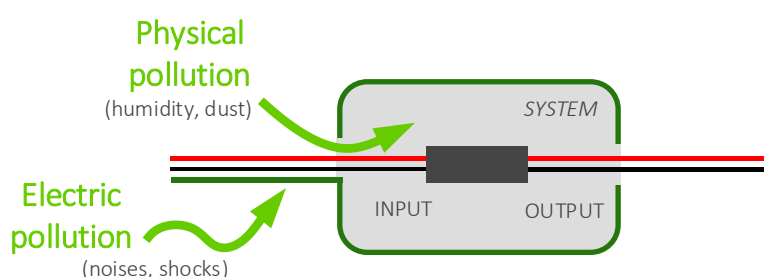


# HOW TO MANAGE ISOLATION IN POWER SYSTEMS ?

The main international standards NF EN60664-1 (or IEC 60664-1) give requirements and methods to achieve a good isolation inside power systems (we talk mainly about clearance and creepage distances). The isolation depends on:

- Rated voltage,
- Physical pollution degree: PD1, PD2 and PD3. This should consider all product life cycle,
- Electric pollution: Cat. I, II, III, IV: often, the electrical network on which systems are connected is basically not clean (due to homogeneous or heterogeneous shock voltages).
- Altitude: since the year 2007, the standard considers the effect of altitude > 2000 m (in case of transportation and storage). To have a significant margin, consider that civil EV vehicles cannot be driven over an altitude of 4000 m approximately (mountain roads).



On mobility application (EV vehicle, solar, fuel cell) it is defined for  $U_{rated} < 1000$  VDC. Basically, designers can apply the rule shock voltage =  $2 \times U_{rated} + 1000 = 3$  kV to define the maximum overvoltage that can happen on networks (due to inverters noises and connection to AC mains voltage for example). This standard considers the impact of shock voltages > 3 kV.

By applying this standard, designers can make systems circuits with basic isolation, additional isolation, or reinforced isolation with the good level of protection:

- By using primary or secondary circuits (as defined by IEC 60950-1),
- By using basic or reinforced isolation that increase the reliability and the safety,
- By using supplementary isolation that is useful in case of failures of components (intrinsic safety or safety by redundancy),
- If any, by using suitable printed circuit board (through the comparative tracking Index - CTI).

Basically, other similar standards can be used to define the isolation: EN 50124-1 (railway), EN 60950 (electrical cabinet). But due to new embedded or stationary energy systems (higher DC voltages and more functional safety aspects), designers should foresee new requirements given through an insulation coordination and create or update their internal corporate policy.

The rules of art IPC-2221 give recommendations for functional isolation and not basic isolation. Functional isolation is for electrical potentials that are in the same group of voltage, when basic, supplementary, or reinforced isolation is for insulation between different groups of voltage.

