



# Shaft voltage analysis of hydrovar® X

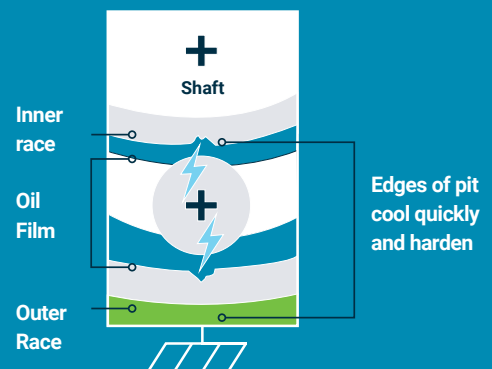


## Shaft grounding rings unnecessary for safeguarding bearings on hydrovar® X motors

Extensive testing confirms mitigation devices are not required.

Motor bearings are essential components in electric motors that provide support and facilitate smooth rotation of the motor's rotating shaft. But fast-switching voltages inherently seen in variable frequency drives and unshielded power cables sometimes give rise to motor shaft voltages that can result in electrical discharge currents within the motor bearings. These discharges pose a substantial risk of bearing failure, which could result in costly maintenance and unanticipated production interruptions.

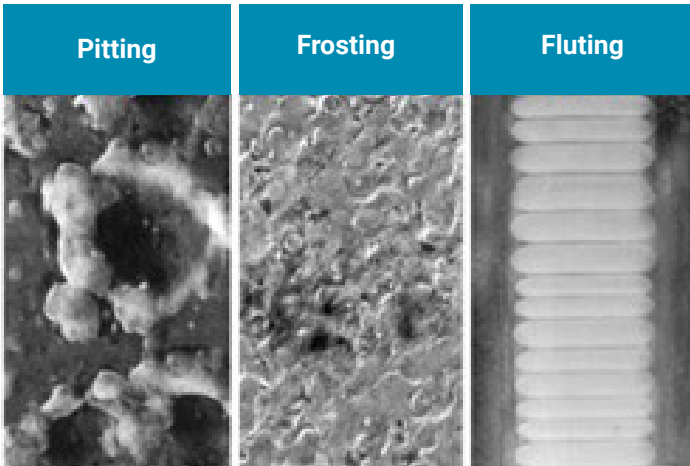
If a voltage potential builds up between the bearing balls and bearing race, and that voltage exceeds the dielectric strength of the insulation material, insulation breakdown occurs. This breakdown creates an electric arc, resulting in material removal from both sides, creating a threat to the bearings by eroding material and altering mechanical properties. With each revolution, bearing balls or rollers displace the removed material, causing additional deformation in the bearing races.





Various types of electric arc damage can occur, including:

- Pitting:** Characterized by the formation of holes, occurring in either the balls or the races
- Frosting:** Appearing as a gray, discolored area surrounding all or part of the bearing race, visible in both the inner and outer race
- Fluting:** Recognizable by a distinctive washboard pattern



Measured Shaft voltages for hydrovar X

	Peak Voltage [V]
Size B - 7.5 hp	3.92
Size C - 15 hp	5.88
Size D - 30 HP	8.15

Mitigation measures such as the use of insulated bearings or shaft grounding rings can be implemented to diminish the risk of potential damage. To assess if hydrovar X motor technology required these mitigation measures, Xylem executed an extensive test program to determine if shaft voltages reached levels where potential bearing damage could occur.

**NEMA MG1 Part 31.4.4.3** defines a shaft voltage level of 10V as a reliable warning threshold. It is worth noting that no definitive study currently exists establishing the quantifiable correlation between peak voltages resulting from inverter operation and bearing lifespan or failure.

Xylem’s test results confirmed that shaft voltages remain below 10V during normal operation. These consistently low levels of recorded shaft voltage show there is a negligible risk of bearing damage or reduced bearing lifespan due to electrical discharges. Xylem also conducted endurance tests exceeding 3,000 hours on multiple units, with post-test analyses by several bearing manufacturers revealing no indications of damage caused by shaft voltages.

Consequently, the installation of shaft current mitigation devices, such as shaft grounding rings, is deemed unnecessary for safeguarding bearings on hydrovar X motors.