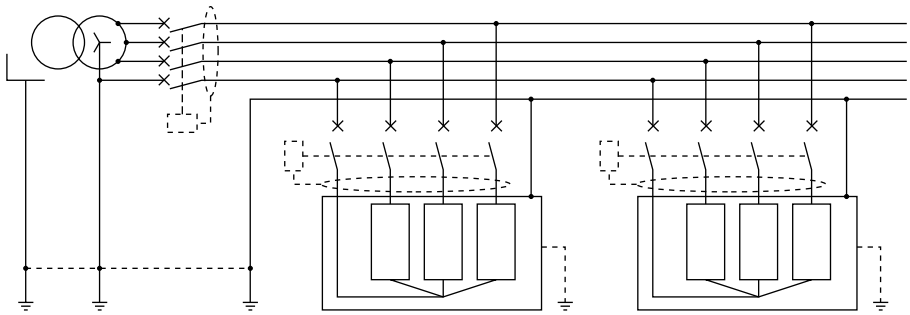
presentation

■ For LV networks, three types of earthing systems, called neutral systems, can be used, namely:
□ TT directly earthed neutral
□ TN multiple earthed neutral of frames available in 2 versions:
- TN-C (4 wires) Neutral and PE together
- TN-S (5 wires) Neutral and PE separate
□ IT unearthed neutral

■ They differ by the earthing or unearthing of the neutral and by the method used to earth the frames. The schematic diagrams and the main characteristics of the three earthing systems are recalled below.
■ The devices installed on the networks must ensure the protection of persons and equipment. Among other factors, they depend on legislation and on the required degree of continuity of supply of the installation.

TT directly earthed neutral

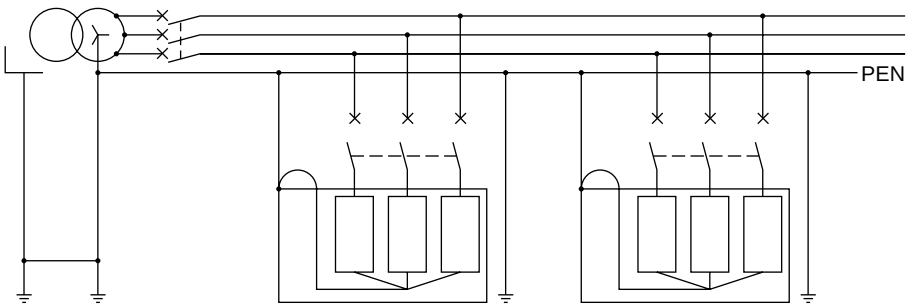


■ directly earthed neutral
■ load frames interconnected and connected to the earth on a point
■ **tripping compulsory on the first insulation fault, eliminated by a residual current device placed at the incoming end of the installation (and/or, if required, on each outgoer to enhance discrimination)**
■ the simplest solution to study and install
■ it does not require permanent monitoring during operation (only a periodical inspection of the residual current devices may sometimes be necessary).

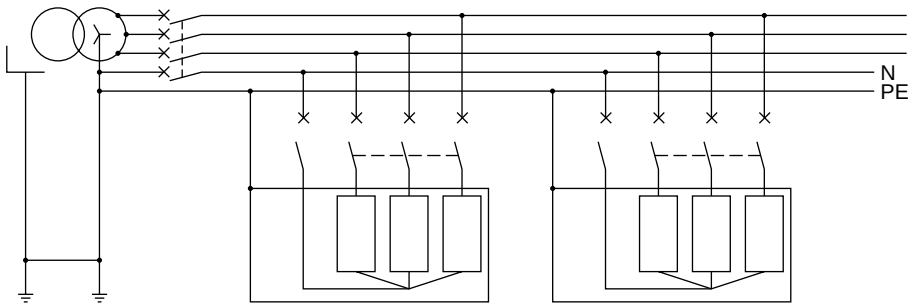
Note: if the utilisation frames are connected at several points to the earth, an RCD must be installed on each of the outgoing circuits connected to the same earthing connection.

TN multiple earthed neutral (of frames)

4-wire TN-C earthing system



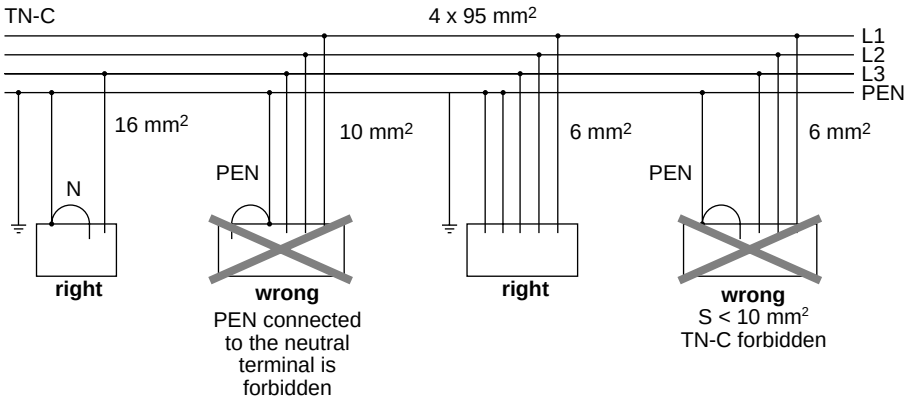
5-wire TN-S earthing system

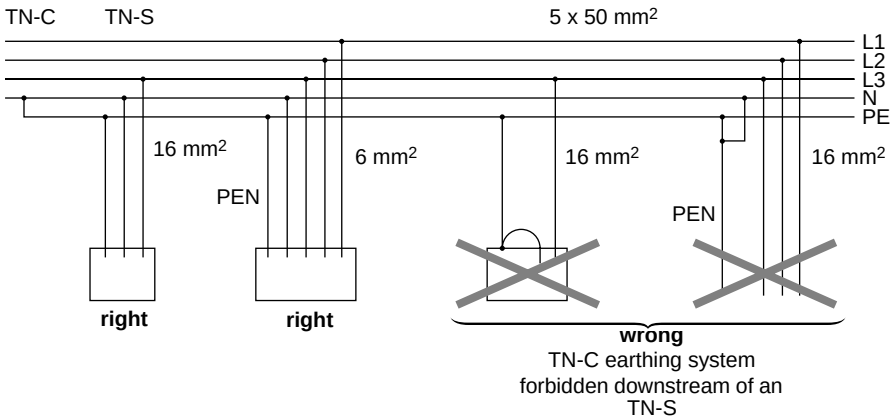


■ directly earthed neutral
■ neutral conductor and protection conductor combined (PEN): TN-C earthing system
■ neutral conductor and protection conductor separate: TN-S earthing system
■ **tripping compulsory on the first insulation fault, eliminated by the overcurrent protection devices**
■ requires competent maintenance personnel
■ increases the risk of fire due to the strong fault currents
■ the TN-C system may prove economical on installation (elimination of a switchgear pole and a conductor)
■ the savings made on installation will often be compensated by additional expenses on study and operation
■ tripping must be checked if possible on study by calculation and obligatorily on commissioning by taking measurements. This check is the only guarantee of operation both on reception and during operation as well as after all intervention (modification, extension) on the network.

Note: if it is not possible to calculate loop impedances, an RCD must be installed on each outgoer for which the calculation is impossible.

specific features of the TN earthing system



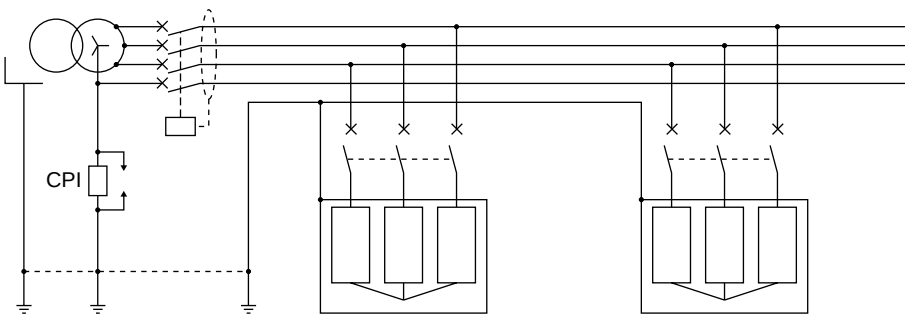


Note 1: in the TN-C earthing system, the combined neutral and PE conductor (PEN) must never be broken.
In the TN-S earthing system, as in the other earthing systems, the PE conductor must never be broken.

Note 2: in the TN-C earthing system, the "protection conductor" function takes priority over the "neutral" function. In particular, a PEN conductor must always be connected to the "earth" terminal of a load, and a bridge must be established between this terminal and the neutral terminal.

Note 3: the TN-C and TN-S earthing systems can be used in the same installation. The TN-C system MUST be upstream of the TN-S system. The TN-S system is compulsory for cable sections < 10 mm² Cu or < 16 mm² Al, or for flexible cables.

TT unearthed neutral



- unearthed or impedant neutral
- load frames interconnected and connected to the same earthing connection
- indication compulsory on the first insulation fault, followed by location and elimination of the fault using a permanent insulation monitor installed between the neutral and the earth
- **it is not compulsory to trip on the first fault, thereby guaranteeing increased continuity of supply**
- **tripping compulsory on the second insulation fault by overcurrent protection devices**
- solution guaranteeing the best possible continuity of supply during operation
- requires maintenance personnel for monitoring during operation
- requires a high level of network insulation (involves fragmentation of extensive networks, and the supply of loads with a high leakage current by insulating transformers)
- checking of trippings on the 2nd fault must be carried out if possible in the study phase by calculation, and is compulsory on commissioning by taking measurements.

Note: if the earthing connection of the substation frames is separate from the load frames, a residual current device must be installed at the incoming end of the installation.