

Ground System Components

Ground Conductors

Conductors

There are two basic criteria for grounding conductor selection:

1. The physical characteristics of the conductor must be of a robust nature, sufficient for the environment.
2. The cross sectional area of the conductor must be of sufficient size, so that it shall successfully conduct the maximum fault (surge) current for a period, which allows the operation of protection equipment (or the dissipation of this energy).

Physical Characteristics

The most common ground conductor is a soft drawn, stranded copper conductor. Flat copper strip / tape is also popular because it offers a large surface area. When site conditions are corrosive towards copper (eg. sulphurous soil), a tinned copper conductor is often the first choice.

In some circumstances, the maximum fault current for the installation is small. While a conductor of correspondingly small size could be used, a minimum cross section, often set by the governing authority or applicable Standards body (to minimize potential damage likely to occur from any future excavation on the site), is applied.

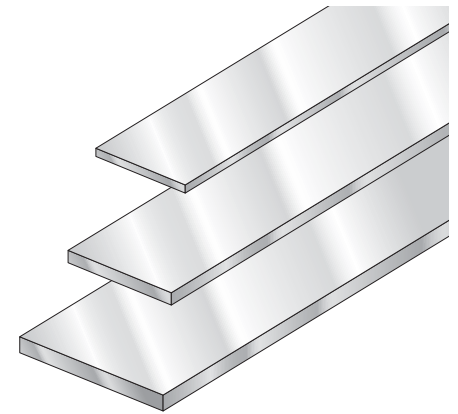
Maximum Fault Current

Where higher fault conditions exist, the conductor size is determined by considering the circumstances required to avoid fusing (melting) the conductor. The accepted industry Standard is IEEE 80, Guide for Safety in Substation Grounding.

ERITECH® Flat Strip Ground Conductor

- Pure electrolytic copper
- Low impedance
- Lower impedance than equivalent sized round conductor

| Part No. | Description | Dimensions | | |
|-------------|--------------------|------------|---------|---------|
| | | H (in.) | W (in.) | L (ft.) |
| A811A26F20 | Copper Strip, roll | .0159 | 2 | 20 |
| A811A26F50 | Copper Strip, roll | .0159 | 2 | 50 |
| A811A26F500 | Copper Strip, roll | .0159 | 2 | 500 |
| A811C20F100 | Copper Strip, roll | .032 | 3 | 100 |
| A811K26F100 | Copper Strip, roll | .0159 | 6 | 100 |
| A811K20F100 | Copper Strip, roll | .032 | 6 | 100 |



Also available tin plated

ERITECH Ground Conductor

- Pure electrolytic copper

| Part No. (100 Ft. Reel) | Part Number (250 Ft. Reel) | Wire Size | Type | Description |
|-------------------------|----------------------------|-----------|----------|----------------|
| A809A07F100 | A809A07F250 | #2 | Solid | Bare |
| A809A06F100 | A809A06F250 | #4 | Solid | Bare |
| A809A04F100 | A809A04F250 | #6 | Solid | Bare |
| A809A07TF100 | A809A07TF250 | #2 | Solid | Bare Tinned |
| A809A02F100 | A809A02F250 | #2 | 7 Strand | Bare |
| A809A01F100 | A809A01F250 | #4 | 7 Strand | Bare |
| A809A024F100 | A809A024F250 | #6 | 7 Strand | Bare |
| A819A02F100 | A819A02F250 | #2 | 7 Strand | THW insulation |
| A819A03F100 | A819A03F250 | #4 | 7 Strand | THW insulation |
| A819A04F100 | A819A04F250 | #6 | 7 Strand | THW insulation |



Ground System Components

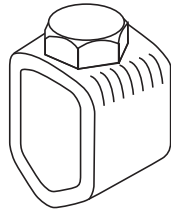
Grounding Clamps and Connectors

ERITECH® Ground Clamps

- For use with copperbonded ground rods.
- Suitable for direct burial.

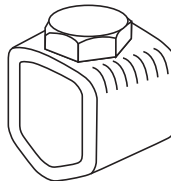
Bronze Standard Duty

| Part No. | Conductor Range | Rod Size |
|----------|-----------------|----------|
| CP38 | 10 Sol.- 4 Str. | 3/8 |
| CP12 | 8 Sol.- 2 Str. | 1/2 |
| CP58 | 8 Sol.- 2 Str. | 5/8 |
| CP34 | 8 Sol.- 2 Str. | 3/4 |



Bronze Heavy Duty

| Part No. | Conductor Range | Rod Size |
|----------|------------------|----------|
| HDC12* | 10 Sol.- 2 Str. | 1/2 |
| HDC58R* | 8 Sol.- 1/0 Str. | 5/8 |
| HDC58* | 8 Sol.- 1/0 Str. | 5/8 |
| HDC34* | 8 Sol.- 1/0 Str. | 3/4 |
| HDC34SP | 8 Sol.- 3/0 Str. | 3/4 |
| HDC1 | 1 Sol.- 4/0 Str. | 1 |



*UL Listed

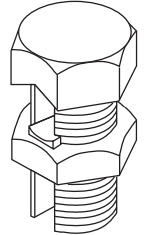
Galvanized Steel Clamps

| Part No. | Rod Size |
|----------|---|
| S58 | 1/2" rod #8 - 3/0 wire 5/8" rod #14 - 1/0 wire |
| S68 | 5/8" rod #14 - 16 wire 3/4" rod - 4/0 wire |



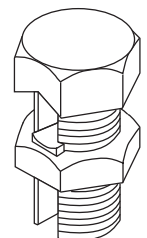
ERITECH Split Bolts - Silicon Bronze

| Part No. | Wire Range |
|----------|-------------------|
| ESB8 | 10 sol - 8 str. |
| ESB6 | 8 sol - 6 sol. |
| ESB4 | 8 sol - 4 sol. |
| ESB3 | 6 sol - 3 str. |
| ESB2 | 6 sol - 2 str. |
| ESB1/0 | 4 sol - 1/0 str. |
| ESB2/0 | 2 sol - 2/0 str. |
| ESB4/0 | 2 sol - 4/0 str. |
| ESB250 | #1 str - 250 KCM |
| ESB350 | 250 KCM - 350 KCM |
| ESB500 | 400 KCM - 500 KCM |



ERITECH Split Bolts - Tin Plated Silicon Bronze

| Part No. | Wire Range |
|----------|-------------------|
| ESBP8 | 12 sol - 8 str. |
| ESBP6 | 10 sol - 6 sol. |
| ESBP4 | 10 sol - 4 sol. |
| ESBP2 | 6 sol - 1 sol. |
| ESBP1/0 | 2 sol - 1/0 str. |
| ESBP2/0 | 2 sol - 2/0 str. |
| ESBP4/0 | 2 sol - 4/0 str. |
| ESBP350 | 250 KCM - 350 KCM |
| ESBP500 | 400 KCM - 500 KCM |



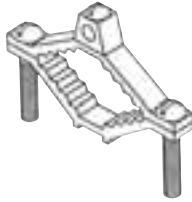
Ground System Components

Grounding Clamps and Connectors

ERITECH® Bronze Water Pipe Clamps

- High-strength silicone bronze clamps can be utilized for connecting copper conductors to metallic water pipe or ground rods.

| Part No. | Water Pipe Size | Conductor Range | |
|----------|-----------------|-----------------|--------|
| | | Min. | Max. |
| CWP1J** | 1/2-1 | 10 Sol. | 2 Str. |
| CWP1JJ | 1/2-1 | 10 Sol. | 4 Str. |
| CWP2J** | 1-1/4-2 | 10 Sol. | 2 Str. |
| CWP4J** | 2-1/2-4 | 10 Sol. | 4 Str. |
| CWP6J | 4-1/4-6 | 10 Sol. | 4 Str. |
| CWP1JU* | 1/2-1 | 10 Sol. | 2 Str. |
| CWP2JU* | 1-1/4-2 | 10 Sol. | 2 Str. |

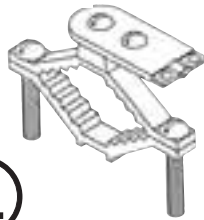


*With copper screw for use in direct burial applications.
**UL Listed

ERITECH Bronze Water Pipe Clamps

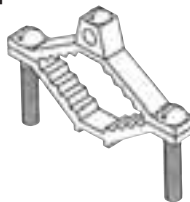
- For use in grounding armored cable to metallic pipe

| Part No. | Water Pipe Size | Conductor Range | |
|----------|-----------------|-----------------|--------|
| | | Min. | Max. |
| CWP1JA | 1/2-1 | 10 Sol. | 6 Sol. |
| CWP2JA | 1-1/4 - 2 | 10 Sol. | 6 Sol. |
| CWP4JA | 2-1/2 - 4 | 10 Sol. | 6 Sol. |



ERITECH Zinc Water Pipe Clamp

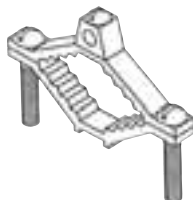
| Part No. | Water Pipe Size | Conductor Range | |
|----------|-----------------|-----------------|--------|
| | | Min. | Max. |
| ZWP1J | 1/2-1 | 10 Sol. | 6 Sol. |



ERITECH Dual Rated Aluminum Water Pipe Clamps

- For use with copper or aluminum conductors.

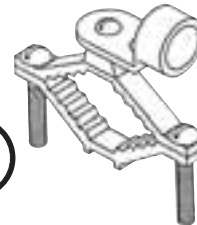
| Part No. | Conductor Range | | Pipe Range |
|----------|-----------------|---------|------------|
| | Min. | Max. | |
| EGC1 | 14 Sol. | 10 Sol. | 1/2 - 1 |



ERITECH Bronze Water Pipe Clamps

- For use in grounding rigid conduit systems to metallic water pipe.

| Part No. | Water Pipe Size | Conduit Size | Conductor Range | |
|----------|-----------------|--------------|-----------------|----------|
| | | | Min. | Max. |
| CWP1JH12 | 1/2 - 1 | 1/2 | 10 Sol. | 6 Sol. |
| CWP2JH12 | 1-1/4 - 2 | 1/2 | 10 Sol. | 6 Sol. |
| CWP4JH12 | 2-1/2 - 4 | 1/2 | 10 Sol. | 6 Sol. |
| CWP1JH34 | 1/2-1 | 3/4 | 10 Sol. | 2/0 Str. |
| CWP2JH34 | 1-1/4 - 2 | 3/4 | 10 Sol. | 2/0 Str. |
| CWP4JH34 | 2-1/2 - 4 | 3/4 | 10 Sol. | 2/0 Str. |
| CWP1JH44 | 1/2 - 1 | 1 | 10 Sol. | 3/0 Str. |
| CWP2JH44 | 1-1/4 - 2 | 1 | 10 Sol. | 3/0 Str. |
| CWP4JH44 | 2-1/2 - 4 | 1 | 10 Sol. | 3/0 Str. |



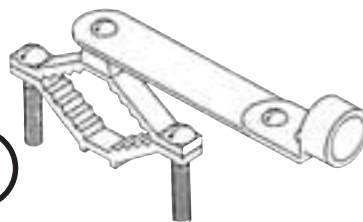
ERITECH Bronze Water Pipe Clamps

With Copper Strap - Heavy-Duty Hub

| Part No. | Water Pipe Size | Conduit Size | Conductor Range | |
|----------|-----------------|--------------|-----------------|----------|
| | | | Min. | Max. |
| CWP12SH | 1/2 - 1 | 1/2 | 10 Sol. | 6 Sol. |
| CWP34SH | 1/2 - 1 | 3/4 | 10 Sol. | 2/0 Str. |
| CWP44SH | 1/2 - 1 | 1 | 10 Sol. | 3/0 Str. |

With Copper Strap - Standard-Duty Hub

| Part No. | Water Pipe Size | Conduit Size | Conductor Range | |
|-----------|-----------------|--------------|-----------------|----------|
| | | | Min. | Max. |
| CWP12SH-E | 1/2 - 1 | 1/2 | 10 Sol. | 6 Sol. |
| CWP34SH-E | 1/2 - 1 | 3/4 | 10 Sol. | 2/0 Str. |
| CWP44SH-E | 1/2 - 1 | 1 | 10 Sol. | 3/0 Str. |



Ground System Components

Grounding Clamps and Connectors

ERITECH® Pipe Clamp

- 2" wide tinned copper strap draws tightly around pipe (all hardware is included)
- Conductor stub is easily spliced to ground conductor
- Adjusts to fit pipes from 3" NPS to 12" NPS
- CADWELD® connection of conductor to strap eliminates a mechanical interface

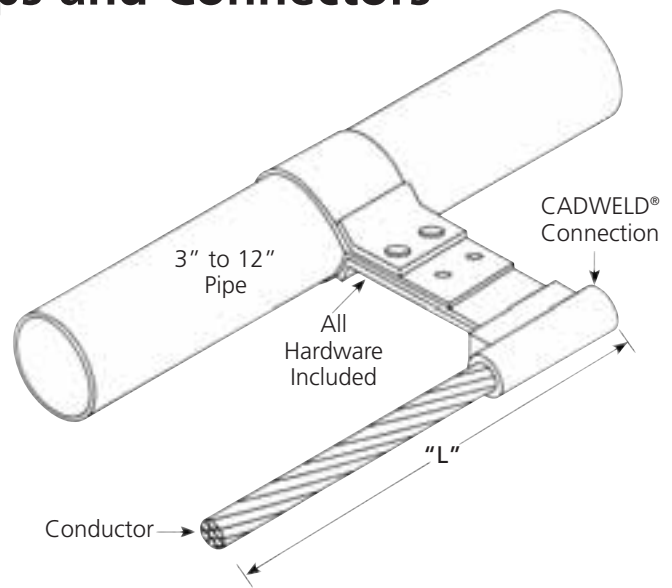


Figure 9. ERITECH Pipe clamp fitted to metal pipe with conductor stub CADWELD exothermically welded to copper conductor.

Ordering Information:

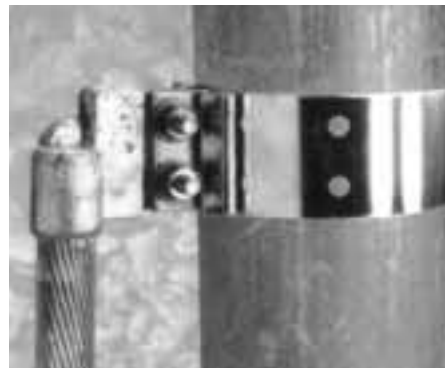
Part No. B852A12C

Conductor Code

Conductor Length, inches "L"

Example: 4/0 Bare, 12 Inches Long;
Part No. B852A12C2Q12

| CONDUCTOR SIZE | CONDUCTOR CODE |
|----------------|----------------|
| 1/0 | 2C |
| 2/0 | 2G |
| 4/0 | 2Q |
| 250 | 2V |
| 500 | 3Q |
| 750 | 4L |

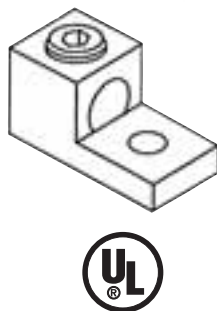


ERITECH Transformer Tank Ground Connectors

- Cast of high conductivity bronze and 1/2"-13 stud. Fits all standard EEI-NEMA distribution transformers.
- Eyebolt rotates to accommodate cable in either vertical or horizontal direction and no special tools are required - use regular lineman's wrench.
- RUS Listed.

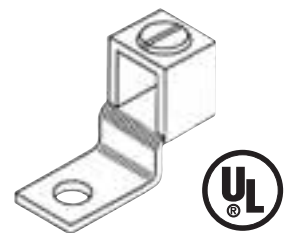
ERITECH Aluminum Mechanical Connectors

| Part No. | Wire Range |
|----------|-------------------|
| 4AT | 14 sol - 4 str. |
| 2AT | 14 sol - 2 str. |
| 10AT3 | 14 sol - 1/0 sol. |
| 20AT | 14 sol - 2/0 str. |
| 300AT | 6 sol - 300 KCM |
| 350AT | 6 sol - 350 KCM |
| 10AT32 | 14 sol - 1/0 str. |
| 20AT2 | 14 sol - 2/0 str. |
| 300AT2 | 6 sol - 300 KCM |
| 350AT2 | 6 sol - 350 KCM |

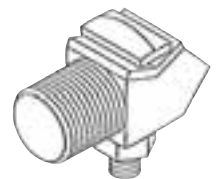


ERITECH Copper Mechanical Connectors

| Part No. | Wire Range |
|----------|------------------|
| ECM25 | 14 str - 10 str. |
| ECM35 | 14 str - 6 str. |
| ECM70 | 8 str - 2 str. |
| ECM125 | 8 str - 1/0 str. |
| ECM175 | 4 str - 3/0 str. |



| Part No. | Conductor Range | | Stud Thread Size |
|----------|-----------------|--------|------------------|
| | Max. | Min. | |
| TGC2/0 | 2/0 Str. | 8 Sol. | 1/2" - 13 |



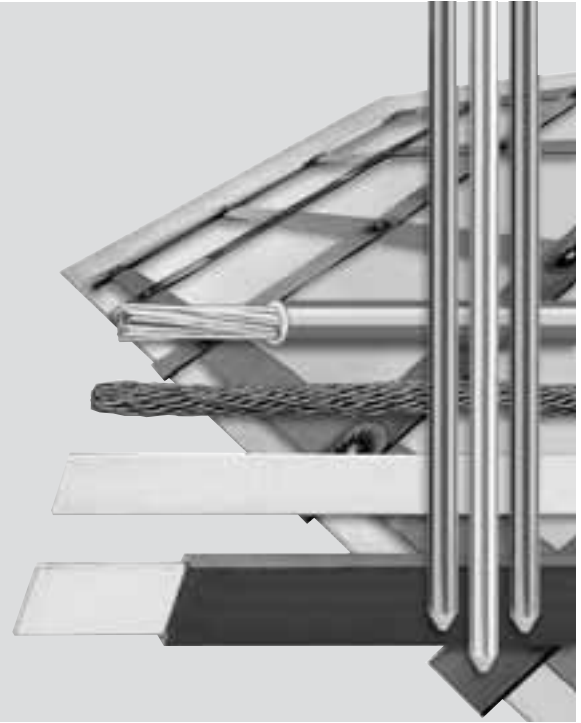
Ground System Components

Ground Electrodes

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 facilities' 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 aluminium 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.

As a compromise, steel cored ground rods, swaged in a copper or stainless steel sheath were developed. These ground rods are much less expensive than their solid counterparts. They are capable of being deep driven. However, the sheath of this rod type has been known to slip or tear, particularly the copper version. Once this sheath has been damaged, the integrity of the entire electrode is at risk.

Ask for the ERICO® White Paper on Ground Rods – Copperbonded vs. Galvanized.

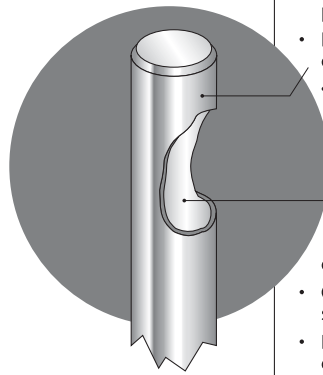


Figure 10.
Copperbonded ground rod
versus Galvanized ground rod.

| COPPERBONDED GROUND ROD | GALVANIZED GROUND ROD |
|--|---|
| <ul style="list-style-type: none">• Cost effective - long service life <p>Copperbonded 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 <p>Carbon Steel core and tip:</p> <ul style="list-style-type: none">• Greater tensile strength• Deep driving capability | <ul style="list-style-type: none">• Lower purchase price - not as cost effective as Copperbonded <p>Galvanized coating:</p> <ul style="list-style-type: none">• Relatively short service life• May crack if rod is bent <p>Steel core and tip:</p> <ul style="list-style-type: none">• High tensile strength• Deep driving capability |



Ground System Components

Ground Electrodes

The copperbonded 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 copperbonded 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. Copperbonded ground rods have a high resistance to corrosion and provide a low resistance path to ground.



Figure 11.
Photo shows two ground rods subjected to the same pressure load test. The ERITECH® copperbonded ground rod, shown on the left, will bend without tears, cracks or folds, to the outer sheath. The inferior copperclad rod shown on right, has developed cracks and creases to the outer sheath, which will significantly reduce its servicable life and put the integrity of the entire electrode at risk.

The Stainless Steel 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.

GROUND ROD LIFE EXPECTANCY

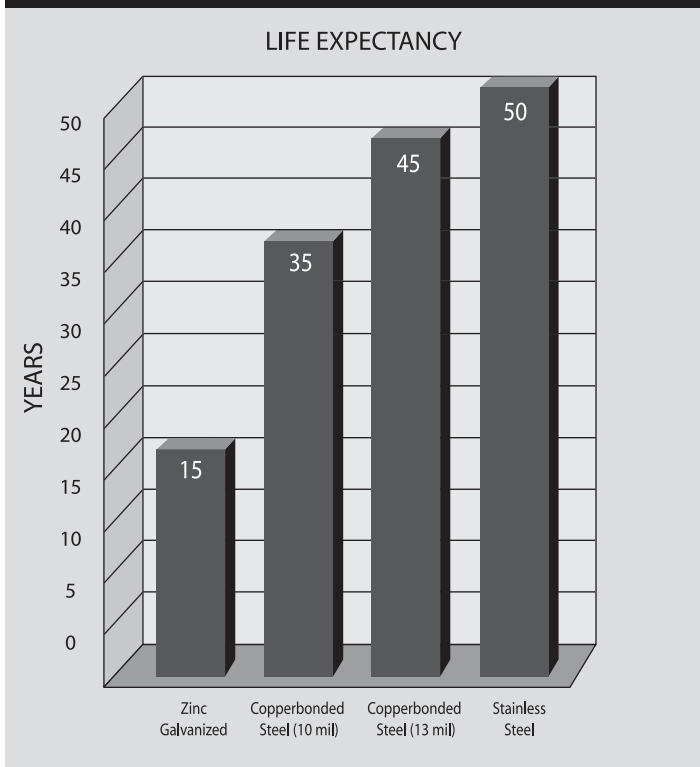


Figure 12.

GROUND ROD ANNUAL COST

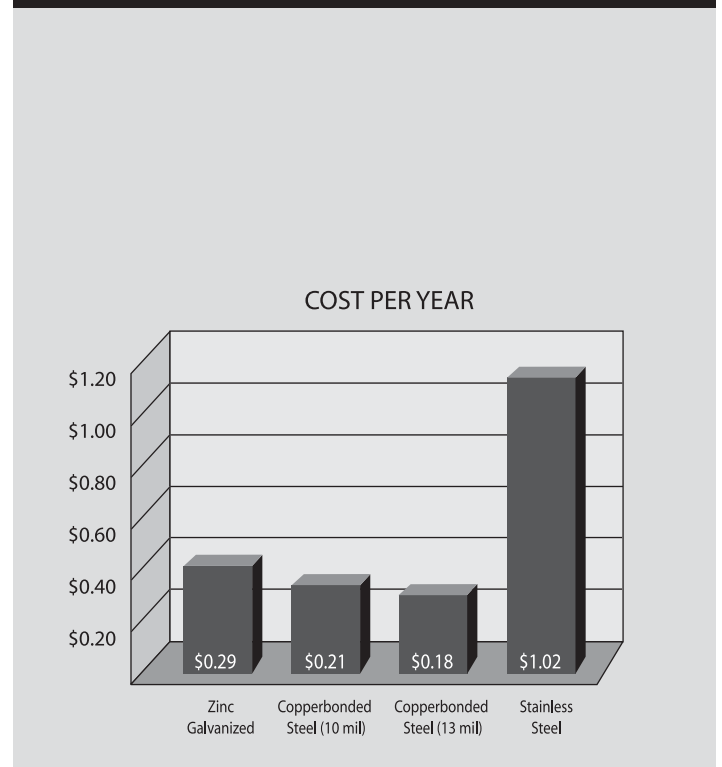


Figure 13.

Ground System Components

Ground Electrodes

Ground Rod Accessories and Application

ERICO® is the world's largest manufacturer of UL listed ground rods and accessories and offers a complete range of rods, driving heads, rod coupling methods and connections for reliable grounding in nearly any application.

Driving Sleeves

The driving head fits over the ground rod to protect the rod end from "mushrooming" as the ground rod is driven into earth.

Coupling

Couplings enable ground rods to be driven deep quickly and easily without the risk of rod separation. They are generally tapered so when the rod is driven into the coupling, the two parts compress to form a conductive connection.

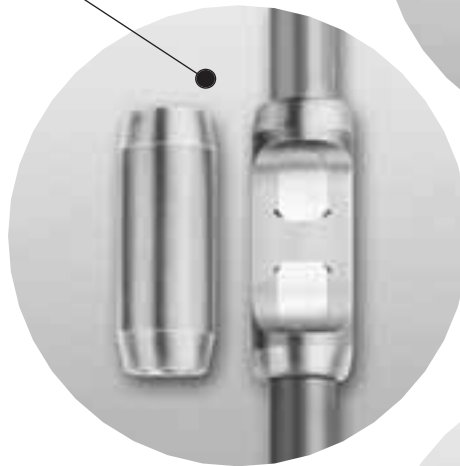
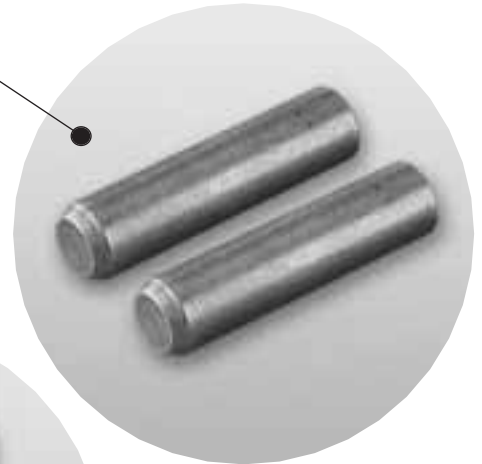
Ground Rod

Ground Rod Diameter & Length

Ground rod diameter must also be considered. Although larger diameter rods are more rigid and less prone to whip or bending, they may have a greater drag than smaller diameter rods when being driven. It must also be noted that increasing the ground rod diameter has little impact on grounding system resistance. Standards nominate a minimum diameter or periphery and thickness if not cylindrical.

In general, lightning protection standards recommend copper bonded electrodes of specified diameter. Standard UL 467 requires a minimum rod length of 8' with a minimum diameter of 0.50" and 10 mils of copper.

Other Standards may nominate a specific resistance for the installation. If space is limited, the contractor may be required to install electrodes to a depth that achieves the required value.



Ground System Components

Ground Electrodes

Ground Rod Installation

There are two main methods of installing ground rods.

- It is common for the ground rod to be driven into the earth using a hand held ground rod driver or mechanically operated driver.
- Where driving the rod is not possible due to ground conditions, a hole may be drilled to take the ground rod.

ERITECH® Ground Rod Driver

The ERITECH Ground Rod Driver from ERICO® is a safe, simple and effective way to install longer ground rods. This one tool enables driving of rods to ground level, without heavy sledge-hammers or ladders. This saves time and money and dramatically reduces risk of employee injury.

Features

- Suitable for use on all types of cylindrical ground rods: copper-bonded, galvanized, stainless steel.
- 5/8" and 3/4" inserts are interchangeable with standard driver body to enable easy driving of standard rods.
- Integral insert prevents driver from slipping off the rod near ground level.
- The driver will not deform the end of the rod – making the connection of the ground conductor quick and easy.
- Convenient retaining collar holds the insert in tool when not in use.
- Self-contained and easy to store.
- Heavy-duty steel construction provides robustness and excellent driving force.
- Soft rubber ergonomic grip provides user comfort.



Figure 14. The ERITECH Ground Rod Driver from ERICO, provides a safe, simple and affordable way to install ground rods.



Ground System Components

Ground Electrodes

Installation of Ground Rods

Using the ERITECH® Ground Rod Driver



Figure 15.

Step One

Remove the insert and slide driver body over ground rod.



Figure 16.

Step Two

Position rod in vertical position and drive rod by sliding driver body in an up-and-down motion over the ground rod.



Figure 17.

Step Three

When the end of the rod reaches approximately 900mm (30") above ground, slide the body off the rod and place insert on ground rod. Slide the driver body over the insert and drive rod to installed depth.

ERITECH Ground Rod Drivers

- Heavy-duty steel construction provides maximum driving forces, while the soft rubber ergonomic grip provides user comfort.
- 5/8" and 3/4" inserts are interchangeable with standard driver body.
- Use on all types of ground rods without deforming ends.
- No heavy tools or ladders required.

| Part No. | Description |
|----------|---|
| EGRD58 | 5' Driver body with insert for up to 5/8" ground rods |
| EGRD581* | Replacement insert for 5/8" ground rods |
| EGRD34 | 5' Driver body with insert for up to 3/4" ground rods |
| EGRD341* | Replacement insert for 3/4" ground rods |

* Both 5/8" and 3/4" inserts fit standard body of EGRD58 or EGRD34.

The Mechanical Hammer

For adverse soil conditions where it is not suitable to hand drive rods or where a greater depth must be achieved, it may be necessary to use power operated aids. For normal applications we recommend the use of medium tools in the 15 to 25 lb. range, with a stroke of approximately 2" to 4" delivering 2200 blows per minute.

Drilling Options

Where driving is difficult or progress is inhibited, it is necessary to use purpose-designed drilling equipment, such as electric, pneumatic and petrol driven machinery capable of penetrating rock. Once the hole is drilled, you can use one of two methods to install the ground rod:

- Backfill the hole with Ground Enhancement Material, and add water to the hole as rod is driven to the required depth.
- Insert the rod into the drilled hole, then add Ground Enhancement Material which has been mixed with water to form a slurry. For more details, see page 30 (GEM installation).



Ground System Components

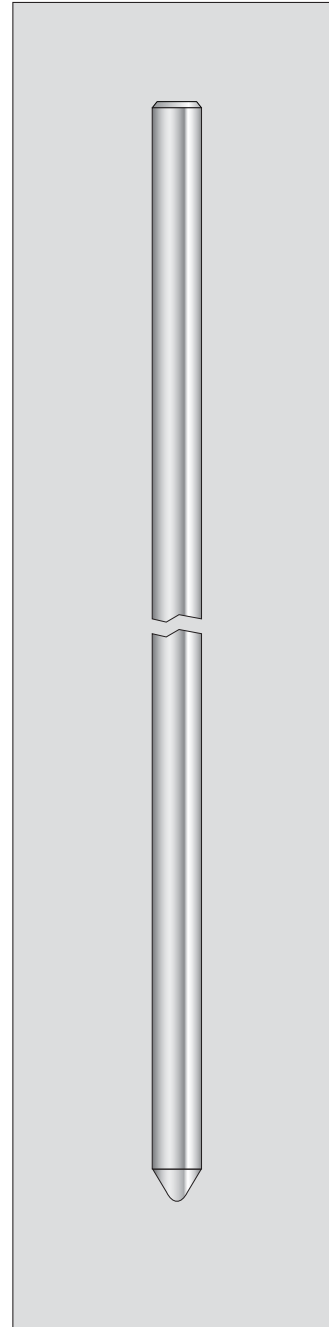
Ground Electrodes

ERITECH® Copperbonded Pointed Ground Rods

- Copper is molecularly bonded to nickel-sealed high-strength steel cores.
- ERITECH ground rods provide the company name, length, diameter, part number, roll-stamped within 12" of chamfered end and the UL logo and control number where applicable on each rod for easy inspection after installation.
- See specifications on page 69.

| Part No. | Plating Thickness (ml.) | Dia. (in.) | Lgth (ft.) |
|----------|-------------------------|------------|------------|
| 613852 | 5 | 3/8 | 5 |
| 613862 | 5 | 3/8 | 6 |
| 613880 | 10 | 3/8 | 8 |
| 611255 | 5 | Nom. 1/2 | 5 |
| 611265 | 5 | Nom. 1/2 | 6 |
| 611285 | 5 | Nom. 1/2 | 8 |
| 611380* | 10 | 1/2 | 8 |
| 611205 | 5 | Nom. 1/2 | 10 |
| 611300* | 10 | 1/2 | 10 |
| 615850 | 10 | 5/8 | 5 |
| 615860 | 10 | 5/8 | 6 |
| 615880* | 10 | 5/8 | 8 |
| 615883* | 13 - RUS | 5/8 | 8 |
| 615800* | 10 | 5/8 | 10 |
| 615803* | 13 - RUS | 5/8 | 10 |
| 615812* | 10 | 5/8 | 12 |
| 615815* | 10 | 5/8 | 15 |
| 613460 | 10 | 3/4 | 6 |
| 613480* | 10 | 3/4 | 8 |
| 613483* | 13 - RUS | 3/4 | 8 |
| 613400* | 10 | 3/4 | 10 |
| 613412* | 10 | 3/4 | 12 |
| 613415* | 10 | 3/4 | 15 |
| 614400* | 10 | 1 | 10 |

*UL Listed rods



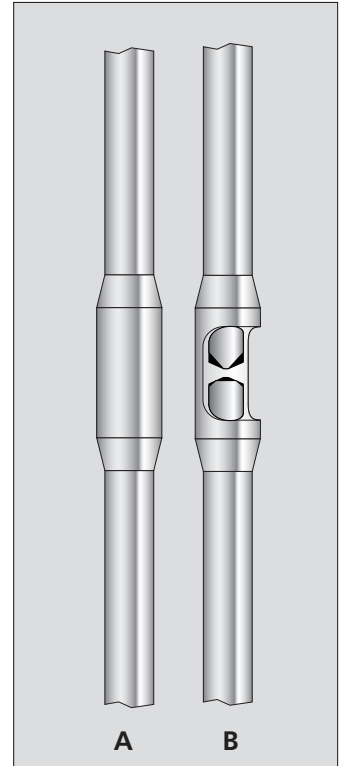
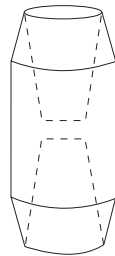
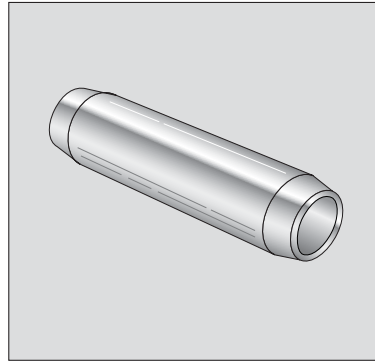
Ground System Components

Ground Electrodes and Accessories

ERITECH® Threadless Couplings for Copperbonded Pointed Rods

- Made of high-strength silicon bronze.
- Tapered so when the rod is driven into the coupling, the two parts compress to form a conductive connection.

| Part No. | Nominal Diameter |
|----------|------------------|
| CC12 | 1/2" Nominal |
| CC12F | 1/2" Full |
| CC58 | 5/8" |
| CC34 | 3/4" |



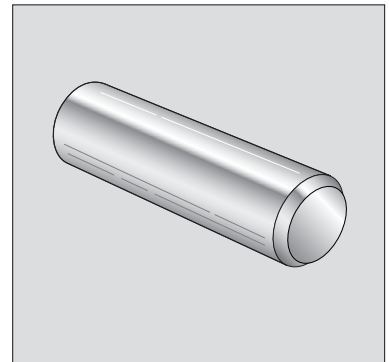
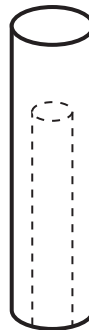
A Compression Coupling – Full View
B Compression Coupling – Cut Away

ERITECH Ground Rod Driving Sleeves*

- Slides on top of ground rod to prevent mushrooming while driving into ground.

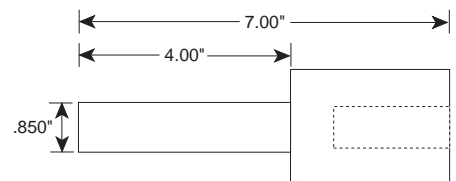
| Part No. | Ground Rod Size |
|----------|--------------------------------|
| B137-14 | 1/2" Copperbonded or Steel Rod |
| B137-16 | 5/8" Copperbonded (.563" dia.) |
| B137-31 | 5/8" Steel (.625" dia.) |
| B137-18 | 3/4" Copperbonded (.682" dia.) |
| B137-33 | 3/4" Steel (.750" dia.) |
| B137-22 | 1" Copperbonded (.914" dia.) |
| B137-37 | 1" Steel (1.00" dia.) |

* For plain (unthreaded) ground rods only.



- Sleeves for use in power assisted ground rod drivers.

| Part No. | Ground Rod Size (Unthreaded) |
|----------|--------------------------------|
| DH58 | 5/8" Copperbonded (.563" dia.) |
| DH34 | 3/4" Copperbonded (.682" dia.) |



Ground System Components

Ground Electrodes and Accessories

ERITECH® Copperbonded Sectional Ground Rods, Couplings and Driving Studs

- The cold-rolled threads with their continuous unbroken grain flows are stronger than cut-threads.
- High-strength couplings are threaded bronze and chamfered at both ends for easy driving.
- High strength, corrosion-resistant couplings ensure permanent, low resistance copper-to-copper connections.

| Part No. | Plating Thickness (ml) | Dia. (in.) | Length (ft.) |
|----------|------------------------|------------|--------------|
| 631380* | 10 | 1/2 | 8 |
| 631300* | 10 | 1/2 | 10 |
| 635830 | 10 | 5/8 | 3 |
| 635840 | 10 | 5/8 | 4 |
| 635850 | 10 | 5/8 | 5 |
| 635860 | 10 | 5/8 | 6 |
| 635880* | 10 | 5/8 | 8 |
| 635883* | 13 - RUS | 5/8 | 8 |
| 635800* | 10 | 5/8 | 10 |
| 633480* | 10 | 3/4 | 8 |
| 633400* | 10 | 3/4 | 10 |
| 634400* | 10 | 1 | 10 |

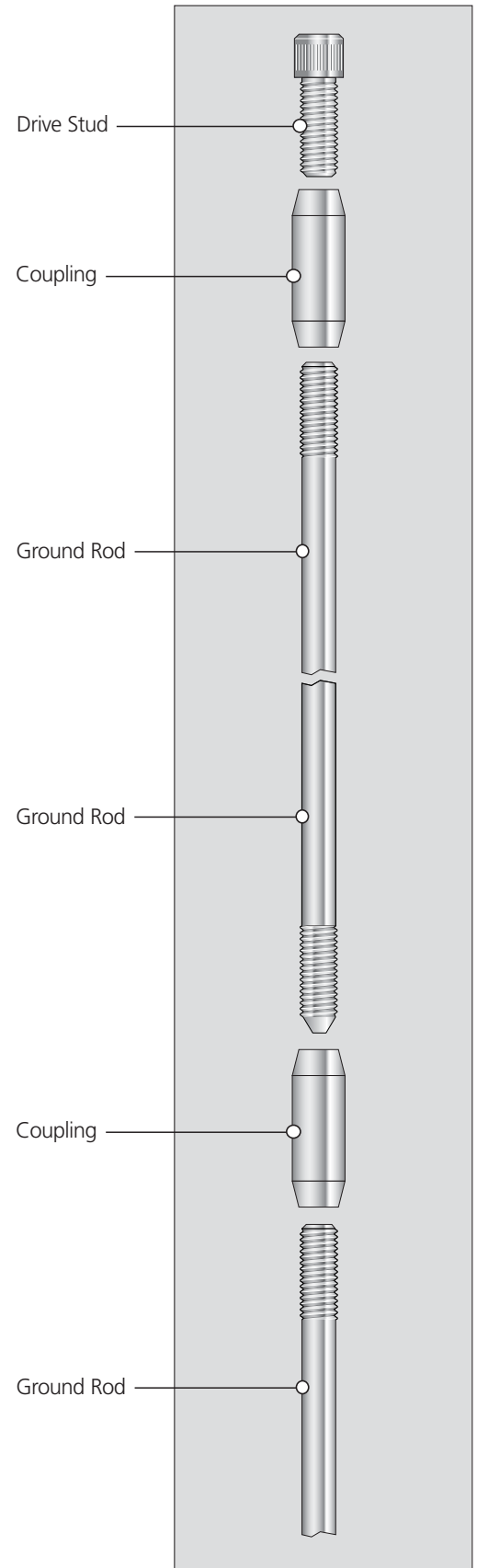
*UL Listed rods

ERITECH Couplings for Sectional Rods

| Part No. | Rod Size |
|----------|----------------|
| CR-12 | 1/2" Nominal |
| CR-12S | 1/2" Full Size |
| CR-58 | 5/8" Nominal |
| CR-34 | 3/4" Nominal |
| CR-100 | 1" Nominal |

ERITECH Driving Studs for Sectional Rods

| Part No. | Rod Size |
|----------|----------------|
| DS12 | 1/2" Nominal |
| FDS12 | 1/2" Full Size |
| DS58 | 5/8" Nominal |
| DS34 | 3/4" Nominal |
| DS1 | 1" Nominal |



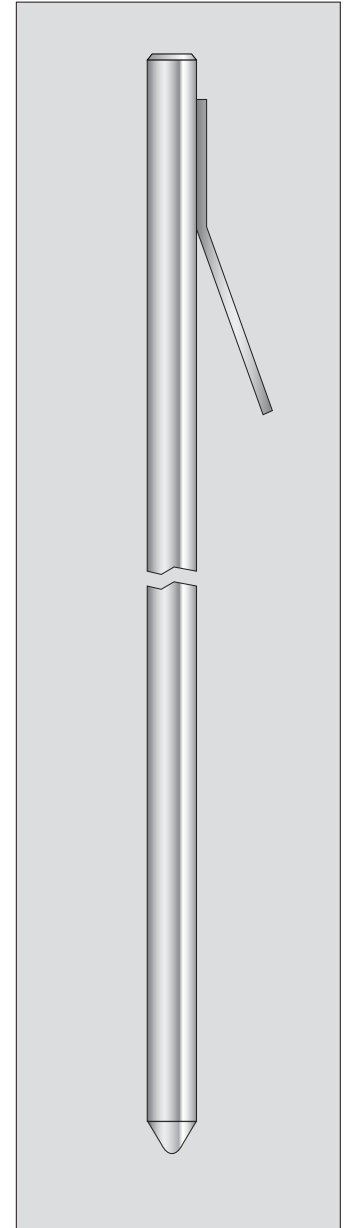
Ground System Components

Ground Electrodes and Accessories

ERITECH® Copperbonded Pigtail Ground Rods

- Pigtails are either Copperweld® or copper wire securely mig-welded to rod.
- Contact ERICO for specific requirement.

| Part No. | Nominal Dia X Length | Cu Thickness (Mil.) | Wire |
|----------|----------------------|---------------------|--------------------|
| 6138529 | 3/8" x 5' | 5 Mil | #10CW x 18" Lg |
| 6138629 | 3/8" x 6' | 5 Mil | #10CW x 18" Lg |
| 615889 | 5/8" x 8' | 10 Mil | #6 AWG Cu x 48" Lg |
| 615809 | 5/8" x 10' | 10 Mil | #6 AWG Cu x 48" Lg |
| 6158839 | 5/8" x 8' | 13 Mil | #6 AWG Cu x 48" Lg |
| 6158039 | 5/8" x 10' | 13 Mil | #6 AWG Cu x 48" Lg |



Ground System Components

Ground Electrodes and Accessories

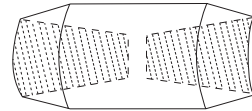
ERITECH® Solid Stainless Steel Ground Rods

- Sectional rods utilize a cut thread for highly corrosive soil.
- Contact ERICO® for other available sizes.

| Part No. | Description | Dia. (in.) | Length (ft.) |
|----------|---------------|------------|--------------|
| 681300 | 304 Pointed | FS 1/2 | 10 |
| 683400 | 304 Pointed | 3/4 | 10 |
| 683400S | 304 Sectional | 3/4 | 10 |
| 685880 | 304 Pointed | 5/8 | 8 |
| 685800 | 304 Pointed | 5/8 | 10 |
| 685880S | 304 Sectional | 5/8 | 8 |
| 681300S | 304 Sectional | 1/2 | 10 |

ERITECH Threaded Stainless Steel Coupling

| Part No. | Description |
|----------|----------------|
| CR13SS | 1/2" Full Size |
| CR58SS | 5/8" |
| CR34SS | 3/4" |



ERITECH Galvanized Pointed Ground Rods

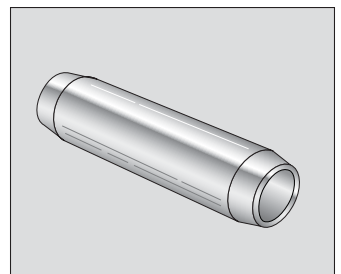
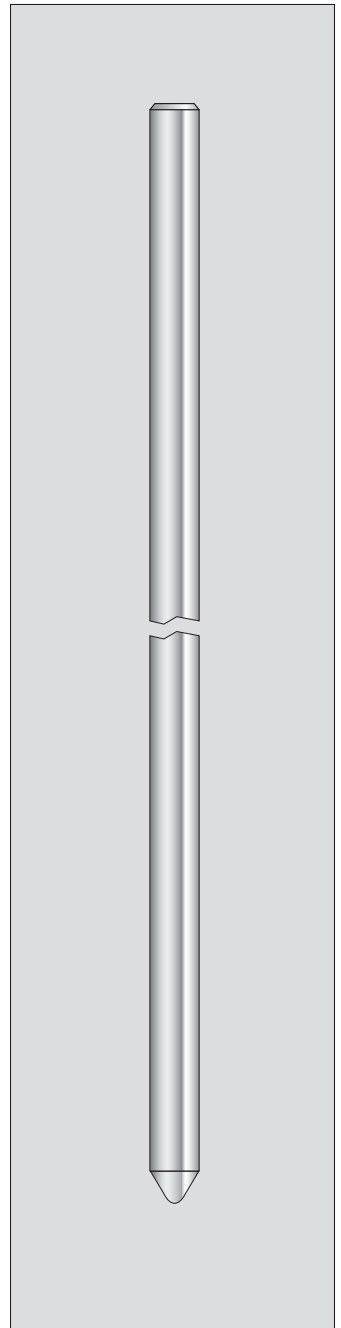
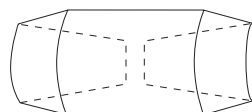
- Meets NEMA, GR1 and is RUS Approved.
- Zinc-coated exteriors are hot-dip galvanized for solid protection against corrosion in accordance with ASTM specification A153-78.
- Surfaces are rigidly inspected to eliminate seams, slivers and other defects.

| Part No. | Rod Size |
|----------|------------|
| 811250 | 1/2" x 5' |
| 811260 | 1/2" x 6' |
| 811280 | 1/2" x 8' |
| 815860 | 5/8" x 6' |
| 815880* | 5/8" x 8' |
| 815800 | 5/8" x 10' |
| 813480* | 3/4" x 8' |
| 813400 | 3/4" x 10' |
| 814400 | 1" x 10' |

*RUS Approved

ERITECH Galvanized Steel Coupling

| Part No. | Rod Type | Rod Size |
|----------|------------|----------|
| GCC58 | Threadless | 5/8" |



Ground System Components

Ground Electrodes and Accessories

ERITECH® Copper Ground Plate Electrode with Terminated 2 Foot Welded Pigtail Connection

| Part No. | Dimensions |
|-------------------|------------------|
| GPECEAH24 "xx" 24 | 12"x24"x20 Ga Cu |
| GPECEAJ18 "xx" 24 | 18"x18"x20 Ga Cu |
| GPECEAJ24 "xx" 24 | 18"x24"x20 Ga Cu |
| GPECEAJ36 "xx" 24 | 18"x36"x20 Ga Cu |
| GPECEAK24 "xx" 24 | 24"x24"x20 Ga Cu |
| GPECEAM36 "xx" 24 | 36"x36"x20 Ga Cu |
| GPECEBH12 "xx" 24 | 12"x12"x1/16" Cu |
| GPECEBH24 "xx" 24 | 12"x24"x1/16" Cu |



ERITECH Copper Ground Plate Electrode with 2 Foot Welded Through Pigtail Connection

| Part No. | Dimensions |
|-------------------|------------------|
| GPECCA24 "xx" 24 | 12"x24"x20 Ga Cu |
| GPECCAJ18 "xx" 24 | 18"x18"x20 Ga Cu |
| GPECCAJ24 "xx" 24 | 18"x24"x20 Ga Cu |
| GPECCAJ36 "xx" 24 | 18"x36"x20 Ga Cu |
| GPECCA24 "xx" 24 | 24"x24"x20 Ga Cu |
| GPECCAM36 "xx" 24 | 36"x36"x20 Ga Cu |
| GPECCBH12 "xx" 24 | 12"x12"x1/16" Cu |
| GPECCBH24 "xx" 24 | 12"x24"x1/16" Cu |

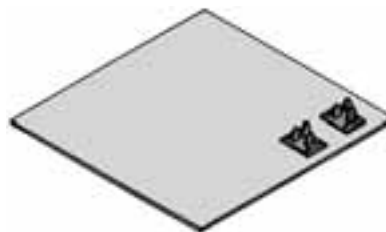


"xx" - Cable code for required conductor type and size

ERITECH Copper Ground Plates

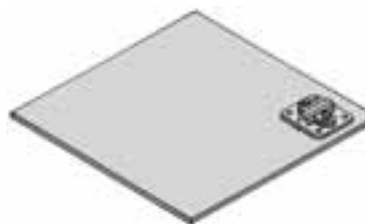
- Made from 20 gauge thick, high conductivity copper sheet.
- Two cable attachments LPC535L securely fastened to plate.

| Part No. | Dimensions |
|----------|----------------------|
| LPC750 | 12" wide by 24" long |
| LPC751 | 18" wide by 18" long |
| LPC752 | 36" wide by 36" long |



- Cable attachments LPC532L securely fastened to plate.

| Part No. | Description |
|----------|----------------------|
| LPC753 | 12" wide by 24" long |
| LPC754 | 18" wide by 18" long |
| LPC755 | 36" wide by 36" long |

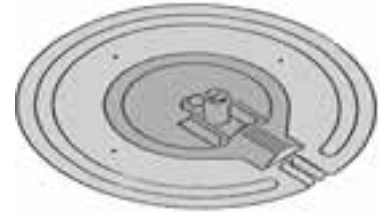


Ground System Components

Ground Electrodes and Accessories

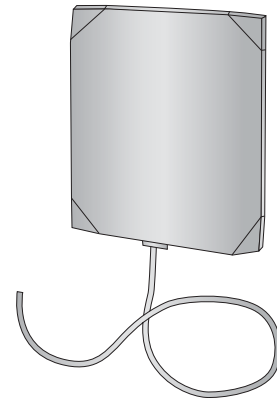
ERITECH® Copper Utility Pole Butt Plate

| Part No. | Conductor Range | Plate Diameter |
|----------|-----------------|----------------|
| EGP100 | #14-#4 AWG | 7.5" |



ERITECH Copper Utility Pole Ground Plate

| Part No. | Description | Dimensions |
|----------|---|---------------|
| GPECEHX1 | Copper w/#6 solid ground wire 10' long exothermically welded to plate | 1/16"x17"x17" |



ERITECH Steel Ground Plate Electrode

| Part No. | Description | Dimensions |
|----------|----------------------------------|--------------------------------|
| EGGP* | Galvanized steel grounding plate | 1/4"x10"x16" w/o connector |
| EGGPC* | Galvanized steel grounding plate | 1/4"x10"x16" w/HDC58 connector |
| EBGP | Bare steel grounding plate | 1/4"x10"x16" w/o connector |
| EBGPC | Bare steel grounding plate | 1/4"x10"x16" w/HDC58 connector |

*CSA Listed



Ground System Components

Ground Electrodes and Accessories

Chemical Ground Rod

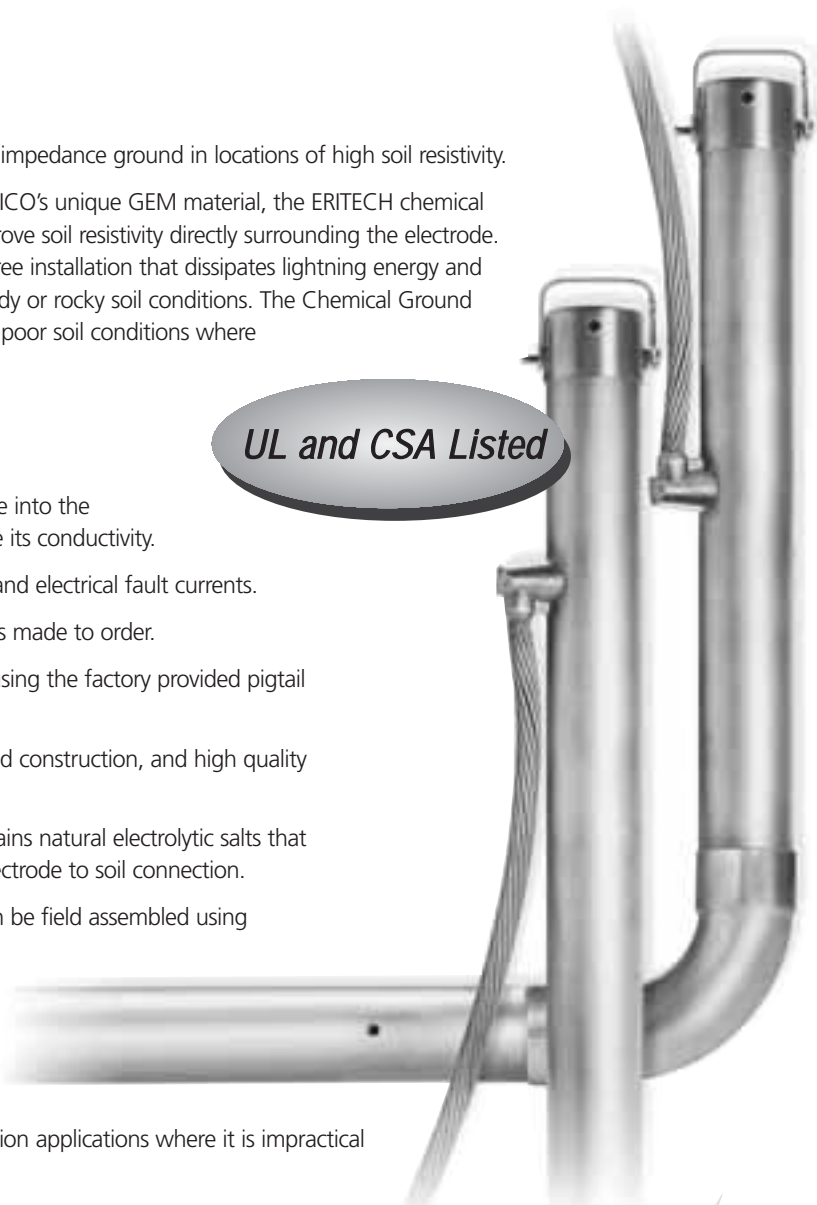
ERITECH® chemical ground electrodes provide a low impedance ground in locations of high soil resistivity.

Used in conjunction with a bentonite backfill and ERICO's unique GEM material, the ERITECH chemical ground electrode system, provides a method to improve soil resistivity directly surrounding the electrode. It maintains a low ground resistance, maintenance-free installation that dissipates lightning energy and other dangerous electrical fault currents, even in sandy or rocky soil conditions. The Chemical Ground Electrode is useful for providing an effective earth in poor soil conditions where spacing for electrodes is limited.

Benefits and Features

- Contains natural electrolytic salts, which permeate into the surrounding soil to condition the soil and increase its conductivity.
- Low impedance to effectively dissipate lightning and electrical fault currents.
- Over 70 configurations available, other assemblies made to order.
- Easy connection to ground electrode conductor using the factory provided pigtail (up or down orientation)
- Provides decades of reliable services due to rugged construction, and high quality metals with a 30 year minimum service life
- 2-1/8" OD Type K copper pipe, 0.083" wall contains natural electrolytic salts that permeate into the surrounding soil, improving electrode to soil connection.
- Available up to 20 feet in length. Longer rods can be field assembled using 10 foot sections.
- Optional factory attached radial strips are available to reduce impedance to high-frequency lightning energy and to control the direction of the dissipation
- L-shaped rods are available for horizontal installation applications where it is impractical to auger deep vertical holes.

UL and CSA Listed



See specification on page 70.

The Chemical Ground Electrode is suitable for high soil resistivity, dry soil conditions, as it can replace multiple conventional ground rods, making the system ideal where space limitations apply. Where seasonal variations cause fluctuations in soil resistivity, the Chemical Ground Electrode ensures a constant and reliable low impedance ground.

Market Applications

- Telecommunications
- Power Generation & Distribution
- Commercial & Industrial
- Manufacturing
- Transport – Rail, Aviation
- Lightning Protection
- Recreational Facilities
- Defense



Ground System Components

Ground Electrodes and Accessories

Chemical Ground Rod

Chemical Ground Electrode System

ERICO® Chemical Ground Electrodes are most effective when installed as part of a total system that includes high conductivity backfill materials, access/inspection wells, and permanent, reliable CADWELD® connections. They may be installed either vertically or horizontally, as shown below in figure 18. ERICO recommends installing the complete system.

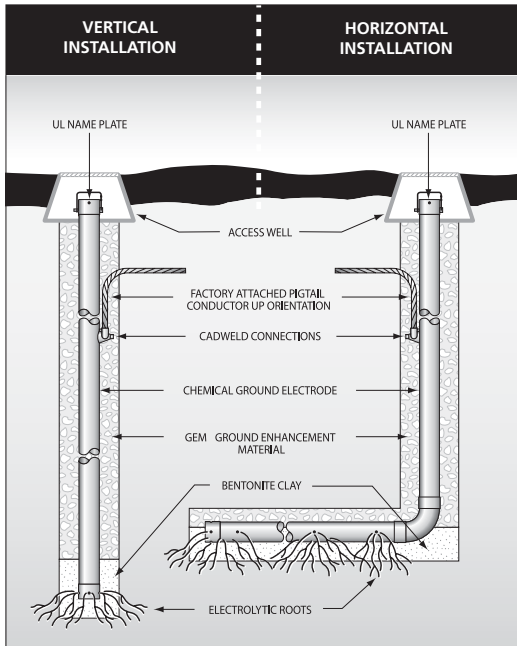


Figure 18. Chemical Ground Electrode can be installed either vertically or horizontally. Chemical electrodes are available in a range of standard and custom configurations and are available individually or as part of a complete kit.

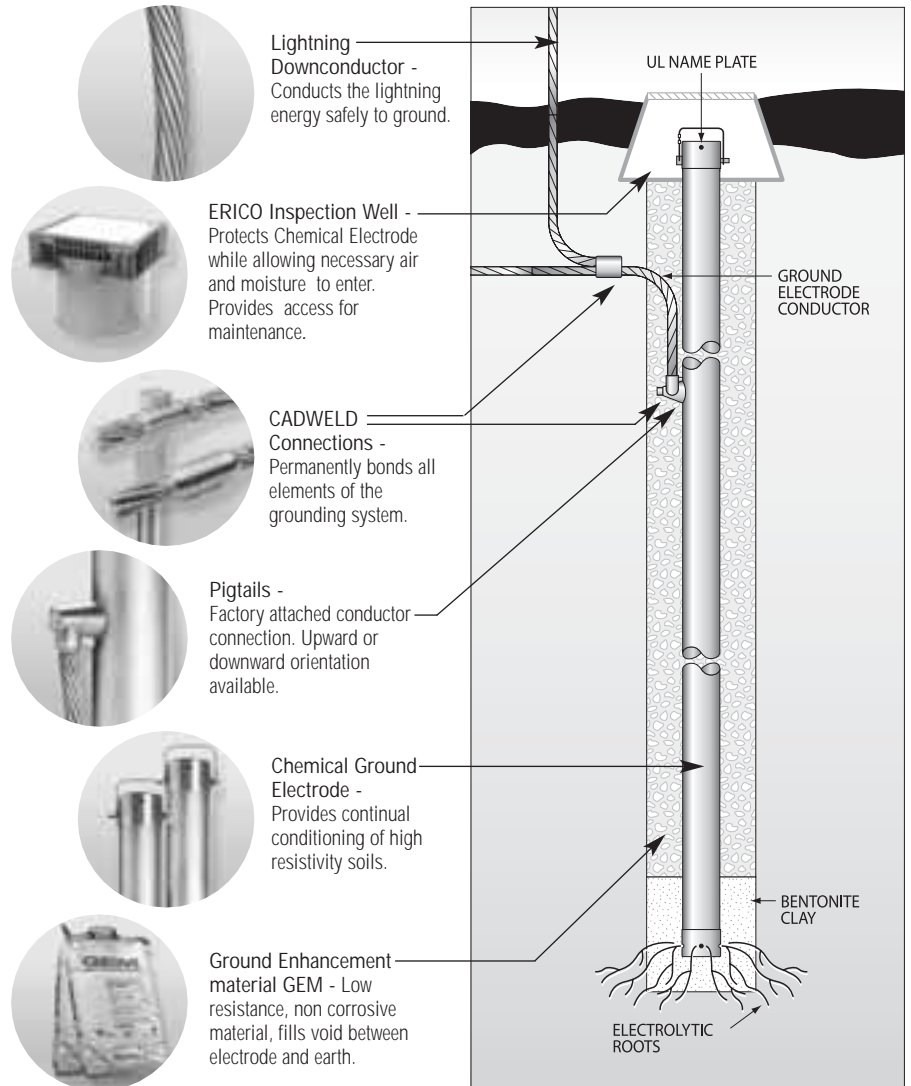
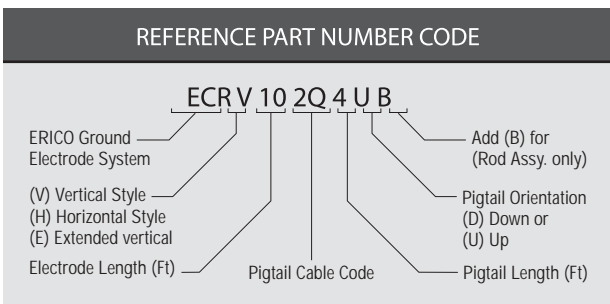


Figure 19. Typical vertical installation showing major components required to form an effective ground electrode.

How to Order

Chemical ground rods can be ordered as individual components or as a complete kit. Kits include the chemical electrode (pre-filled with electrolytic salts), bentonite, GEM backfill and an access well. To order the chemical electrode only, add "B" to the end of the part number.



COPPER CONDUCTOR CODES - Pigtail Conductor

| Conductor Code | Size Description | Conductor Code | Size Description |
|----------------|------------------|----------------|------------------|
| 1T | #2 Solid Tinned | 2Q | 4/0 Conc. |
| 2C | 1/0 Conc. | 2V | 250 Kcmil Conc. |
| 2G | 2/0 Conc. | 3Q | 500 Kcmil Conc. |

INDIVIDUAL COMPONENTS

| Part No. | Description |
|--------------------|---|
| (see above) | Chemical ground rod electrode only |
| GEM25A | 25 lg. (11.4 kg) bag of GEM Ground Enhancement Material |
| BENTFILL | 50 lb. (22.7 kg) bag of bentonite |
| (see catalog #A1A) | CADWELD® material for cable-to-cable connections |
| T416BH | High-density polyethylene access pit for no traffic areas (type supplied with kits) |
| T416D | Concrete access well for traffic areas |

Ground System Components

Ground Electrodes and Accessories

Ground Enhancement Material (Part# GEM25A)

Only rarely do grounding system designers and contractors get to work on a site with good grounding conditions. Even under ideal circumstances, soil structure can vary and make it difficult to achieve uniform, low levels of resistivity across a wide area. Under almost all soil conditions, the use of a ground enhancement material will improve grounding effectiveness. Some are permanent and require no maintenance. When selecting a ground enhancement material be sure it is compatible with the ground rod, conductor and connection material.

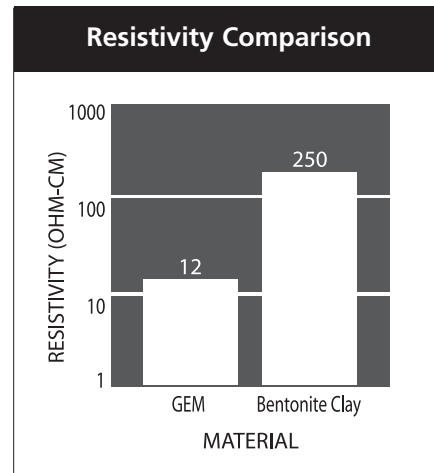


Figure 20. As the graph clearly shows, GEM has a resistivity factor more than 20 times lower than bentonite clay.

To improve the conductivity of a grounding system, ERICO® recommends using Ground Enhancement Material (GEM).

GEM is a low-resistance, non-corrosive, carbon dust based material that improves grounding effectiveness, especially in areas of poor conductivity. GEM contains cement, which hardens when set to provide a permanent, maintenance-free, low-resistant grounding system that never leaches or washes away.

Benefits and Features

No other material matches GEM for reducing earthing resistance and maintaining low resistance permanently. No other material equals GEM in providing conductivity for the life of the grounding system.

GEM is effective

- GEM can dramatically lower earth resistance and impedance measures
- GEM maintains constant resistances for the life of the system once in set form
- GEM performs in soil conditions even during dry spells
- Because it is chemically stable and very low in sulfate and chloride, it protects ground conductors from corrosion instead of attacking them like salts do.

GEM is Permanent

- Does not dissolve, decompose nor leach out with time
- Does not require periodic charging treatments nor replacement
- Does not require maintenance
- Does not require continuous presence of water to maintain effectiveness
- Freezing will increase resistivity by only 10-15 percent

GEM is Environmentally Friendly

- Does not adversely affect the soil
- Does not leach ions or contaminate ground water
- Meets (USA) Environmental Protection Authority requirements for landfill

Application

GEM improves grounding effectiveness regardless of soil conditions and provides excellent permanent conductivity:

- For areas with high resistance, such as rocky ground, mountain tops, and sandy soil
- As a backfill when you have to drill because the ground is too hard to drive, or where ground rods cannot be driven, or
- Where limited space makes adequate grounding difficult by conventional methods



Ground System Components

Ground Electrodes and Accessories

GEM INSTALLATION

GEM is supplied in easy-to-handle 25 lb. bags for one-man installation. GEM can be installed dry or wet (recommended). GEM quickly absorbs moisture from the soil when used dry, to reach its maximum conductivity in days. To accelerate curing time, water can be added after GEM is installed, or it can be pre-mixed with water.



Ask ERICO for a complimentary Six Point Plan CD that includes the GEM calculator to determine the amount of GEM required for your grounding application.

TRENCH INSTALLATION

1. Dig a trench at least 4 inches wide x 30 inches deep or below the frost line, whichever is deeper. Spread out enough GEM to uniformly cover bottom of trench-about 1 inch deep.
2. Place conductor on top of GEM.
3. Spread more GEM on top of conductor to completely cover conductor about 1 inch deep.
4. Carefully cover the GEM with soil to a depth of about 4 inches, making sure not to expose the conductor. Tamp down the soil, then fill in the trench. For various trench widths and GEM thicknesses, see the table on page 28.

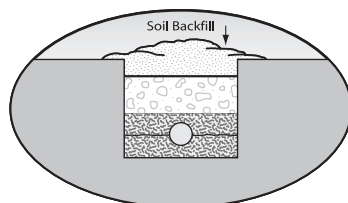
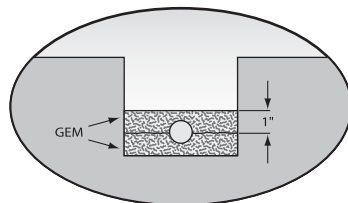
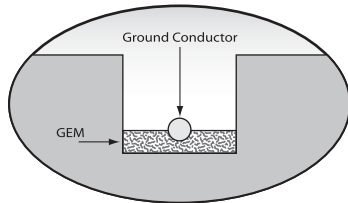
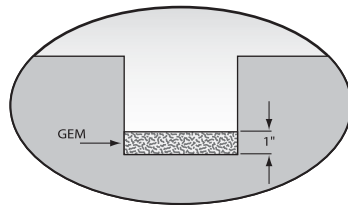


Figure 21.

GROUND ROD BACKFILL INSTALLATION

1. Auger a 3 inch or larger diameter hole to a depth of 6 inches less than the length of the ground rod.
2. Place ground rod into augered hole and drive one foot (if possible) into bottom of the hole. The top of the ground rod will be approximately 6 inches below grade. At this time, make any connections to ground rod using CADWELD connections.
3. Pour the appropriate amount of GEM around the ground rod. To ensure the GEM material completely fills the hole, tamp around the ground rod with a pole.
4. Fill remainder of augered hole with soil removed during augering. For various augered-hole diameters and depths, see the table on page 28.

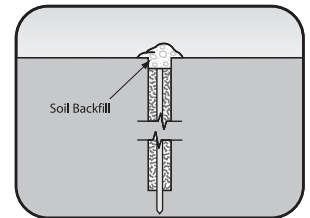
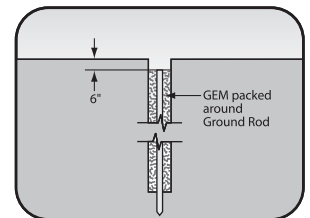
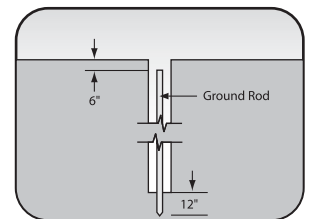
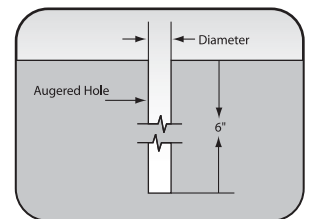


Figure 22.

Note: If premixing GEM into a slurry form, use a standard cement mixer or hard-mix in a mixing box, wheelbarrow, etc. Use 1-1/2 to 2 gallons of clean water per bag of GEM.

Note: Excess standing water must be removed from the hole.

Ground System Components

Ground Electrodes and Accessories

TRENCH INSTALLATION

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

| Trench Width | Total Thickness of GEM | | | |
|--------------|------------------------|---------------|---------------|----------------|
| | 1" (2.5cm) | 2" (5.1cm) | 3" (7.6cm) | 4" (10.2cm) |
| 4" (10.2cm) | 14.0 (4.3m) | 7.0 (2.1m) | 4.7 (1.4m) | 3.5 (1.1m) |
| 6" (15.2cm) | 9.3 (2.8m) | 4.7 (1.4m) | 3.1 (0.9m) | 2.3 (0.7m) |
| 8" (20.3cm) | 7.0 (2.1m) | 3.5 (1.1m) | 2.3 (0.7m) | 1.8 (0.5m) |
| 10" (25.4cm) | 5.6 (1.7m) | 2.8 (0.9m) | 1.9 (0.6m) | 1.4 (0.4m) |
| 12" (30.5cm) | 4.7 (1.4m) | 2.3 (0.7m) | 1.6 (0.5m) | 1.2 (0.4m) |

A 25-pound bag of GEM will cover 7 linear feet (2.1m) of conductor length for a 4-inch-wide (10.2cm), 2-inch-thick (5.1cm) covering [1 inch (2.5cm) below and 1 inch (2.1cm) above conductor], based on 63.5 lb/cu ft (1017^{kg}/m³).

GROUND ROD BACKFILL INSTALLATION

Estimated bags of GEM for backfilling around ground rods to a density of 90 lb/cu ft (1442kg/m³)

| Dia. of hole | Depth of hole (feet)* | | | | | | |
|--------------|-----------------------|--------------|--------------|--------------|---------------|---------------|---------------|
| | 6' (1.8m) | 7' (2.1m) | 8' (2.4m) | 9' (2.7m) | 17' (5.2m) | 19' (5.8m) | 20' (6.1m) |
| 3" (7.6cm) | 2 | 2 | 2 | 2 | 4 | 4 | 4 |
| 4" (10.2cm) | 2 | 3 | 3 | 3 | 6 | 7 | 7 |
| 5" (12.7cm) | 3 | 4 | 4 | 5 | 9 | 10 | 10 |
| 6" (15.2cm) | 5 | 5 | 6 | 7 | 13 | 14 | 15 |
| 7" (17.8cm) | 6 | 7 | 8 | 9 | 17 | 19 | 20 |
| 8" (20.3cm) | 8 | 9 | 11 | 12 | 22 | 25 | 26 |
| 9" (22.9cm) | 10 | 12 | 13 | 15 | 28 | 31 | 32 |
| 10" (25.4cm) | 12 | 14 | 16 | 18 | 34 | 38 | 40 |

*8-foot (2.44m) minimum rod length required to be in contact with the soil (or GEM). Per NEC 250-52.

How to Specify GEM

- Ground enhancement material must be permanent and maintenance-free (no recharging with salts or chemicals which may be corrosive) and maintain its earth resistance with time.
- It must set up firmly and not dissolve or decompose or otherwise pollute the soil or the local water table.
- The ground enhancement material shall be suitable for installation in dry form, or in slurry form.
- The ground enhancement material shall not depend on the continuous presence of water to maintain its conductivity.
- Ground enhancement material in its set form shall have a resistivity of not more than 20 ohm-cm.



Figure 23. GEM permanent ground enhancement material, is ideal in areas of poor conductivity and is suitable for both backfilling around ground rods and trench installations.

Ground System Components

Ground Electrodes and Accessories

Ground Inspection Wells

For periodically measuring the electrical resistance of a buried ground system, inspection wells are used as a means of access to the ground conductor. To make electrical resistance measurements, remove the cover and attach a lead from a resistance measuring instrument to the ground conductor.

Inspection wells are available in various sizes and materials. Light-duty units are generally used. For areas of high vehicular traffic, you should use heavy-duty inspection wells.

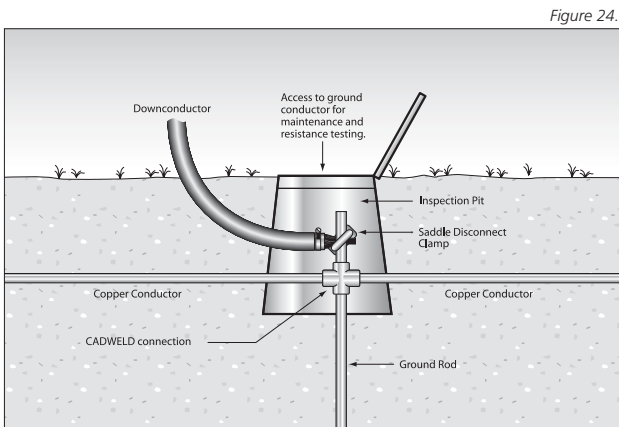


Figure 24.

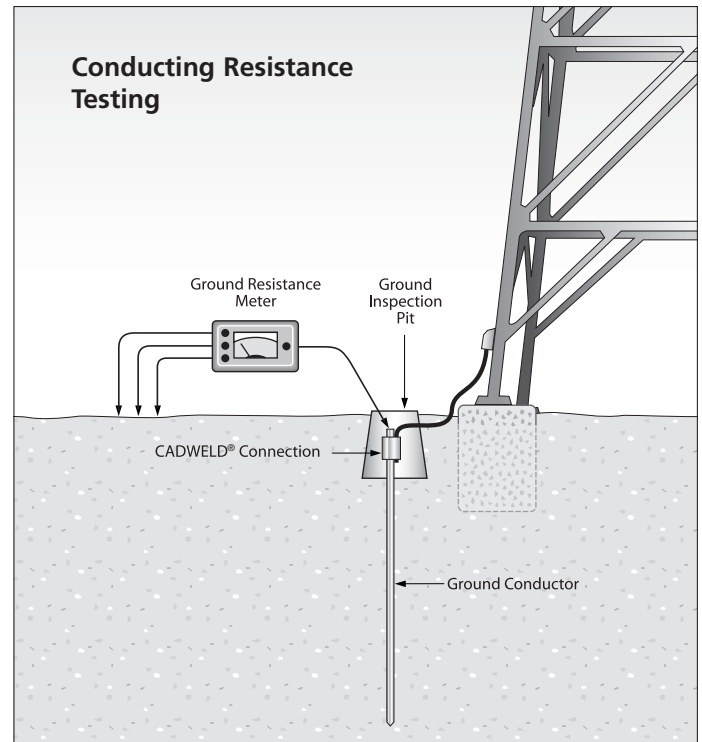
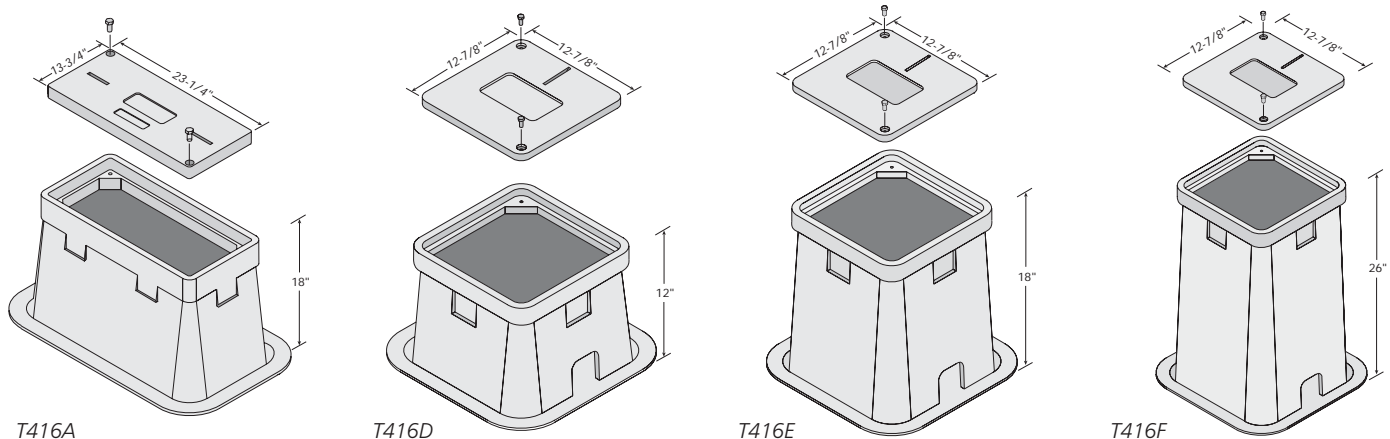


Figure 25. Resistance testing using a ground resistance meter, with access to the ground conductor provided by the ground inspection well.

ERITECH® Polymer Concrete Wells

| Part No. | Material | Color | Dimensions | Cover Weight | Box Base with Inserts Weight | Features |
|----------|-------------------|---------------|----------------------|--------------|------------------------------|---|
| T416A | Polymer Concrete* | Concrete Gray | 14" x 23" x 18" deep | 25 lbs. | 50 lbs. | Bolt down cover; skid resistant surface |
| T416D | Polymer Concrete* | Concrete Gray | 13" x 13" x 12" deep | 25 lbs. | 50 lbs. | Bolt down cover; skid resistant surface |
| T416E | Polymer Concrete* | Concrete Gray | 13" x 13" x 18" deep | 25 lbs. | 50 lbs. | Bolt down cover; skid resistant surface |
| T416F | Polymer Concrete* | Concrete Gray | 13" x 13" x 26" deep | 25 lbs. | 50 lbs. | Bolt down cover; skid resistant surface |

*Polymer Concrete reinforced with heavy weave fiberglass resulting in high strength and minimal weight. Enclosures and covers rated for 10,000 lbs. maximum load.

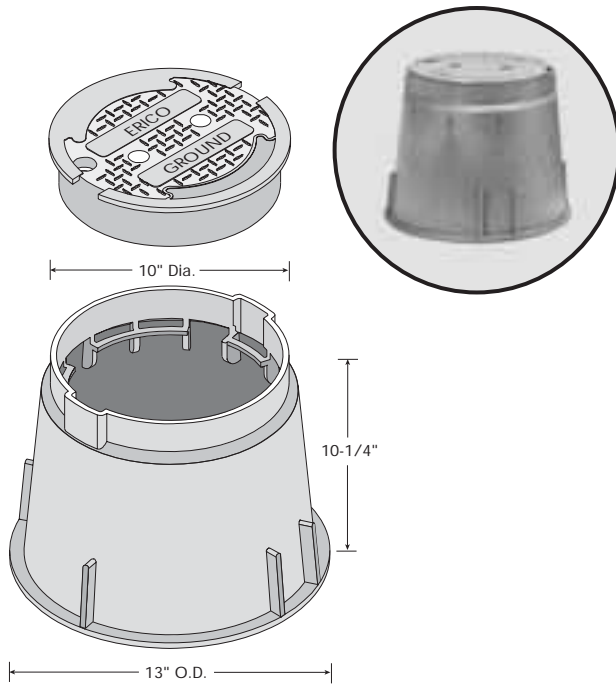


Ground System Components

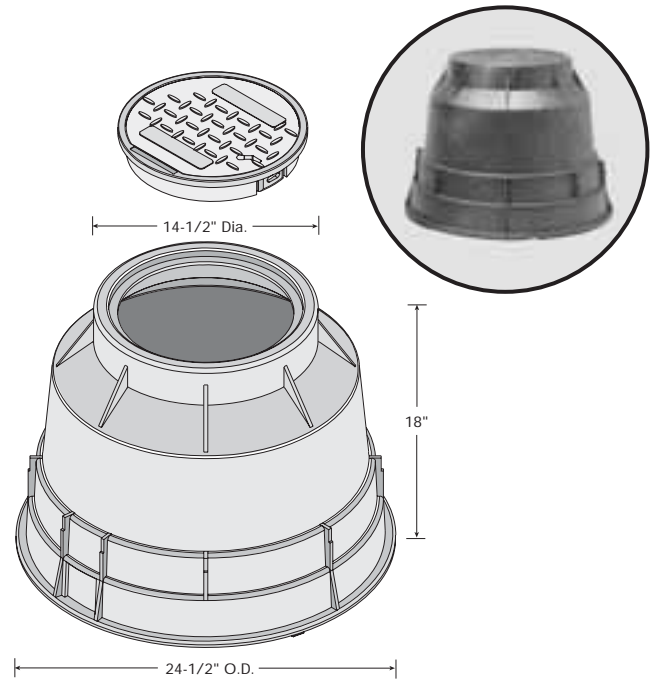
Ground Electrodes and Accessories

ERITECH® High Density Polyethylene Wells

| Part No. | Material | Color | Dimensions | Cover Weight | Box Base with Inserts Weight | Features |
|----------|---------------------------|-------|----------------------|--------------|------------------------------|--|
| T416B | High Density Polyethylene | Green | 10" round x 10" deep | 1-1/2 lbs. | 3 lbs. | Stainless steel lock bolt (3/8"-16 x 1-3/4"); very resistant to acids and chemicals; boxes and covers nest in 3-1/4" increments; 2 knockouts per box (3-1/2" x 1-1/2") |
| T416C | High Density Polyethylene | Black | 14" round x 18" deep | 4-1/4 lbs. | 13.4 lbs. | Resistant to acids and chemicals; pipe slot (2 places) |



T416B



T416C

