

Technical note

Motors and generators in severe environments



Motors and generators in severe environments

“Severe environments” is a collective designation for various situations that may be prevalent in a production environment. In the IEC 60721 Standard, atmospheres are classified according to several environmental criteria by their severity and divided into several categories. As regards electric motors, the following conditions are typical and critical: hot and cold conditions, deserts, offshore, corrosive and hazardous atmospheres.

Cold conditions

Extremely cold environments, typically down to -50°C [-58°F], have a significant effect on motor design, especially in terms of material selection and treatment of shafts, frames, end-shields, bearings and their lubricants. However, some parts of the motors might still need to be equipped with special heaters to maintain temperatures above certain limits to avoid malfunction and material breakdowns. Starting a motor when it is cold is one of the most critical conditions that must be considered during the design phase. The electronic and non-electronic accessories also require special attention to cope with cold conditions.

Correct design and material selection for these parts will positively affect motor lifetime and reliability, and the motor will run as smoothly as it would in a normal environment.

Hot conditions

Extremely hot environments affect motor design and motor components. Typically, hot conditions are areas where temperatures can reach levels of $+55^{\circ}\text{C}$ [131°F]. Motors intended to be used in these environments must be designed so that their own heat generation (loss) is lower than normal, and the total temperature of the different parts falls within the absolute limits that would exist in a normal environment. Extreme heat primarily affects the stator, bearings and their lubrication as well as operation and selection of accessories. In general, each additional 10°C for design temperatures cuts the lifetime of the windings in half. Therefore, it is important that motors are designed with the correct ambient temperature, and that the effect of higher temperatures is taken into account when designing them. Motors are also installed outdoors where they can be affected by direct sunlight, which also influences the absolute temperatures of a motor and its bearings. Direct sunlight should be taken into account when designing the motor, or the motor can be covered by a sun shade.

Desert environments

In addition to periods of extreme heat, sandstorms must also be taken into account in desert climates in order to ensure problem-free operation when adapting the equipment to the climate. There are different means of preventing sand from entering bearings and enclosures, and of minimizing its effect on the parts. Merely selecting the correct sealing and ingress protection can give satisfactory results. Additionally, bearings can be equipped with purging facilities to keep them free of sand during idle periods. In some installations, there is a risk that sand can be abrasive on windings. Special treatment is available in these cases to prevent potential stator failures. Furthermore, surface treatment inside and outside the motors needs to be adequate for abrasive conditions and direct sunlight.

Hazardous environments

Hazardous atmospheres contain potentially explosive elements including gases, vapors, mists and dust. This means that all equipment and accessories must be designed, manufactured, operated and maintained according to international standards, and they must adhere to applicable local regulations. Motors intended to be used in these areas need to be designed and certified to prevent different potentially explosive sources such as sparks and high surface temperatures.

ABB has its own standard designs for different severe environments that target maximized reliability of motor operation. Our global expert network is ready to help you to find the appropriate design and specification for demanding environments.

Offshore, humid and corrosive environments

Examples of corrosive environments include offshore platforms and production facilities for the chemical industry. These environments place high demands on material selection for motor fans, seals, heat-exchangers, terminal boxes and even small bolts and nuts. Other parts need to be correctly coated based on the appropriate corrosion classes according to the ISO 12944-2 Standard. For example, chemical environments can corrode aluminum fans and seals in a short amount of time if the material is not selected correctly, or a water-cooled motor heat exchanger might start leaking if water specification is not taken into account when selecting tube materials.

In offshore installations, the dynamic motions of the unit must be considered when designing the motor. Additional loads generated by roll, pitch and accelerations affect bearing selection, in particular of sleeve bearing arrangements.