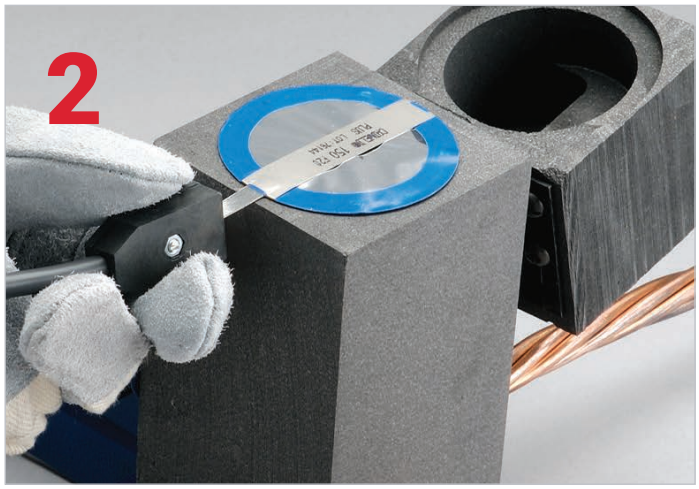
It is important to note that certain soils and landfill areas may not be compatible with copper. In these situations, stainless steel is a better choice. Stainless steel may also be an alternative, when structures or components, such as steel towers, poles or lead sheathed cables are in close proximity to an array of ground electrodes. In these circumstances, consideration must be given to the consequence of galvanic corrosion.

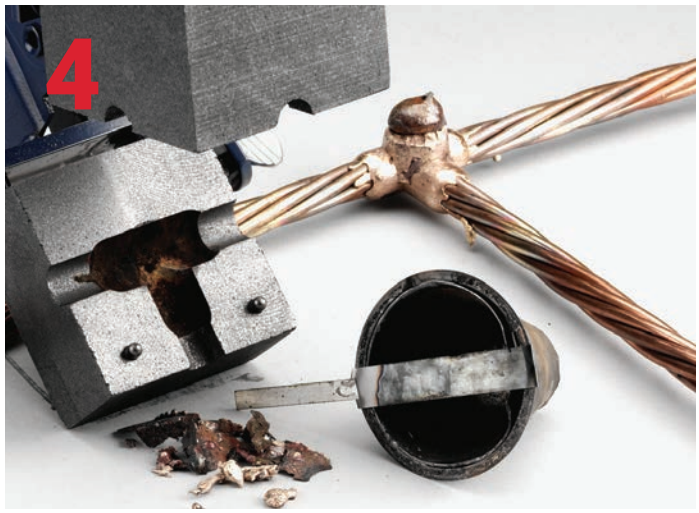
GROUNDING CONNECTIONS

Grounding connections are vital to the proper operation and integrity of the electrical system. nVent ERICO offers a range of mechanical grounding connections including clamps, jumpers, fence connections, U-Bolts and other clamps.

However, the nVent ERICO Cadweld Plus welded electrical connection is our recommended method of making grounding connections. The principle technology consists of bringing together a welding material and through electronic ignition in a suitable graphite mold. The reduction of copper oxide by aluminum produces molten copper and aluminum oxide slag at extremely high temperatures. The shape of the mold, its dimensions, and the size of welding material, are all dependent on the items to be welded.







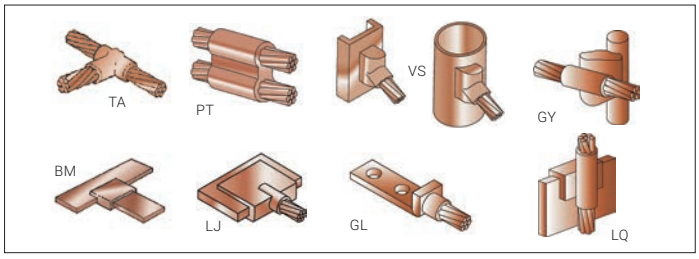
Ground Rods, Connections and Accessories

The key benefits of Cadweld are

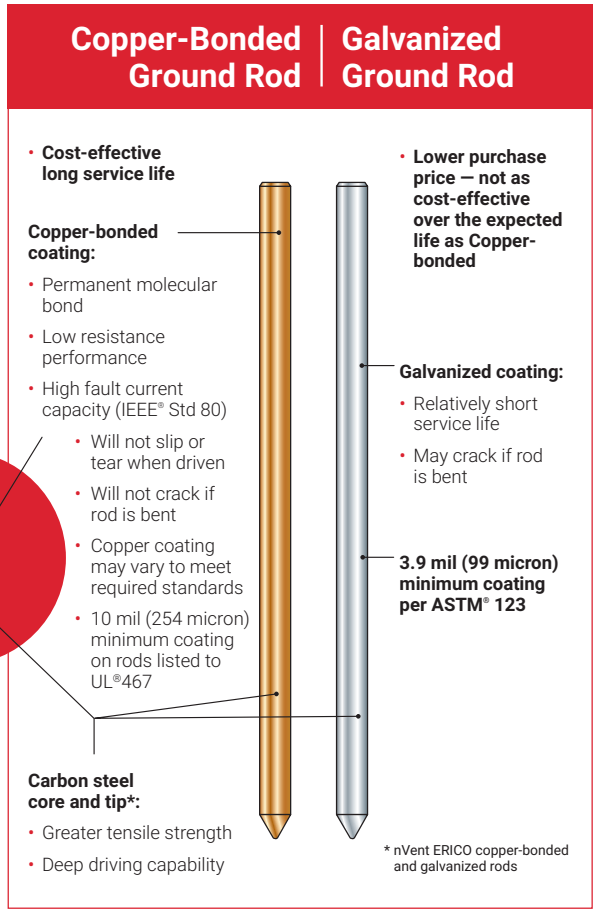
- Connections are permanent and will not loosen or corrode.
- Connections are made with inexpensive, lightweight equipment.
- Connections can be made without the need for any special skills.

The Cadweld connection is essentially a fusing through of the grounding conductor, whereby there is greater amount of metal across the cross section of the connection than that across the conductor. It can be intuitively seen that the connection is as good as the conductor, if not better, which is a unique feature of Cadweld. Independent scientific tests have been done to Cadweld using the most stringent standards associated with high voltage electrical installations.

Hammerlock



Typical Cadweld connections used in telecommunications grounding and bonding



GROUNDING CONDUCTORS AND ACCESSORIES

Traditionally the most common type of grounding conductor has been copper tape 25 x 3mm, solid round copper #2AWG or stranded round copper in the range of 50–75mm^2 cross sectional area. nVent ERICO offers a range of copper conductors.

As copper theft has become more predominant in many countries, nVent ERICO offers alternative conductor options:

- nVent ERICO Cu-Bond Round Coductors
- Theft-deterrent composite cables

GEM25A

Quickfill

In situations where ground conditions make it difficult to achieve the required resistance, nVent ERICO offers a ground enhancement material called GEM. GEM is a low-resistance, non-corrosive, carbon dust based material that improves grounding effectiveness, especially in areas of poor conductivity. GEM25A exceeds the requirements of IEC 62561-7. Quickfill is a no-mix ground-enhancing backfill that reduces resistance to ground and enables convenient installations. Quickfill is designed to minimize dust and eliminate mixing. It is the ideal material to use in areas of poor conductivity such as rocky ground, mountain tops, and sandy soil.

nVent ERICO offers a range of mechanical ground connections suitable both for flat tape and round conductors and a range of ground test equipment.

nVent ERICO recommends the Cadweld method of connection for all underground and near ground connections. Mechanical connections are prone to corrosion and if used, they need to be protected against moisture using water proof tapes. Furthermore all mechanical connections need to be inspected and hence require inspection wells. Waterproofing and inspection wells are not required for Cadweld because the connection is welded or fused through, it does not loosen and is highly resilient against corrosion in both below and above ground connection.

Protection Grounding and Bonding of Street Cabinets and Pole Mounted Remote Electronics

STREET AND POLES MOUNTED TELECOMMUNICATIONS ASSETS

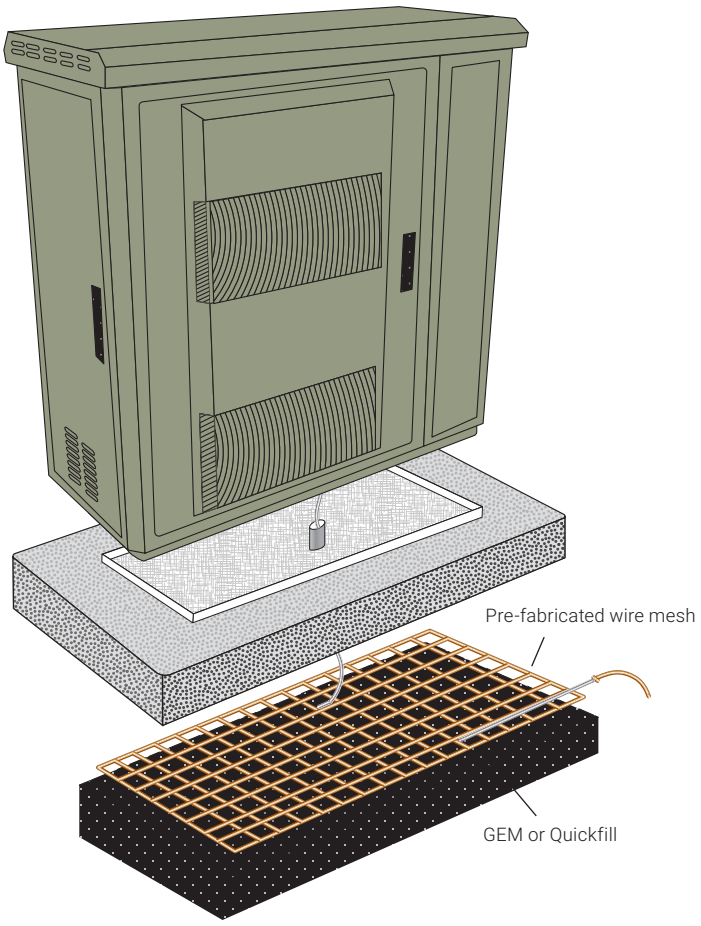
Street Cabinets

There has been a significant increase in the use of street mounted cabinets in the telecommunication industry. The challenges associated with grounding of these cabinets include risk of damaging buried services, limited footprint availability, inability to bring in heavy machinery, desire to have common design for all sites and lack of methods and standards of grounding. nVent nVent ERICO offers several method of grounding that overcomes the challenges often faced by carries. An example of a proven method is depicted below.

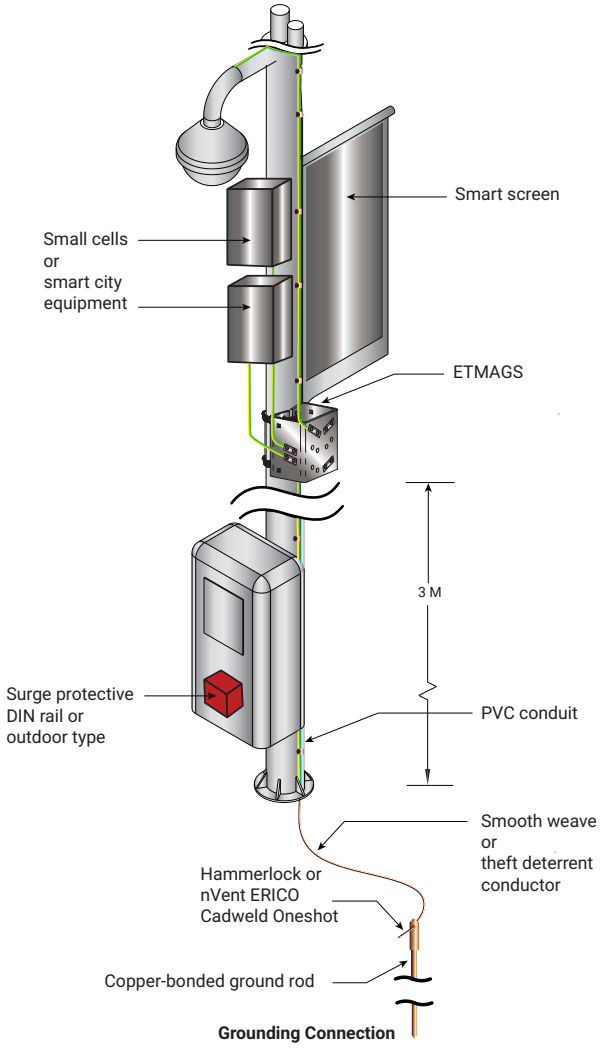
Modern telecommunications networks will see a marked increase pole mounted telecommunications equipment. Examples of these are small cells, DAS equipment and 4G and 5G antennas.

There are two methods of providing protection these assets.

- Isolated method
- Bonding method



Mesh Method for Street Cabinet Protection



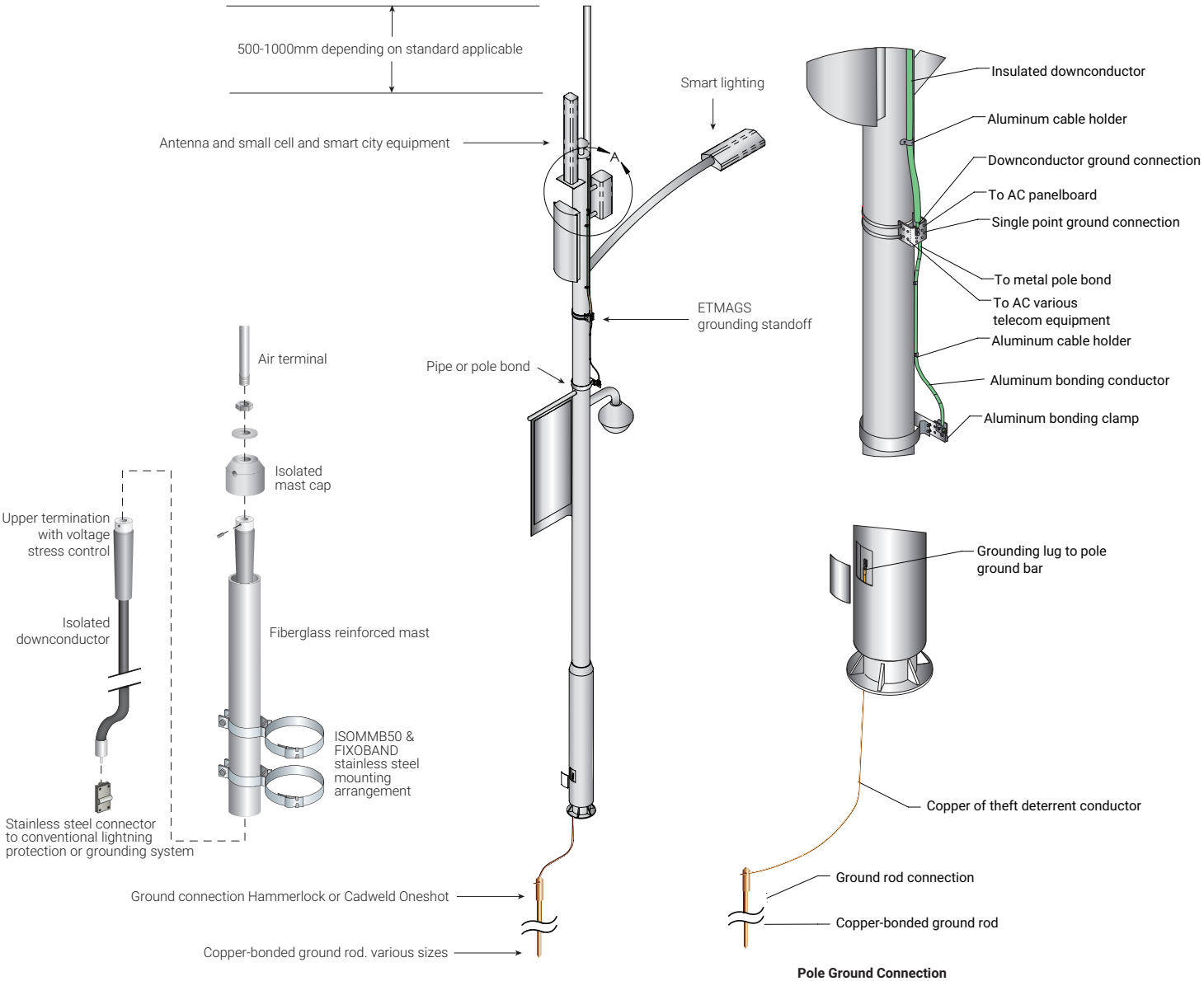
Bonding Method of Protection

Protection Grounding and Bonding of Street Cabinets and Pole Mounted Remote Electronics

Isolated lightning protection systems that could be used to protect these assets in high expose geographies and on elevated locations.

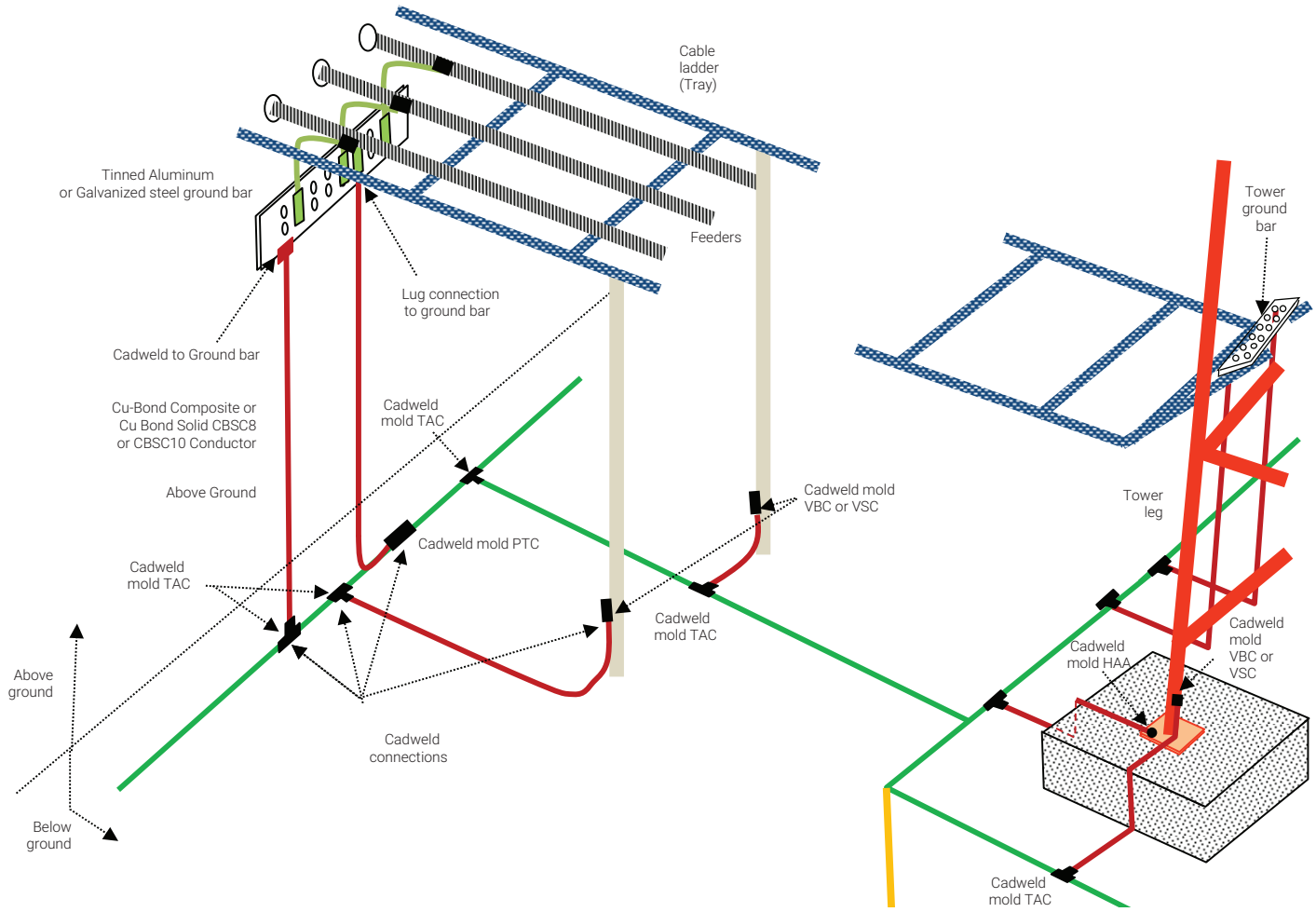
A traditional lightning rod is mounted of sufficient height to ensure that the communication equipment is under a zone of protection. An insulated conductor that can contain the lightning energy for short lengths of the cable is connected to the air terminal. The conductor is then run to a distance down the pole so that it bypasses the communications equipment. The bottom end of the insulated downconductor connects to the metallic pole or to a physical bare cable downconductor. This connection also becomes the common point where the communication equipment and the AC power ground also connects. This provides a solid single point grounding system hence reducing the need for an extremely good ground resistance. At most sites where this equipment is installed there will be limited space to install any more than one vertical ground rod and often no access for drilling equipment to drive very deep rods.

In isolated arrangement the grounding and bonding will be identical to the that in a bonding method. The advantage of the isolated method is that that lightning energy is conducted via an insulated cable that can contain the energy in the top part of the pole, where the telecommunications equipment is installed.



Isolated Lightning Protection Grounding of Pole Mounted Electronics

nVent ERICO Theft Deterrent Grounding Solutions

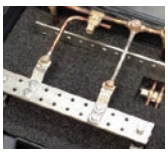


Application of nVent ERICO Theft Deterrent Grounding at Radio Site

nVent ERICO Cu-Bond Round Conductor

The Cu-Bond Round Conductor (Copper Bonded Steel Conductor, CBSC) is comprised of an electro-plated coating of copper deposited over a layer of nickel surrounding a steel core. This process helps ensure a long-lasting molecular bond between the copper layer and the steel. The conductor core consists of a low-carbon steel grade for improved flexibility in the field. The copper surface of the conductor provides high conductivity and corrosion-resistance properties.

- Theft Deterrent: Due to its steel core, the conductor is very difficult to cut with hand tools.
- Cost Effective: The cost of the conductor is minimized by reducing the total amount of copper in the cable, because the copper is bonded to a steel core.
- Superior Corrosion Resistance: In comparison to other steel-based products, Cu-Bond Round Conductor provides excellent application life of typically 30–40 years in most soil conditions.

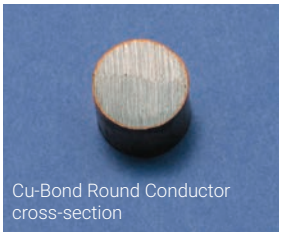


COMPLETE SYSTEM
Conductor
Mountings
Connectors
Design
Installation

MEET STANDARDS
IEC 62561-2 for conductor
IEC 62561 -4 Test criteria for fasteners
IEC 62561-21 Test for mechanical connectors
IEEE837 for Cadweld

COST EFFECTIVE
Lower Cost than Copper System
Comparable cost to good quality GI System

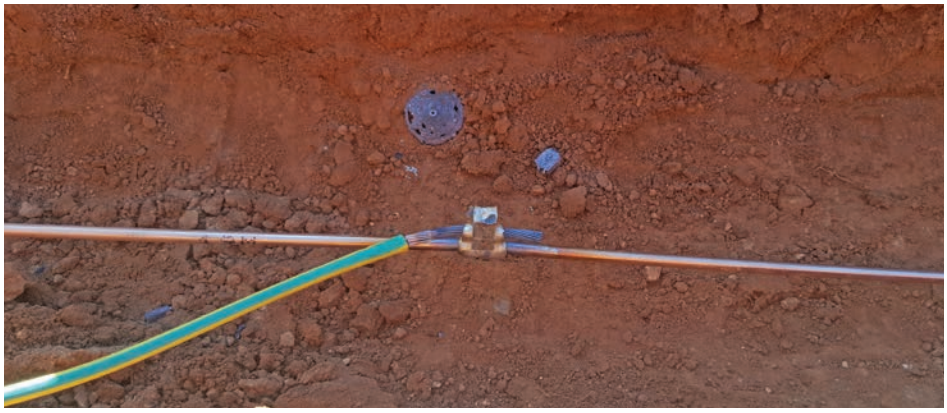
PERFORMANCE
Long Life time 30-40 Years
Same Resistance Values as for Copper or Steel System


Cu-Bond Round Conductor cross-section

Cross-Sectional Area

Product Code	CBSC8	CBSC10
Conductor Cross Section in mm²	50.27	78.52
Conductor Cross Section in in²	0.08	0.12

nVent ERICO Theft Deterrent Grounding Solutions

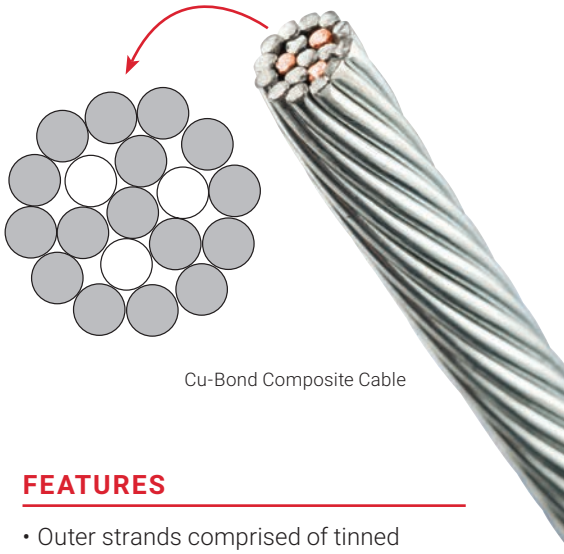


Application of Cu-Bond Round

nVent ERICO Cu-Bond Composite Conductor

Cu-Bond Composite Conductor is a bare concentric stranded conductor that consists of peripheral tinned copper plated steel which protects and conceals the internal copper stranding.

This conductor is ideal for exposed electrical grounding applications where copper theft may occur due to its tinned outer strands. The conductor is difficult to cut with hand tools, but the copper core makes it easier to install than other theft deterrent conductors. The outer stranding is magnetic, which further deters thieves looking for copper. The CC5A05CB is suitable for telecommunications radio sites.



Cu-Bond Composite Cable

FEATURES

- Outer strands comprised of tinned copper-bonded steel for theft deterrence and improved corrosion resistance
- Inner copper stranding is tinned for superior corrosion resistance
- Copper stranding inside of conductor increases conductivity and conductor flexibility
- Copper strands are hidden by outer galvanized steel strands
- Suitable for direct burial applications

Bonding of Tower Equipment – ETMAGS and ETMAGSDAT

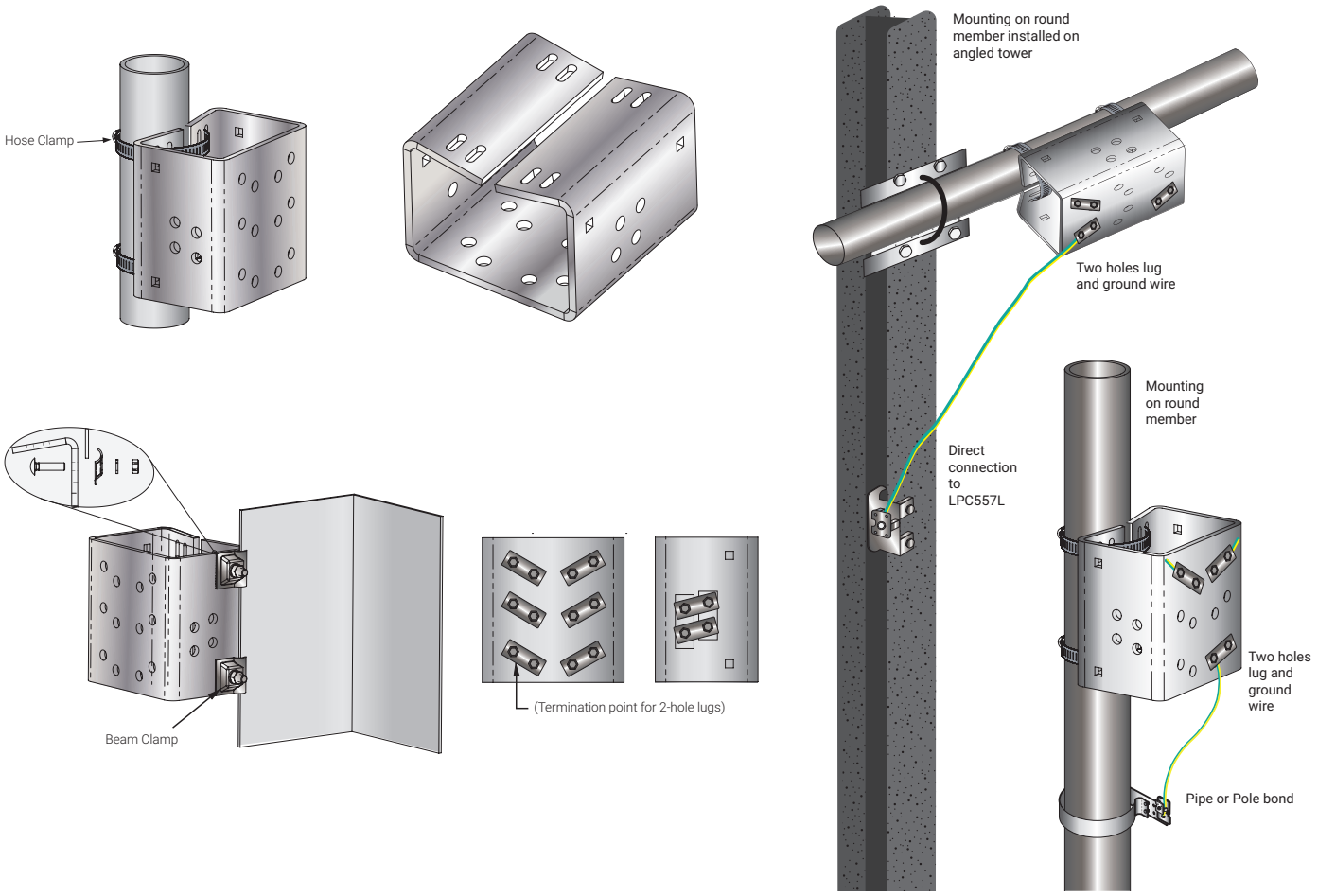
Most equipment on a telecommunication tower is grounded by connecting a copper conductor to a ground bar mounted to the tower itself. The lead length of the conductor is often extensive, which can add resistance to the grounding system.

The ETMAGS and ETMAGSDAT grounding standoff for telecommunications towers offers a direct, low-impedance electrical ground connection to the tower. Due to its compact size and unique direct-mounting feature, it can be installed close to amplifiers, antennas and other equipment.

FEATURES

- Provides a direct, low-impedance electrical ground connection to the tower
- Offers a quick installation process
- Compact design fits in tight and confined locations
- Available in tinned copper to reduce dissimilar metal issues
- Six TIA double-hole lug attachment points

Application of ETMAGSDAT



Surge Protection for Power and Telephone Lines

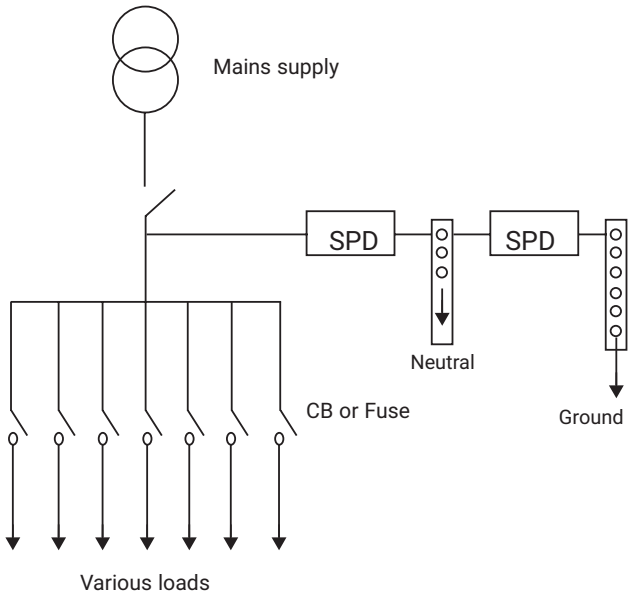
A telecommunications site needs reliable grounding for the purpose of good reference ground, noise control and dissipation of any lightning energy. Surges in the power and copper based telephone lines can also originate from lightning strikes that have struck objects some distance from the actual site, in many cases, even miles away. Having a good ground alone is not enough to minimize damage due to these surges caused by distant strikes. Surges can also occur in power lines due to switching of circuit breakers in the power systems under fault conditions. It is important to have adequate surge protection on the AC mains and on telephone lines.

nVent ERICO offers surge protective devices (SPDs) with technology options of traditional, or nVent ERICO TD Technology. nVent ERICO DT series of SPDs have been designed with traditional technology to achieve high surge rating performance. nVent ERICO EDT series of SPDs utilize TD Technology to ensure continued operation during and after sustained and abnormal over-voltage events. These products have been independently tested and certified to the latest editions of both IEC and UL standards.

nVent ERICO continues to be a pioneer in the low voltage surge protection industry, having been involved in grounding and bonding applications for over 100 years, and as a manufacturer of SPDs for over thirty years.

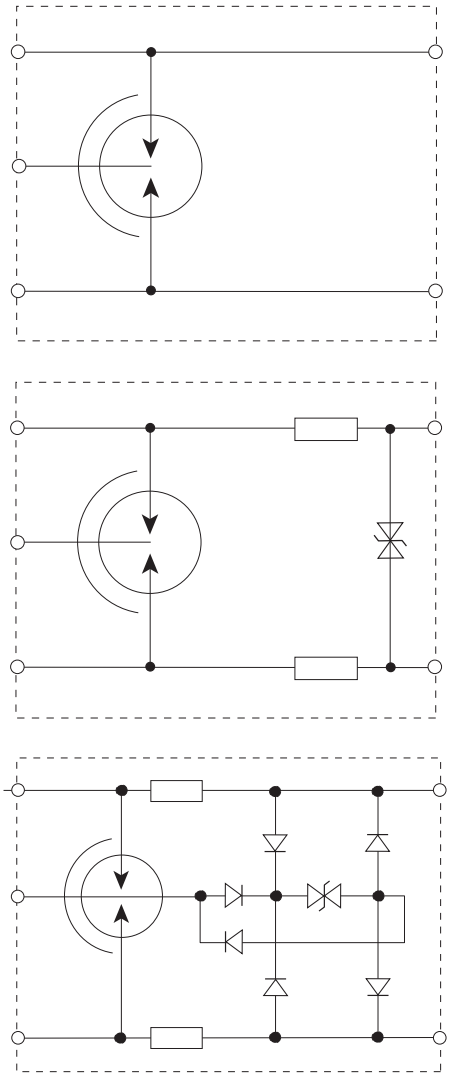
Our involvement in the industry predates the creation of the initial IEC and UL low voltage surge protection standards. We've been on the journey since the early days of Low Voltage AC surge protection, with the issuing of the IEEE587 standard in 1980, and we have been active on all major worldwide SPD standards committees and industry bodies (including IEEE, IEC, and UL) since.

Typical Wiring of a SPD at a Main Switch Board



Surge Protection for Communications Lines

Lightning surges can get coupled into communications lines, in a very similar manner that they couple into power lines.

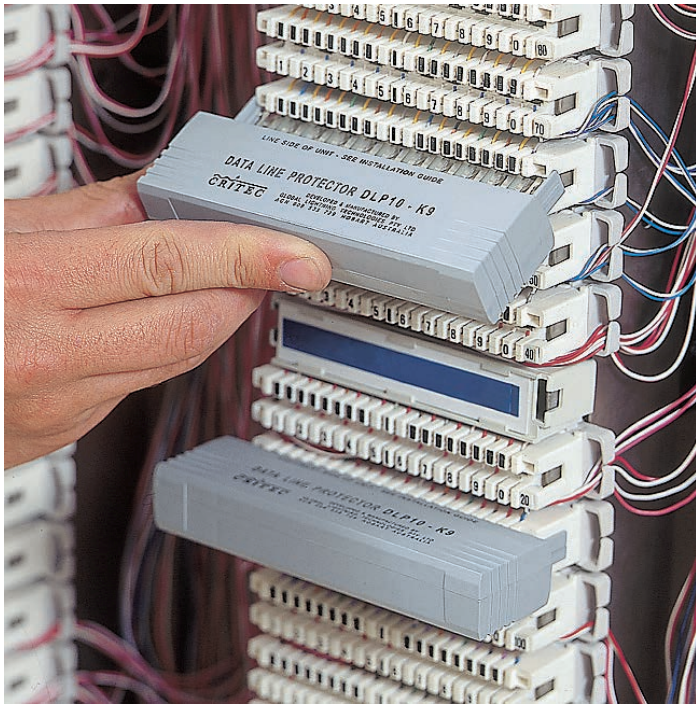


Topologies for communication line protection

The SPD arrangement shown left is called shunt surge protection whereby the SPD is connected in parallel with the load. The limitation of this type of protection is that while the surge voltage is controlled to a manageable level, these devices do not lower the voltage rise time of the incoming surges. It is widely acknowledged that both the voltage level as well as the rise time of power surges can cause damage to sensitive electronics. In applications where a higher level of protection is deemed necessary due to the critical nature of the telecommunications, Surge reduction filters (SRFs) can be used to effectively to reduce the voltage levels and rise times.

Surge Protection for Power and Telephone Lines

Telecommunication line surge protection are installed at the main distribution frame helps ensure that both of the lines are shorted to ground momentarily to take bulk of the energy down to ground when a surge occurs.



Krone type telephone line protectors

Surge reduction filter

Coaxial radio feeders are grounded at the point of entry of the building. In the case of high lightning exposure geographies and where very long lengths of coaxial feeders are used, there may be a need to provide surge protection to the coaxial feeders.

Newer cellular installations may have CAT6 or ethernet type cable running to the top of tower for purposes of signaling or alarming. When not properly protected these can be a source of surges into the equipment room and hence should always be surge protected.

nVent ERICO AC power SPD's

Surge protection CAT6

Coaxial surge protectors, CSP

DC Surge Protection of Remote Radio Units for Fiber to the Antenna

Traditionally cellular radio antennae are connected to base station radio equipment using coaxial feeders. The coaxial feeders would carry the baseband frequency and the RF signal. RF feeders have served the industry extremely well. However as the frequency and the bandwidth transmitted increases, the losses in the feeder and connectors become more significant. There is a limitation on the length of the RF feeder before losses become intolerable and the error rate significant.

The next generation of cellular equipment utilized remote radio units close to the antennae which would convert the frequencies to a intermediate frequency and this could be transmitted more efficiently on smaller coax feeders with losses being less of a problem.

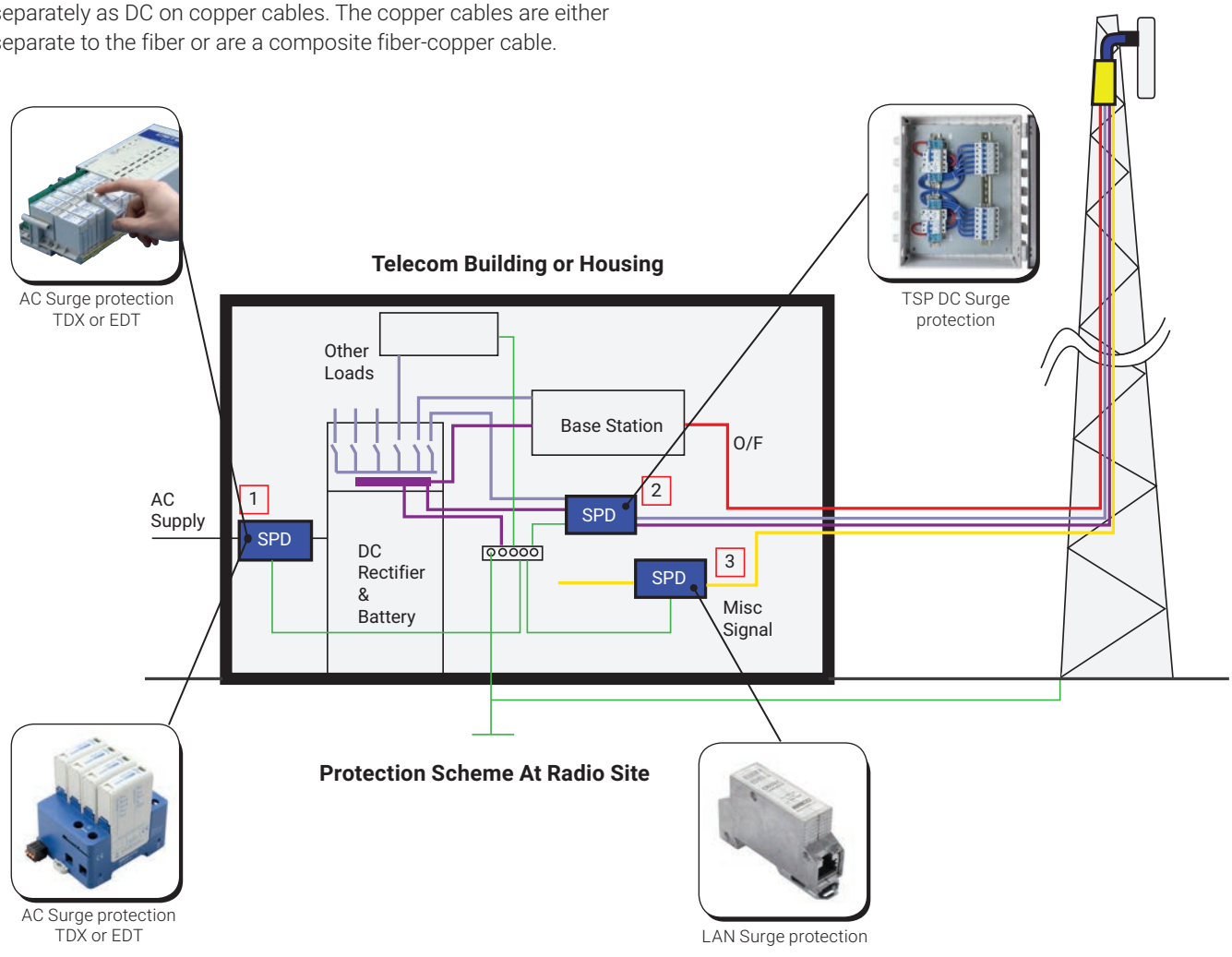
Modern cellular equipment utilize remote radio unit RRU or remote radio head RRH which is fed from the base station via optical fiber. This eliminates the loss issues on feeders and allows transmission to occur at much higher frequencies and with larger bandwidth. The snag with this method of transmission is that power cannot be transferred from the base station to RRU or RRH via the optical fiber. This power is fed separately as DC on copper cables. The copper cables are either separate to the fiber or are a composite fiber-copper cable.

The DC feed act as a source of lightning surge back into the equipment room and more precaution needs to be taken on how to control these surges, than ever before. In traditional radio, the extent of damage to equipment would normally be the radio equipment. In the modern scenario damage can occur to the rectifiers or the whole DC power system, which would jeopardize other equipment installed at the site.

The simple solution to this may seem like installing surge protection devices or SPD on the DC feeds. However, there are intricacies that involve earth loops & voltage drops associated with cable lengths that need to be understood before choosing the correct location of SPD. DC SPD's typically deplete with number of surges and attention needs to be paid to alarming and monitoring of these.

nVent ERICO provides application advice on the use of DC surge protection for remote radio heads.

Additionally miscellaneous data and alarms going up to the tower must be protected.



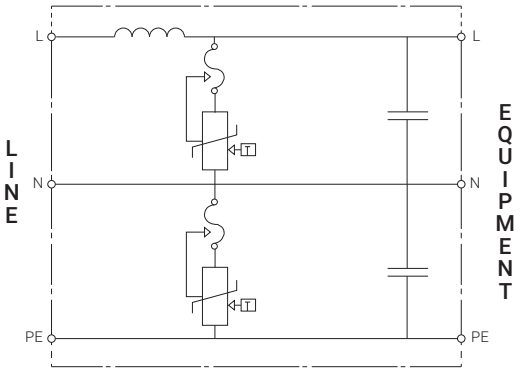
Protection Scheme At Radio Site

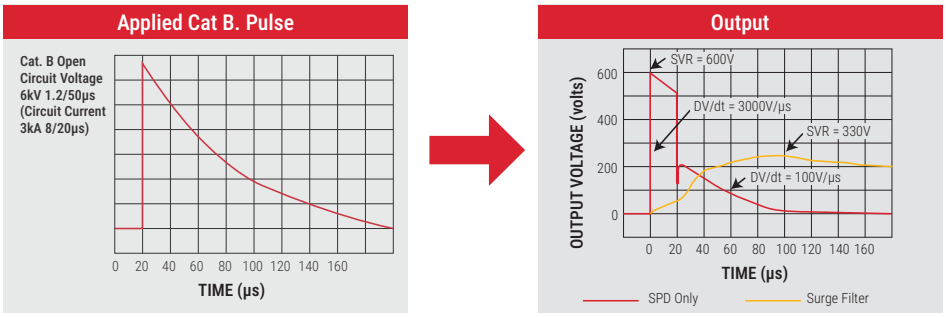
Surge Reduction Filters for Remote Enclosures and Shelters

Surge reduction filters are designed to fit into cabinets and enclosures housing telecommunications and control equipment provide several benefits that traditional surge protectors cannot achieve.

1. Traditionally surge protection in buildings or other commercial and industrial installations, is done by the installation of shunt connected surge protective devices, SPD's at several places including the main switch boards, distributions boards and sometimes sub-distribution boards. Sometimes this is referred to a cascaded design. These surge protectors when designed and installed properly, coordinate effectively and provide good surge protection to critical loads connected at the end. The inductance in the cable in between the main distribution board and the distribution and sub-distribution boards provide excellent means of de-coupling between the various tiers of surge protection. This type of coordination is not possible to achieve in cabinets and enclosures installed outside of buildings, in streets or distributed at an external facility like a water treatment plant, because they may just be one tier of power distribution board. This article will demonstrate how this problem can be overcome by the use of a surge reduction filter that provide performance at its output similar to or better than a cascaded arrangement.
2. Traditional shunt connected SPD's would normally provide details of how well they clamp in its datasheets or on the nameplate These value is depicted by Up or Voltage Protection Level in IEC61643 series of standards and as Vpr in UL1449-Edition 3 and IEEEVVV Triology Set of Standards. This value is the measured voltage across the device when a certain current of standard surge test wave shape 8/20 is applied. Hence this is perceived as a measure of how well the device protects the load. What is often overlooked that other than the voltage across the device terminal there will be added voltage on the cable leads connecting to the shunt device and the voltage level to which the load is protection is a sum of the voltage across the SPD plus the voltage across the cable connections. Surge reduction filters overcome this inherent problem with traditional SPD's.
3. Thirdly, surge reduction filters when design to filter lightning frequencies can offer an new attribute that is not offered by traditional SPDs. That is it can provide significant attenuation on the voltage rise time or DV/dt associated with surges and transients, which shunt connected devices cannot achieve.

nVent ERICO Surge Reduction Filters





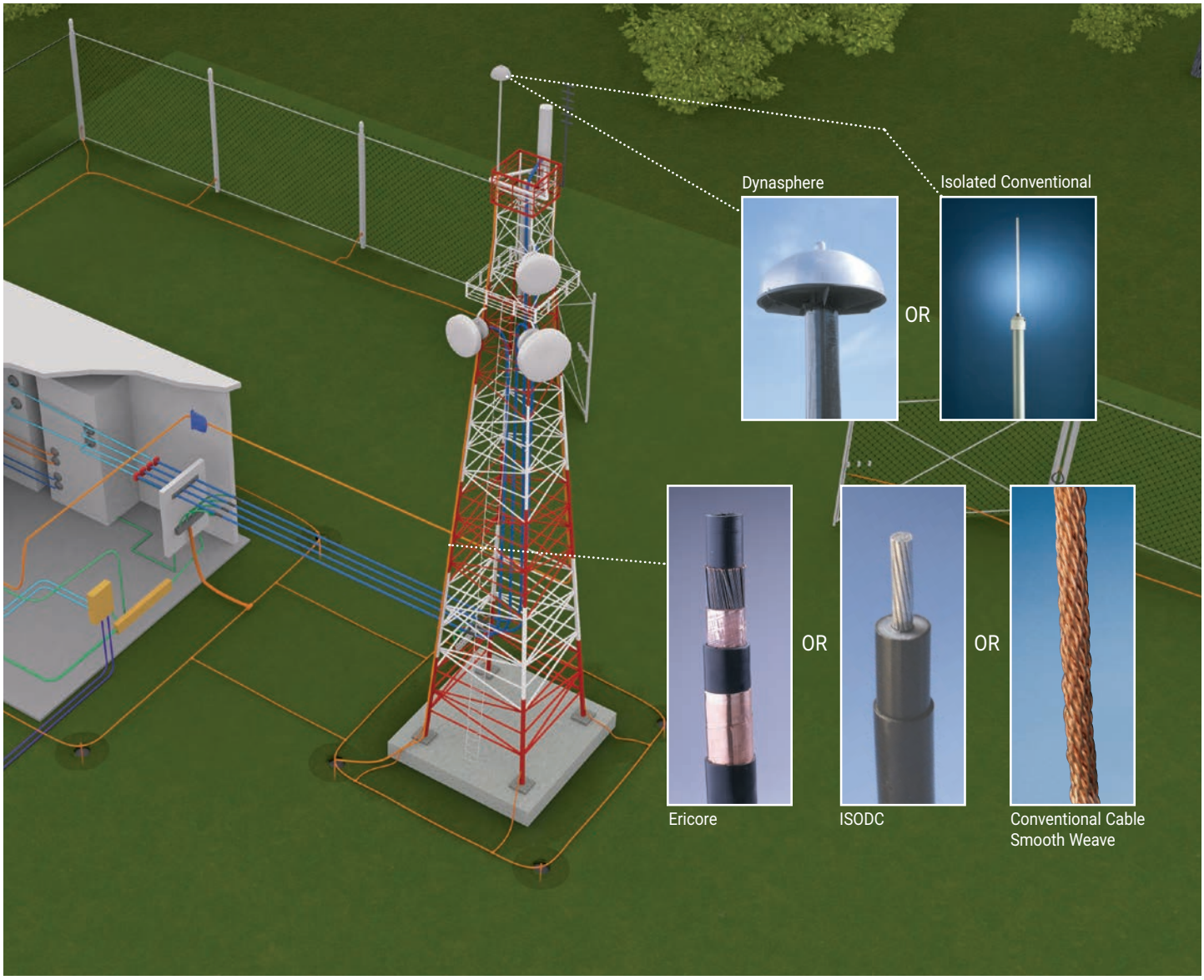
Surge filters, TSF

Lightning Protection for Telecommunications Towers

Direct lightning strikes to telecommunications towers are a reasonably regular occurrence, more so on mountain tops and in certain parts of the world. The traditional approach to lightning protection on towers is to have a lightning rod on the top of the tower and having either a dedicated down conductor or use the tower as the downconductor.

A modern method is to use an optimal air terminal design, the nVent ERICO Dynasphere mounted on top of the telecommunications mast on a 3-4 metres long fibreglass reinforced pole, (FRP). The FRP provides isolation between the air terminal and the tower and helps ensure that the lightning does not flash over and electrify the mast or the antenna. A special purpose downconductor, called the nVent ERICO Ericore is routed in the core of the FRP and connects to the bottom of the Dynasphere via a high voltage, impulse rated termination. The Ericore runs along a leg of the tower away from the routes of feeders, down to the tower grounding system.

When using isolated downconductor or ISODC system traditional lightning rod is mounted of sufficient height to ensure that the communication equipment is under a zone of protection. An insulated conductor that can contain the lightning energy for short lengths of the cable is connected to the air terminal. The conductor is then run to a distance down the pole so that it bypasses the communications equipment. The bottom end of the insulated downconductor connect to the tower some 12-15m, 36-45 ft from the top.

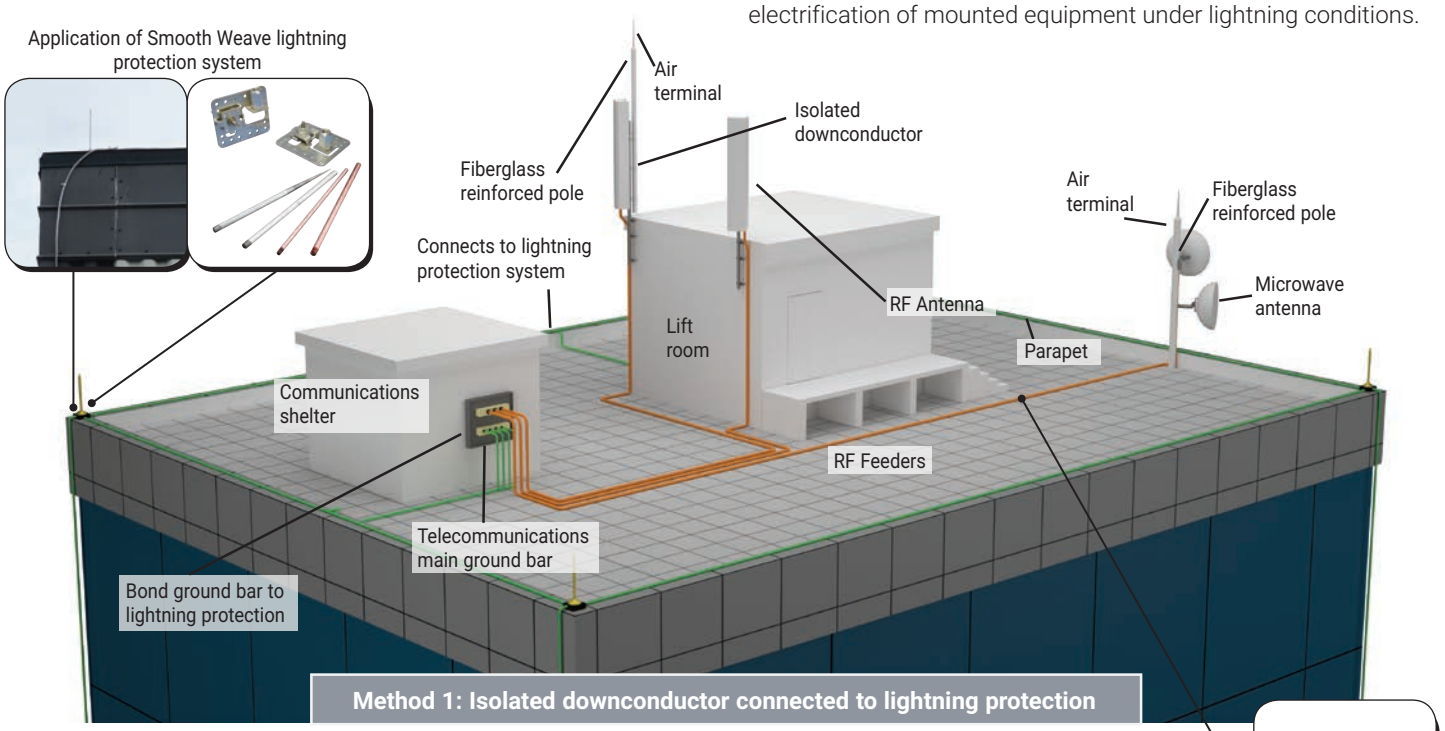


Lightning Protection for Roof Mounted Installations

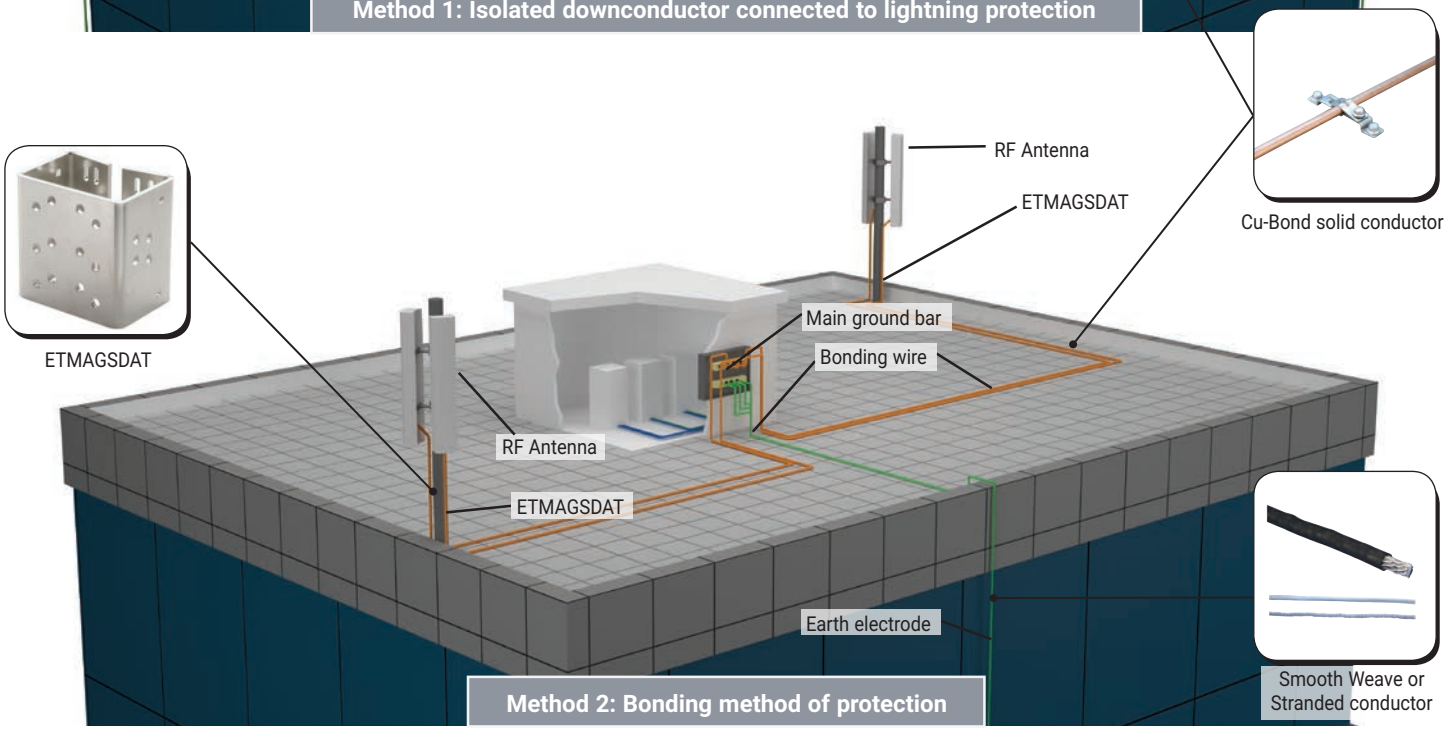
Traditionally, some rooftop installation have been protected by the use of air terminals (Franklin Lightning Rods), often connected to the building lightning protection system. However, the traditional building lightning protection techniques are not well suited to protect these roof top installations. Hence many telecommunications companies have opted not to provide any form of air terminal. Instead they do extensive bonding of all their roof mounted equipment.

The Isolated Downconductor System provides a modern approach to lightning protection for rooftop installations. The nVent ERICO isolated systems provide a traditional air terminal fitted to an isolated fiberglass reinforced plastic (FRP) mast. The isolated downconductor internally connects to the air terminal inside the FRP. The FRP mast has natural isolation properties, high strength for windy sites and low weight to minimize mast loading.

The advantage is that this downconductor can be mounted directly on the mast or structure to be protected – without electrification of mounted equipment under lightning conditions.

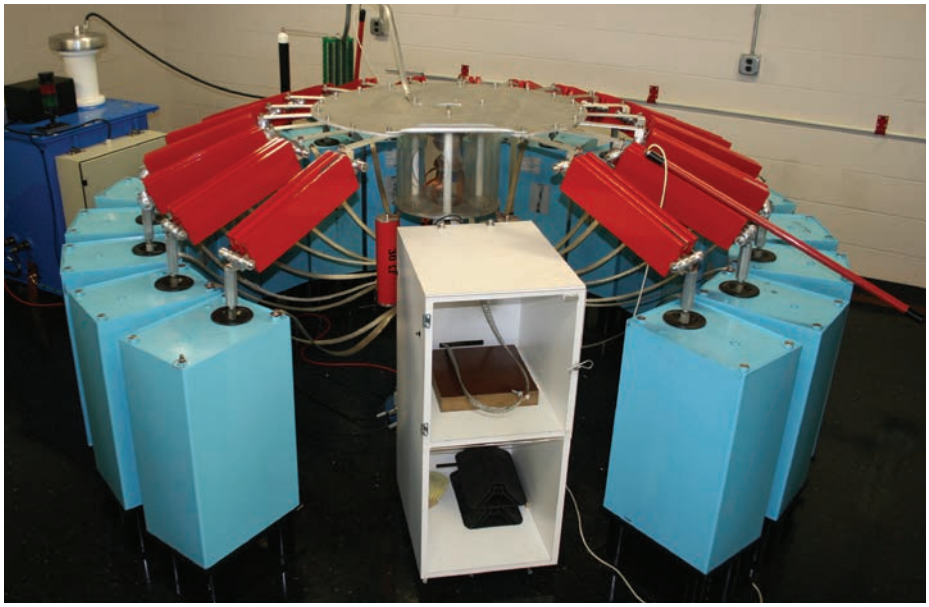


Method 1: Isolated downconductor connected to lightning protection



Method 2: Bonding method of protection

nVent ERICO Expertise



The nVent ERICO advantage is our approach to the complete Facility Electrical Protection Solution. Well designed and high quality Surge Protection is critical to a facility equipment's reliable operation, however it is only part of the solution.

nVent ERICO therefore offers the complete range and expertise in grounding, bonding, surge and lightning protection, providing the complete solution worldwide and across applications including Commercial, Industrial, Telecom, Utility and Railway. Our service and expertise encompasses more than just the product.

PRODUCT TESTING

To effectively meet market requirements and ensure our products are designed and tested to the highest of performance standards, nVent ERICO has invested in state of the art testing equipment that is able to:

- Support application testing for clients – to ensure your equipment is adequately protected.
- Participate in the UL Client Test Data Program.
- Support competitive product testing.
- Test and evaluate to a range of mechanical, electrical and environmental requirements.

HISTORY

nVent ERICO engineers have been developing earthing & surge solutions for over 100 years. In 1903, the Electric Railway Improvement Company (ERICO®) was created to supply power bonds, signal bonds and related welding equipment to railroads, mining and street railway industries.

They are experts in designing products to achieve a variety of global certifications including, but not limited to, UL 1449 Ed. 4 and IEC 61643-11. In addition to this, nVent ERICO engineers have designed unique, innovative surge technologies like Transient Discriminating (TD) Technology and high-performance surge filters. Our engineers have developed surge products and technologies protecting a variety of industry-specific needs with some examples being: rail signaling, photovoltaics, telecommunications, LED lighting, and wind turbines.

SEMINARS AND SITE AUDITS

Each year nVent ERICO conducts hundreds of seminars in numerous countries around the world, educating specifiers, engineers, and installers on Facility Electrical Protection.

Our powerful portfolio of brands:

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