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INSTALLATION PROCEDURES HANDBOOK
CMCE SERTEC

CMCE SERTEC

ELECTRO-ATMOSPHERIC FIELD PROTECTOR

DUN & BRADSTREET
D-U-N-S® REGISTERED™

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SERTEC Electro-Atmospheric field protector

The SERTEC CMCE protector has the purpose of guarding people, animals, and structures in facilities on ground, air or water from any electric phenomena conducted by air.

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1 CMCE SERTEC TECHNOLOGY

CMCE NANO
Weight: 980 grams
(Gross)

CMCE HOME
Weight: 2,460 kilograms
(Gross)

CMCE SERTEC 120
Weight: 7.4 kilograms
(Gross)

CMCE-AT 120
Weight: 7.4 kilograms
(Gross)

HIGH RESISTANCE
Weight: 20 kilograms
(Gross)

CMCE HIGH VIBRATION
Weight: 11.1 kilograms
(Gross)

CMCE BLACK 120
Weight: 7.4 kilograms
(Gross)

CMCE GRAPHENE
Weight: 7.4 kilograms
(Gross)

SERTEC S.R.L.
Av. Gral. Santos Nº 2555 c/
18 de Julio
Asunción - Paraguay
Phone No: (595) 21 302023
Asunción - Paraguay
www.sertec.com.py

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DEFINITIONS AND BASIC CONCEPTS

Grounding System: Electric equipment, electronics, machines, generators, transformers, silos, towers, lightning rods, containers, metallic structures in general, should be connected to a grounding system previously install with the purpose of protecting them, improving reliability, and protecting people from over-voltage, induced currents, ground potencial rise, etc. When these or any type of electric danger occurs, these should be derived to ground, therefore the grounding system should be as good as possible, it should have the least electric resistance possible so that when these events occur, it is easier to conduct them to ground than to the equipment.

The grounding system is composed of electrodes interconnected by conductors in the foundation or buried in the soil, therefore the reading value of electric resistance should be as low as possible, depending of what is required.

Ground Electrode. This is a conductor (wire, bar, tube, plate, etc), buried in direct contact with the ground or submerged in water in contact with ground.

Grounding Mesh . It is a group of electrodes electrically joined through a conductor.

Grounding connection. It is the electric connection between a mesh or electrode on the ground and an outer part. The parts of ground connection that are not isolated and buried, are considered as part of the electrode mesh.

Connect to ground. This refers to the vertical electrical connection of equipment or installations to a grounding mesh or electrode.

Soil Resistivity. It is the relation between the potential of the mesh in connection with the ground of reference, and the potential dropping to ground through the mesh (V/R).
Where V is measured in Volts (V)
Where R is measured in ohms (Ω)

Differences between ground and neutral connections
A common mistake when connecting equipment and equalizing the potential by a conductor is the confusion between ground (GND) and neutral (N). Even though ideally these two end up at some point connected to the ground, the purpose of each one is very different. The neutral wire is in charge of transmitting current and the ground conductor is a primary safety measure of equipment against electric shock. Identifying them as if they had the same role would be to nullify the safety of the ground against electric shock. In the hypothetical case that both are taken as being the same, when the ground wire is cut or interrupted, the chassis of the equipment that is connected to this ground-neutral will have the line potential, therefore, any person or animal that is in contact with this will be exposed to an electric discharge.

TYPES OF GROUND CONNECTION SYSTEMS
According to their application, the grounding connection systems are:
- Ground connection for electric systems.
- Ground connection of electric equipment.
- Ground connection for electronic signal transmission.
- Ground connection for electronic protection.
- Ground connection for atmospheric protection.

NOTE: All grounding connection systems should be at the same potential, all interconnected to the same grounding mesh.

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Av. Gral. Santos Nº 2555 c/
18 de Julio
Asunción - Paraguay
Phone No: (595) 21 302023
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www.sertec.com.py

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NOTE:
The instructions and recommendations of this handbook are basic for the installation of the CMCE SERTEC. In case of any doubts or need for clarification please **Contact with the Manufacturer**

GROUNDING MESH

Grounding systems should be designed to ensure that, in the event of failure of one of their components, the potentials on the soil as well as in the conductors connected to the ground electrode or in the conductors exposed in the vicinity are under the appropriate limits.

The grounding systems are done through grounding meshes. Such meshes are made of a system of bare electrodes interconnected, buried, installed horizontally (bare copper conductors) as well as vertically (rods), providing an equipotential surface for the electric devices and metallic structures arranged in an installation.

Step 1: Measure previously the electric resistance of the soil, before preparing the grounding mesh

Step 2: Determination of the grounding area and soil modeling. This involves knowing where the installation will be made, what area is available, what the distribution network and transmission in the location, and what the characteristics are of the soil where the mesh will be constructed.

Step 3: Choose the conductor of the mesh. This involves determining the material to be used, not only for the mesh, but also in all the auxiliary elements, such as connectors for the conductors, the different derivations and connections for the bonding of the diverse metallic parts of the installation. After gaining some experience designing grounding meshes, and understanding the limitations at the building level, this step is generally omitted.

Step 4: Determine the acceptable step and touch voltages. Knowing the local electrical network and its different possible configurations, as well as the characteristics of the soil, one shall determine what the maximum step and touch voltage are that may be tolerated by the human body, without suffering irreversible damage.

Step 5: Physical design and calculation of the grounding mesh. This involves determining the short-circuit phase-to-ground according to the specific installation, proposing a preliminary grounding mesh, and evaluating its performance in the event of a failure. If this does not meet the safety requirements, the mesh should be redesigned until it does, and every step should be repeated, until all safety conditions are verified and fulfilled.

Step 6: Define the design details. Once the geometry of the mesh has been determined, the details corresponding to the grounding of the various components of the installation must be established.

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MINIMUM AMOUNT OF RODS

R≤10Ω

The minimum amount of rods recommended is 6 to 8 units with a minimum length of 2.10 mt x 5/8" for the section, with a separation equal to the rods length, even though the initial resistance measured before the grounding is less than
10Ω (ohms) distributed in a radial or mesh configuration, guaranteeing the connection to ground even upon failure of some rods.

As a general rule, the lower the resistance of the grounding, better and more effective operation of the CMCE SERTEC will be.

This is to guarantee the good drainage and dispersion of the charges absorbed by the CMCE SERTEC device.

R>10Ω

When the resistance of the soil is bigger than 10Ω (ohms) we resort to techniques that involve additives such as: salt, conductive cement, humic acids, etc.
Please ask the manufacturer.
These calculations depend on the granulometry, humidity of the soil and material of the electrode.

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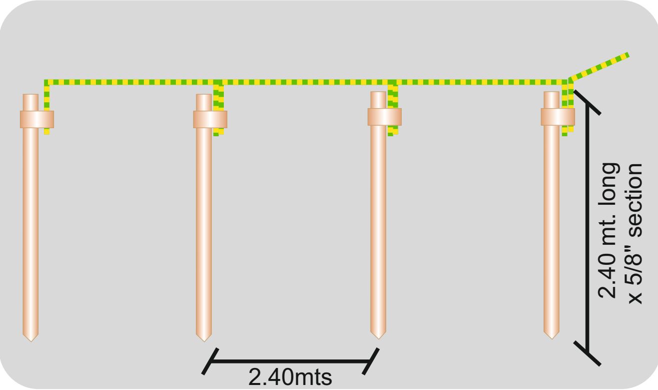
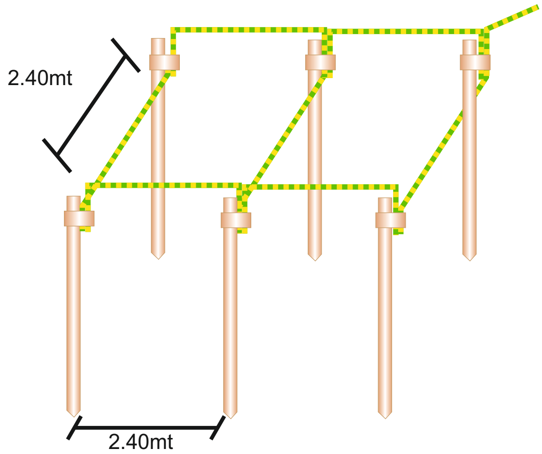
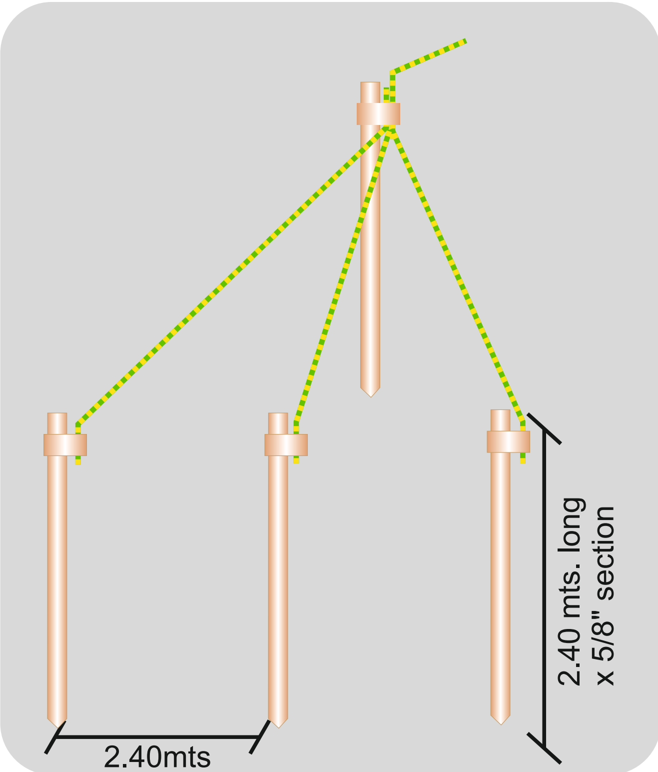
DESIGN OF THE GROUNDING SYSTEM
Different topologies of installations





The distance of separation among electrodes should be equal to the length of the electrode. **For example: If the electrode is 2.40 mt long, the distance between electrodes should be 2.40 mt**

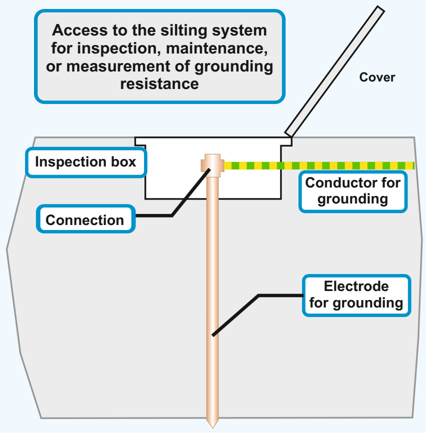


OBS.:

The minimum length of the electrode should be 2.10mts and 5/8" cross section.

GROUNDING INSPECTION BOX:

All grounding systems should have the possibility of being inspected. The point of union of the grounding with the linking line is known as grounding point, and it should be an easy-to-inspect element, accessible for periodical checking of the grounding resistance and the electric continuity of the linking line, as well as for any other required maintenance activities.



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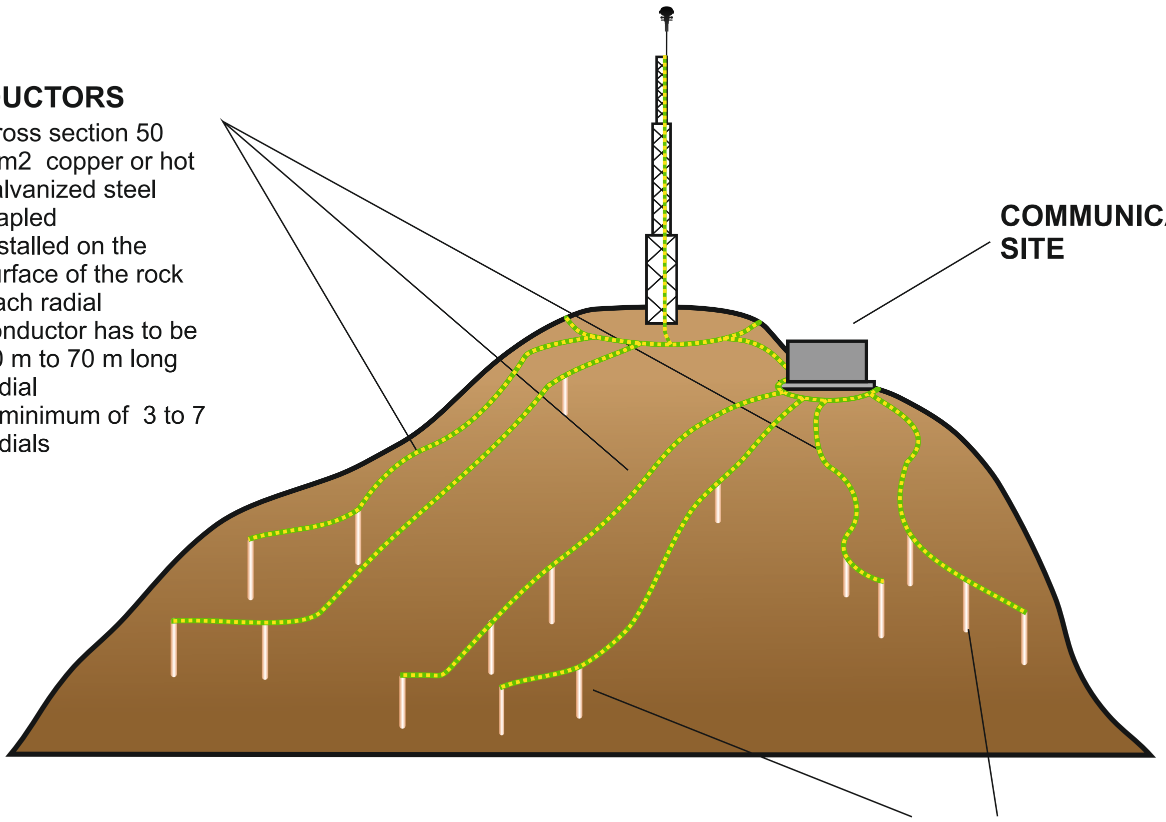
Grounding on rock:

When we need to ground a tower or structure on rocky places such as mountains, quarries, etc., it is necessary to extend radials toward less rocky areas.
Extended radials should be installed upon to the rock for the whole distance until a less rocky area is found where an grounding mesh may be made



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EQUIPOTENTIALITY OF THE EQUIPMENT

Elements to be “grounded”

There are two categories of ground circuits in the installations, each one of them includes a series of devices with common characteristics:

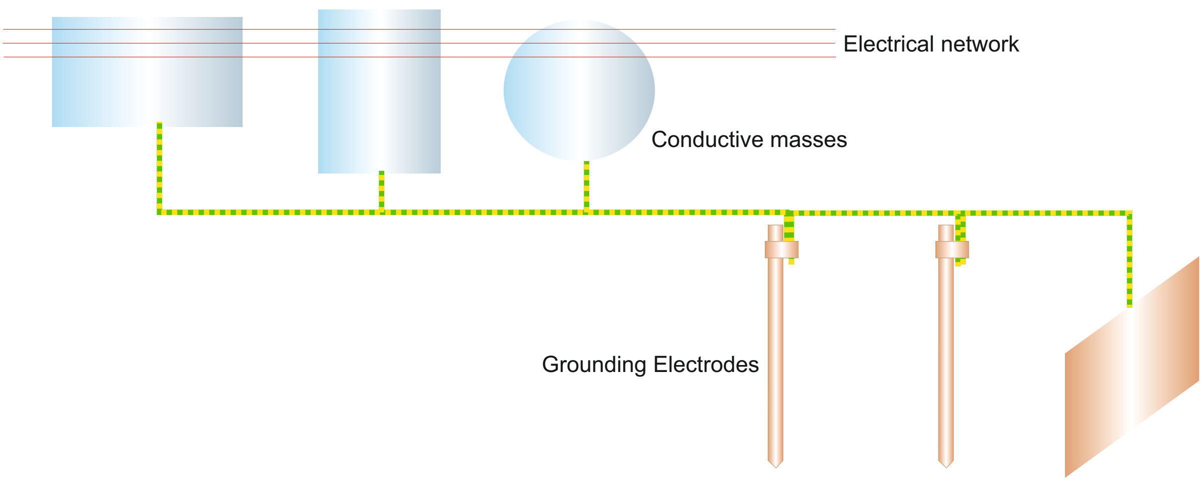
Protective grounding:
This classification covers the grounding of all metallic elements that accidentally may have a potential rise: frames, isolators of circuit breakers made with ironwork, enclosures for LV boards and MV cells, doors, gates, windows, and guard rails in buildings.

“Service” grounding:
This classification covers the devices intentionally set to ground: over-voltage dischargers, grounding isolators, converter neutral wires of every type.
Norm IEEE-80 advices to have a common grounding mesh to inter-connect both grounding systems.

All equipment, structures, and elements such as converters, generators, containers, silos, metallic structures, towers, tanks with any content, water pumps, etc.; should be independently connected to the grounding mesh through a bare wire whose section needs to be determined according to the element's distance to the grounding mesh.

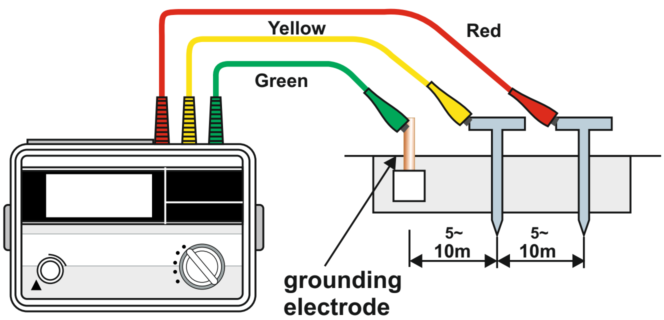
The neutral wire of any equipment should be connected to the grounding mesh independently with an insulated wire that should run on an independent ground bar; also, bare wires belonging to equipment's chassis should go to another independent ground bar, wich is supported with insulators.

In conclusion, every element capable of conducting electricity should be interconnected to the grounding mesh independently.



FINAL RESISTANCE MEASUREMENT:

After grounding with the necessary number of javelins for the installation and interconnection, the grounding mesh's resistance should be measured with a ground resistance Meter, in order to check that the resistance originally measured could be reduced to a value less than 10 Ω.



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7 PROTECTION OF THE ELECTRIC INSTALLATION

It is very important to protect the electric community when we install a CMCE SERTEC, since not all discharges or impacts are direct.

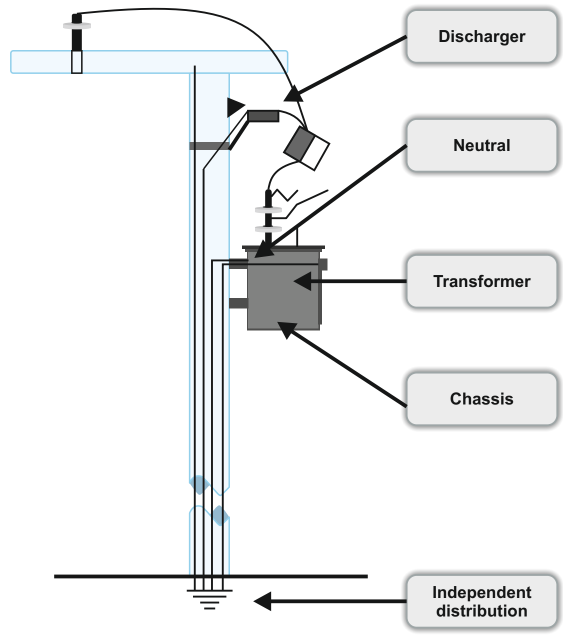
There are indirect discharges as well, outside the coverage area, such as an impact received through the medium voltage line. This causes an over-voltage on the installation's transformer.

This discharge may be fatal for the transformer if it is not properly silted; in order to prevent damage the transformer should be made independent as follows:

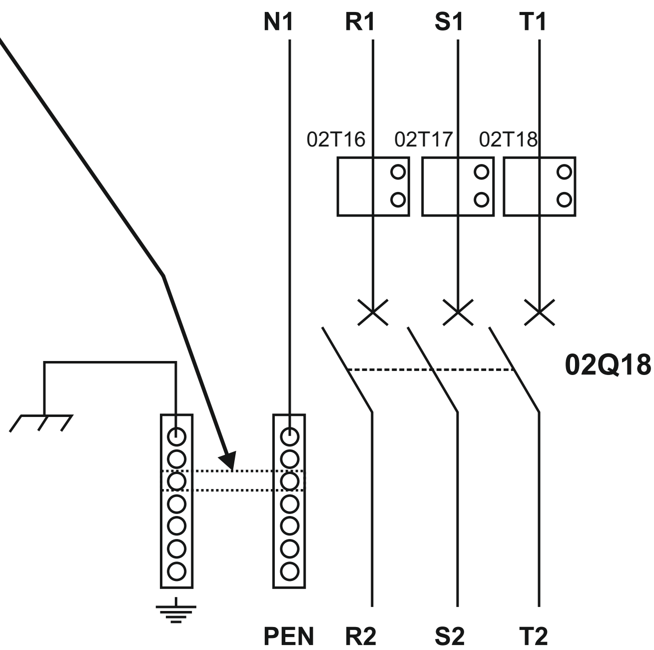
1) The transformer's medium voltage discharge wire should go directly to the grounding mesh with a 50 mm^2 wire.
2) The transformer's chassis should be grounded with an independent 50mm^2 wire, directly to the grounding mesh.
3) The neutral wire should be grounded independently with an insulated 50mm^2 wire at least, directly to the grounding mesh

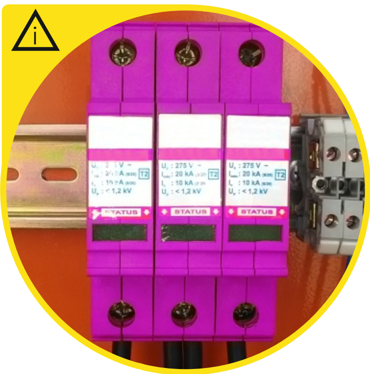
The following graph illustrates the above mentioned.

Connection of a transformer with independent Neutral wire, Chassis, and Dischargers



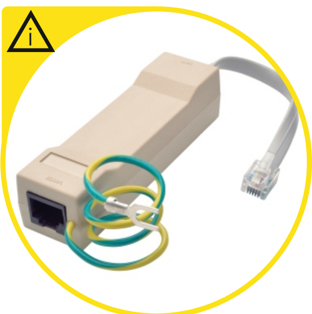
The connection (bridge) between the neutral wire and the chassis that transformers and generators normally have should be disconnected, and each one should be independently connected to the grounding mesh, in order to guarantee protection and even reduction of energy consumption.





Overvoltage protections should be installed on the electric panel for the 20kA, 40kA, 80kA, and 100kA electric lines; according to the need at the place of installation.

Protections for wire telephone lines should be installed



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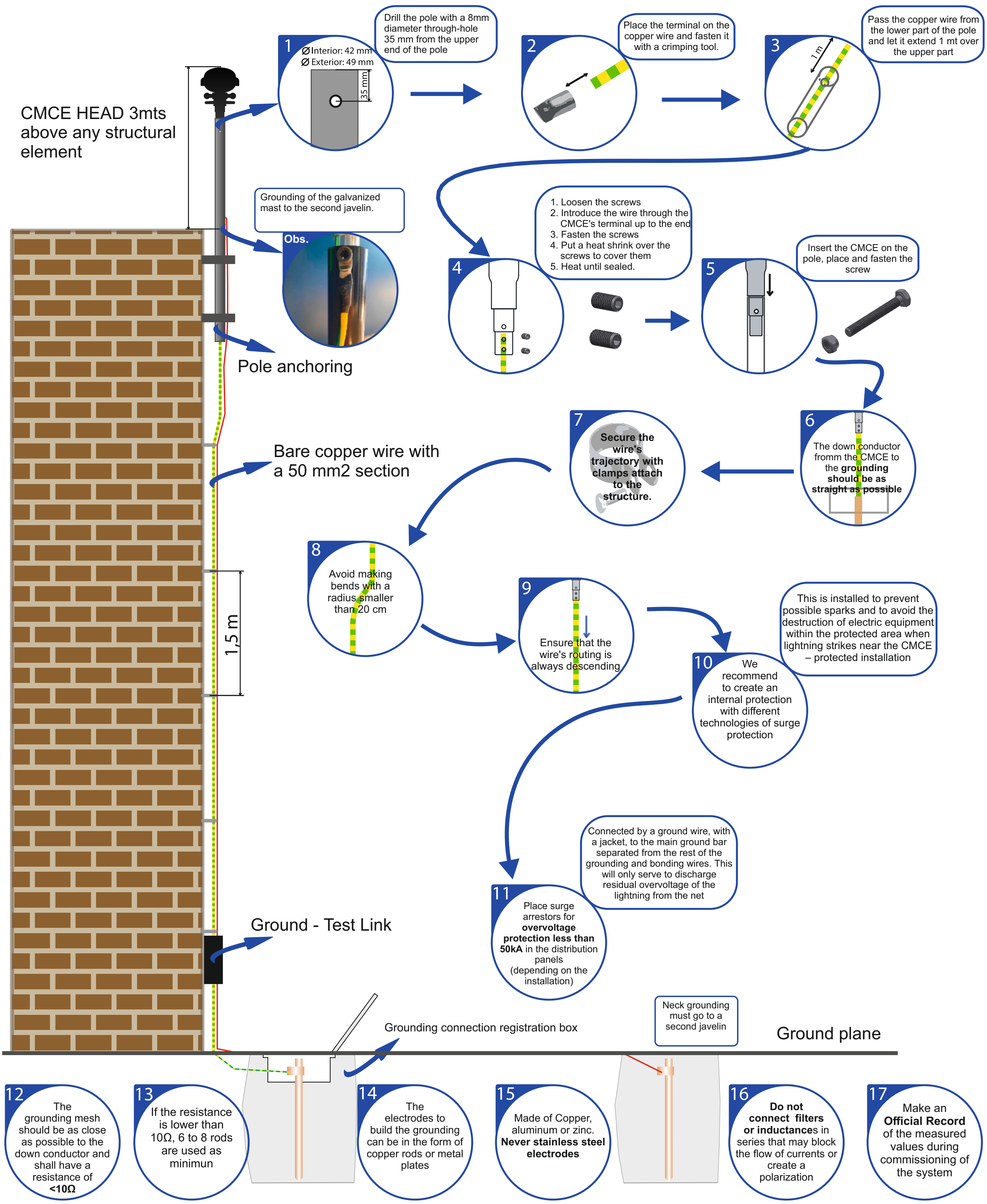
8 QUICK INSTALLATION GUIDE CMCE TECHNOLOGY



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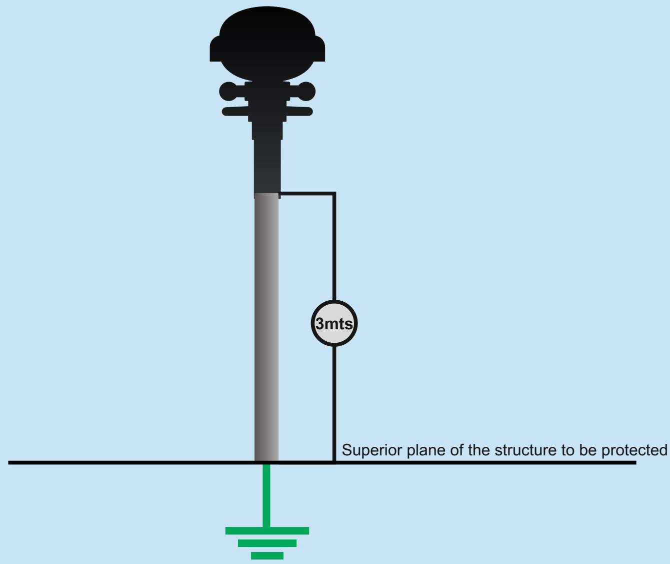
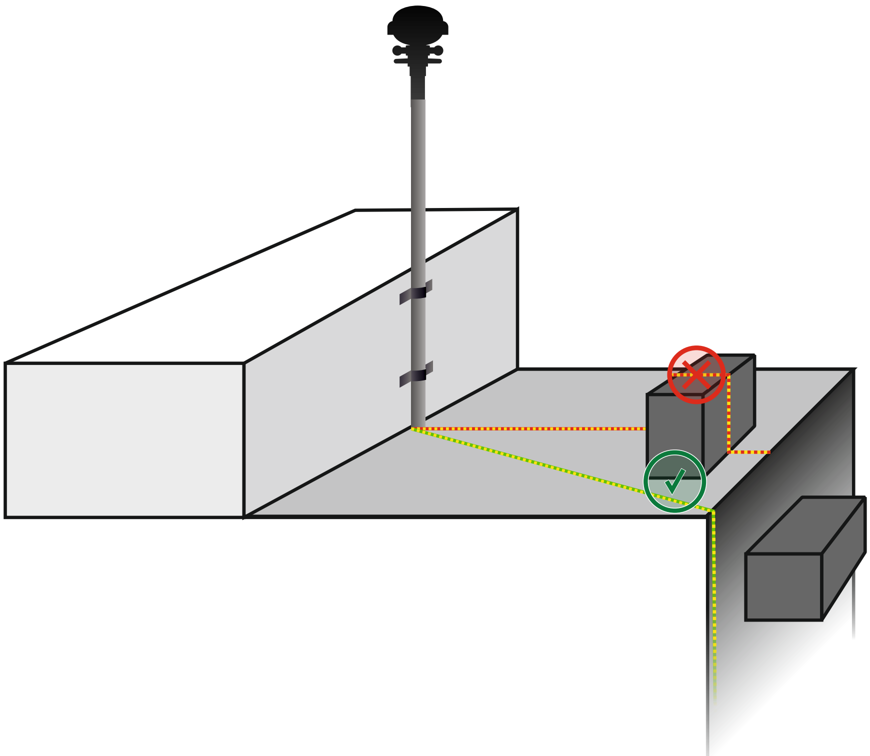
9 CMCE SERTEC MINIMUM HEIGHT

The height that the CMCE SERTEC should surpass regarding the tallest structure in the coverage area, should be at least 3 meters above it, in order to avoid the point effect, which could attract lightning -as mentioned in other sections of the handbook- and to guarantee an effective operation.





VERTICALITY OF THE DOWN CONDUCTOR 10

The CMCE SERTEC down conductor should be as vertical as possible; if there is a horizontal trajectory there should not be a sudden climb followed by a drop because of some obstacle along the trajectory. If there is an imminent obstacle in the drop, a maximum detour of 45° from the horizontal or vertical is allowed. **Except in extreme cases, the down conductor should always have total verticality. See image**

10 DOWN CONDUCTOR CROSS SECTION

The bare copper wire cross section of the down conductor must be at least $50mm^2$ in order to guarantee an optimum conductivity of the atmospheric charges to the grounding mesh where they are drained to the ground.

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Av. Gral. Santos Nº 2555 c/
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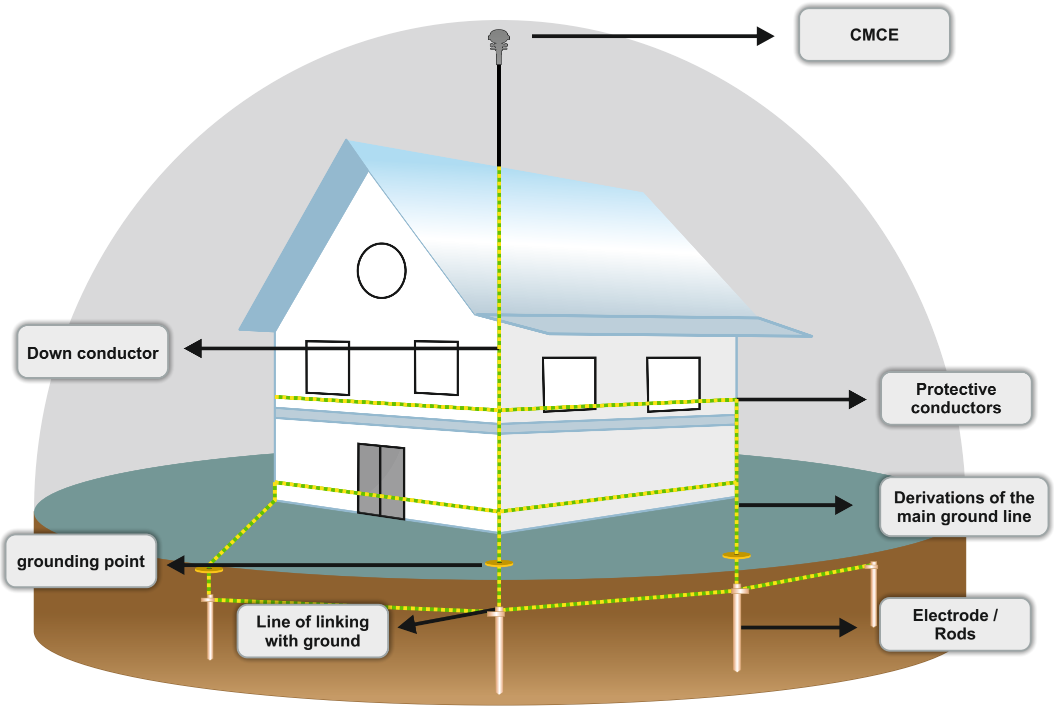
12 TYPES OF STRUCTURES

HOUSE

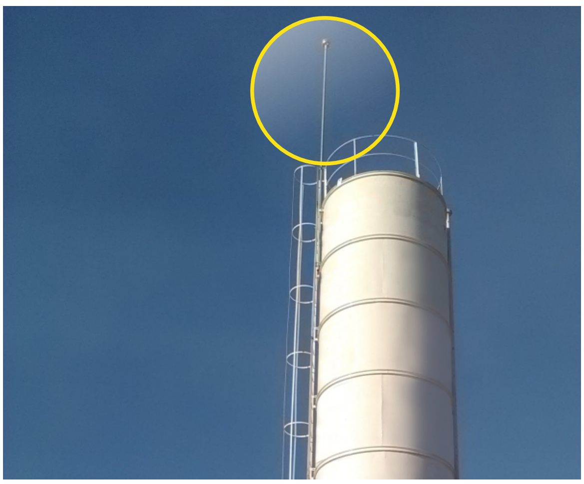
First we need to take into account the resistance to ground. Identify the element with the highest point, which should be surpassed. According to that, we will choose on what element the CMCE SERTEC will be mounted with its pole (tower, structure itself, column, chimney, etc).
Protective elements against electric lines should be installed.
If there is a generator or a transformer, we recommend grounding of the neutral and chassis with a separate connection to the grounding mesh.



Industrial Plant:

We should first take into account the resistance to ground. Identify the element with the highest point, which should be surpassed. According to that, we will choose on what element the CMCE SERTEC will be mounted with its pole (silo, tower, structure, etc).
A grounding mesh should be made for potencial equalization of the equipment and structures, silting each one independently. If there are generators and transformers, the respective neutrals and chassis should also be connected to independent bars supported by insulators.

The feeding lines should have overvoltage protection according to the electric installation.
In the case of industrial scale, there should be an independent grounding mesh and the neutral should be connected to ground.

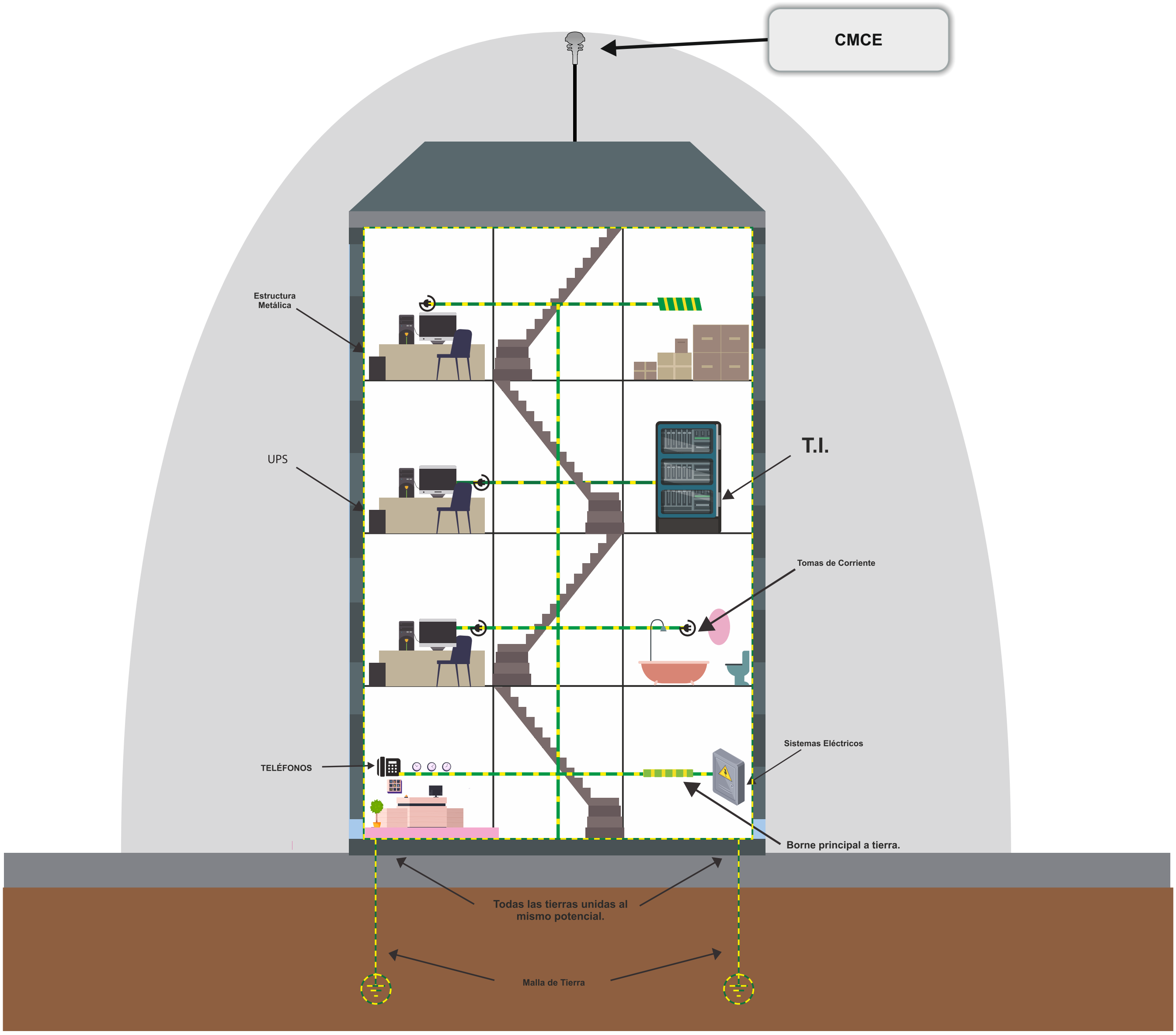


Building:

We should first take into account the resistance to ground. The CMCE SERTEC with its respective pole should be mounted on the tallest part of the building, surpassing any element located on the highest part.

An grounding mesh should be made for the equipotentiality of the equipment and structures in case it is necessary, silting each one independently to the grounden mesh. If there are generators and transformers, the respective neutrals and chassis should also be connected to independent bars made for neutrals and chassis; these bars should be supported by insulators at the moment of fixing.

The lines should have overvoltage protection depending on the electric installation.
If there is a data center, there should be a silted bar, to which the neutral will be connected, and a differentiated bar to connect the chassis

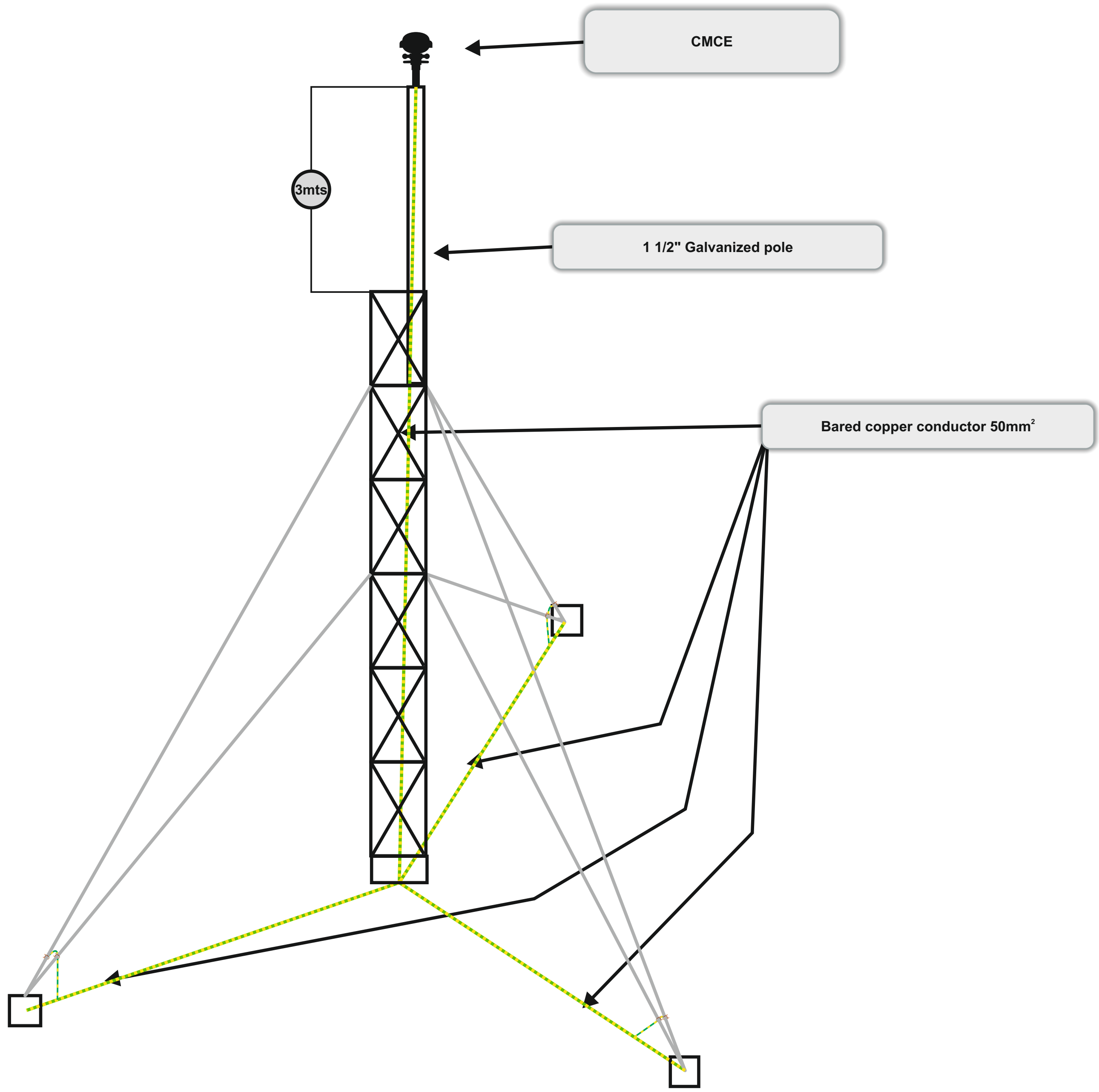


Towers with tensor cables

First we need to take into account the soil's resistance regarding the tower, so as to determine according to the result obtained from the measuring, the number of electrodes to use.

The CMCE SERTEC should be installed on the highest point of the tower with a 1 ½ inch galvanized pole surpassing the tower by 3 meters.

All tensors should be silted and interconnected with the grounding mesh.



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CONTACT US

Av. Gral Santos 2555

Asunción - Paraguay

PHONE NO:

+ 595 21 302023

+ 595 21 302024

E-mail:

sertec@sertec.com.py

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