

Session 20 – Earthing/Grounding Regulations



Earthing/Grounding Requirements

Conductors and Earth rods

As with lightning protection, the first choice faced by the designer of an earthing system is the type of conductor to be used. The correct choice of conductor is extremely important, whether it be a simple below ground electrode or a complex computer room signal reference grid.

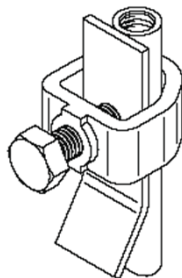
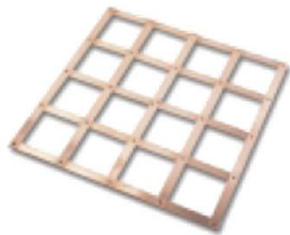
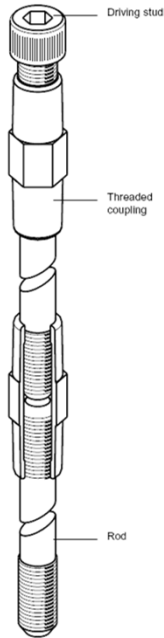
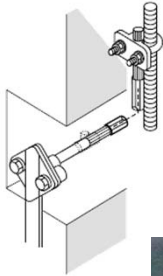
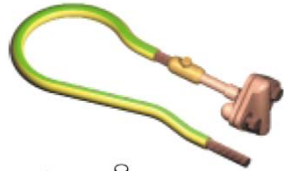


Conductors

Typical conductor types include flat tape, solid circular and stranded cable. For above ground applications, copper, aluminum and steel may be used. Below ground, copper is the most common choice due to its high resistance to corrosion.

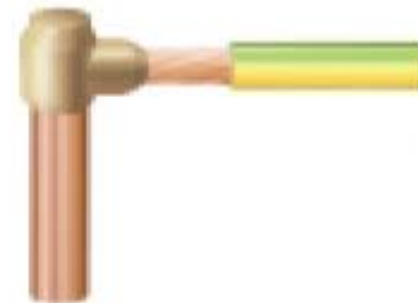
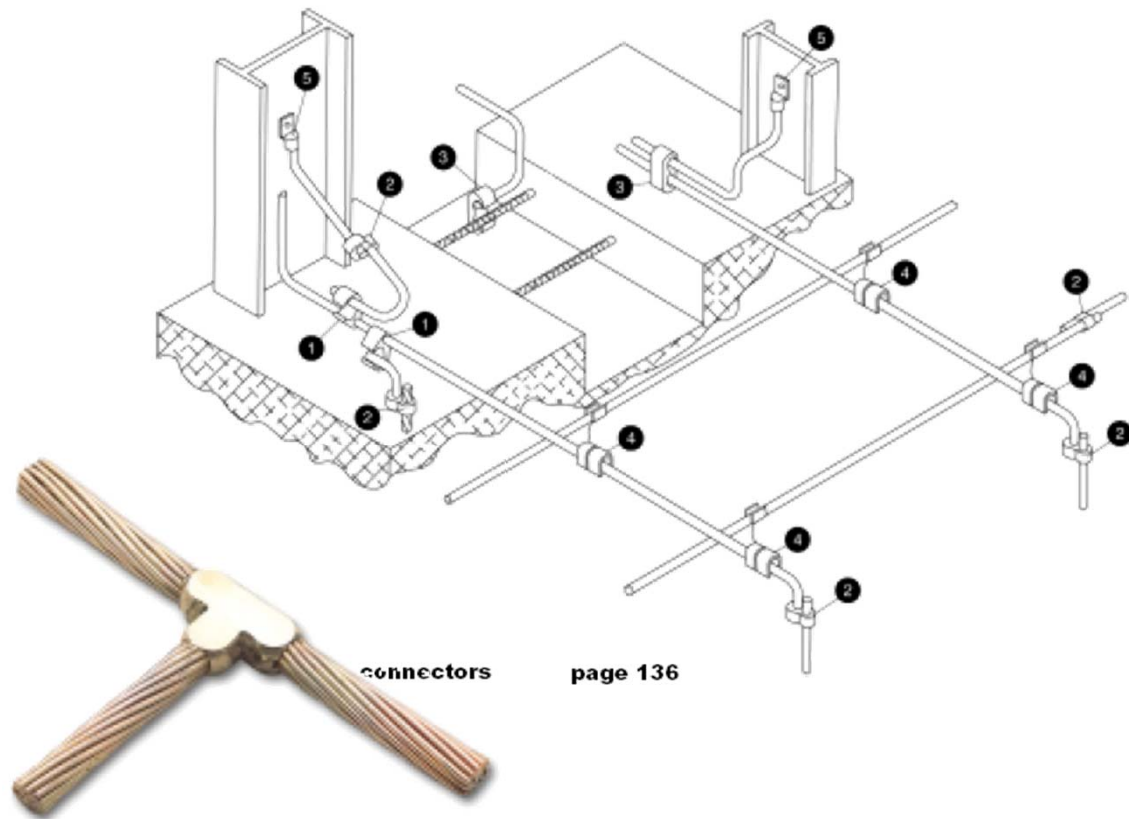
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Examples of typical earthing installation

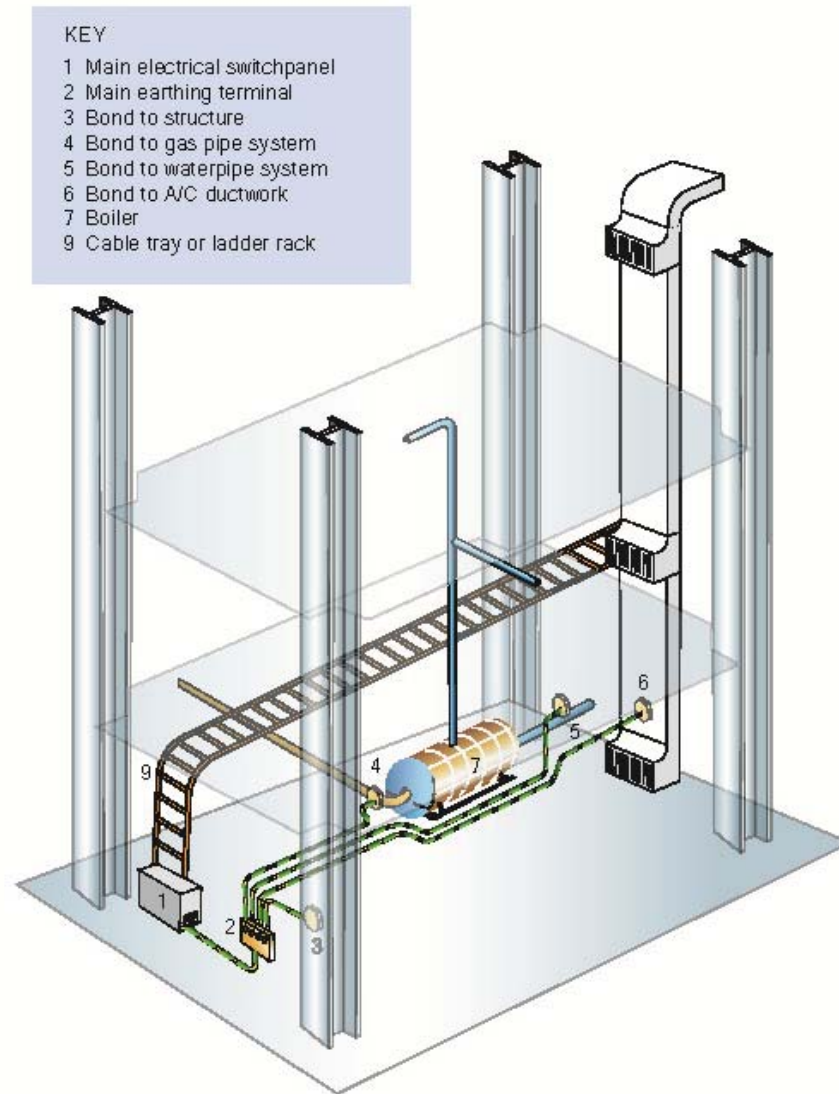


Types of Earthing Connections

Mechanical or Exothermic type connections are both used in the International World for earthing connections. Specific countries and clients have preferences for one method or the other, but in general, both are widely used and are accepted engineering practice.



Examples of typical earthing installation

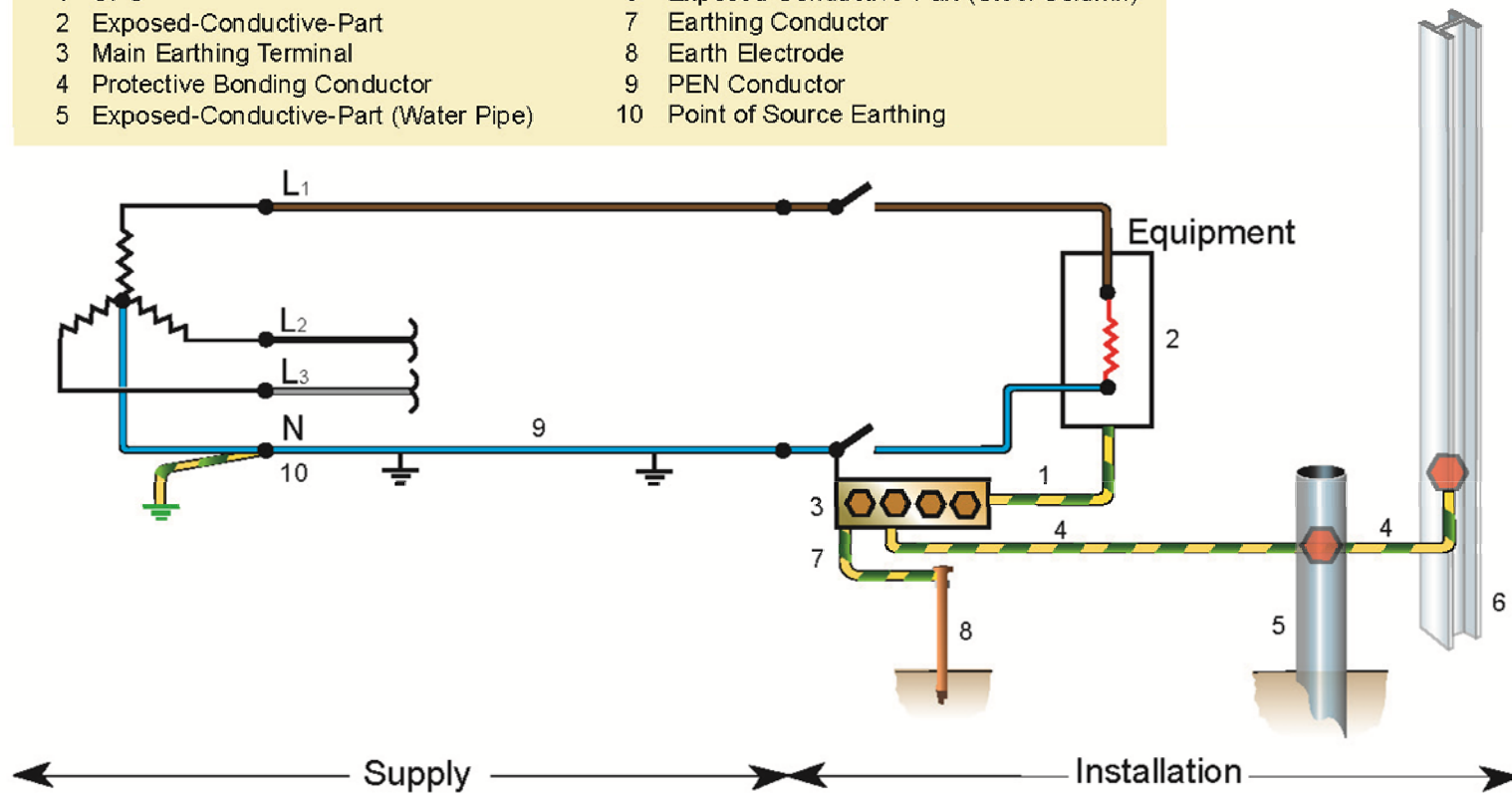


Protective equipotential bonding via multiple cables

Typical Earthing Arrangement

KEY

- | | |
|--|--|
| 1 CPC | 6 Exposed-Conductive-Part (Steel Column) |
| 2 Exposed-Conductive-Part | 7 Earthing Conductor |
| 3 Main Earthing Terminal | 8 Earth Electrode |
| 4 Protective Bonding Conductor | 9 PEN Conductor |
| 5 Exposed-Conductive-Part (Water Pipe) | 10 Point of Source Earthing |



Various earthing and bonding conductors and components

Surge Protective Devices

When using surge devices make sure they comply with IEC 61643 and connect in the appropriate manner

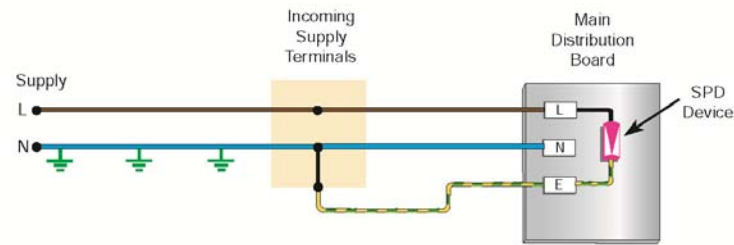


Figure D 8.1 Connection of SPD in TN-C-S system (PME).

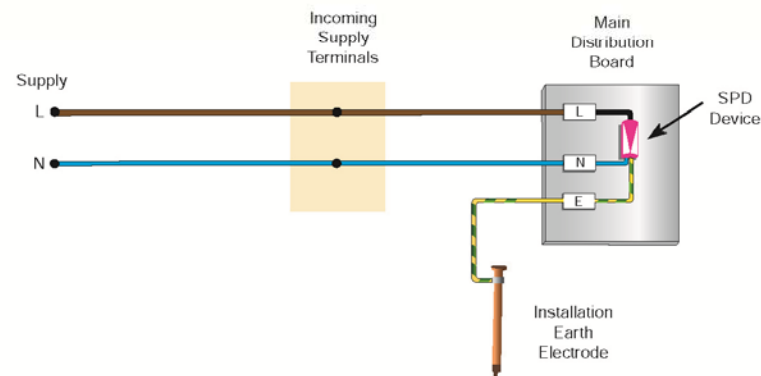


Figure D 8.2 Connection of SPD in TT system.

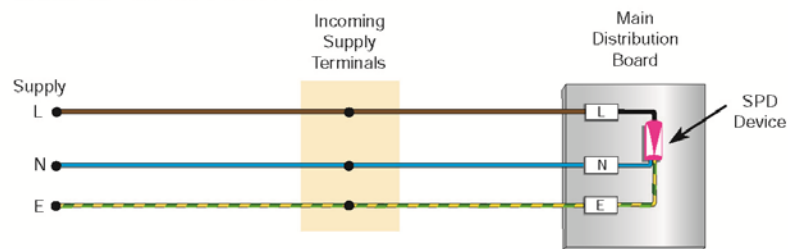


Figure D 8.3 Connection of SPD in TN-S system.

Typical Earthing Cable Sizing



The cross-sectional area of branch conductors connecting equipment and structures to plant earth ring shall be as followed as a rule of thumb as recommended by various earthing equipment manufacturers and IEC 62035 & AS1768/2007

To metallic enclosures of HV electrical equipment	70mm ²
To metallic enclosures of LV electrical equipment, having a supply cable cross-sectional area $\geq 35\text{mm}^2$	70mm ²
To metallic enclosures of LV electrical equipment, having a supply cable cross-sectional area $< 35\text{mm}^2$	25mm ²
To control panels, etc.	25mm ²
To non-electrical equipment exposed to lighting, e.g. tanks, columns and tall structures	70mm ²
To other non-electrical equipment	25mm ²

Earthing and Bonding Systems

The principal reasons for earthing and bonding in electrical installations are:

- To eliminate the possibility of electric shock to personnel
- To enable protection devices to operate correctly so that the duration of fault currents are kept to a minimum
- To equalize the voltage potential of normally non-current carrying metalwork
- To prevent electrostatic charge of process plant to fluid movement

In hazardous areas, the elimination of sources of ignition is very important and effective earthing and bonding play an important role. EN60079-14 clause 4.7 states that “care shall be taken to ensure that the earthing and potential equalization bonding provisions in hazardous areas are maintained in good condition”

Types of common systems are as followed:

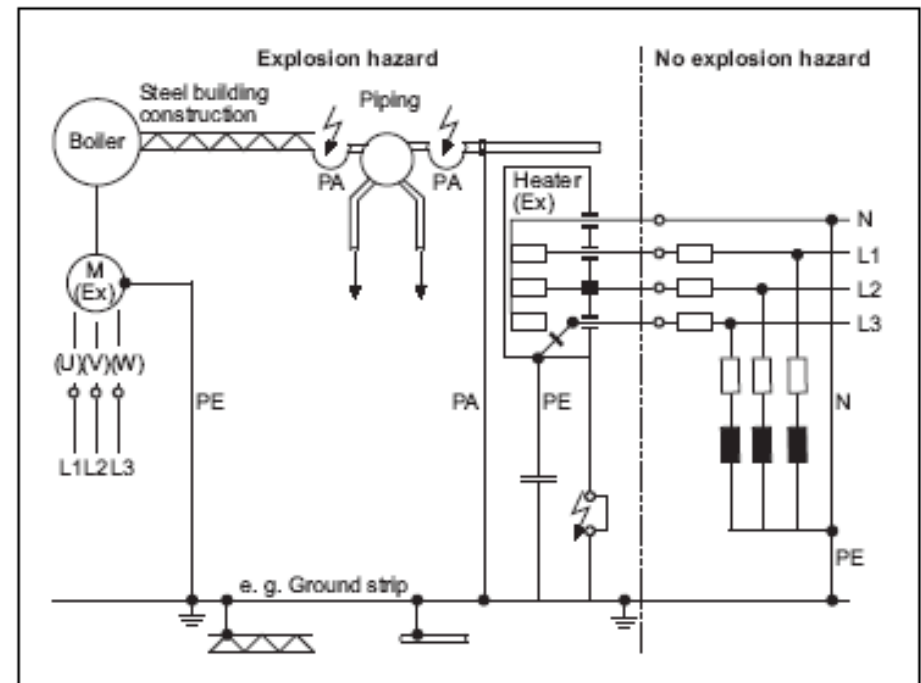
- TN-S – System has separate neutral and protective conductors throughout
- TT – A system in which one point of the source of energy is directly earthed but which is electrically independent of the electrodes used to earth the exposed conductive parts of the electrical system.
- TN-C – A system in which a single conductor serves as both the neutral and protective conductor in part of a system
- IT – A system in which there is no direct connection between live parts and earth but exposed conductive parts of the electrical installation are earthed.



Equipotential Bonding in Hazardous Areas

The EN/IEC 60079-14 installation directive requires equipotential bonding within hazardous areas of Zones 0 and 1 to prevent the occurrence of sparks capable of causing ignition or of a temperature rise caused by potential differences. Implementation of the equipotential bonding must comply with the system configuration to DIN VDE 0100 Part 410 and the design ratings to DIN VDE 0100 Part 540.

Full equipotential bonding is achieved by connecting not only the housings of the electrical equipment into the equipotential bonding, but also all other accessible, conductive structural parts such as building construction, metal containers, piping etc. Extraneous conductive parts which do not belong to the structure or installation of the system (e.g. door frames, window frames) need not be incorporated into the equipotential bonding



Universal Plug and Socket Systems??

The IEC started working on coming up with a universal design for plugs and sockets worldwide, trying to ensure that dangerous situations could not arise during the periods when the new system and the multitude of existing ones had to exist side by side. The first drafts of a universal system considered by SC 23C proposed all flat pins and this was pursued for many years. However, at the voting stage, objections grew and, many National Committees expressed themselves more in favor of a round pin solution. The other serious problem encountered was in trying to find a unique solution for 125V and 250V distribution systems. After long, and often acrimonious, discussion, the subcommittee came to an acceptable solution which was finally formulated in 1986 as publication IEC 906-1 (now IEC 60906-1) for 250V installations using round pins and in 1992 as IEC 906-2 (now IEC 60906-2) for 125V installations using the familiar US flat pin design.

More recently, in the 1990s, CENELEC, in Europe, was put under pressure by the European Commission to devise a harmonized plug and socket system for Europe.

CENELEC took as its starting point the IEC standard of 1986 and spent thousands of man-hours undertaking the almost impossible task of modifying the design with the aim of ensuring 100% risk-free operation of the system when used in conjunction with all the existing types in Europe. Naturally, apart from the technical difficulties, there was the clash of the many vested commercial and political interests and it was not surprising that, after much work and many meetings, CENELEC had to admit defeat and abandon its efforts.



Example of two- and three-pin plugs built to IEC 60906-1, the international standard for a system of plugs and socket-outlets for household and similar purposes.