

CRITICAL ELEMENTS FOR CORRECT CLIMATE CONTROL DESIGN FOR ELECTRICAL PANELS

Environmental conditions

Readers were provided with essential know-how on the humid air concept and concerning the psychrometric diagram in our last edition. We'll take another step in this publication to allow readers to understand why these topics are discussed and their pertinence in the electrical cabinet world.

Electrical cabinets contain components that make up an electrical panel. The latter can only work correctly if the climate conditions, also called “**design conditions**”, are suitable.

First of all, the designer must set the “design conditions”:

- $T_{in}[^{\circ}C]$, **U.R.in** [%] (cabinet interior)
- $T_{out}[^{\circ}C]$, **U.R.out** [%] (cabinet exterior)

This information must be entered in the formulas provided in the previous publication or in the psychrometric diagram to calculate other thermodynamic coordinates:

- **specific enthalpy** h_{in}, h_{out} [kJ/kgas]
- **specific humidity** X_{in}, X_{out} [gv/kgas]

Temperature control

All the above listed parameters are essential for residential designs. In electrical panels, the term that requires the highest focus is temperature. For the latter, each electrical panel component has a maximum design limit: the accidental phenomenon of excessive temperature translates into component deterioration, causing reduced performance and a reduction in durability and reliability. **CEI EN 61439** standard referred to low voltage electrical panel, does not indicate a precise numerical value for acceptable maximum pressure, but defers to standards referring to single devices and the limits stated by manufacturers. Therefore, the maximum design limit in a cabinet should not jeopardise the reliability of the contained equipment.

The same layout of the single components in the cabinet is important: temperatures are higher at the top, due to air stratification, thus it is best to install parts that generate more heat in the lower areas.

Overheating is due to the environmental conditions in which the panel is installed and, on this

topic, the **CEI EN 61439** standard sets the maximum air temperature and relative environmental humidity. For both indoor and outdoor installation, the standard sets **+40°C** as the maximum environmental temperature. To meet this requirement, in heat dimensioning we recommend setting design temperature to **35°C** for the cabinet interior (average temperature; there will be hotter areas at the top and colder ones in lower zones). In this design condition, hot-spots will not reach the **40°C** limit and, albeit indirectly, **35°C** will make condensate formation highly improbable.

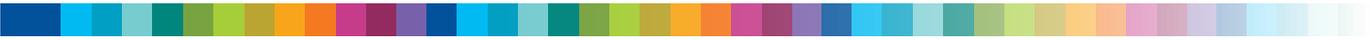
In indoor installation, internal **35°C** also avoid condensate when cooling is created by mixing internal air with an air flow from the exterior, using Fan-filters or exhaust units.

For outdoor units, to avoid condensation problems, since relative environmental humidity is **not** a controllable parameter and can frequently be high, we recommend a different solution that guarantees a net separation between external and internal air (TCUs, conditioners, air-air exchangers, water-air exchangers). Specifically, the conditioner permits air dehumidifying and is perhaps the best solution for highly humid outdoors.

The **CEI EN 61439-1** standard sets the following climate conditions indicated in **figures 1** and **2** referred to the installation environment:

ENVIRONMENTAL INSTALLATION CONDITIONS FOR OUTDOORS		
Relative humidity	Air temperature	Altitude
100% temporary (for maximum temperature of 25°C)	maximum temperature $\leq 40^{\circ}\text{C}$	not more than 2000m
	maximum average temperature in a period of 24 hours $\leq 35^{\circ}\text{C}$	
	minimum temperature $\geq -25^{\circ}\text{C}$ for temperate climates	
	minimum temperature $\geq -50^{\circ}\text{C}$ for arctic climates	

1 - Environmental installation conditions according to CEI EN 61439-1



ENVIRONMENTAL INSTALLATION CONDITIONS FOR INDOOR

Table 3.1

Relative humidity	Air temperature	Altitude
50% (for maximum temperature of 40°C) 90% (for maximum temperature of 20°C)	maximum temperature $\leq 40^{\circ}\text{C}$	not more than 2000m
	maximum average temperature in a period of 24 hours $\leq 35^{\circ}\text{C}$	
	minimum temperature $\geq -5^{\circ}\text{C}$	

2 - Environmental installation conditions according to CEI EN 61439-1

Once the admissible limits are set, $\Delta T = T_{out} - T_{in}$, the temperature difference between the cabinet interior and exterior, also called “thermal gradient”, is set.

ΔT is calculated for two distinct cases:

1. ΔT_{isc} to design heating systems;
2. ΔT_{traff} to design cooling systems.

In heating system designs, the minimum temperature possible in the installation environment and the minimum required inside the electrical cabinet are considered.

In cooling system designs, the maximum temperature that can occur in the installation environment and the maximum required inside the electrical cabinet are considered.

In both design cases, we recommend setting 35°C as the internal electrical cabinet temperature.

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