

Selection does not depend on safety criteria. The three systems are equivalent in terms of protection of persons if all installation and operating rules are correctly followed. The selection criteria for the best system(s) depend on the regulatory requirements, the required continuity of service, operating conditions and the types of network and loads.

2.4 Selection criteria for the TT, TN and IT systems

In terms of the protection of persons, the three system earthing arrangements (SEA) are equivalent if all installation and operating rules are correctly followed. Consequently, selection does not depend on safety criteria.

It is by combining all requirements in terms of regulations, continuity of service, operating conditions and the types of network and loads that it is possible to determine the best system(s) (see **Fig. E37**).

Selection is determined by the following factors:

- Above all, the applicable regulations which in some cases impose certain types of SEA
- Secondly, the decision of the owner if supply is via a private MV/LV transformer (MV subscription) or the owner has a private energy source (or a separate-winding transformer)

If the owner effectively has a choice, the decision on the SEA is taken following discussions with the network designer (design office, contractor)

The discussions must cover:

- First of all, the operating requirements (the required level of continuity of service) and the operating conditions (maintenance ensured by electrical personnel or not, in-house personnel or outsourced, etc.)
- Secondly, the particular characteristics of the network and the loads (see **Fig. E38** next page)

	TT	TN-S	TN-C	IT1	IT2	Comments
Electrical characteristics						
Fault current	-	--	--	+	--	Only the IT system offers virtually negligible first-fault currents
Fault voltage	-	-	-	+	-	In the IT system, the touch voltage is very low for the first fault, but is considerable for the second
Touch voltage	+/- -	-	-	+	-	In the TT system, the touch voltage is very low if system is equipotential, otherwise it is high
Protection						
Protection of persons against indirect contact	+	+	+	+	+	All SEAs (system earthing arrangement) are equivalent, if the rules are followed
Protection of persons with emergency generating sets	+	-	-	+	-	Systems where protection is ensured by RCDs are not sensitive to a change in the internal impedance of the source
Protection against fire (with an RCD)	+	+	Not allowed	+	+	All SEAs in which RCDs can be used are equivalent. The TN-C system is forbidden on premises where there is a risk of fire
Overvoltages						
Continuous overvoltage	+	+	+	-	+	A phase-to-earth overvoltage is continuous in the IT system if there is a first insulation fault
Transient overvoltage	+	-	-	+	-	Systems with high fault currents may cause transient overvoltages
Overvoltage if transformer breakdown (primary/secondary)	-	+	+	+	+	In the TT system, there is a voltage imbalance between the different earth electrodes. The other systems are interconnected to a single earth electrode
Electromagnetic compatibility						
Immunity to nearby lightning strikes	-	+	+	+	+	In the TT system, there may be voltage imbalances between the earth electrodes. In the TT system, there is a significant current loop between the two separate earth electrodes
Immunity to lightning strikes on HV lines	-	-	-	-	-	All SEAs are equivalent when a HV line takes a direct lightning strike
Continuous emission of an electromagnetic field	+	+	-	+	+	Connection of the PEN to the metal structures of the building is conducive to the continuous generation of electromagnetic fields
Transient non-equipotentiality of the PE	+	-	-	+	-	The PE is no longer equipotential if there is a high fault current
Continuity of service						
Interruption for first fault	-	-	-	+	+	Only the IT system avoids tripping for the first insulation fault
Voltage dip during insulation fault	+	-	-	+	-	The TN-S, TNC and IT (2 nd fault) systems generate high fault currents which may cause phase voltage dips
Installation						
Special devices	-	+	+	-	-	The TT system requires the use of RCDs. The IT system requires the use of IMDs
Number of earth electrodes	-	+	+	-/+	-/+	The TT system requires two distinct earth electrodes. The IT system offers a choice between one or two earth electrodes
Number of cables	-	-	+	-	-	Only the TN-C system offers, in certain cases, a reduction in the number of cables
Maintenance						
Cost of repairs	-	--	--	-	--	The cost of repairs depends on the damage caused by the amplitude of the fault currents
Installation damage	+	-	-	++	-	Systems causing high fault currents require a check on the installation after clearing the fault

Fig. E37 : Comparison of system earthing arrangements