



ERICO

SOLUTIONS GUIDE

GROUNDING, BONDING AND ERICO CADWELD

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Introduction

Pentair Engineered Electrical & Fastening Solutions is a leading global manufacturer and marketer of superior engineered products for niche electrical, mechanical and concrete applications. These Pentair products are sold globally under a variety of market-leading brands: ERICO welded electrical connections, facility electrical protection, and rail and industrial products; CADDY fixing, fastening and support products; ERIFLEX low voltage power and grounding connections; and LENTON engineered systems for concrete reinforcement.

For more information on ERICO, CADDY, ERIFLEX and LENTON, please visit erico.pentair.com.

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Pentair products shall be installed and used only as indicated in Pentair's product instruction sheets and training materials. Instruction sheets are available at www.erico.pentair.com and from your Pentair customer service representative. Improper installation, misuse, misapplication or other failure to completely follow Pentair's instructions and warnings may cause product malfunction, property damage, serious bodily injury and death and/or void your warranty.

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Facility Electrical Protection for the 21st Century

Lightning strikes and the dangerous over-voltage surges caused by lightning and man-made events represent a direct threat to people, buildings and sensitive electronic equipment.

Today, the consequences of an unexpected lightning strike or power surge can be catastrophic for a company. Proper protection can save thousands of dollars in damage, operational downtime and lost business opportunities.

Total Facility Protection

The consequences of an unexpected lightning strike or power surge can be catastrophic for a facility:

- Personnel are at risk.
- Critical equipment may be damaged or destroyed.
- Data can be corrupted.
- The costs of operational downtime and lost revenue can be very substantial.

As industries become more dependent on increasingly sensitive equipment, proper protection from lightning and dangerous over-voltage transients is necessary.

With over 60 years of research, testing and product development, ERICO has acknowledged that no single technology can totally eliminate vulnerability to lightning and surges.

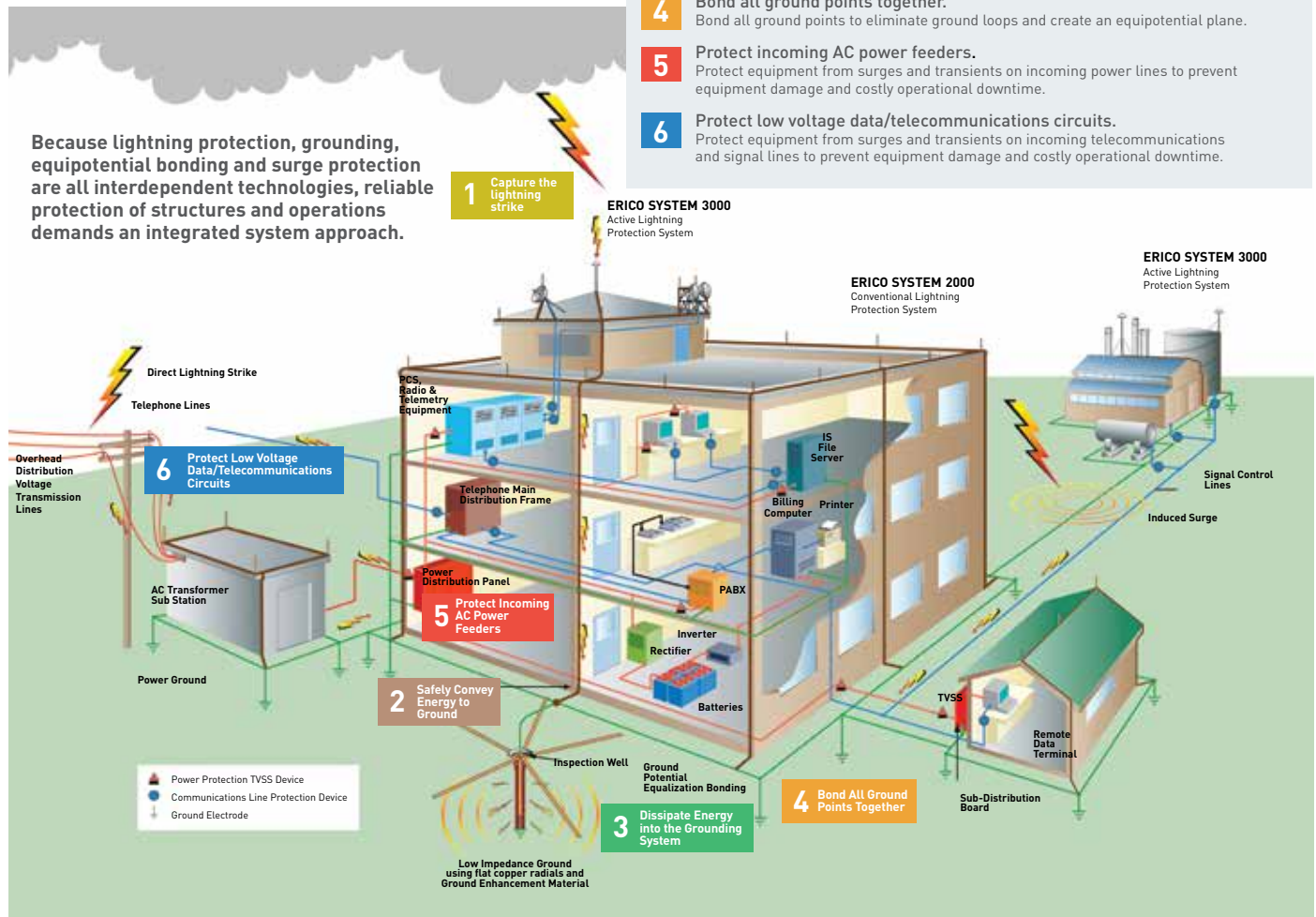
The ERICO Six Point Plan of Protection is designed to provide total facility protection by integrating several concepts.

The Six Point Plan will minimize the risk of damage to facilities through:

- Direct Strike Protection
- Grounding and Bonding
- Surge and Over-voltage Transient Protection

The Six Point Plan of Protection from ERICO

- 1 Capture the lightning strike.**
Capture the lightning strike to a known and preferred attachment point using a purpose-designed air terminal system.
- 2 Convey this energy to ground.**
Conduct the energy to the ground via a purpose-designed downconductor.
- 3 Dissipate energy into the grounding system.**
Dissipate energy into a low impedance grounding system.
- 4 Bond all ground points together.**
Bond all ground points to eliminate ground loops and create an equipotential plane.
- 5 Protect incoming AC power feeders.**
Protect equipment from surges and transients on incoming power lines to prevent equipment damage and costly operational downtime.
- 6 Protect low voltage data/telecommunications circuits.**
Protect equipment from surges and transients on incoming telecommunications and signal lines to prevent equipment damage and costly operational downtime.



ERICO is a leading global designer, manufacturer and marketer of precision-engineered specialty metal products serving niche markets in a diverse range of electrical, construction, utility and rail applications. The company is headquartered in Solon, Ohio, USA with a network of sales locations serving more than 25 countries and with manufacturing and distribution facilities worldwide.

ERICO's well-known brand names include: CADDY electrical and mechanical fixings, fasteners and supports; CADWELD welded electrical connections; ERICO surge protection devices; ERICO rail and industrial products; ERIFLEX low voltage power distribution; ERICO facility electrical protection; and LENTON concrete products. Visit ERICO online at www.ERICO.com.

Facility Electrical Protection for the 21st Century

Direct Strike Protection

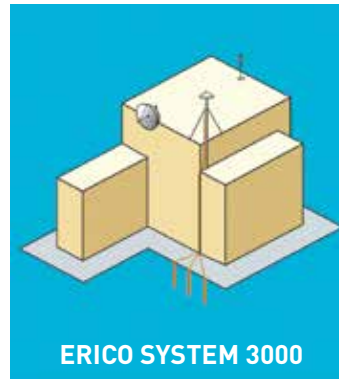
ERICO's innovative technology provides two systems for capturing lightning energy. The ERICO SYSTEM 2000 provides conventional air terminal technology to meet traditional needs.

An alternative approach to lightning protection is the ERICO SYSTEM 3000, which utilizes the collection volume principle to determine the effective placement of lightning protection to ensure the safe conveyance and dissipation of the lightning energy into the ground.

Over 7000 facilities, including some of the tallest and most vulnerable buildings in the world, are protected by ERICO SYSTEM 3000.



- Well known technology of passive rods or air terminals, familiar to installers
- Air terminals available in aluminum, copper and stainless
- IEC®, B.S., and U.S. Standard Compliant
- Precision manufacturing helps ensure easy assembly and installation
- Computer-aided design to IEC62305, NFPA®-780, AS/NZS1768



- Advanced lightning protection system based on latest lightning research and technology
- Enhanced area of protection, fewer air terminals needed
- Economical and easy to install
- Fewer downconductors are required
- Designed to protect all types of structures and "open areas"
- Computer-aided design using Collection Volume method



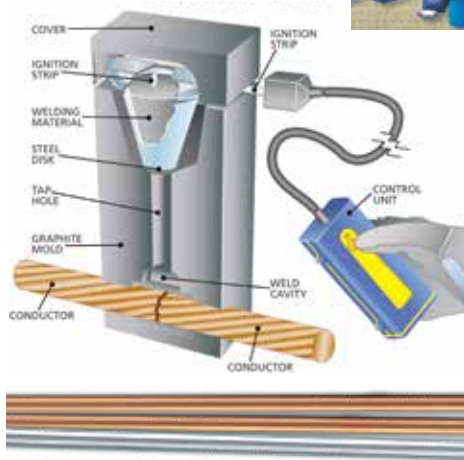
Grounding and Bonding

For the efficient performance of a lightning protection system, it is essential that a low impedance ground be provided to facilitate the dissipation of the lightning energy into the earth mass.

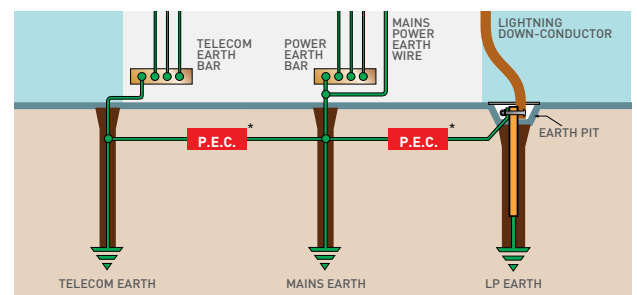
Because soil conditions and seasonal patterns vary from site to site, the methods of grounding need to be considered on an individual basis.

As a grounding specialist, ERICO provides a range of grounding systems to suit any application.

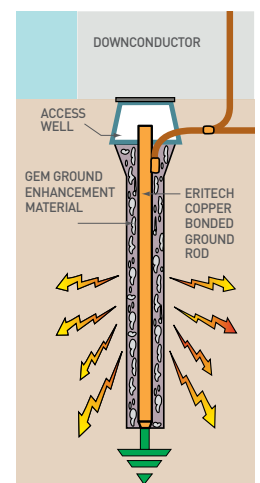
ERICO CADWELD PLUS

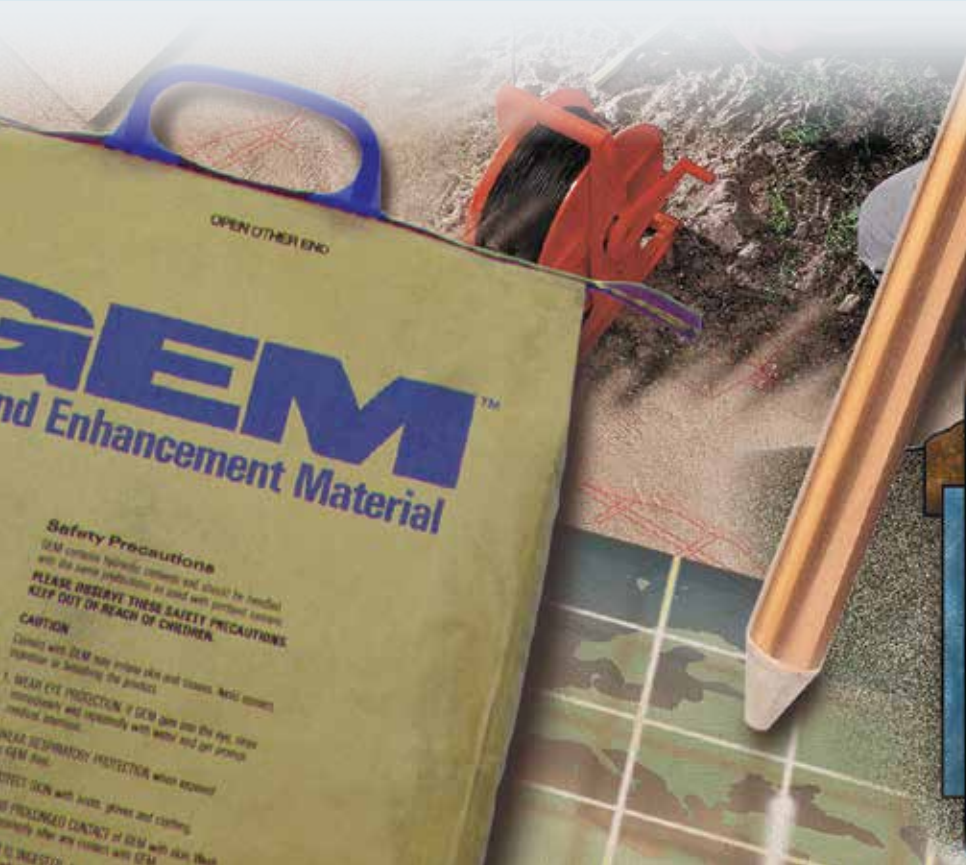


Connections are often the most critical element of grounding systems, so the preferred method of connection is the ERICO CADWELD exothermic welding process.



ERICO offers a variety of products, such as ground bars, signal reference grids, ground plates and potential equalization clamps, which are designed to create an equipotential plane and help protect personnel and valuable equipment. ERICO CADWELD copper-bonded or stainless steel earth rods and GEM facilitate the transfer of surges and fault currents into the earth, and provide a very long service life due to superior construction and quality.





Introduction

Grounding and bonding are an integral part of any modern electrical protection system design. An effective, low-impedance ground system is a key element of this system.

It is crucial to help provide personnel safety, as well as reliable protection for vital equipment and to minimize interruptions of service and costly downtime.

With over a century of experience in the design and manufacture of bonding and grounding products, ERICO, a single source provider, offers what we believe is the best range of long lasting and cost-effective grounding products available.

Soil conditions and seasonal patterns vary from site to site, the methods of grounding need to be considered on an individual basis.

Basic Definitions

Ground: A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

Earth: The conductive mass of the earth, whose electric potential at any point is conventionally taken as equal to zero. (In some countries the term "ground" is used instead of "earth.")

Bonding: The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct any current likely to be imposed.

The need to ground!

There are important reasons why a grounding system should be installed.

1. The most important reason is to help protect people!
2. To help provide protection of structures and equipment from unintentional contact with live conductors.
3. To help support maximum safety from electrical system faults and lightning.

It is a fundamental fact that electricity ALWAYS flows to the point of lowest potential. The task is to help ensure that electricity, including faults, lightning and electronic noise, flows to this point with maximum safety to people, while maintaining the reliability of equipment. Therefore we must help ensure the safe, controlled flow of electricity with minimum voltage drop to earth in all cases.

Grounding Codes and Standards

Grounding needs vary according to function. The grounding requirements of a power system will vary from those of electrical equipment, lightning protection or for the proper function of electronic equipment.

Proper installation of appropriate grounding systems requires knowledge of the needs and layout of the facility. Soil characteristics, grounding conductor materials grounding connections and terminations, are significant factors determining the design of a grounding system. Applicable standards and codes must be applied.

While many codes and standards contain minimum grounding and bonding requirements, the design and installation of electrical grounding systems is one of the most important aspects of any electrical distribution system. However, codes and standards are often misunderstood and grounding systems subsequently installed improperly.

Grounding Principles

Why is Good Grounding Important?

The transient nature of lightning with its associated fast rise times and large magnitude currents mean that special consideration needs to be given to grounding, for lightning protection to be effective. Many factors such as soil resistivity variations, installation accessibility, layout and existing physical features are all site specific and tend to affect decisions on grounding methods employed. The primary aim of a direct strike grounding system is to:

- Efficiently dissipate lightning energy into the ground
- Help protect equipment and personnel

Grounding Principles

Low impedance is the key to lightning protection. All grounding connections should be as short and direct as possible to minimize inductance and reduce peak voltages induced in the connections. The ground electrode system must efficiently couple lightning surges into the ground by maximizing capacitive coupling to the soil. The resistance of the ground itself to lightning currents must also be minimized. Only when all these factors are taken into account will maximum lightning protection be achieved.

Ground Impedance

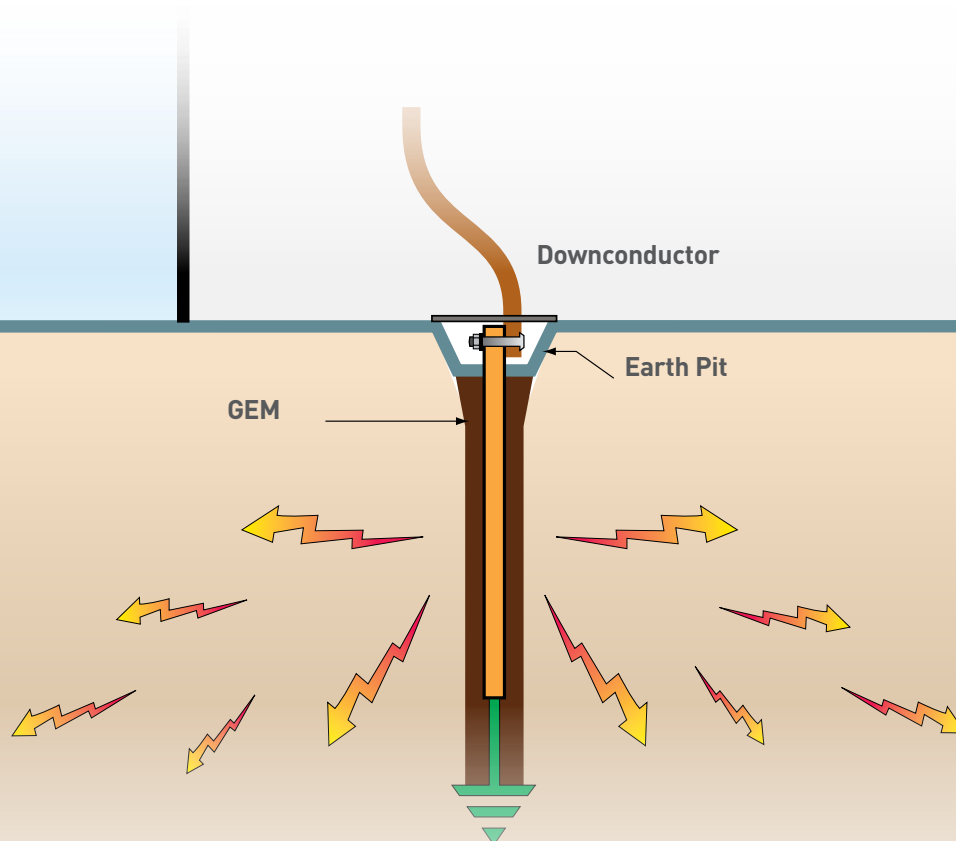
Soil resistivity is an important design consideration. It varies markedly for different soil types, moisture content and temperatures and gives rise to variations in ground impedances.

Short, Direct Ground Connections

The voltage generated by a lightning discharge depends primarily on the risetime of the current and the impedance (primarily inductance) of the path to ground. Extremely fast rise times result in significant voltage rises due to any series inductance resulting from long, indirect paths, or sharp bends in the routing of ground conductors. This is why short, direct ground connections are important.

Coupling from the Electrode System to the Ground

The efficiency of a ground electrode system in coupling a lightning current to ground is dependent on a number of factors, including the geometry of the ground electrode system, the shape of the conductors and the effective coupling into the soil.



A typical grounding system.

Figure 1-A

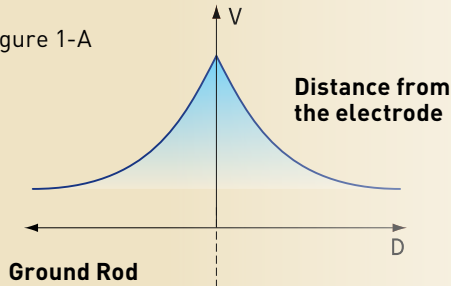


Figure 1-B

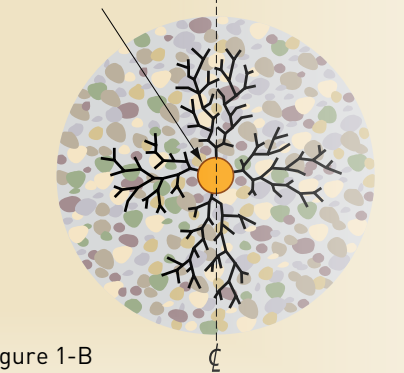


Figure 1-B illustrates current flow from the injection point of a single ground electrode. As current flows out from the central injection point, a voltage gradient on the ground surface around the electrode is produced. This gradient levels off to a plateau at some distance from the electrode, as seen in Figure 1-A. The impedance seen by the current is determined by the soil particles in direct contact with the surface of the rod, and by the general impedance of the soil.

- **Good electrical conductivity**
- **Conductors capable of withstanding available electrical fault currents**
- **Long life — at least 40 years**
- **Low ground resistance and impedance**

The basic philosophy of any grounding installation should be an attempt to maximize the surface area of electrodes or conductors with the surrounding soil. Not only does this help to lower the earth resistance of the grounding system, but it also greatly improves the impedance of the grounding system under lightning surge conditions.

• Equipotential bonding

Equipotential bonding helps ensure that hazardous potential differences do not occur between different incoming conductors such as metallic water services, power systems, telecommunication systems and the local ground, and also minimizes step and touch potentials.

• Good corrosion resistance

The ground electrode system should be corrosion resistant, and compatible with other conductors that are buried and bonded to the ground system. Copper is by far the most common material used for grounding conductors. In general, some form of maintenance or inspection procedure should be adopted to ensure the long-term effectiveness of a grounding system.

• Electrically and mechanically robust and reliable

Mechanical coupling can be used to join ground conductors, but suffers from corrosion effects when dissimilar metals are involved. As well as mechanical strength, ERICO CADWELD connections provide excellent low impedance, long life electrical connections with excellent corrosion resistance.

Ground Resistance

When current flows from a ground electrode into the surrounding soil, it is often described as flowing through a series of concentric shells of increasing diameter.

Each successive shell has a greater area for current flow and consequently, lower resistance. At some point distant from the earth conductor the current dissipation becomes so large and current density so small, that the resistance is negligible.

In theory, the ground resistance may be derived from the general formula:

$$R = \rho \frac{L}{A} \quad \text{Resistance} = \text{Resistivity} \times \frac{\text{Length}}{\text{Area}}$$

This formula illustrates why the shells of concentric earth decrease in resistance the farther they are from the ground rod:

$$R = \text{Resistivity of Soil} \times \frac{\text{Thickness of Shell}}{\text{Area}}$$

In the case of ground resistance, uniform earth (or soil) resistivity throughout the volume is assumed, although this is seldom the case in nature. The equations for systems of electrodes are very complex and often expressed only as approximations. The most commonly used formula for single ground electrode systems, developed by Professor H.R. Dwight of the Massachusetts Institute of Technology, is the following:

$$R = \frac{\rho}{2\pi L} \left\{ (\ln \frac{4L}{r}) - 1 \right\}$$

R = resistance in ohms of the ground rod to the earth (or soil)

L = grounding electrode length

r = grounding electrode radius

ρ = average resistivity in ohms-cm.

Conditions Influencing Soil Resistivity

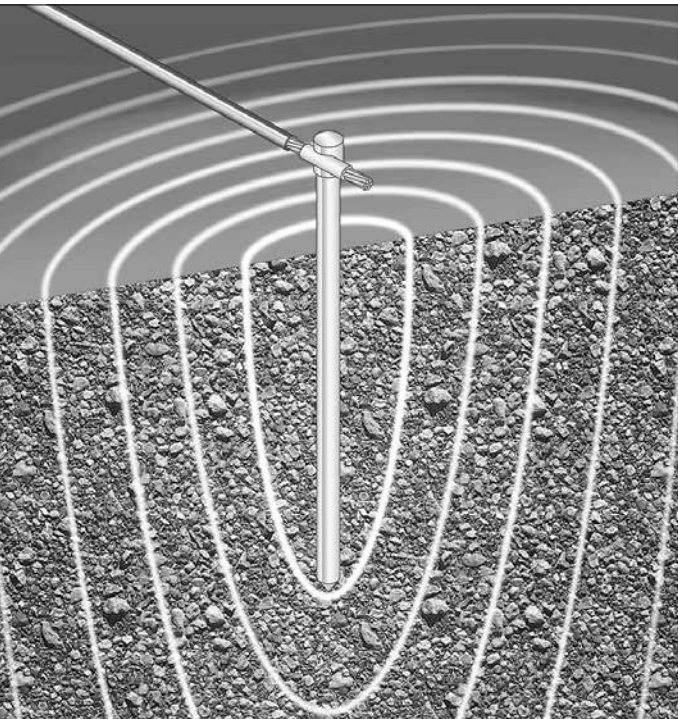
The resistance of the earth itself (soil resistivity) can significantly impact the overall impedance of the grounding system. Several factors, such as soil composition, moisture content, mineral content, contaminants, etc., determine the overall resistivity of the earth.

SOIL TYPE	Resistivity ohm-cm		
	Average	Min.	Max.
Fills – ashes, cinders, brine wastes	2,370	590	7,000
Clay, shale, gumbo, loam	4,060	340	16,300
Clay, shale, gumbo, loam with varying proportions of sand and gravel	15,800	1,020	135,000
Gravel, sand, stones, with little clay or loam	94,000	59,000	458,000

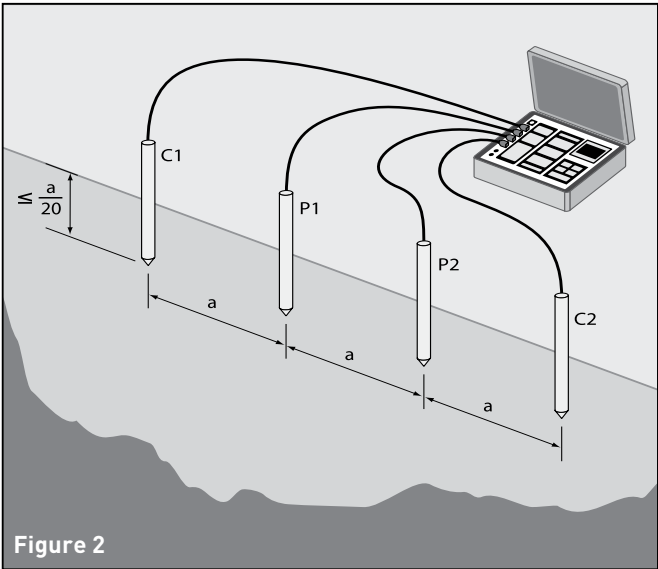
U.S. Bureau of Standards Technical Report 108

Soil Resistivity Testing

To properly design a grounding system, it is essential to test soil resistivity. Several methods can be used to measure earth resistivity: the four-point method, the variation in-depth method (three-point method) and the two-point method. The most accurate method and the one that ERICO recommends is the four-point method.



Sphere of Influence - electrical current flows from the ground rod into surrounding soil and progressively dissipates in waves of increasing diameter.



The Four-Point Method

- 1. Four test stakes are positioned in a straight line an equal distance apart and are hammered into the ground to be surveyed to a depth of not more than 1/20 the distance between the adjacent stakes.
- 2. An earth resistance tester is connected to these four stakes as shown in Figure 2.
- 3. The DC test option on the tester is then selected and performed, and the resistance figure "R" recorded.
- 4. The soil resistivity level "r" (in ohms/cm) is then calculated using the formula: $r=2paR$ where:

R = the resistance figure, in ohms
a = the separation of the test stakes, in meters.

$$p = \frac{4\pi AR}{\frac{1 + \frac{2A}{\sqrt{A^2 + 4B^2}}}{\sqrt{A^2 + 4B^2}} - \frac{2A}{\sqrt{A^2 + 4B^2}}}$$

Where:

A = distance between the electrodes in centimeters
B = electrode depth in centimeters

If $A > 20 B$, the formula becomes:

$p = 2\pi AR$ (with A in cm)
 $p = 191.5 AR$ (with A in feet)
p = Soil resistivity (ohm-cm)

This value is average resistivity of the ground at a depth equivalent to the distance "A" between two electrodes.



Avoid hazardous Step and Touch Potentials (shock) or even death by low impedance grounding and bonding between metallic equipment, chassis, piping, and other conductive objects so that currents, due to faults or lightning, do not result in hazardous voltage rise.

Step and Touch Potential

Step Potential

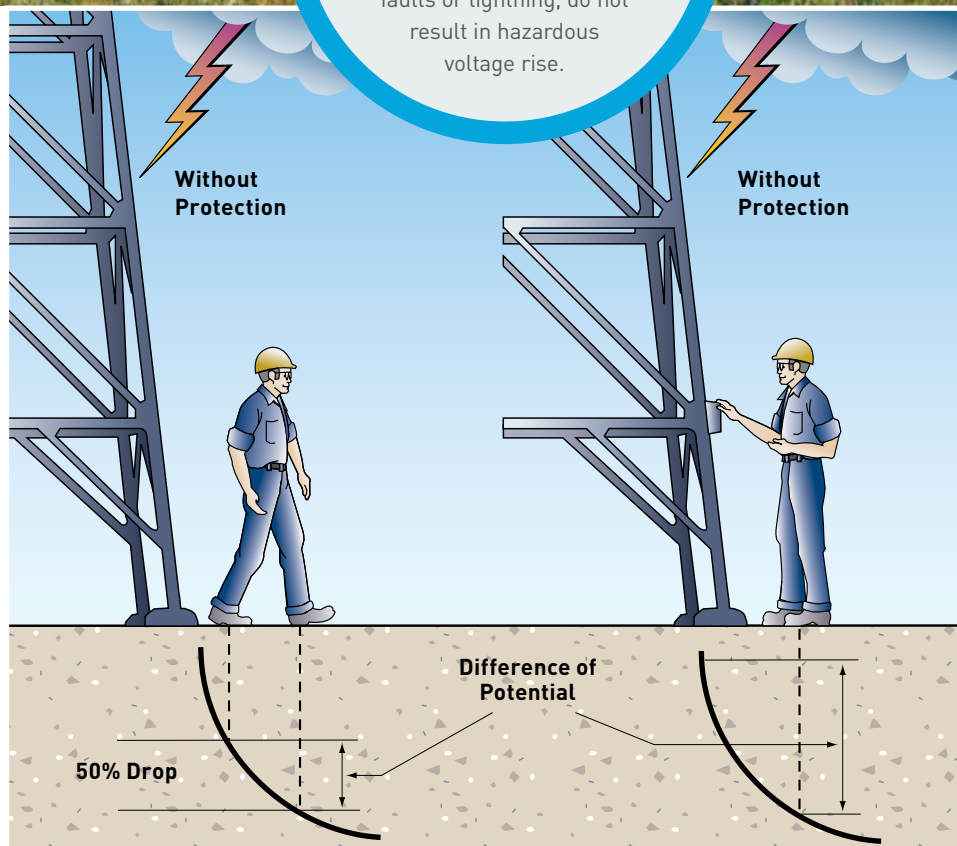
Step Potential is the voltage difference between a person's feet caused by the dissipation gradient of a fault entering the earth.

Touch Potential

Touch Potential is similar to "Step Potential" except that the fault current passes through the person's arm and torso on the way to the ground.

Another function of the grounding system is to provide a reference for circuit conductors to stabilize their voltage to ground during normal operation. The earth itself is not essential to provide a reference function; another suitable inductive body may be used instead.

The function of a grounding electrode system and a ground terminal is to provide a system of conductors, which ensures electrical contact with the earth.



Grounding Principles

Grounding / Earthing System Design

Grounding systems are important. It is not expensive to build an appropriate ground system during initial construction of a facility, but it can be very expensive to add to it, enhance it, or replace it after the facility is complete. Care should be taken to design a system that is appropriate both for clearing ground faults and dissipating lightning energy. The system must have a long performance life, meet applicable codes / standards for safety, and have sufficient bonding points to make it easy to add new equipment / facility grounding to it easily.

Design considerations include:

- Purpose of facility
- Design life of facility
- Soil resistivity at 3 depths
- Corrosive nature of soil
- Shape and available area of facility site
- Existing structures and their grounding systems
- Seasonal variations in moisture and temperature for facility site
- Public access & personnel use
- Adjacent facilities and electrical systems
- Future uses, additions, equipment for facility

For proper operation of overcurrent devices, it is important to have a low DC ohmic resistance to remote earth. In many instances, this is best achieved by installing a deep ground electrode on site. It should be driven deep enough to reach the permanent water table.

For dissipation of direct or indirect lightning currents, it is better to have many horizontal ground conductors in the soil, preferably in a radial array. This provides a low impedance path of dissipation to the high frequency component of the lightning energy.

For personnel, particularly where people congregate or where equipment operators will be located, it is important to have a grid system or other equipotential plane to reduce “step potential” and have equipment and metal structures bonded to the ground system to reduce “touch potential”.

A proper facility grounding system incorporates these necessities in the most cost-effective manner that will last for the design life of the facility.

ERICO is a manufacturer and marketer of grounding, bonding, lightning protection and surge protection products and systems. ERICO has many knowledgeable and experienced engineers on staff with the training and the tools (including some of the latest design software) to design appropriate grounding systems. These engineers can assist facility owners, engineers and contractors in designing the most appropriate system for the facility in question.

Grounding Chain

1. Grounding Electrode Conductor
2. Grounding Connections
3. Grounding Electrode
4. Electrode to Soil Resistance
5. Soil



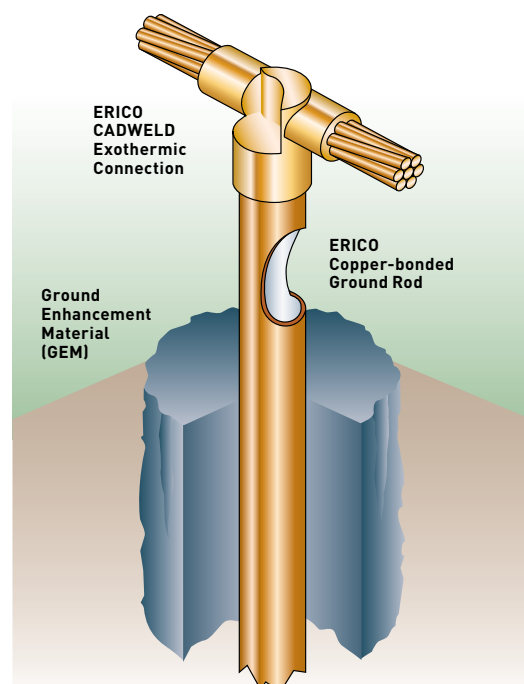
The Grounding Chain

The performance of the grounding system is determined by the quality of the following five components all of which are of equal importance.

1. **The Grounding Electrode Conductor.** Typically made from copper or copper-bonded steel, the grounding electrode conductor must be large enough to withstand the maximum available fault current over the maximum clearing time.
2. **The Grounding Connections.** Often overlooked, the grounding connections are used to tie the elements of the electrode system together. Exothermically welded connections provide a molecular bond that will never loosen or corrode. Mechanical connectors, such as crimp, bolted, and wedge type, rely on physical point-to-point surface contact to maintain the integrity of the electrical connection. IEEE® Standard 837-2014 provides detailed information on the application and testing of permanent grounding connections. ERICO can provide an independent, third-party test report evaluating the performance of these connectors in accordance with the testing procedures set forth in IEEE Standard 837-2014 Standard for Qualifying Permanent Substation Grounding Connections.
3. **The Grounding Electrode.** The grounding electrode provides the physical connection to the earth and is the instrument used to dissipate current into it. There are two main types of electrodes. "Natural" electrodes are intrinsic to the facility and include metal underground water pipe, the metal frame of the building (if effectively grounded), and reinforcing bar in concrete foundations. "Made" electrodes are installed specifically to improve the performance of the ground system and include wire meshes, metallic plates, buried copper conductor and rods or pipes driven into the ground. The ground rod is the most widely used electrode.
4. **Electrode to Soil Resistance.** Amount of rod surface and rod replacement are the controlling factors. Doubling diameter reduces resistance by only 10% and is not cost effective. Doubling rod length, however, theoretically reduces resistance by 40%. The most common solution is proper placement of multiple rods that are driven to the required depths.
5. **The Soil.** The soil resistivity, measured in ohm-centimeters or ohm-meters, plays a significant role in determining the overall performance of the grounding system and must be known before a proper grounding system can be engineered. Measuring soil resistivity allows the design engineer to locate an area with the most conductive soil and to determine the depth of the conductive soil so that electrodes can be placed accordingly.



The grounding system will carry little or no current for long periods of time until a fault occurs or a lightning strike or other transient requires dissipation. At that point, the grounding system components will be expected to perform like new while conducting large amounts of current. Most of the grounding system is concealed below grade, making inspection of the grounding components difficult or impossible. The underground environment is a harsh one. The initial selection of the components used in the grounding system is of critical importance to its long-term effectiveness.

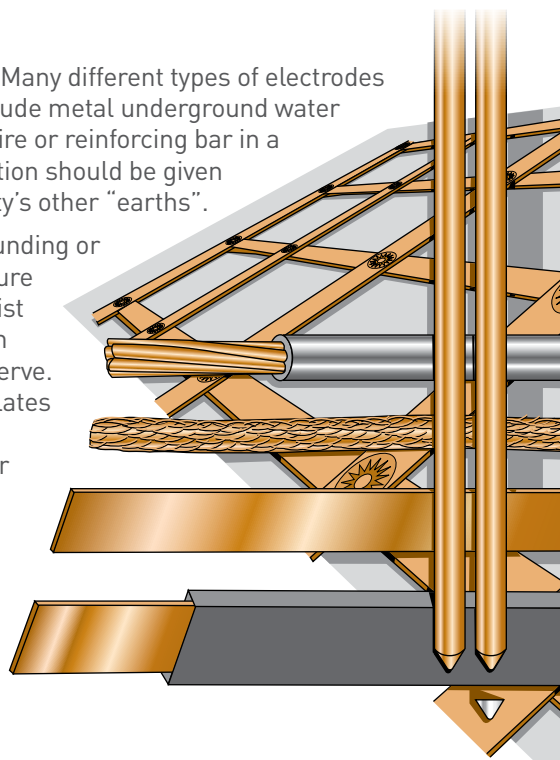


Ground System Components

Ground Electrodes

The ground electrode is a critical component of the grounding system. Many different types of electrodes are available, some “natural” and some “made”. The natural types include metal underground water pipe, the metal frame of a building (if effectively grounded), a copper wire or reinforcing bar in a concrete foundation or underground structures or systems. Consideration should be given to bonding of natural earths to ensure electrical continuity with a facility’s other “earths”.

“Made” electrodes are specifically installed to improve the system grounding or earthing. These earth electrodes must ideally penetrate into the moisture level below the ground level to reduce resistance. They must also consist of metal conductors (or a combination of metal conductor types), which do not corrode excessively for the period of time they are expected to serve. Made electrodes include rods or pipes driven into the earth, metallic plates buried in the earth or a copper wire ring encircling the structure. Underground gas piping or aluminum electrodes are NOT permitted for use as ground electrodes.



Ground Rods - Which ground rod should be used?

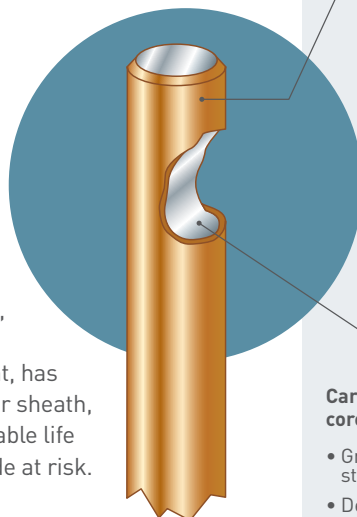
Ground rods are often selected on the basis of their resistance to corrosion. The other major factor is cost. All too often, the cost of a product is seen as the initial up front price, but the real cost is determined by the serviceable life of the ground rod.

Galvanized steel rods are one of the cheapest electrodes available. However, they are not the most cost effective since they have a relatively short service life. Solid copper and stainless steel rods have a long service life. However, they are considerably more expensive than galvanized steel rods. In addition to this, solid copper rods are not suited to deep driving or even driving short lengths into hard ground, without bending.

Ask for the ERICO White Paper on Ground Rods – Copper-bonded vs. Galvanized.

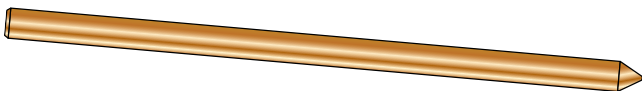


The photo shows two ground rods subjected to the same pressure load test. The ERICO copper-bonded ground rod, shown on the left, will bend without tears, cracks or folds, to the outer sheath. The inferior copperclad rod shown on the right, has developed cracks and creases to the outer sheath, which will significantly reduce its serviceable life and put the integrity of the entire electrode at risk.



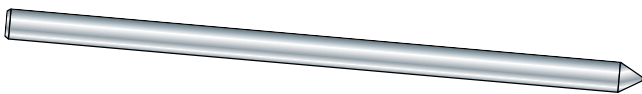
Copper-Bonded Ground Rod	Galvanized Ground Rod
<ul style="list-style-type: none">• Cost-effective long service life	<ul style="list-style-type: none">• Lower purchase price — not as cost-effective over the expected life as Copper-bonded
<p>Copper-bonded coating:</p> <ul style="list-style-type: none">• Permanent molecular bond• Low resistance performance• High fault current capacity (IEEE® Std 80)• Will not slip or tear when driven• Will not crack if rod is bent• Copper coating may vary to meet required standards• 10 mil (254 micron) minimum coating on rods listed to UL® 467	<p>Galvanized coating:</p> <ul style="list-style-type: none">• Relatively short service life• May crack if rod is bent
<p>Carbon Steel core and tip*:</p> <ul style="list-style-type: none">• Greater tensile strength• Deep driving capability	<p>3.9 mil (99 micron) minimum coating per ASTM® 123</p>

* ERICO copper-bonded and galvanized rods



Copper-Bonded Ground Rod

The copper-bonded ground rod has an electrolytic coating of copper deposited over a layer of nickel. This process ensures a long lasting, molecular bond between the copper layer and the steel core. 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.



The Stainless Steel Ground Rod Option

It is important to note that certain soils and land fill areas may not be compatible with copper. In these situations, stainless steel is a better proposition. Stainless steel may also be an alternative, where 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. The high cost of stainless steel rods prohibits their widespread use.

NEGRP

The photo on the left shows two ground rods that were driven into the soil vertically at the Pecos testing site in Las Vegas, NV in December of 1992. The top ground rod is galvanized steel, 3/4" x 10'. Bottom ground rod is copper-bonded, 5/8" x 8'. Both ground rods were exhumed from the site in April of 2004. The loss of zinc resulted in excessive corrosion of the steel. The copper-bonded steel ground rods showed minimal corrosion.



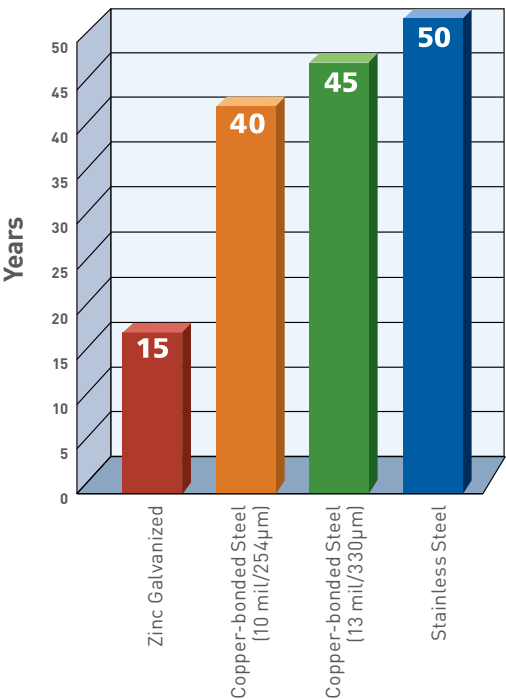
Excavated after 12 years.



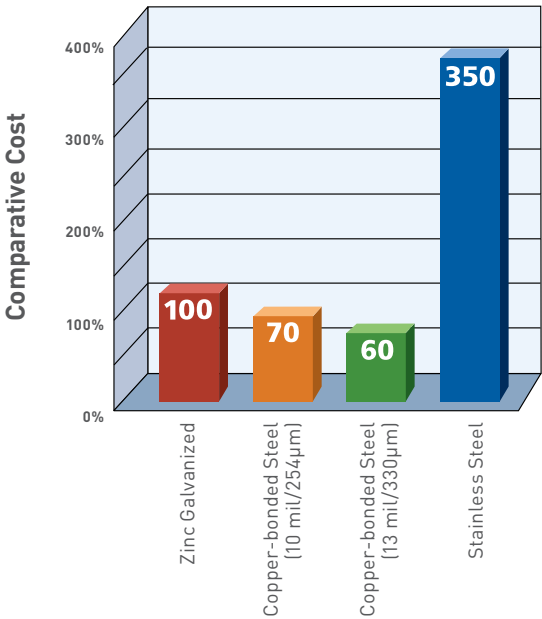
Excavated after 11 years.

The photo on the right shows a galvanized steel ground rod driven vertically into the ground at the Pawnee testing site in Las Vegas, NV. One area is reduced from a 3/4" diameter to approximately a 1/4" diameter due to extensive corrosion. The eventual failure would result in a potentially catastrophic loss of ground.

Ground Rod Life Expectancy



Ground Rod Annual Cost

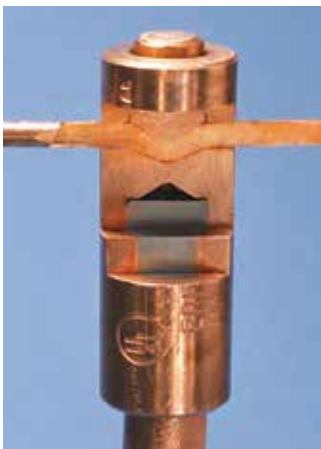




ERICO HAMMERLOCK is machined from highly conductive copper.



It is easy to see why acorn clamps are more susceptible to corrosion than any other type of grounding connection.



ERICO HAMMERLOCK cutaway.

High Quality Connections

The patented ERICO HAMMERLOCK grounding connector from ERICO connects the grounding conductor to the ground rod. Machined from highly conductive copper, the state-of-the-art ERICO HAMMERLOCK provides a low-resistance connection designed to withstand ground fault currents and lightning transients. The ERICO HAMMERLOCK connector's mechanically rugged design will help ensure that the highest level of performance is maintained for many years after the connection has been buried in the harsh underground environment. The ERICO HAMMERLOCK is one of the quickest and easiest grounding connectors to install and requires no special tools or training. It has been engineered to be user-friendly, cost-effective, and provides a high level of protection for people and expensive equipment.

Features Include:

- Machined from 100% high-conductivity copper
- Excellent mechanical strength
- Irreversible connection
- Fast and simple installation requires only a hammer
- No training required
- Provides a visual indication of completed connection
- Allows for "T" or pass-through connections
- UL® Listed (#2, 4 and 6 solid to 5/8" copper or galvanized rod)

The Importance of Grounding Connections

Electrical utilities and other industries are discovering significant cost benefits when high-quality electrical grounding systems are installed. Many are specifying low-resistance grounds along their transmission and distribution networks. These low-resistance electrodes limit neutral-to-ground voltage, improve safety and provide better protection against lightning damage. In fact, the savings realized from reduced equipment damage and the decrease in service interruptions have prompted many utilities to undertake large-scale grounding improvement programs.

The three main components of the grounding system are the grounding connector, grounding conductor and ground rod. They are all equally important to the performance of the system. A loose or corroded connection will render the grounding system ineffective. While acorn clamps are still the connector of choice, many installers recognize the serious deficiency in their performance and the risks associated with poor-quality connections. Many acorn clamps are loose the day they are installed.

In order to install an acorn clamp effectively, it is necessary to know the proper torque level for the bolt. Since acorn clamps don't come with instructions and most crews don't have or wouldn't use a torque wrench, many are broken or installed incorrectly. The cost of replacing damaged equipment, and the labor associated with doing so, quickly puts the cost of using inferior connectors into perspective.

Installation Costs

The actual cost of the grounding connector represents only a small fraction of the total installed expense when the labor rate of the installation crew, equipment overhead costs, ground rod and conductor costs are considered. Installation costs increase significantly when deep-driven rods are used—a common practice in grounding improvement programs.

Therefore, investing in the best-performing, longest-lasting grounding connector is a wise choice. Initially paying more for a quality connector will actually save money in the long run, by reducing downtime and eliminating the need for crews to return to the site for repairs.

ERICO HAMMERLOCK Is The Answer!

Acorn clamps are utilized because they are inexpensive. They were developed before the proliferation of expensive electronics, at a time when the demand for electric power was lower and before power quality was a serious consideration. The ERICO HAMMERLOCK, on the other hand, was designed to meet the needs of today's modern grounding programs. Therefore, an upgraded or perhaps more aptly stated, updated, grounding program specification should require a quality connector and exclude the acorn clamp.

How the ERICO HAMMERLOCK works



The ground wire is placed through the connector body and then the body is placed on the top of the ground rod. As the connector is struck with a hammer, ERICO HAMMERLOCK is connected to the ground rod using the same compression technology used in the ERICO threadless couplers that connect deep-driven rods together.

At the same time, the ground wire is locked in place as the connector plug enters the body.

Ease of Installation

Installing the ERICO HAMMERLOCK is as easy as swinging a hammer. Its intuitive design requires no special tools or training. When the large diameter on the ERICO HAMMERLOCK plug is flush or below the round body, the connection is complete and irreversible. The ERICO HAMMERLOCK can be installed three to five times faster than an acorn clamp and is easier to install in a trench.

The ERICO HAMMERLOCK provides a high-quality grounding connection that is easy to use and cost-effective — withstanding 100% of the current carrying capacity of the conductor. Given the important function of today's grounding system, the ERICO HAMMERLOCK provides excellent connector value.



ERICO HAMMERLOCK Specification

Cable to ground rod connectors shall be made from a round, high conductivity copper alloy bar stock, with a minimum of 90% IACS. The connector shall provide a high quality, irreversible, compression connection area for the conductor and a taper fit compression connection area for the ground rod. The connector shall be able to withstand 100% of the current carrying capacity of the conductor. The connector shall not rely on bolts or screws to maintain the integrity of the connection. Each connector shall be clearly marked with the catalog number and clear description of the conductor and ground rod to be connected and packaged with installation instructions.

A hammer shall be required for the connector installation. The connector shall provide a positive visual means of verifying a successfully completed connection. The connector shall be the ERICO HAMMERLOCK as manufactured by ERICO or approved equal. Silicon bronze connectors are not acceptable.

Ground Enhancement Material (GEM)

ERICO Ground Enhancement Material (GEM) is the effective, maintenance free, permanent, easy to use, and environmentally sensitive solution to your toughest grounding problems.

GEM is a low-resistance, non-corrosive, carbon-based superior conductive material that improves grounding effectiveness, especially in areas of poor conductivity such as rocky ground, mountain tops and sandy soil. GEM is also the answer in situations where ground rods can't be driven or where limited land area makes adequate grounding difficult with conventional methods.

GEM contains portland cement, which sets within 3 days and fully cures within 28 days, to become a highly conductive concrete that performs in all soil conditions irrespective of the presence of water. GEM maintains a constant level of superior performance once cured that will not diminish over the life of the grounding system.

GEM comes in easy to use 25 lb (11.3 kg) bags or buckets that one person can install. GEM is maintenance-free and will never leach or wash away. A Material Safety Data Sheet (MSDS) is available on request.

GEM is effective

- Dramatically reduces earth resistance and impedance measurements
- Maintains constant resistance for the life of the system once in its set form
- Performs in all soil conditions even during dry spells
- May reduce the size of the grounding system where conventional methods are unsatisfactory

GEM is maintenance free

- Does not require periodic charging treatments or placement
- Does not require the continuous presence of water to maintain its conductivity

GEM is permanent

- Fully sets within 3 days, fully cures within 28 days.
- Does not dissolve, decompose or leach out with time
- Non-corrosive
- Reduces vandalism and theft since conductors are hard to remove from concrete

GEM is easy to use

- Easy-to-handle 25 lb (11.3 kg) bags or buckets
- Requires one person to install

GEM is environmentally sensitive

- Exceeds IEC® 62561-7 which sets the benchmark for corrosion, leaching, sulfur content, and other environmental regulations
- MSDS sheet available upon request

GEM

Ground Enhancement Material
Conforms to IEC 62561-7



Fast and Easy Ordering

For more information, contact your local ERICO sales representative for a quote. You can reference the GEM part numbers.

Part Number	Description
GEM25A	25-lb. (11.3 kg) bag with handles
GEM25ABKT	25-lb. (11.3 kg) plastic bucket with locking lid

Design and Estimating Software

Design software estimates the quantity of GEM needed and calculates the anticipated ground resistance on any installation. GEM software is available at www.ERICO.com/products/GEM.asp.

PARAMETER	RECOMMENDED VALUES	TEST METHOD
Standards Compliance		Full compliance to IEC 62561-7 EPA Toxicity Characteristic Leaching Procedure (TCLP), test method 1311
Leaching	Arsenic < 1.5 mg/L, Barium < 60 mg/L, Cadmium < 0.15 mg/L, Chromium < 3.0 mg/L, Lead < 1.5 mg/L, Mercury < 0.06 mg/L, Etenium < 1.0 mg/L	EC 62561-7 EN 12457-2
Sulfur Content	< 2%	ISO 14869-1
Resistivity	<2 Ω-cm for powder <20 Ω-cm for mixed and cured material	Compressed powder according to ASTM G187-12 Mixed and cured per ASTM D991-89
Corrosion Performance	For copper-plated earth electrodes, the polarization resistance shall be > 8 Ω x m2 for aggressive environments For galvanized earth electrodes, the polarization resistance shall be > 7.6Ω x m2 for aggressive environments	IEC 62561-7, Sec 5.5, aggressive environment.
Flexural Strength	300-450 psi [2070-3100 kPa]	ASTM C293
Compressive Strength	100-200 psi [690-1390 kPa] after 672 hours curing time	ASTM C109

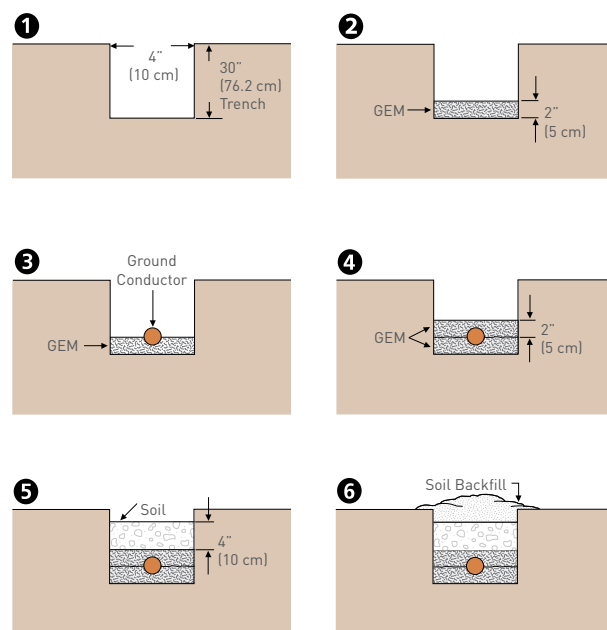
Installation Instructions

Trench Installation:

1. Mix GEM into a slurry form by using a standard cement mixer or mix in a bucket, mixing box, wheelbarrow, etc. Use 1.5 to 2 gallons [5.7 to 7.6 liters] of clean-potable water per bag of GEM. Do not mix GEM with salt water.
2. Spread out enough GEM to uniformly cover bottom of trench –about 2 in [5 cm] deep. (See Table). Let the GEM harden to prevent the conductor from sinking to the bottom of the trench.
3. Place conductor on top of GEM. (See Note 1)
4. Spread more GEM on top of conductor to completely cover conductor – about 2 in [5 cm] deep. Allow GEM to harden. Wait 30 minutes to one hour before filling the trench with soil backfill.
5. Carefully cover the GEM with soil making sure not to expose the conductor.

Note 1: Wait for the GEM to harden, about 15 to 20 minutes, before placing the conductor on top of the GEM. You must apply 4 inches [10 cm] of insulating material to the conductors and ground rods exiting the GEM, starting 2 inches [5 cm] inside the GEM.

Note 2: Excess standing water must be removed from trench.



Estimated linear feet of ground conductor covering with each bag of GEM.

		Total Thickness of GEM					
Trench Width		in		cm		in	
Inches	Centimeters	4	10.2	5	12.7	6	15.2
4	10.0	3.5	1.0m	2.8	0.8m	2.3	0.7m
6	15.2	9.3	0.7m	1.8	0.5m	1.5	0.4m
8	20.3	7.0	0.5m	1.4	0.4m	1.1	0.3m
10	25.4	5.6	0.4m	1.1	0.3m	0.9	0.3m
12	30.5	4.7	0.3m	0.9	0.3m	0.7	0.2m

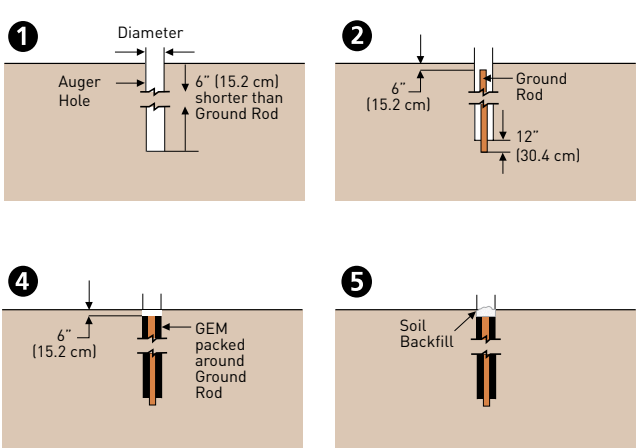
A 25 lb. bag of GEM will cover 3.5 linear feet (1.0 m) of conductor length for a 4" wide (10.2 cm), 4" thick (10.2 cm) covering [2" (5.1 cm) below and 2" (5.1 cm) above conductor], based on 63.5 lb/cu ft (1017 kg/m3)

ERICO Ground Enhancement Material (GEM)

Ground Rod Backfill Installation:

1. Auger a 3-inch (7.5 cm) or larger diameter hole to a depth of 6 inches (15 cm) shorter than the length of the ground rod.
 2. Place ground rod into augered hole and drive 1 foot (30 cm) (if possible) into bottom of the hole. The top of the ground rod will be approximately 6 inches (15 cm) below grade. At this time, make any connections to ground rod using ERICO CADWELD connections. (See Note 1)
 3. Premix GEM into a slurry form. Use 1.5 to 2 gallons (5.7 to 7.6 liters) of clean-potable water per bag or bucket of GEM. The installation of GEM in a dry state is acceptable for vertical ground rod applications.
 4. Pour the appropriate amount of GEM (see table) around the ground rod. To ensure the GEM material completely fills the hole, tamp around the ground rod with a pole. Wait 30 minutes to 1 hour before filling the hole with soil backfill.
 5. Fill remainder of augered hole with soil removed during augering.
- For various augered-hole diameters and depths, see the table below:

- Note 1:** 4 inches (10 cm) of insulating material must be applied to the conductors and ground rods exiting the GEM, starting 2 inches (5 cm) inside the GEM.
- Note 2:** Excess standing water must be removed from the hole.



Estimated bags of GEM for backfilling around ground rods to a density of 63.5 lb/ft³

		Depth of Hole*											
Diameter of Hole		ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
Inches	Centimeters	5	1.5	6	1.8	8	2.4	10	3.0	15	4.6	20	6.1
4	10.2	2		2		2		3		4		5	
6	15.2	3		3		4		5		8		10	
8	20.3	5		6		8		9		14		18	
10	25.4	7		9		12		14		21		28	
12	30.5	10		12		16		20		30		40	

*8' (2.4 m) minimum rod length required to be in contact with the soil (or GEM). Per NEC® 250-52

Note: To mix GEM into a slurry form, use a standard cement mixer or mix in a mixing box, wheelbarrow, etc. Use 1.5 to 2 gallons (5.7 to 7.6 liters) of clean-potable water per bag of GEM. Do not mix GEM with salt water. For storage and safety precautions, see product packaging.

Customer Support

Support representatives are available to answer any product or application questions you may have; visit www.erico.pentair.com to find a phone number for your nearest customer support representative.

ERICO CU-BOND Composite Cable



ERICO CU-BOND 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. The conductor is difficult to cut with hand tools and the outer stranding is magnetic, which further deters thieves looking for copper.

The CC5A05CB (19 strand) is electrically equivalent to a 4 AWG (25mm²), the CC5A20CB is electrically equivalent to a 2/0 AWG (70mm²) and the CC5A40CB is electrically equivalent to a 4/0 AWG (120mm²). These conductors are ideal for transmission tower, distribution pole and a wide range of above and below grade grounding applications.

Features

- Outer strands comprised of tinned copper bonded steel for corrosion resistance and theft deterrence
- Inner copper stranding is tinned for superior corrosion resistance
- Copper stranding inside of conductor provides increased conductivity and conductor flexibility
- Copper strands are hidden by outer tinned copper bonded steel strands
- Available in three sizes / configurations with electrical equivalency to 4, 2/0 and 4/0 AWG copper
- Suitable for direct burial applications
- More flexible and easier to work with than copper clad steel conductors



ERICO CU-BOND Round Conductor



Substation earthing riser

For decades, ERICO has provided the market with high quality copper-bonded ground rods.

ERICO has taken that same concept in ground rods and made this into a revolutionary new grounding conductor. The ERICO CU-BOND Round Conductor 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.

Features

- Copper-bonded coating will not crack or tear when the conductor is bent
- High resistance to corrosion and provides a low resistance path to Earth
- Available in standard packaging lengths of 100 meters, 50 meters, and 25 meters
- Minimum copper plating thickness of 254 microns
- Available in nominal diameters of 8, 10, 13, 14, 16, and 18 mm
- Meets the requirements of IEC® 62305-3 Edition 2 and IEC/EN 62561-2 for lightning protection applications
- ERICO CU-BOND Round conductors are UL certified to IEC® 62561-2



Benefits As An Alternative To Copper Conductor

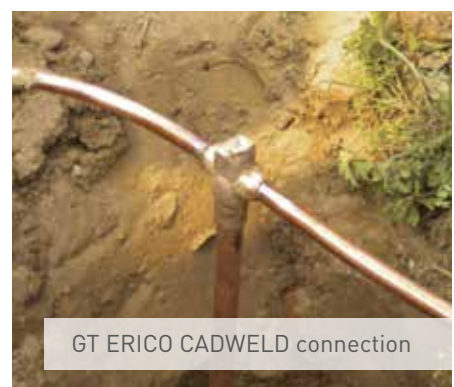
- **Theft deterrent:** Copper theft is a problem everywhere. ERICO CU-BOND Round Conductor is hard to cut with hand tools due to its steel core. They are also magnetic, notifying potential thieves that the materials within are of little scrap value.
- **Cost-effective:** Because the copper is bonded to a steel core, the cost of the conductor is minimized by reducing the total amount of copper in the cable.

Benefits As An Alternative To Galvanized Steel Conductor

- **Superior corrosion resistance:** In comparison to other steel-based products, ERICO CU-BOND Round Conductor provides excellent application life of typically 30-40 years in most soil conditions.



Equipotential grounding conductor



GT ERICO CADWELD connection

ERICO CU-BOND Round Conductor



Lightning protection

Above Grade Applications

The unique properties of ERICO CU-BOND Round Conductor make it ideal for both horizontal and vertical placement. Above grade, the conductor is well-suited as a lightning-protection conductor when applied in accordance with the IEC 62305-3 Edition 2.0 standard.

- **Utility**
 - Distribution down-lead conductor and assemblies
 - Bonding kits for substation fence or equipment ground risers back to the grid
- **Commercial and Industrial**
 - Alternative conductors to solid copper rod and tapes in grounding and lightning protection
- **Telecom**
 - Conductor for connecting equipment ground to ground grid, and riser (down-lead) conductors for tower
 - Grounding conductor for datacenter mesh bonding
- **Rail**
 - Trackside bonding conductor and stray current conductor
 - Grounding kits for trackside equipment, electrical traction power
 - Substation, wayside shelters, communication antenna equipment



Telecom tower grounding

Below Grade Applications

Copper-bonded steel conductors are ideal as earthing and bonding conductors where copper theft on-site may occur. ERICO CU-BOND is ideal for use in a variety of applications including power distribution earthing and bonding; substation earthing; commercial, industrial, and railway earthing.

- Buried ground grid conductors and electrodes:
 - Wireless telecom tower earthing
 - Utility substation earthing; power distribution and transmission earthing
 - Large scale ground mount solar farm earthing
 - Industrial facility earthing, for example, petro-chemical and mining infrastructure
 - Railway earthing
- Interconnecting grounding conductor between wind towers or grounding grid at base of wind tower



ERICO CU-BOND Round Conductor is stamped with compliance markings directly on the product to ensure genuine product and high quality standards. Beware of imitations.

Ground Stainless Steel Braids (CPI + CPIW)



Stainless Steel Braids Technical Characteristics

- 316L stainless steel braid ready to use
- Full application range: 16 to 70 mm² section with 150 to 1100 mm length
- High-quality 316L stainless steel: superior abrasion, corrosion, chemical, and UV resistance for outdoor applications
- Time savings: Quick and easy to install. Ready to use. No additional cutting, stripping, crimping and punching needed. Less labor time for installation
- Material savings: No additional lugs or terminals needed
- Durable in outdoor, salt and corrosive environments
- Non-magnetic material
- UL® Listed to UL467 - grounding and bonding equipment for US and Canada
- Great for expansion joints where constant movement requires a flexible and indestructible covering

Ready-to-use stainless steel braids for multiple applications



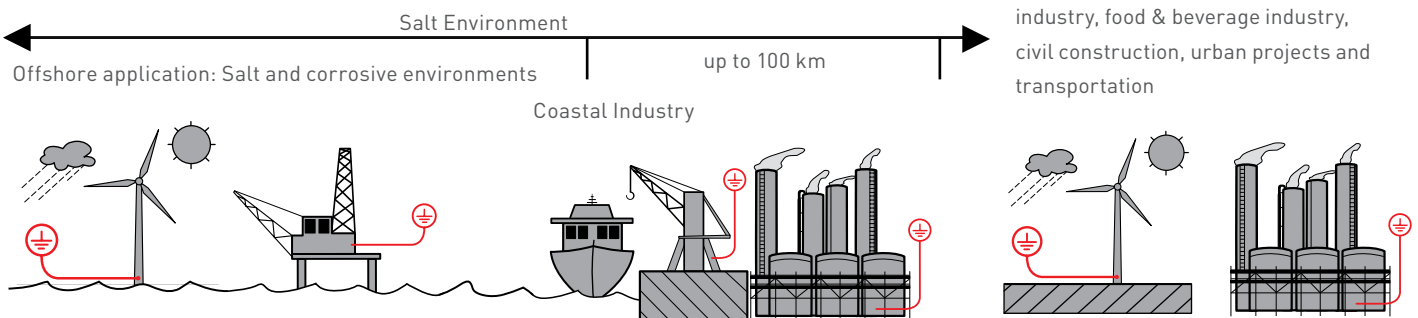
ERICO developed and manufactures a range of ground stainless steel braids. These high-quality 316L stainless steel braids can be installed in extremely corrosive environments, like offshore applications or coastal applications. The CPI braid is ideal for applications using stainless steel pipe or tanks, like the food and beverage industry, building industry, transportation, oil and chemical industry.

ERICO offers 316L stainless steel, one of the highest resistant stainless steel options on the market. ERICO has mastered the process of manufacturing stainless steel for braiding, crimping, cutting or punching and offers a full range of ready-to-use stainless steel braids.

In addition, the CPIW offered by ERICO allows for more connections to larger bolts than any other 50 mm² or 70 mm² braid.



Where stainless braids can be used:



Tinned Copper Ground Braids Technical Characteristics

With integral palm

- A complete range of ground flexible connections from 6 to 100 mm² section and from 100 to 500 mm length
- Resistant to vibration and fatigue, reducing maintenance
- Reliable: No extra contact due to the lugs crimped at the ends of the cable
- Provides weight savings, material savings and lower impedance when compared to similar lugged cables with insulation
- Integral palm, without tin or crimped lugs for superior electrical contact and tensile strength resistance
- Quick and easy to install: Ready to use. No cutting, stripping, crimping or punching. Less labor time for installation
- Material savings: No lugs or terminals
- GOST compliant
- RoHS compliant



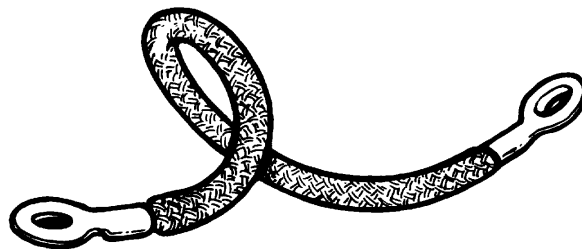
Innovative, state-of-the-art manufacturing process.

ERICO manufacturing directly massivates the palms of the MBJ tinned-plated braids. This manufacturing process provides an effective electrical contact, due to the integral palms, without the addition of tin or crimped lugs.


This process welds the flexible braid and brings back a solid tinned or red copper block as a palm. Unlike the traditional press-welded palms process, ERICO's process is suitable for red copper, but also for tin plated copper. The electrical contact between each wire is optimized.

This ERICO process also helps eliminate moisture issues in the palms. By using crimped lugs in a severe environment, moisture can enter in the lug (often by capillarity) and create corrosion between each wire. After several years, the electrical contact between each wire can deteriorate and alter the electrical conductivity of the equipment. The corrosion in the palm is impossible to remove without changing the element.

This process produces RoHS products; no additional substances are added to the tinned-plated wires during the manufacturing process.



BJ Round braids with crimped lugs

Part No.	Description	Cross Section	L in	Ø D in	Intensity A	
556900	BJ 6-150 S	11.84 kcmil	5.91	0.006	45	10
556910	BJ 6-200 S	11.84 kcmil	7.87	0.006	45	10
556920	BJ 10-300 S	19.74 kcmil	11.81	0.006	75	10

ERICO CADWELD PLUS

ERICO CADWELD PLUS connections offer all the benefits of conventional ERICO CADWELD connections:

- Current carrying capacity equal to or greater than that of the conductor
- Withstand repeated fault currents without failing during operation
- Permanent, molecular bond that will not loosen or corrode, resulting in a connection with a lifetime equal to that of the installation
- Join copper to copper, copper to galvanized or plain steel, copper to copper clad steel, copper to bronze/brass/stainless steel, steel to steel, etc.
- No external power or heat source required
- Quality Assurance Inspection is easy and visual
- Minimal installation training required
- Exceed requirements of "IEEE Std. 837-2014 -Std. for Qualifying Permanent Connections Used In Substation Grounding"



The ERICO CADWELD molecular bond will last the lifetime of the conductors.

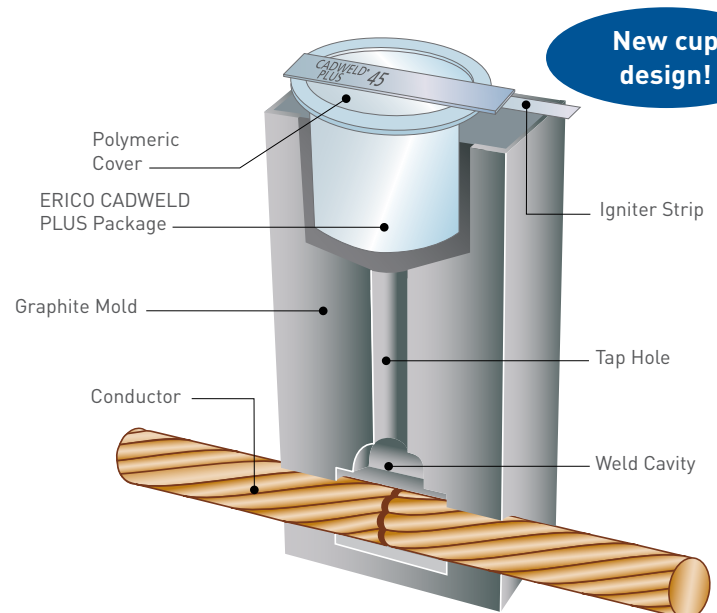
ERICO CADWELD PLUS

The ultimate welded connection that will never loosen, corrode or increase in resistance.

ERICO is dedicated to continuous product improvement to meet its customers' needs and maintain the highest level of satisfaction. The introduction of ERICO CADWELD electrical connections in 1938 enabled them to be quickly recognized as the ultimate connection for rail, cathodic, power and grounding applications.

Continuing the tradition of technical leadership, ERICO CADWELD PLUS was developed as a simplified method of performing exothermically welded electrical connections. This trusted system now features a new ERICO CADWELD PLUS cup design for the integrated welding material package which has streamlined the installation process by eliminating ignition materials.

The tamper proof, integrated welding material package consists of a steel cup containing ERICO CADWELD patented welding material alloys and an ignition source. This newly shaped welding material package is designed for use in all standard ERICO CADWELD molds, including ERICO CADWELD MULTI. Once placed in the ERICO CADWELD mold, the welding material is electronically ignited using a simple battery-powered control unit with a six-foot lead.



Feature

Integrated Welding Material Package

Color Coded Welding Material

Electronic Control Unit

Replaceable Six or Fifteen Foot Control Unit Lead

Benefits

- Simplifies training and set up
- Saves labor
- Simplifies cleaning
- Helps reduce risk of misapplication
- Simple visual verification of correct welding material size
- No starting material required
- Easy ignition
- Increased flexibility in hard to reach areas

- Consists of a tamper proof, disposable, moisture-resistant welding material cup. The welding material, disk and ignition source are incorporated into the self-contained package
- Long shelf life
- Completes welds at distances of up to 6 ft/1.8 meters (up to 15 ft/4.6 meters with optional lead)
- Requires minimum components – no starting material, no disks, no flint igniters
- Easy to handle, store and transport – by air, land or sea in unlimited quantities
- Reduces installation time by 20%
- Has color-coded welding material containers – by size and alloy type – for easy identification
- Has electronic ignition with a CE/UL battery powered controller box that is designed for 600 connections with one set of 8 standard AA batteries (included) – requiring no special batteries or chargers
- Designed for use in standard ERICO CADWELD molds including ERICO CADWELD MULTI

Installation Is Easy! 4 Simple Steps For Permanently Welded Electrical Connections



Self contained welding material package



1 Insert ERICO CADWELD PLUS cup into mold (may require use of a cover/baffle)



2 Attach control unit termination clip to ignition strip



3 Press and hold control unit switch and wait for the ignition



4 Open the mold and remove the expended steel cup – no special disposal required

ERICO CADWELD PLUS Control Unit initiates the reaction of the metal crucible. The standard unit includes a 6-foot (1.8 meter) high temperature control unit lead. The lead attaches to the ignition strip using a custom made, purpose-designed termination clip.

After the termination clip is installed on the ignition strip, the installer pushes and holds the ignition button to start a charging and discharging sequence. Within a few seconds the control unit sends a predetermined voltage to the ignition strip and the reaction is initiated.

ERICO CADWELD MULTI



ERICO CADWELD MULTI

The complete welding system for improving grounding system performance, reliability, and installation convenience.

ERICO CADWELD MULTI simplifies the exothermic welding process. Make over 30 separate connection types with a single, universal mold, which now enables you to make connections to a ground rod.

Welding material sold separately.



Exothermic Welded Connections

Exothermic welded connections are immune to thermal conditions which can cause mechanical and compression joints to become loose or corrode. They are recognized for their durability and longevity.



ERICO CADWELD Connection

The ERICO CADWELD PLUS exothermic welding process fuses conductors together to form a molecular bond with a current-carrying capacity equal to that of the conductor. Grounding systems incorporating this type of connection therefore operate as a continuous conductor with lower resistivity.

ERICO CADWELD MULTI offers enhanced user benefits:

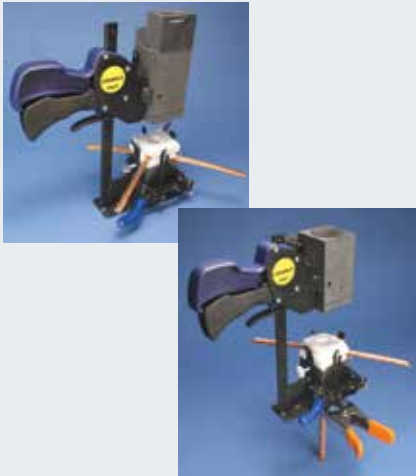
- Performs welds to ground rods
- Versatile mold produces an unlimited variety of connections
- Compact compression structure enables easy alignment of conductors
- Language-free instruction guide
- Lightweight kit for easy transportation
- Easy-to-use system completes weld in seconds
- Video available on www.ERICO.com

Standard Compliance

ERICO CADWELD MULTI satisfies the requirements of:

- BS 6651
- BS 7430
- NFC 15-100
- IEEE® 837-2014
- IEEE 80-2000
- IEC 1025-1 (ENV 61024-1)

4 Easy steps for multiple, permanently welded, electrical connections



Step 1: Layer batting and variable conductor sizes to be welded into dry mold.



Step 2: Add ERICO CADWELD PLUS welding material.



Step 3: Close cover and connect ERICO CADWELD PLUS control unit.



Step 4: Press and hold operate button. Open mold after 10 seconds.

How Does It Work?

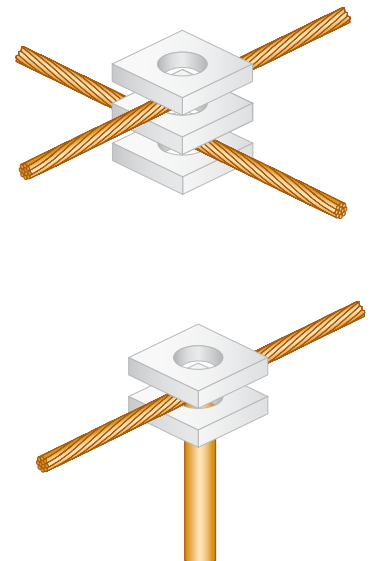
ERICO CADWELD MULTI combines a versatile mold block and a range of gaskets (batting) to allow numerous different welded connections to be produced without the need to change the mold for each connection type



The process is similar to the ERICO CADWELD with one distinct difference...

there is no need to change the mold for different connection types.

The whole process is complete in about one minute. Page 31 details the gasket quantities required for each weld.



ERICO CADWELD MULTI

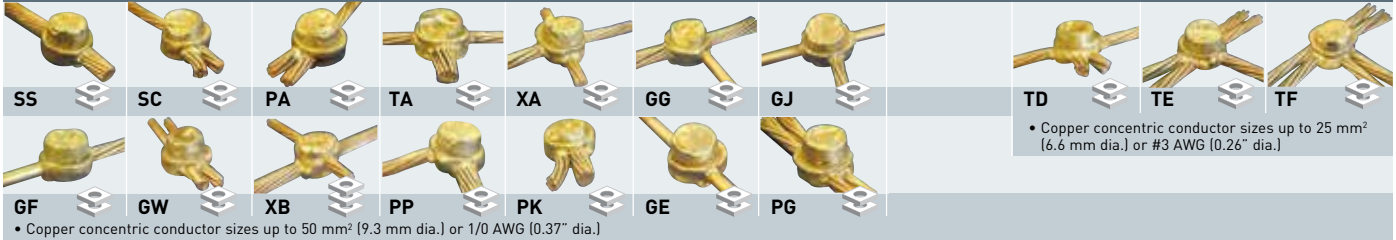
ERICO CADWELD MULTI offers all of the benefits of ERICO CADWELD connections:

- Current-carrying capacity equal to that of the conductor
- Permanent molecular bond that will not loosen or corrode
- Works with ERICO CADWELD traditional welding material
- Works with ERICO CADWELD PLUS welding material
- Will withstand repeated fault currents
- No external power or heat required
- Ground rod capabilities
- Visual inspection possible
- Requires minimal training



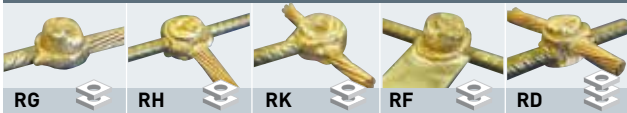
ERICO CADWELD MULTI Connection Capabilities

Copper Cable/Solid to Copper Cable/Solid



• Copper concentric conductor sizes up to 50 mm² (9.3 mm dia.) or 1/0 AWG (0.37" dia.)

Copper Cable/Solid Strip to Rebar



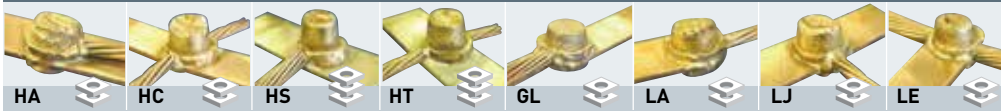
- Copper concentric conductor sizes up to 50 mm² (9.3 mm dia.) or 1/0 AWG (0.37" dia.)
- Copper or steel strip sizes up to 30 x 3,5 mm (1.2" x 0.14")
- Rebar sizes up to 10 mm (#3)

Copper Strip to Copper Strip



- BB and CG: Copper strip sizes up to 30 x 3,5 mm (1.2" x 0.14")
- BG and EB: Copper strip sizes up to 30 x 3,0 mm (1.2" x 0.12")

Copper Cable/Solid to Copper or Steel Strip/Lug



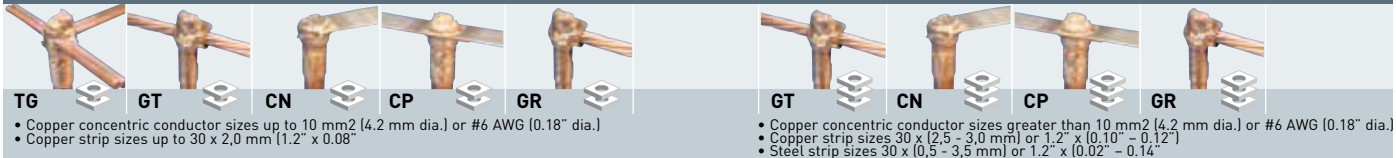
- Copper concentric conductor sizes up to 50 mm² (9.3 mm dia.) or 1/0 AWG (0.37" dia.)
- Copper or steel lug / strip sizes up to 30 x 3,5 mm (1.2" x 0.14")

Galvanized Steel Strip to Galvanized Steel Strip



- Galvanized steel strip sizes up to 30 x 3,5 mm (1.2" x 0.14")

Ground Rod Connections



- Copper concentric conductor sizes up to 10 mm² (4.2 mm dia.) or #6 AWG (0.18" dia.)
- Copper strip sizes up to 30 x 2,0 mm (1.2" x 0.08")

- Copper concentric conductor sizes greater than 10 mm² (4.2 mm dia.) or #6 AWG (0.18" dia.)
- Copper strip sizes 30 x (2,5 - 3,0 mm) or 1.2" x (0.10" - 0.12")
- Steel strip sizes 30 x (0,5 - 3,5 mm) or 1.2" x (0.02" - 0.14")

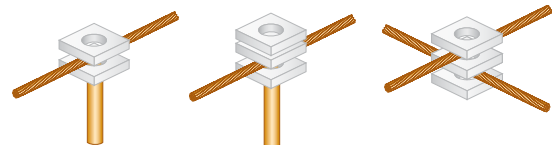
ERICO CADWELD MULTI Available Items

Part Nr	Article Nr	Description	Weight (kg)
KITCDMV01	167782	CADWELD MULTI Kit	25.000
The CADWELD MULTI kit (KITCDMV01) contains the following list of items:			
FMCDMV01	120883	Handle Clamp	1.800
CDMV01H	240399	Mold for H welds	1.200
CDMV0112	240398	Mold for welds on 1/2 rods	1.200
CDMV0158	240397	Mold for welds on 5/8 rods	1.200
CDMV0134	240396	Mold for welds on 3/4 rods*	1.200
SCDM01	120886	Set of 33 batting/gaskets	0.200
B399P	162070	SKK1 clamp	0.500
TSCSTP	197295	Toolset	2.000
B136B	182030	Slag Removal Spade	0.144
		Language free instruction sheet	1
The following items can be used with the CADWELD MULTI Kit (KITCDMV01). They are sold separately.			
T320	165000	Flint Ignitor T320	0.090
90	163040	CADWELD Traditional welding material	0.090
115	163050	CADWELD Traditional welding material	0.115
PLUSCU	165745	Control Unit	1.088
PLUS#90F20	165705	CADWELD PLUS welding material	0.158

Symbol denotes number of batting (gaskets) required for each connection.



Requires 2 batting layers for weld
Requires 3 batting layers for weld



NOTES:

- * For connections using a 3/4" ground rod, it is necessary to use #115 / 115PLUSF20 weld material (sold separately).
- For all other connection types, use #90 or 90PLUSF20.
- For connections using galvanized material, remove galvanizing before welding, for a better connection.

ERICO CADWELD ONE SHOT



Permanent Exothermic Connections without the Mold

ERICO CADWELD ONE SHOT produces a permanent exothermic connection to a ground rod that will not loosen, corrode or increase in resistance for the life of the installation. The convenient single-use package makes the connection to the ground rod without a mold or starting material.

Thanks to the electronic ERICO CADWELD ONE SHOT Control Unit, welds can now be completed up to 6 ft. (1.8 m) away, increasing weld flexibility in hard-to-reach areas. The refractory ceramic body on the ERICO CADWELD ONE SHOT is more durable than conventional ceramic and resists breaking.

Installation is easy!



1. After preparing the ground rod and wire, position the ERICO CADWELD ONE SHOT and attach the lead to the control unit.



2. Ignite the ERICO CADWELD ONE SHOT with the electronic CADWELD PLUS Control Unit.



3. After one minute, break off the ceramic crucible. It can also be left in place, if desired.

Features:

- Easy-to-use electronic ignition. No starting material needed
- Extremely durable disposable ceramic outer body eliminates the graphite mold and frame
- Produces a permanent connection that will not loosen or corrode
- Fits both plain and threaded copper-bonded and full-size steel and stainless steel ground rods
- NEC® compliant
- cULus® Listed

How to order ERICO CADWELD products

This catalog lists the most popular ERICO CADWELD connections using solid or concentric stranded copper conductor, insulated or bare. Look in the index for the connection you need. To save time and money, avoid non-catalog items or specials whenever possible.

If you cannot find the connection you need, contact ERICO or your local distributor or agent. We have designed over 45,000 connections, and “specials” are designed every day.

1. What connection do you want?

We strongly recommend that wherever possible you use molds listed in this catalog. After selecting the connection, turn to the appropriate page and select the mold, weld metal and tools you need.

2. Only the most popular ERICO CADWELD connections are listed in this catalog.

For a complete listing of ERICO CADWELD EXOLON connections, please refer to pentair.erico.com or your local ERICO representative.

3. What are the conductor sizes?

This catalog covers connections between solid or concentric stranded copper conductors to each other, to lugs, to ground rods, to rebar, to rail and to special grounding accessories. For sizes not listed, contact your local ERICO CADWELD distributor, agent, or ERICO.

Note: Other publications describe connections to conductors of copperclad, high voltage copper, aluminum, busbar, lightning protection cable, steel cable, etc.

4. You must have the following to make a weld:

- 4.1 Mold to fit your conductors
- 4.2 Weld metal required by your mold
- 4.3 Handle clamps on frame
- 4.4 Flint ignitor (included with handle clamps and frames)
- 4.5 If using ERICO CADWELD EXOLON, you need a Relia-Start™ battery instead of a flint ignitor.
- 4.6 Lugs, sleeves, packing material listed on the page with the mold.

ERICO CADWELD EXOLON

ERICO CADWELD EXOLON Reduced-Emission Molds

Developed in 1988, ERICO CADWELD EXOLON connections represented a significant advancement in welded electrical connections for sensitive indoor applications like data centers, hospitals, and other clean room environments. The virtual elimination of smoke and a unique electronic starting system makes this an ideal solution for sensitive applications. Each ERICO CADWELD EXOLON package contains ceramic filters that produce an extremely low emission connection.



How to order ERICO CADWELD EXOLON:

1. To order ERICO CADWELD EXOLON products, just specify molds and weld metal from the catalog and add an "XL" prefix.

Example: TAC2Q2Q becomes XLTAC2Q2Q, and 150 becomes XL150.

2. If the weld metal shown in the catalog shows more than one tube required such as 2-#200, you must specify #XL400 to get the correct size filters.

Example: XLTAD-4L3Q: XL400

3. The following molds require a price key change:

- "C" price key molds using 2-#150 weld metals change to XLD price key.
- "E" price key molds using 2-#150 weld metals change to XLJ price key.
- "H" price key molds using 2-#150 weld metals, contact ERICO.
- "M" price key molds using 2-#150 weld metals change to XLV price key.
- "R" price key molds using 2-#150 weld metals change to XLF price key.
- "T" price key molds, ALL change to XLP price key.

Example: TAC3Q3Q using 2-#150 weld metals change to XLTAD3Q3Q using #XL300 weld metal

4. Filters and ignitors are included with the weld metal. XL filters and ignitors are not sold separately.
5. The ignitor can be used only once and then must be discarded. Filters will last as specified in the instructions supplied with each mold.
6. A Relia-Start electric starter, part number XLB971A1 (battery, charger, carrying case and connecting cable), is required for XL weld metal. There is no starting material in the XL weld metal tube. Batteries operate about 200 starts before recharging from 120 VAC is required. The charger, all electrical connections and instructions are included in the battery case.
7. Baffle with cover is required for larger molds. Estimated life of the baffle is 500 welds.
 - XLB972A1 Baffle is required for molds using XL200 and XL250 weld metals.
 - XLB973A1 Baffle is required for molds using XL300 to XL750 weld metals.
8. For EZ Change Handles, add XL prefix. (Flint ignitor not included.)
9. Welding Tray, part number XLB974B2, is used under the mold to protect cables and equipment from hot materials.

Other information

Certain tools may be required for various connections. If required, these tools are listed on the same pages as the connection and in Section A. Some tools in section A can save you a lot of time. Also refer to A9E, Contractor Tips, to make your job easier, and learn about labor saving ideas.

For complete pricing information, please visit pentair.erico.com or contact and ERICO Representative
For ERICO CADWELD literature, guides, instructional videos, and more, visit erico.pentair.com.

For all your connection needs — we’re only a phone call away.

Phone: 800-677-9089

Fax: 800-677-8131

or call your local ERICO CADWELD distribort, agent, or ERICO CADWELD regional sales manager

Required tools summary:

Required tools are listed with each mold. For your reference, handle clamps and/or frame are summarized below.

Mold	Required
A*	Includes frame with handle
C, Q & R	Requires L160
D, F & Z	Requires L159
E*	Includes frame but also requires L160
J*	Includes frame but also requires L159
K*, M* & V*	Includes frame with handles

* To order mold only — without handles or frame — add suffix “M” to mold part number.

Heavy Duty Electrical Connections for Stranded Concentric Copper Conductors

Heavy Duty connections were developed to be used on reclaimd cable. Heavy Duty connections use a larger size connection cavity in the mold and a larger size weld metal than the equivalent standard connections.

The larger size weld metal supplies extra BTU’s (but not a higher temperature) to melt the heavy oxide coating on the conductor and to overcome severe field conditions.

Heavy Duty connections offer the following advantages:

- Eliminates cutting the run conductor on certain types of connections.
- Reduces cable cleaning requirements for old or reclaimed cable.
- Increases reliability under adverse field conditions.

Grounding Connection Specification

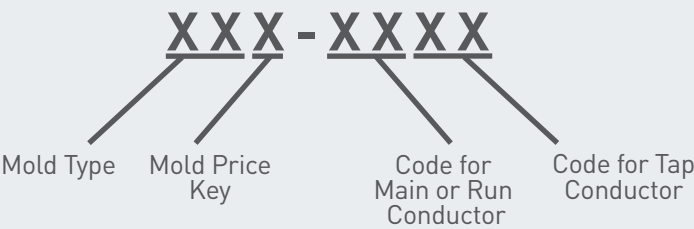
This specification covers the ERICO CADWELD exothermic welding system for use in making electrical connections. The ERICO CADWELD system supplied under this specification shall include welding material, molds, tools and accessories as required.

Unless otherwise specified, ERICO CADWELD exothermic welding system shall be used for all electrical grounding connections of copper to copper and copper to steel conductors. ERICO CADWELD connections shall be suitable for exposure to the elements of direct burial in earth or concrete without degradation over the lifetime of the grounding system.

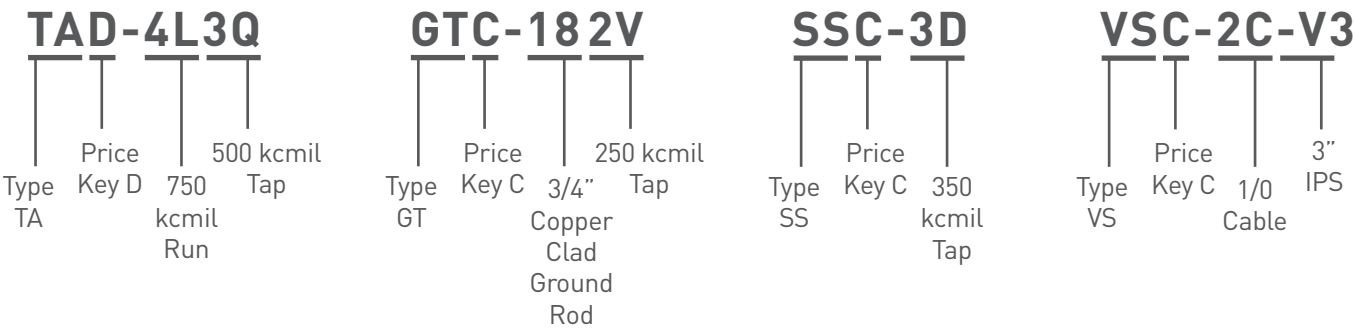
The ERICO CADWELD exothermic welding system furnished under this specification shall meet the applicable requirements of IEEE Standard 80 "IEEE Guide for Safety in AC Substation Grounding" and IEEE Standard 837 IEEE "Standard for Qualifying Permanent Connections Used in Substation Grounding". Independent test data showing conformance to IEEE Std. 837 shall be readily available.

The ERICO CADWELD Mold Numbering System

The ERICO CADWELD mold part number gives, in code, the complete information about the mold.
Type of connection, mold price key, and conductor size(s)



Examples:



A graphite mold is used for making most ERICO CADWELD connections. ERICO CADWELD molds will generally last an average of 50 or more connections under normal usage.

Price Key and Handle Clamp and/or Frames

Handle clamps are required for most molds. Specialized frames with handles are used on some molds. Flint igniters are included with handle clamps. The following handle clamps are most widely used.

L160 for all molds having a "C", "E", "R" and "Q" mold price key (3" wide molds)

L159 for all molds having a "D", "F", "J" and "Z" mold price key (4" wide molds)

Handle Clamps with an "XL" prefix are for use with the ERICO CADWELD® EXOLON system and do not come with a flint igniter. Mini E-Z Change Clamps for use with mini-welders.

Pictured below are the molds and handle clamps / and or frames and handles for the various price key molds:



"A" Price Key Mold
Includes Hold Down Frame



"C", "D", "F", "R", "Q" and "Z" Price
Key Mold L160 or L159
Handle Clamp Required



"E" and "J" Price Key Mold
L160 or L159 Handle Clamp
Required



"M" and "V" Price Key Mold
Includes Frame with Handles



"H" Price Key Mold
Includes Hold Down Frame
with Handles



"G", "K", and "L" Price Key
Mold Includes Frame with Handles



"T", "P" and "N" Price Key Mold
Includes Mini-EZ Handle Clamp
To order mold only, add an "M"
suffix to the part number
(for example, SST1TM)

Mold Options



SPLIT CRUCIBLE MOLDS

Molds made with a horizontal opening and solid crucible section may be specified as a split crucible type. The advantage of the split crucible mold is easier cleaning.

To order a mold with a split crucible, add an "L" suffix to the mold part number (for example, TAC2G2GL).



WEAR PLATES

Wear Plates reduce mechanical abrasion of molds at cable entry points and help prevent leakage of molten metal (particularly on larger 7 strand conductor). These features prolong mold life.

To order a mold with wear plates, add a "W" suffix to the mold part number (for example, PTC2G2GW).

SUPERIOR SOLUTIONS

Over a century of industry experience

Representatives across the US and Globe

Complimentary design and engineering services

Complete facility electrical protection solutions

And more



ERICO and Pentair

Customized solutions for modern industry.

Since 1903, ERICO has been a partner in building global industry and infrastructure. Today, we continue that tradition by offering industry leading products in addition to value-added solutions.

As of 2015, ERICO is now a Pentair company in an effort to continue serving our customers as effectively as possible. Visit our website below for more information.
erico.pentair.com

The ERICO logo is displayed in a bold, blue, sans-serif font.

Grounding, Bonding & Connectivity Products

ERICO Facility Electrical Protection

ERICO offers a full range of grounding, bonding and connectivity products for data centers and other data-com applications worldwide. ERICO's product offerings include grounding and bonding accessories, surge protection and lightning protection products, and welded electrical connections.

Grounding and Bonding

ERICO offers an extensive line of grounding and bonding products, which includes ground rods and accessories, signal reference grids, chemical ground rods, GEM ground enhancement material, couplers, clamps, inspection wells, grounding and perimeter bus bars and ground test instruments.

Surge Protection

ERICO surge protection products are designed to protect against damaging electrical surges on power and communications lines caused by lightning, building systems and other switching events.

Lightning Protection

Direct and indirect lightning strikes can pose many risks to businesses, including damaging buildings and critical equipment. ERICO lightning protection products offer a variety of solutions to help protect valuable equipment and personnel and to avoid disruption and downtime.

Welded Electrical Connections

ERICO CADWELD welded electrical connections are used to connect the grounding and bonding conductors to each other and to the ground electrode system, including ground rod electrodes, building steel and rebar. ERICO CADWELD connections provide a permanent, low-resistance connection needed to create a long-lasting, reliable bonding network. ERICO CADWELD connections will not deteriorate, cannot loosen and are made with inexpensive, lightweight and portable equipment. ERICO CADWELD EXOLON is a filtered, smokeless connection system designed for making connections indoors.



Lightning Protection Cable



ERICO CADWELD Lugs



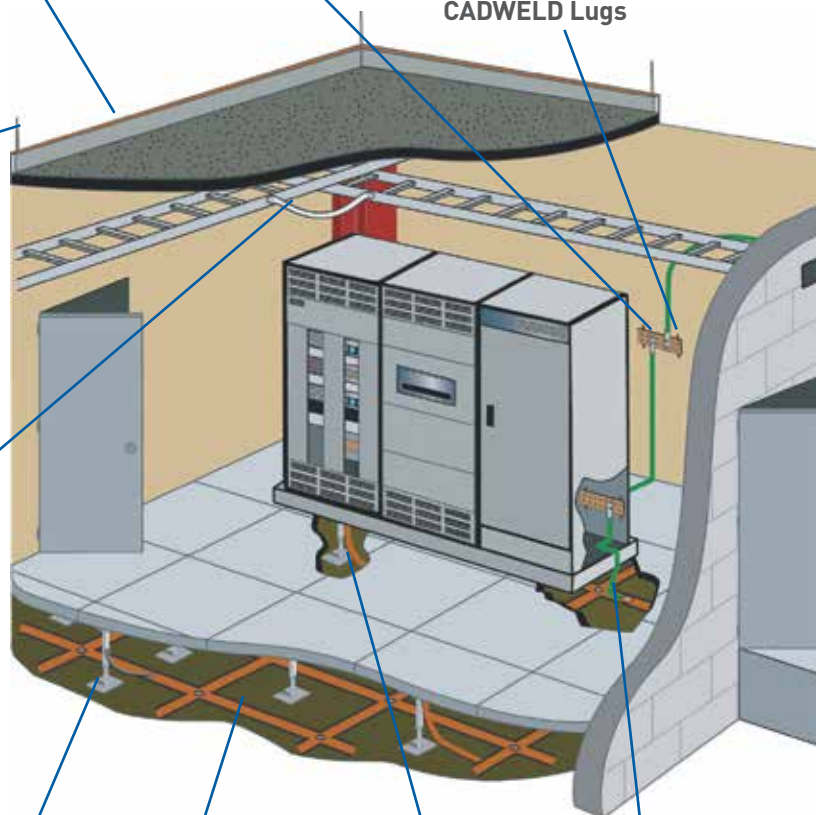
Telecommunications Ground Bar (TGB) and CADWELD Lugs



Lightning Air Terminals



Cable Runway Ground Strap (CRGS6)



Signal Reference Grid (SRG)

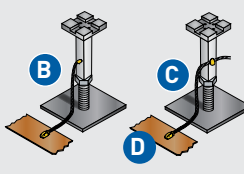


Low Impedance Riser (LIR)



Common Bonding Network Jumper (CBNJ09)

Pedestal Bonding Options

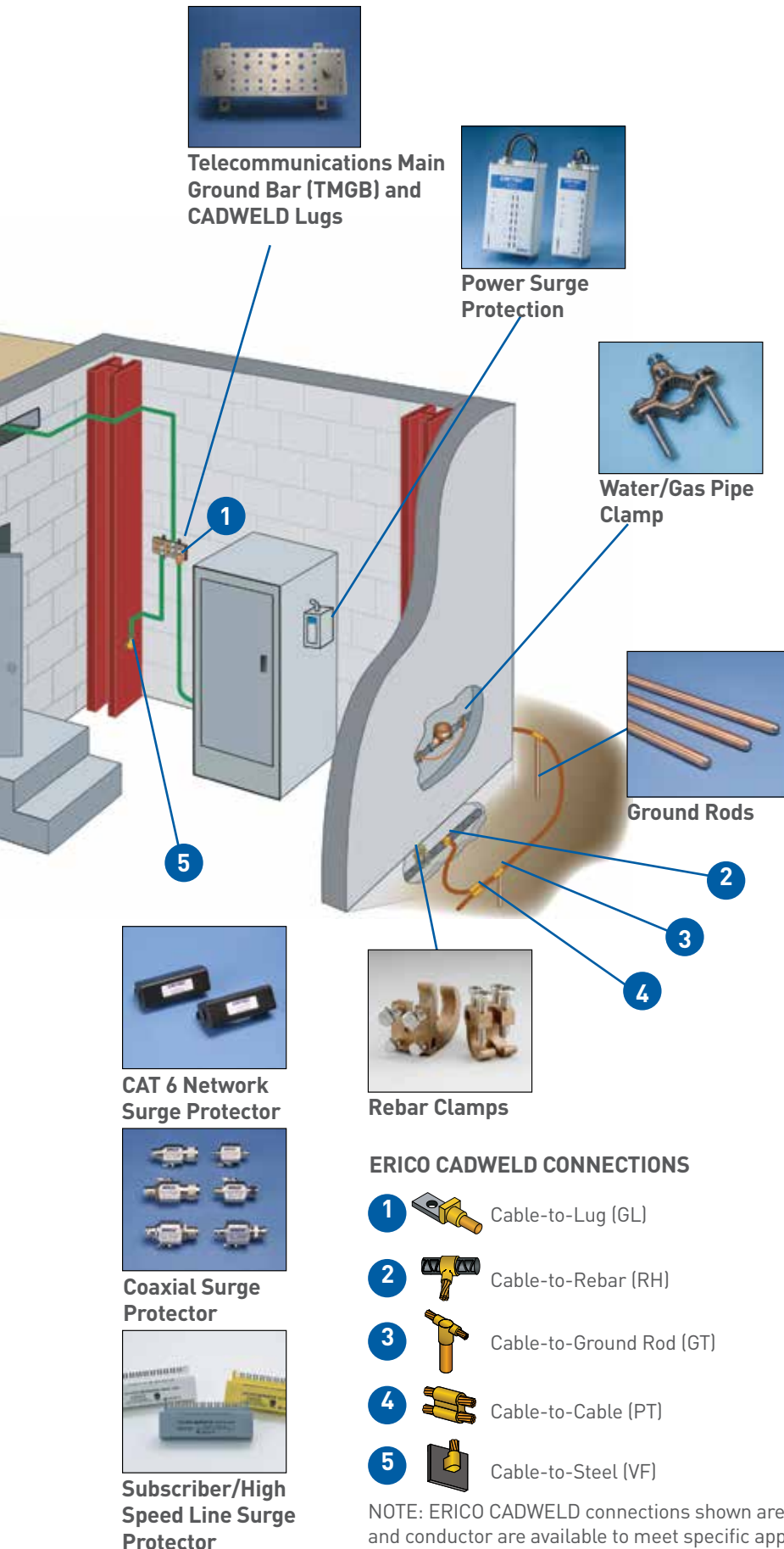


A Universal Pedestal Clamp (MBNUPCJ82, MBNUPCJ240)

B ERICO CADWELD Connection to Pedestal (VS)

C ERICO CADWELD Through Connection to Pedestal (VG)

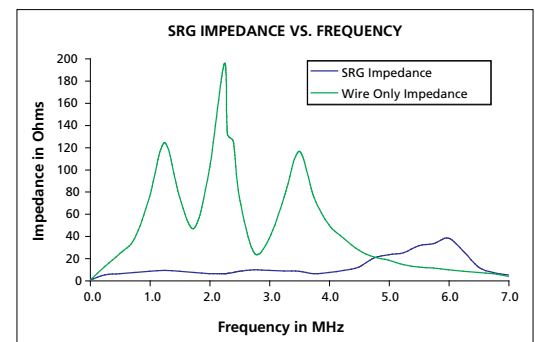
D ERICO CADWELD Connection to SRG (HA)



Prefabricated Signal Reference Grid (SRG)

The SRG is an integrated high-frequency, low-impedance signal reference grid structure, which consists of a network of flat copper strips welded at the cross-overs in accordance with recommendations found in IEEE® 1100 "IEEE Recommended Practice for Powering and Grounding Electronic Equipment." The SRG is also referred to as a "Supplementary Bonding Grid" (SBG) per TIA® 607.

The SRG lies directly on the sub-floor under the raised-floor structure and is used to interconnect metal frames, racks, enclosures, common terminals for signal level power and the electrical distribution grounding system. The SRG is used as a ground reference system for IT equipment by creating an equipotential ground reference plane over a large range of frequencies from DC through the Megahertz range. At high frequencies, flat strip conductors have considerably lower inductive reactance than concentric stranded or solid conductors and the configuration of the SRG results in a lower impedance system, which limits potential differences between data systems and other systems during voltage transients or other power system disturbances. The following graph from IEEE 1100 shows the impedance of an SRG system versus a wire-only grounding system.



SRG Features and Benefits

- Economical and maintenance-free
- Recommended in IEEE® 1100
- Reduces common-mode noise
- Increases noise immunity to electric fields
- Reduces capacitive coupled interference
- Compliant with Information Technology Industry Council Information Letter "Guidelines For Grounding Information Technology Equipment (ITE)" and the National Electrical Code.

IEEE is a registered trademark of The Institute of Electrical and Electronics Engineers, Incorporated.

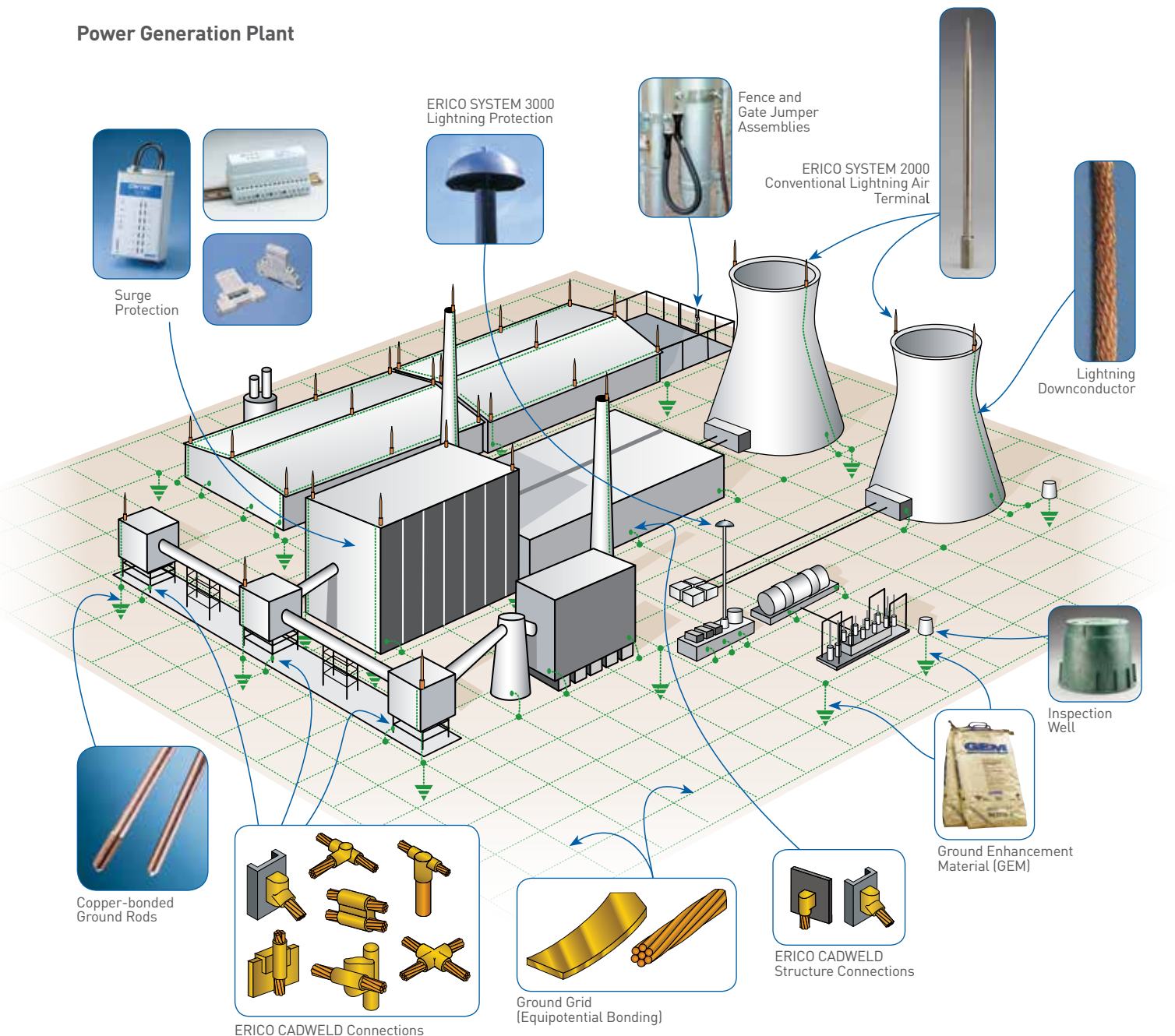
TIA is a copyright of Telecommunications Industry Association

Power Generation

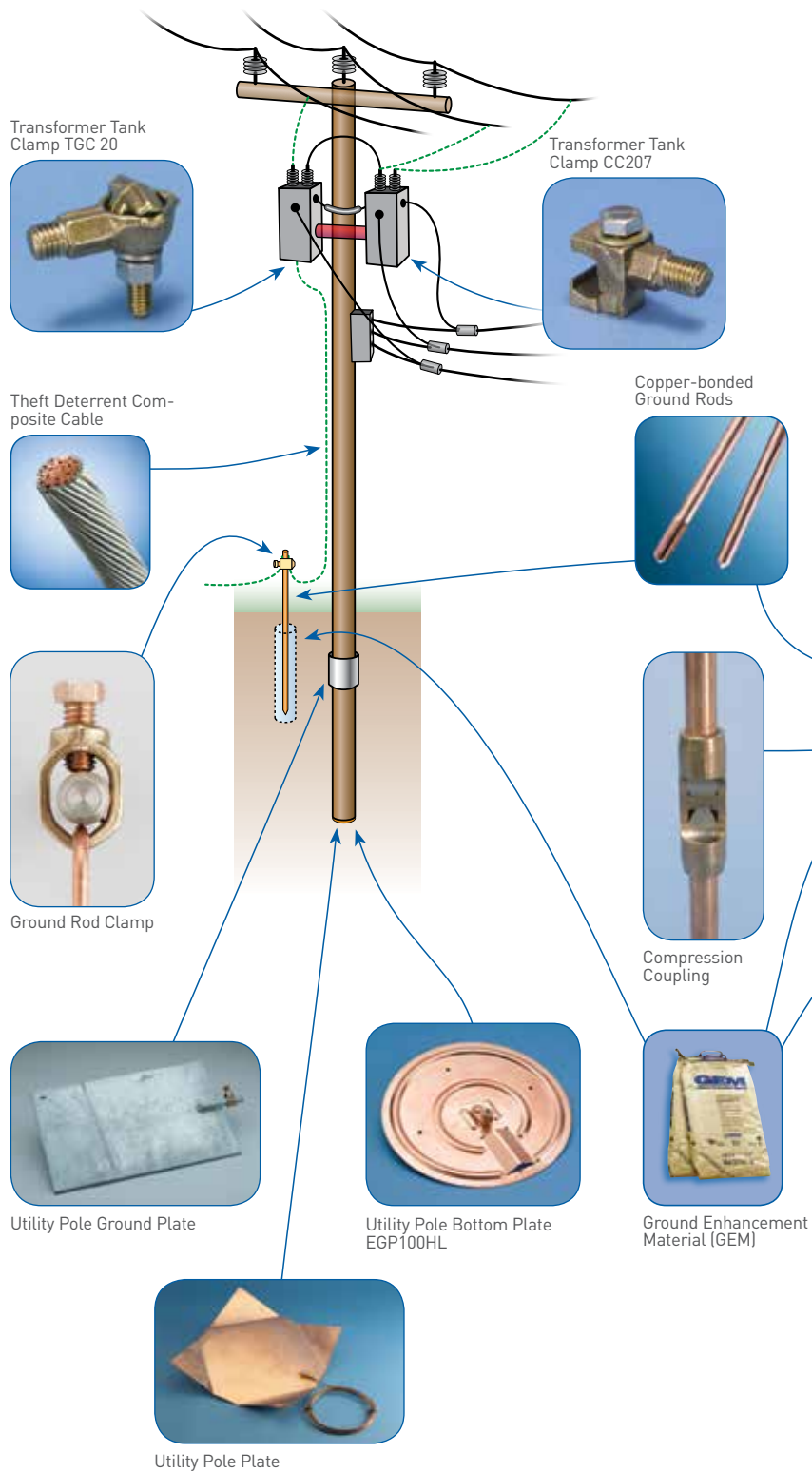
Power Generation Facilities

Traditional power generation facilities have either been coal-fired, gas-fired, nuclear, diesel or hydro-powered. Modern alternative power generation facilities can include geothermal, bio-gas, wind or solar. ERICO brand of lightning protection systems have been used to provide lightning protection to the whole host of facilities in a unique manner. ERICO grounding and bonding solutions can provide a complete system for the grounding and bonding of any of these facilities.

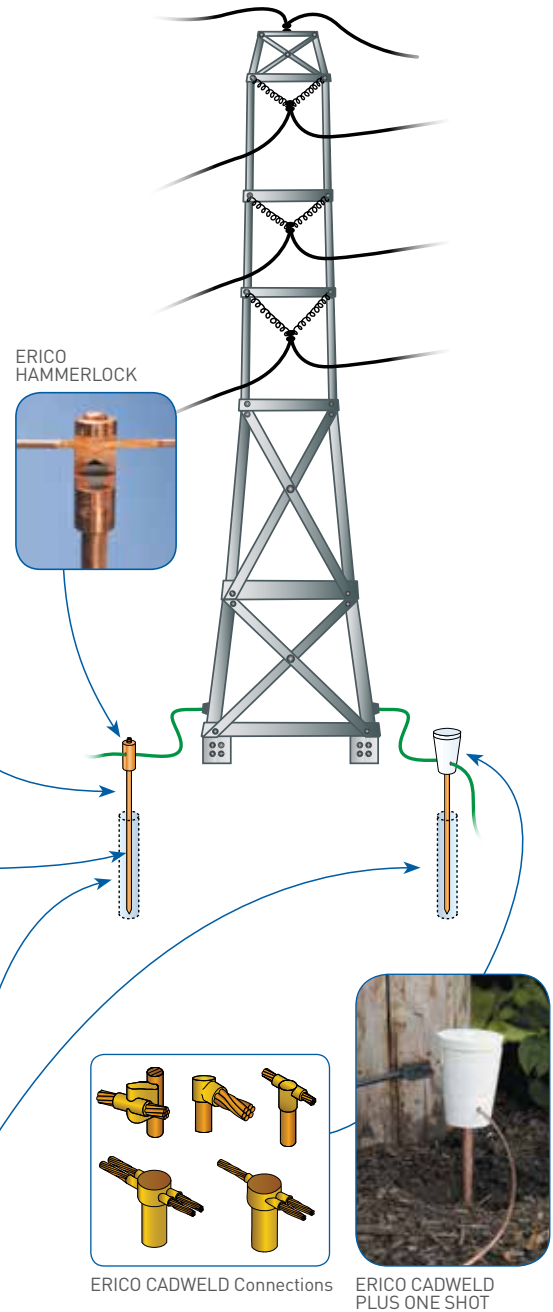
Power Generation Plant



Distribution Pole



Transmission Tower



Substation Earthing/Grounding and Lightning Protection

The conceptual design of a ground grid at a substation is summarized by the points below and depicted on pages 4 and 5.

- a) A continuous loop conductor should surround the perimeter to enclose as much area as practical. Under Standard IEEE® 80, this loop conductor is placed 3 ft (or 1 meter) outside the fence line. This measure helps to avoid high current concentration and high gradients both in the grid area and near the projecting cable ends. Enclosing more area also reduces the resistance of the grounding grid.
- b) Within the substation, conductors are typically laid in a parallel grid and, where practical, along the structures or rows of equipment to provide for short ground connections.
- c) A typical grid system for a substation may include bare copper conductors buried 18" (0.5 m) below grade, spaced 9 ft to 21 ft (3 m to 7 m) apart, in a grid pattern. At cross-connections, the conductors would be securely bonded together. Ground rods may be at the grid corners and at junction points along the perimeter.
- d) This grid system would be extended over the entire substation switchyard and beyond the fence line.

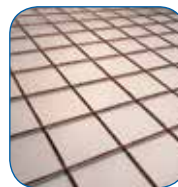
Earth/Ground Rods

ERICO offers a range of ground rods to suit the needs and preferences of the utilities. The most common of these are copper-bonded steel 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. ERICO recommends ERICO brand of 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. The ERICO brand of copper-bonded ground rods comply with UL® 467, BS:7430 & EN50164, Standards.



Surge Protection



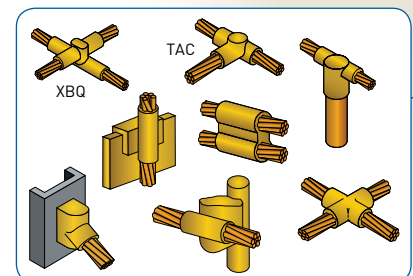
Prefabricated Wire Mesh



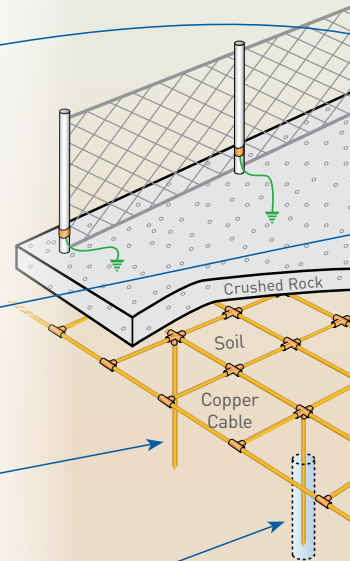
Copper-bonded Rods



Ground Enhancement Material (GEM)



ERICO CADWELD Connections

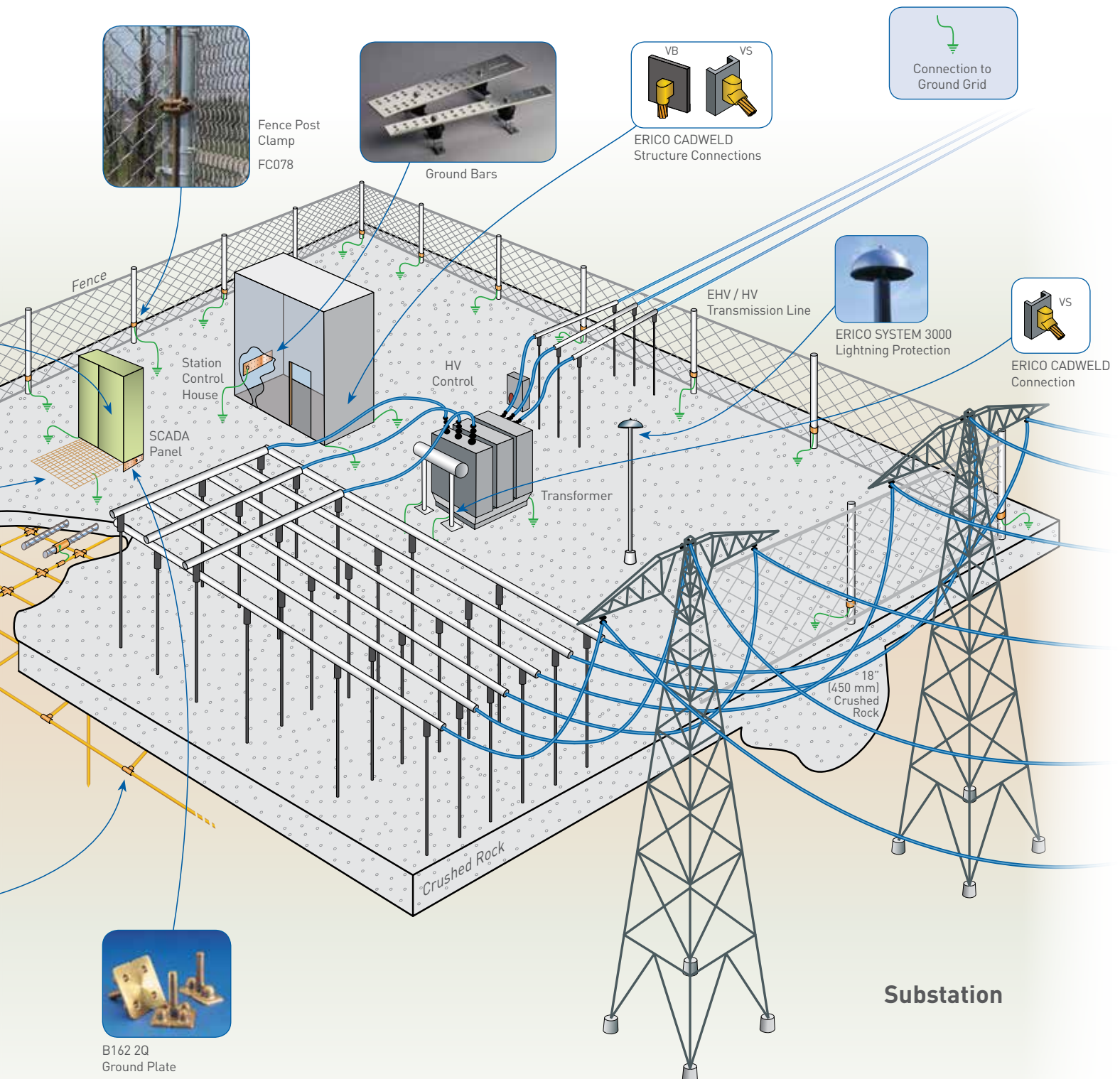


Substation Earthing/Grounding and Lightning Protection

Surge Protection for SCADA-controlled Equipment

Electronic equipment operating within a substation environment is particularly subject to electrical disturbances such as switching, electrical noise, ground potential rise and occasional induced or direct lightning impulse. Surge protection is an extremely cost-effective investment for electronic substation equipment, because:

- Each site's operation is critical to the quality supply of electrical power
- Downtime costs are significant



Solar Products

ERICO offers a wide range of products for the solar market. In addition to an extensive product offering, ERICO engineers and designers can provide design assistance for many solar installation aspects of your facilities worldwide.

The megawatts of solar energy produced continues to increase globally. More countries have focused resources on this valuable endeavor. Solar photovoltaic power systems include modules, inverters, rack mounting components, monitoring systems for off-grid systems, batteries and charge controllers. Solar power systems are designed to be in service for periods of 30 years or more, therefore it is imperative to construct the systems with products that are designed to help provide efficient operation for the lifetime of the installation. ERICO is uniquely positioned to provide the necessary products, components and services for solar programs worldwide.

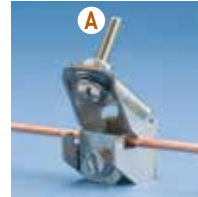
Years of experience in the fields of grounding and bonding, lightning protection, low-voltage power distribution, fastening and support and reinforced concrete construction, combined with global manufacturing capabilities, allow ERICO to provide comprehensive solutions for the solar market. Four of our product lines have joined together to offer a full range of solutions: ERICO facility electrical protection products, ERIFLEX low-voltage power distribution products, LENTON concrete reinforcement products and CADDY fixings, fasteners and supports.

ERICO's products are technically superior, meet or exceed international and industry code requirements and help prolong service life. As a global organization, ERICO is experienced with regional codes, standards and practices, including OEM specs.

Grounding, Lightning Protection, Electrical Connection and Cable Management Solutions for the Solar Power Industry



ERICO Lightning Protection Systems



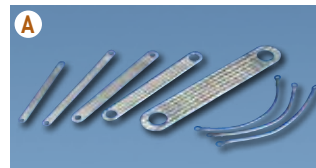
Solar Bonding Lugs



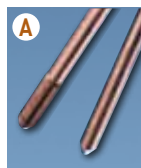
Grounding Accessories



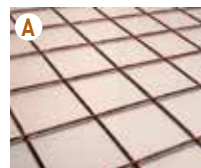
RIGD and SK Series Strut Clamps



MBJ Grounding Braids



Copper-bonded Ground Rods



Equipotential Ground Mesh



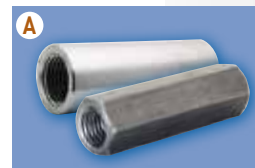
Intersystem Bonding Termination (IBTB)



SCH Series Strut Clamps



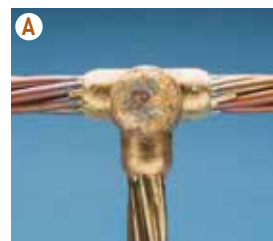
LENTON TERMINATOR



Bolt Couplers



CADDY PYRAMID

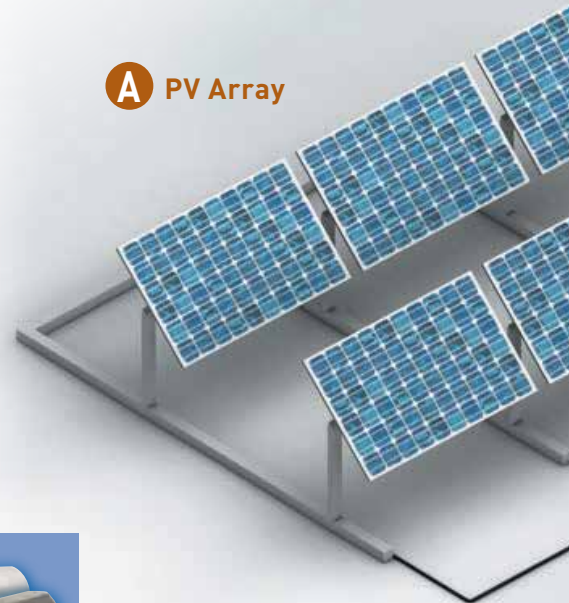


ERICO CADWELD Exothermically Welded Connections



Ground Enhancement Material

PV Array





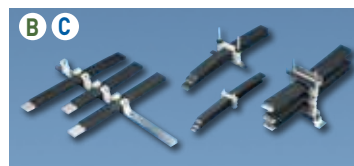
ERIFLEX FLEXIBAR



DIN Rail Profiles



Low Voltage Insulators



ERIFLEX FLEXIBAR Supports



Equipment Grounding Bus Bars



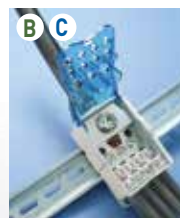
TDS50 DC Surge Protection Devices



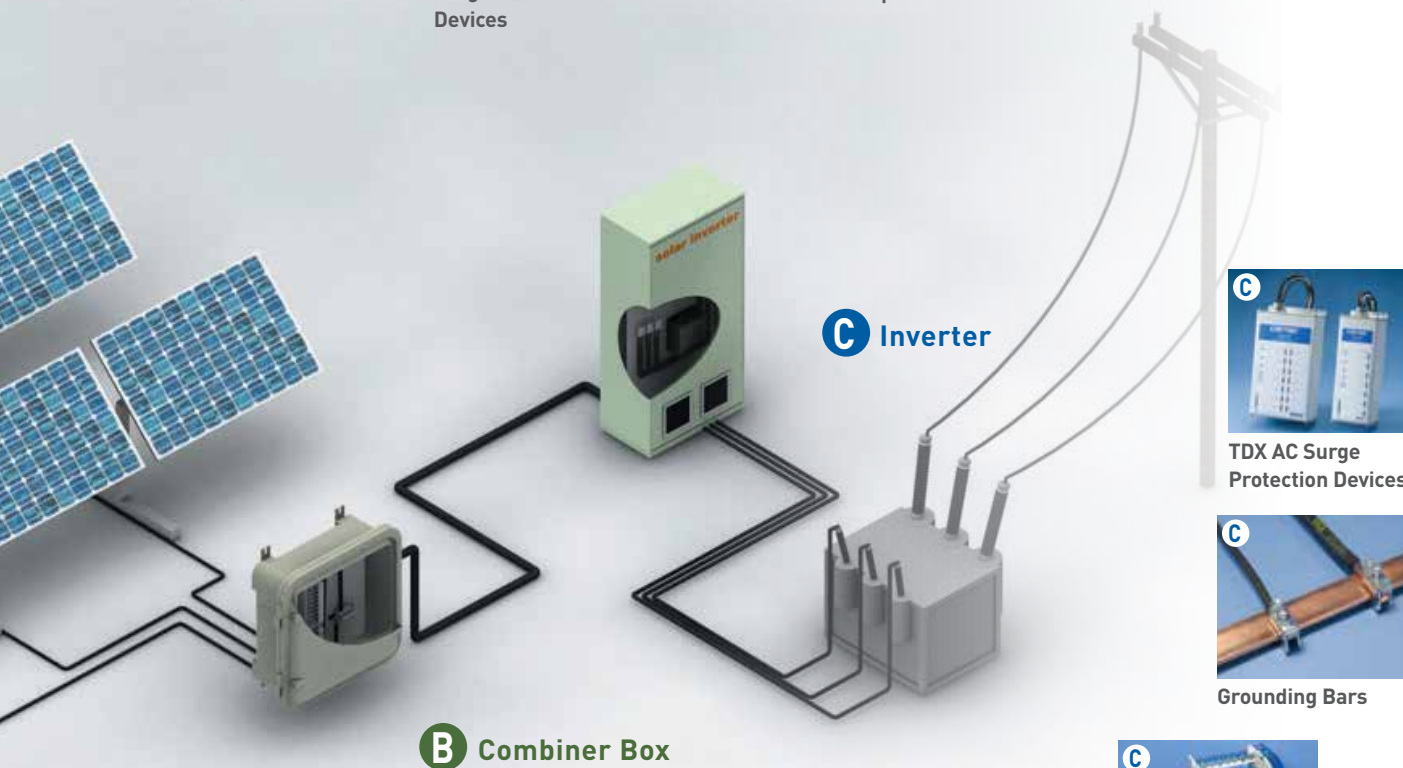
Power Terminals



Power Blocks/Splice Blocks



Distribution Blocks



TDX AC Surge Protection Devices



Grounding Bars

(B) Combiner Box



Terminal Strip



Two and Four Pole Distribution Blocks



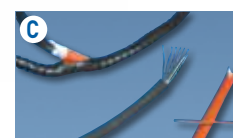
Insulated Braided Shunt



Splice Blocks



Distribution Blocks



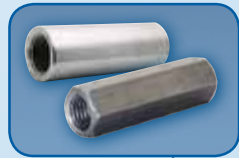
Cabling Sleeves

Wind Products

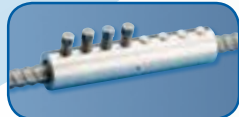
Foundation Grounding and Construction, Bonding, Power Connections, Surge Protection, and Lightning Protection

ERICO offers a complete range of foundation grounding and construction, bonding, power connections, surge protection, and lightning protection products for the wind energy industry. In addition to our extensive product offering, our engineers and designers are ready to provide design assistance for your facilities worldwide.

LENTON Bolt Couplers



LENTON LOCK Mechanical Rebar Splicing System



ERICO Cable to Rebar Connections



Ground Enhancement Material (GEM)



ERICO Multi-Point Lightning Protection Assemblies

Lightning Event Counter and Remote Relay



ERIFLEX FLEXIBAR



Low Voltage Insulators



Power Blocks



ERIFLEX Grounding Braids and Bonding Jumpers

LENTON Standard Couplers and Position Couplers



ERICO Power and Control Surge Protection



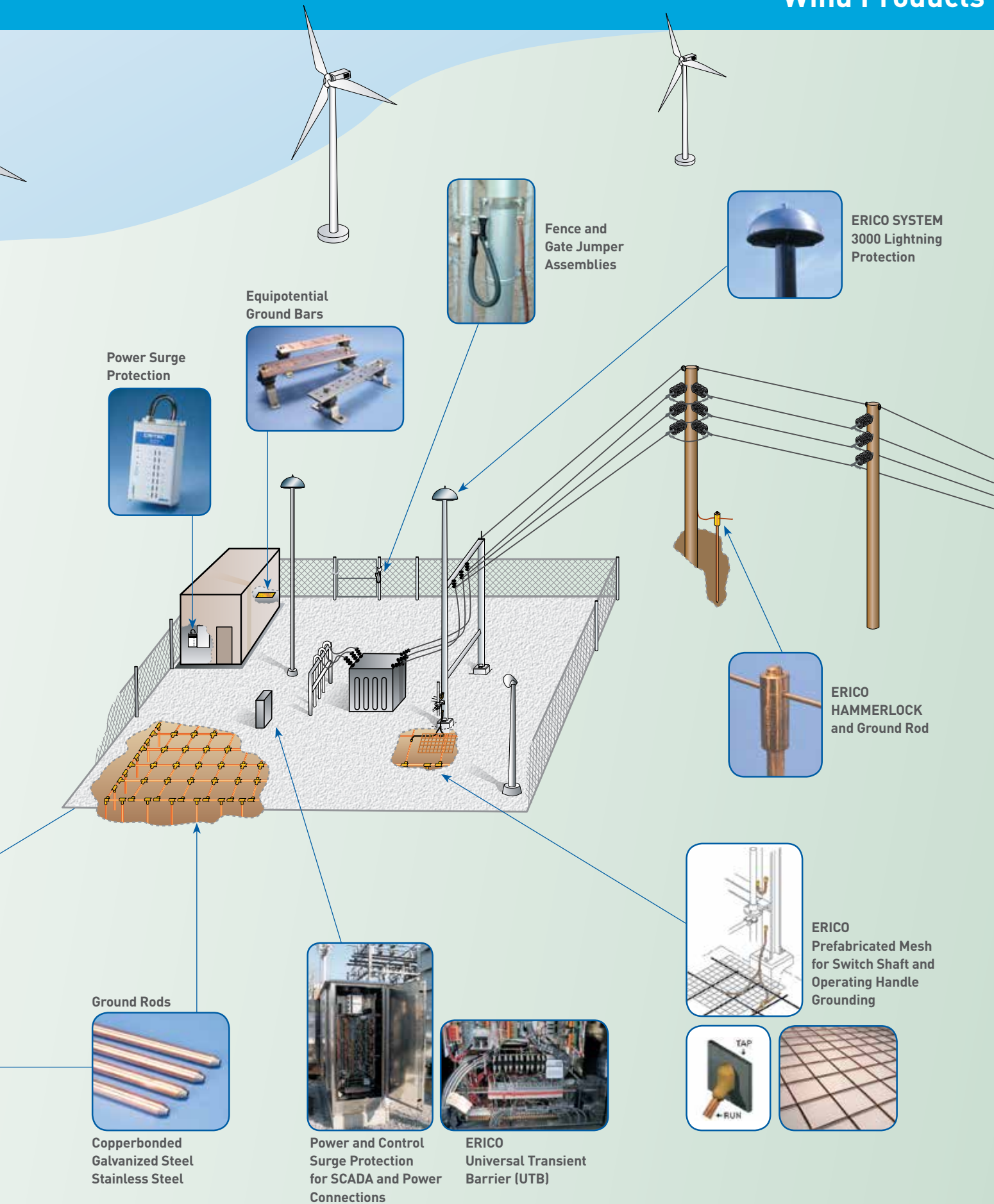
ERICO CADWELD Connections



**Cable to Rebar
Cable to Cable
Cable to Ground Rod**

LENTON TERMINATOR Rebar End Anchors





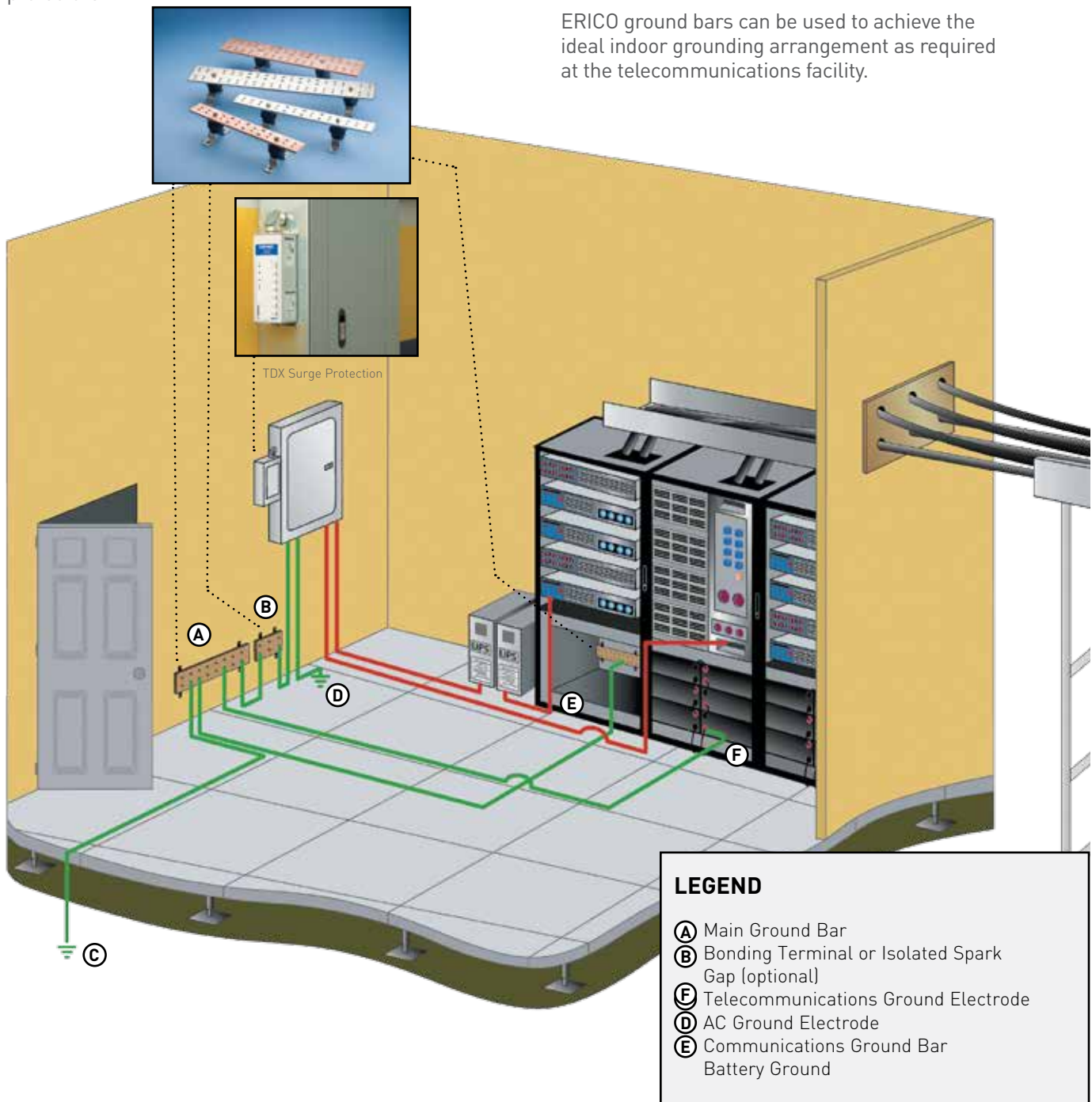
Grounding/earthing, lightning protection and surge protection are critical parts of a telecommunications facility installation. ERICO has complete telecommunications applications solutions to help protect the facility against electrical noise, lightning induced surges and transients caused by switching components in the power systems.

ERICO solutions include ERICO ground rods, ground mats, ground enhancing material (GEM), ground bars, ERICOCADWELD connections, ERICO lightning protection systems and CRITEC MDF, co-axial and power surge protectors.

To make the application of these products simpler, the grounding, lightning protection and surge protection system at a telecommunications facility is divided into 5 components.

1. Indoor Bonding Arrangement
2. Outdoor Grounding Arrangement
3. Surge Protection for Power Lines
4. Surge Protection for Telephone Lines
5. Direct Strike Lightning Protection

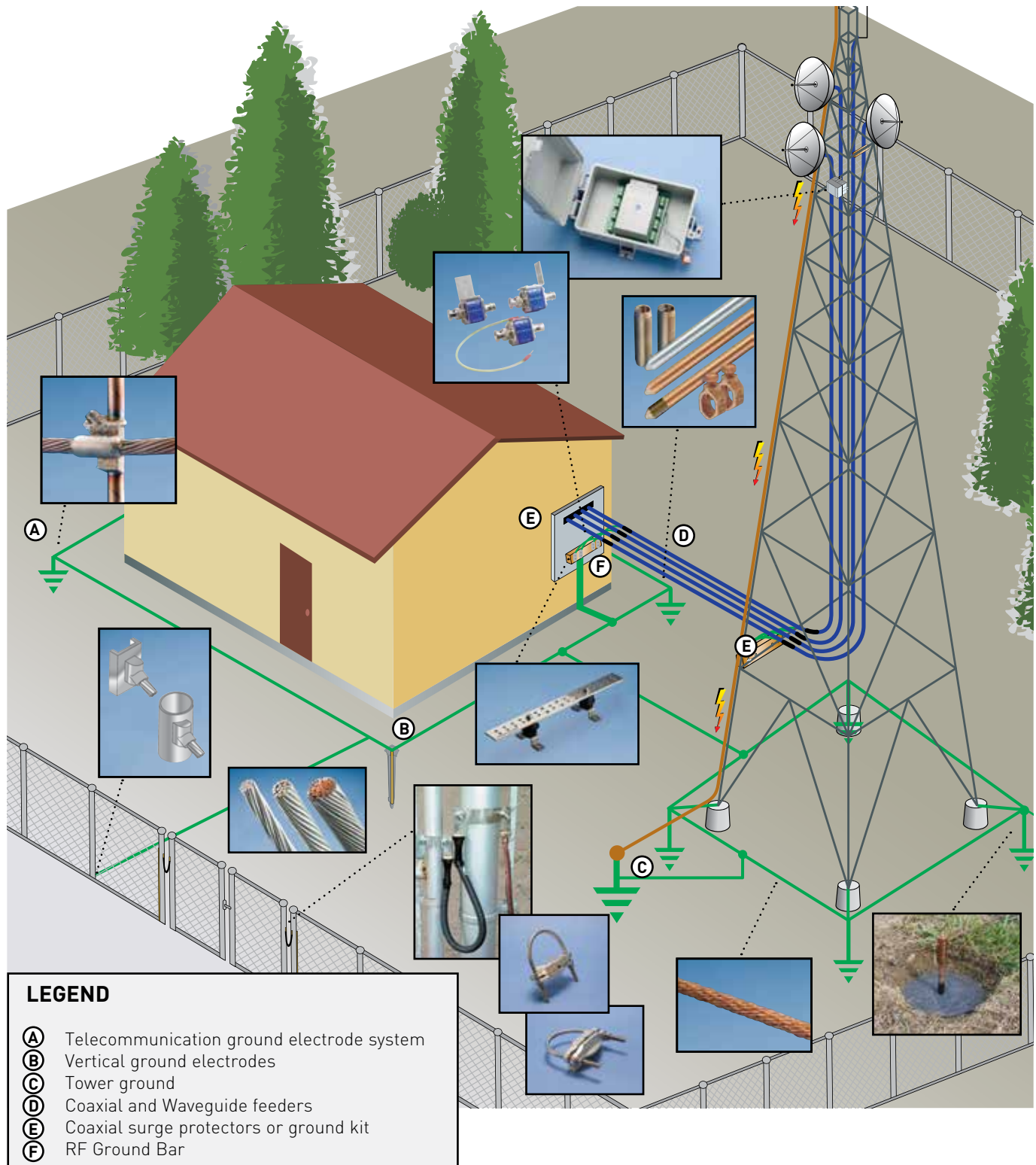
ERICO ground bars can be used to achieve the ideal indoor grounding arrangement as required at the telecommunications facility.



The outdoor arrangement of a grounding system at a telecommunications facility is depicted here. This arrangement is not always possible due to certain constraints at the site. Where the telecommunication equipment is installed in a large multi functional building or several floors above the ground floor this layout may not be possible.

Alternative outdoor ground electrode system needs to be considered on a case by case basis if the suggested layout below is not possible to implement.

ERICO offers a full range of products to form the outdoor grounding system at a telecommunications facility.



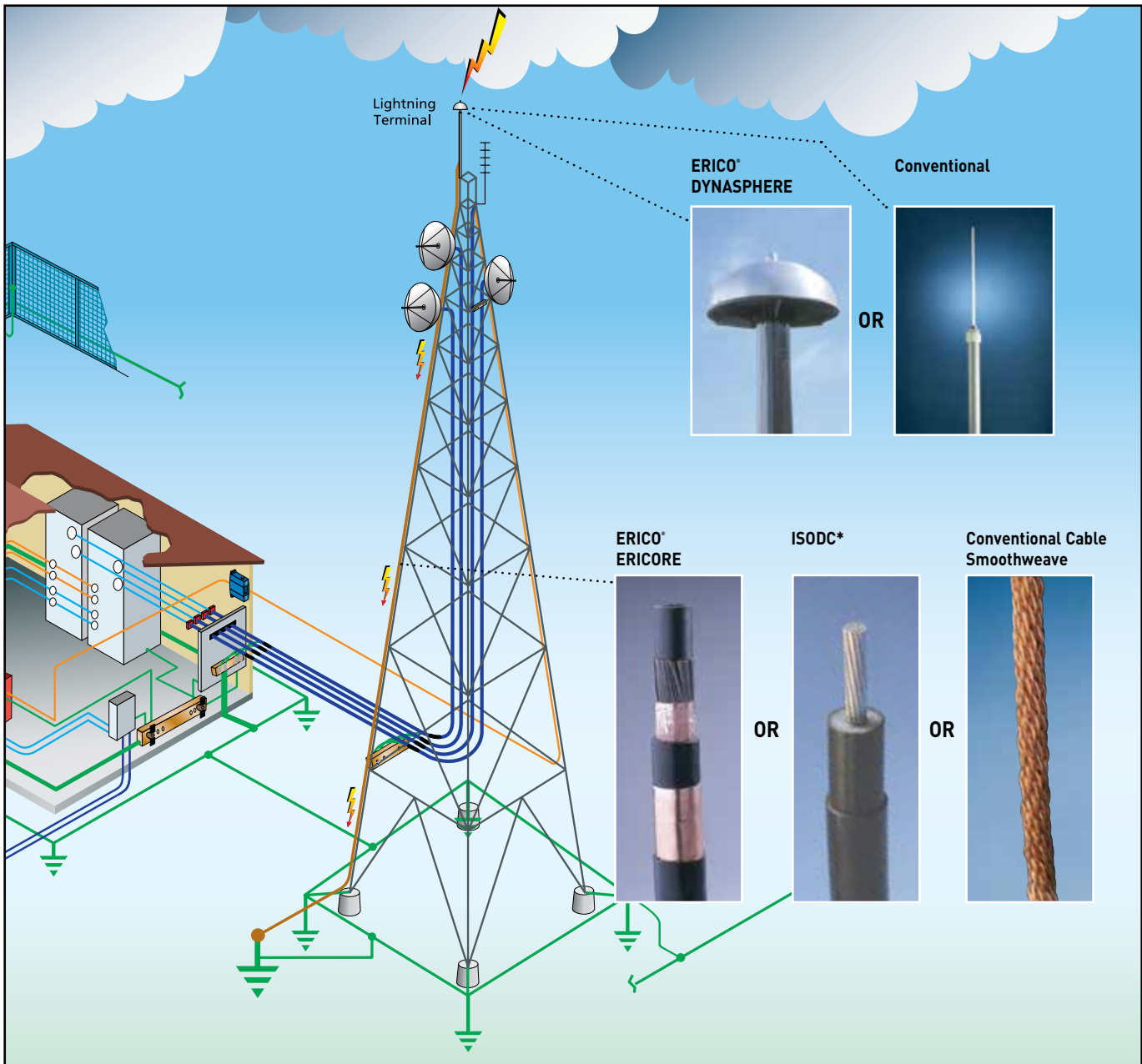
Lightning Protection for Telecommunications Towers

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 a dedicated down conductor comprised of bare cable or tape that is installed on the tower to connect the lightning rod to the ground.

A modern method is to use an optimal air terminal design, the 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 ERICO ERICORE

is routed in the core of the FRP and connects to the bottom of the ERICO Dynasphere via a high voltage, impulse rated termination. The ERICO ERICORE runs along a leg of the tower away from the routes of feeders, down to the tower grounding system. ERICO ERICORE cable is designed to minimize the voltage between itself and the tower so that the bulk of the lightning energy is contained within the cable, thereby protecting the tower and feeders from conducted lightning currents and having much less reliance on bonding practices which sometimes are overlooked or completed incorrectly.



* ISODC - is an isolated lightning protection cable system based around IEC62305. It is designed to isolate the lightning current from sensitive equipment, eliminating the need for separation distances required with conventional cable. Contact ERICO for further information.

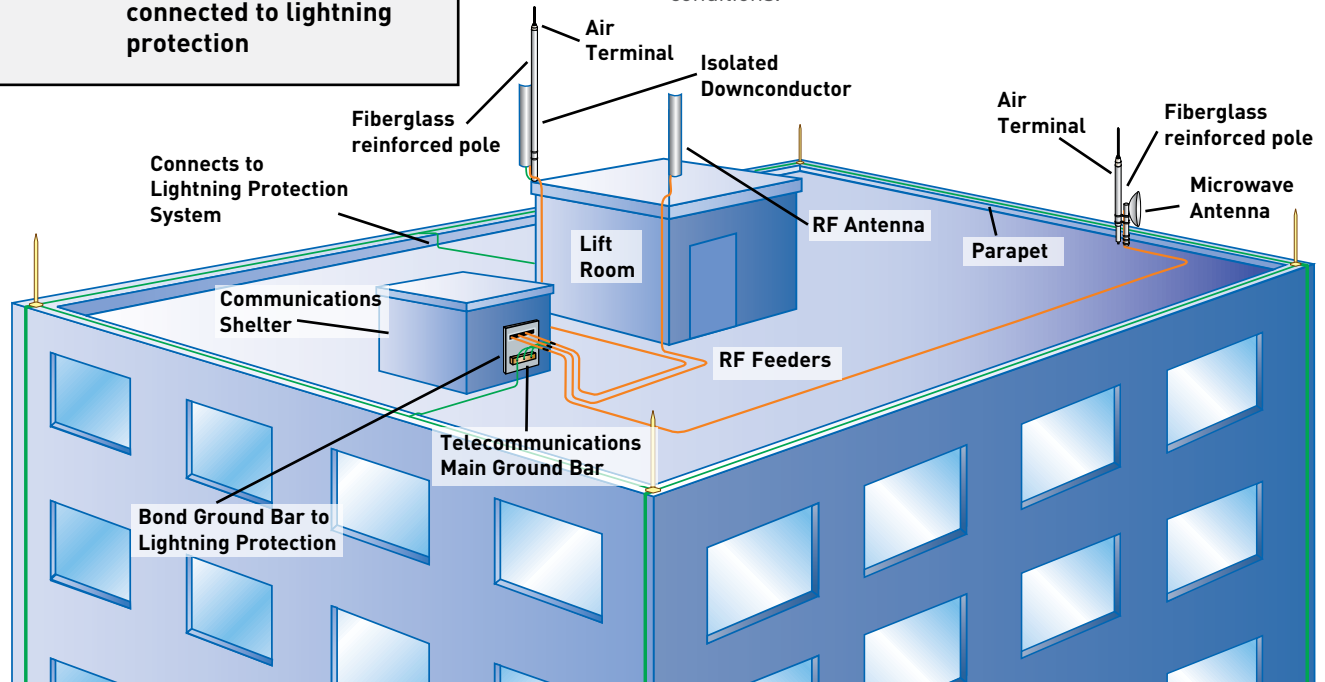
Lightning Protection for Roof Mounted Installations

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 ERICO brand of 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

