TECHNICAL NEWS

CORTEM GROUP
To be sure to be safe.

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The importance of the anti-condensation and the pre-heating systems in electric panels for environments with risk of explosion

1. Preface

In electrical panels for industrial environments, are usually installed systems for preventing the formation of inside condensation, a formation caused by the heat exchange deriving from variations of the ambient temperature in the transition from day to night and vice versa.

It is known that all the metal junction boxes, during the change of temperature from the inside to the outside, undergo a "sweating" due to capillarity that determines the creation of cold air that changes into condensation/water.

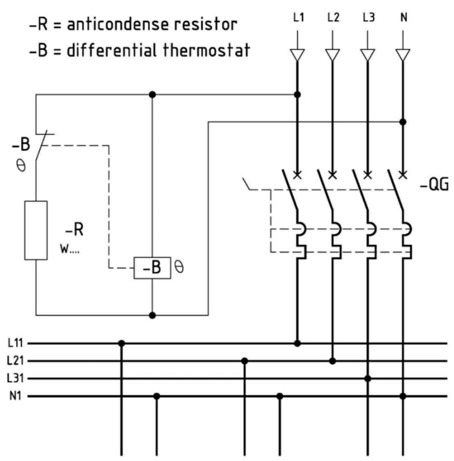
To avoid this phenomenon, since long time the designers have been using simple but functional systems that guarantee the precipitation of the condensation on the junction boxes walls, using either paints that retain this phenomenon or heating systems.

For the same reason, also in electrical and electronic equipment for environments with danger of explosion, it is necessary to adopt the same criterion of prevention and, as this equipment are generally installed outside, they have a greater necessity respect to those installed inside in industrial environments.

2. The systems

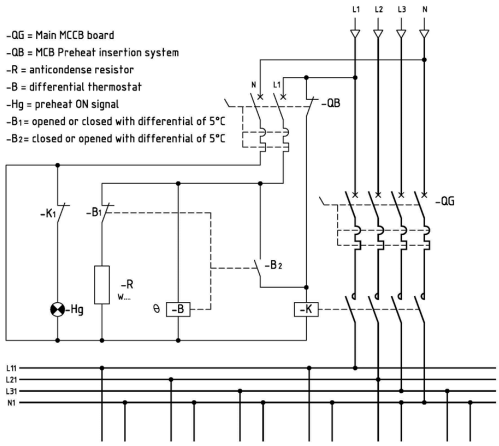
In the process of determining the prevention or protection method, there are two types of systems that can be summarized in:

1. *Anti-condensation system (the scheme is represented voltage free)*



This system consists of a "Resistance" heat generator, sized to guarantee the maintenance of a pre-set temperature inside the enclosure, which is disconnected when a functional safety temperature is reached, in order to avoid the dropping of the metal sheets inside junction box. In general, this system consists of an armoured resistor and a differential thermostat with on/off thresholds pre-set at the factory.

2. *Preheating system (the scheme is represented voltage free and set for operation with negative temperature).*



Sizing the preheating is a variable function that only applies when the ambient temperature is negative (from -20°C to -60°C) and that the designer must consider, even if not expressly requested by the customer, because necessary for the correct operation of the equipment below this negative temperature.

All electrical and electronic equipment is built to operate at precise climatic conditions that may vary from manufacturer to manufacturer, usually ranging from -20°C to + 40°C.

When the temperature is negative, the values declared by the manufacturers must be checked and, if this temperature does not fall within the design value, a preheating system must be provided in order to guarantee the full functionality of the equipment.

This system has a specific function: ensure that the electrical equipment inside the enclosure does not work if the internal temperature is below the minimum functional threshold declared by the manufacturer of such equipment.

In this case, although conceptually conceived with the same components as the first case, this system has the functionality to protect the equipment in environments with extreme negative temperatures (e.g. -60° C typical for arctic areas), therefore it will be necessary to provide the maximum attention in the sizing. The sizing is defined on the basis of eight fundamental parameters such as:

1. Internal dimensions of the junction box
2. Material of the junction box
3. Metal thickness
4. External insulation material (if required)
5. Thermal conductivity coefficient of the junction box material
6. The limit ambient temperature
7. The minimum functional temperature of the equipment placed inside the enclosure
8. The choice of operation "range" (delta "t")

The first five parameters are of primary importance because they are the ones that actually determine the dissipation capacity of the material and, therefore, to be taken into consideration in the calculation model.

The sixth parameter is the limit ambient temperature. In this case we mean the maximum negative temperature, below the "Zero thermal" parameter that will determine the electrical parameter to be considered for a correct functioning of the equipment inside the junction box.

The seventh parameter is the minimum functional temperature of the equipment, another parameter that is of primary importance. In this case, the designer will take care of the "collection" of the technical information of each equipment that must be installed inside the enclosure and, consequently, the determination of the minimum functional temperature, selecting the most critical one (the lowest), in agreement with the functional technical indications given by the equipment manufacturer.

The eighth parameter is the choice of the operating range. A good designer knows that it is not necessary to implement the functionality in the field of extremes but to consider a field that guarantees the functionality and the compliance with the minimum parameters set by the equipment manufacturers. In practice, it is adopted the concept of not allowing the equipment to reach the extreme negative temperature, which obviously involves having to size the system from the minimum extreme to the minimum functional, but to put a lower upper limit, in order to ensure the operation without have to oversize this protection system. For example, if the outdoor temperature will be -60°C and the minimum functional temperature of the equipment will be -20°C, the criterion used will be insert the preheating resistance starting from -5°C with respect to the minimum functional temperature of the equipment, making the system operate in the 5° C range, from -25°C to -20°C, with a lower energy requirement.

Obviously this system must be designed so as to ensure the functionality of the equipment and it must be switched off after a "delta t" temperature, for example 5°C above the minimum functional threshold, in order to avoid the parallelism of dissipations that cannot be contemporaneous. This could cause the exceeding of the maximum allowable dissipation for the equipment according to the temperature class "T

..." and the "Tamb ..." ambient temperature which are determined in the specific certificate parameters for each equipment.

Based on these data, by specific calculation, the "delta t" in °C, the global exchange coefficient, the required power in Kcal and the power required in Watts will be determined.

Assuming that the "delta t" goes from -60°C to -35° C, there will be a "delta t" value equal to 25° C, then the preheating system must be sized for this "delta t" value, in order to guarantee the operation of the equipment without permanent damage.

As can be seen from the scheme above, in order to guarantee the functioning of the equipment with an ambient temperature of - 60° C, it will be necessary to insert a contactor downstream of the main switch which, driven by the -B differential thermostat, will command the closing and opening of the -K contactor and, consequently, the insertion and disconnection of the preheating resistance -R. Through the -QB switch, it will however be possible, in the summer period, to exclude the preheating resistance by simply operating on the opening of the same which, through an auxiliary contact normally closed, supplies the -K contactor, thus allowing the panel to operate.

Cortem Group is responsible for analysing, together with the technicians of its customers, the plant requirements and the most congenial types of protection described above for project. Consequently, it adopts the more suitable functional model, always in full compliance with the parameters provided for in the certifications. As always, the system designer will select the adoptable model.

We conclude recalling that all activities of electro-mechanical sizing are the prerogative of the manufacturer of the explosion-proof Panel board which is responsible for the analysis, the calculations and the consequent executive project by placing the marking plate of compliance with the relevant standards.