



Shock resistance in the marine sector: this is a submersible motor rated for depths of up to 10 metres for up to four days. It is intended to drive a turning gear, which is the drive mechanism used to put a larger main engine into its initial rotational movement. The customer required shock resistance up to 100g, but not continued functionality after shock exposure. All motor components were manufactured from steel and fastened with high-strength screws.

Custom motors often have to fulfil heavy-duty requirements for harsh environments such as dirt, extreme temperatures, vibration or impacts. Shocks are particularly challenging for motors as they exert a short-term high load on the system and therefore also on the motor. The motor must be robust enough to withstand the load so that parts do not break off and the motor does not fail. This blog post describes what to consider when designing shock-resistant motors.

A motor's shock resistance is defined by the level of g-forces it can withstand when subjected to shock. Vibrations, shocks and impacts can generate forces several times greater than gravity. Depending on the application and industry, electric motors must be designed to prevent parts from loosening or functions from being compromised by these forces.

Shock Resistance Categories

We classify shock-resistant motors on the basis of three categories – standard, medium load, and high load – and we design and build our motors accordingly. In the standard range, encompassing loads of up to 15g for six or twelve milliseconds, no special measures are necessary. Our grey cast iron motors, including all components such as bearings or flanges, are already constructed for secure durability under such loads.

In the medium range, 15–25g (for the same duration), we use improved, high-strength screws for all components. In addition, the winding at the heart of the motor is treated and protected with improved materials so that higher shock loads do not affect the individual wires.

Measures for motors that require shock resistance above 25g are assessed individually. Typically, spheroidal graphite iron is used for housings and components which, due to its structure, can better dampen and dissipate sudden shocks without breaking. High-strength steel parts are also used as needed. Additionally, special bearings, such as cylindrical roller bearings, may be selected to further increase stability. The complete specifications – such as mode of operation, operating time, speed, and more – must be considered when choosing materials for these stress ranges.

Example Sectors: Marine and Steel Industry

We often receive requests for shock-resistant motors in the **marine sector** – for drives such as mooring and anchor winches, and for pump motors installed on or below deck. Ship operators require shock resistance to adhere to specific standards, to ensure safety under extreme conditions – for example, when under fire. The key is to keep any parts from breaking free and flying around in a shock event; maintaining functionality is less critical. For smaller vessels such as patrol or supply ships, shock resistance of about 15–20g is standard, but upon request, we build motors for these ranges from spheroidal graphite iron for added safety. Large frigates often require shock resistance up to 100g. For these, we examine materials, screws, and bearings for each motor on a case-by-case basis.



Shock-resistant BEN motor next to a ship's winch

In the **steel industry**, we supply shock-resistant motors to power large forging hammers. Here, the concern is not a single shock but ongoing impacts transmitted to the entire system – including the motors. These applications see up to 30g of g-forces, which we address by using spheroidal graphite iron for all housings, reinforced bearings and high-strength screws where necessary. In applications subject to continuous shock load, it is important not only to prevent a motor from breaking apart, but to guarantee continuous operation.

Shock Testing

On customer request, we conduct shock tests for motors. For example, together with a certified test institute, we recently subjected a size-225 motor for a ship chandler to shocks, checking effects at critical points – such as cast components, high-strength screws, or steel parts.

Typically, shocks affect an object in three directions, so classification societies specify maximum g-forces in three axes: vertical, transverse and longitudinal. For our example: 39g vertical, 26g transverse and 20g longitudinal – a medium-to-high shock load. The motor was built using spheroidal graphite iron and steel parts. We constructed a test frame to suspend the motor and move it into all positions to apply shocks from all three directions. This required elevating the motor on the frame and dropping it to simulate the forces. The test confirmed our design principles in practice once again. We are happy to conduct additional shock tests for other sizes or g-force levels upon request.