ZORC® - Frequently Asked Questions

What is the primary use of the ZORC product?

The ZORC is a unique, high frequency transient over voltage surge suppressor for the protection of motors, transformers and generators from steep wave-front, short rise-time, high magnitude, spikes, surges, other transient voltages and circuit switching.

Does ZORC protect against lightning strikes?

No. ZORC is not designed to protect against direct lightning strikes and it is strongly advised that additional lightning protection be employed in high lightning incidence areas.

How is ZORC selected for a particular application?

The ZORC should be selected to match the system voltage (V_{L-L}) in which it will be installed. Furthermore, consideration should be given to whether the ZORC will be installed in a switchgear panel or close the equipment that it will ultimately protect.

What maintenance checks need to be performed on the ZORC?

The ZORC is maintenance-free requiring only periodic cleaning of bushings in contaminated areas.

Periodic visual inspection on the installed ZORC unit should include checks for:

- Dirty, broken or chipped bushings.
- Tracking on the porcelain bushings.
- Physical damage to the casing.
- Earth/grounding cable and terminal cable. The casing earth and terminal cable should not be corroded.
- Excessive bulging of the metal container. (Needs to be removed from service immediately)
- Oil leaks, especially as a result of hair-line cracks on the bushing. (Needs to be removed from service immediately)

One of two versions of an excel Tool in order to assist in Field Verification is available upon request:

- Zorc-Capacitor from V_I_xvxx.xlsx or
- Zorc Capacitor from V_I_Z Measurements Calc xvxx.xlsx

Refer to the ZORC Manual for additional information.

How often should a ZORC be checked or tested when in service?

Electrical testing may be done once per annum with visual inspections every second month.

What electrical tests are typically performed on the ZORC?

Each ZORC unit is routine tested after the manufacturing process. The tests are typically AC and DC over-potential tests performed in a controlled testing environment and according to certain testing specifications. Furthermore, basic resistance and capacitance testing is done prior to being dispatched.

Can the ZORC be mounted inverted (up-side down)?

ZORC units may be installed in any orientation (including up-side down).
However, consideration needs to be given to any force that may be applied to the porcelain bushing as a result of the mass of the connecting cable. Cable mass needs to be supported to minimise any moment of force on the bushing.

Why are there signs of bulging on the ZORC metal container?

It is normal, during production, that a certain amount of swelling will occur as a result of the heating process required and the packing of internal components.
Excessive swelling would indicate an internal issue as a result of heat build-up. In this case the manufacturer should be consulted.

What is the maximum continuous operating voltage that the ZORC may be exposed to?

The ZORC is capable of operating with a Line to Neutral voltage (L-N) equivalent to the full Line to Line voltage of the system in which the ZORC is installed.

What is the difference between the panel mount and machine mount ZORC units?

The ZORC designed for installation in switchgear panels, that will be close to the source of the switching transient, has a significant wave sloping characteristic that mostly minimises the effect of the transient at the machine end. However, the machine mount ZORC completely eliminates the effect of the transient at the machine end.
The panel mount units are only available up to and including 13.8kV rated ZORCs.

Also, the KPV (knee-point voltage) of the MOVs in the Motor and Panel Mount ZORCs differ as follows:

Machine Mount ZORCs:
Under high magnitude steep wave-front conditions, the MOV / ZnO arrestors 'trigger' between 1 and 2pu for the Motor Mount ZORCs.

Panel Mount ZORCs:
Under high magnitude steep wave-front conditions, the MOV / ZnO arrestors 'trigger' between 0.5 and 1pu for the Motor Mount ZORCs.

where 1pu = $\frac{\sqrt{2}}{\sqrt{3}} V_{L-L}$

Which application is best, machine mount or panel mount?

Machine mount (as mentioned above) is considered to be the best application for ZORC.

What is the maximum distance from the machine or switchgear (supply cable length) that a ZORC may be mounted?

It is recommended that the ZORC be mounted no further than 20m (supply cable length) from the machine or switchgear.

What is the maximum length of the cable that connects the ZORC to the machine terminals or switchgear busbar?

The cable connecting the ZORC to the machine or switchgear busbar should not be more than 5m. However, 3m is strongly recommended.

Does harmonic activity have an effect on ZORC?

Harmonics will generate heat within the sealed ZORC container and this in turn will potentially damage and degrade the capacitor elements, therefore decreasing the life expectancy of the ZORC unit. Excessive harmonic levels could also result in immediate permanent damage to the ZORC or result in catastrophic failure.

Typically, a total harmonic voltage distortion TH(V)D of 8% or above should be considered dangerous to the ZORC unit. A ZORC Phase Current Tool is available upon request, in the event that the system TH(V)D is known in order to evaluate the conditions with harmonics present.

Is there a specification for the tightening of the bushing terminal nuts?

The bushing nuts should be tightened to 20Nm or less.

What size cable should be used to connect a ZORC to the machine or switchgear busbar or terminal?

A minimum cable size of 2.5mm² should be used for ZORCs rated from 3.3kV to 13.8kV. For voltages types from 15kV to 22kV a cable size of 4mm² is recommended and for 25kV to 40kV a cable size of 6mm² to 10mm² will suffice.

Should additional insulation be applied to the bushing terminals of the ZORC?

It is strongly recommended that additional insulation be applied to the bushing terminals of the ZORC. This could be in the form of standard taping or the use of 'bird cage' type insulator caps.

What size earth / grounding cable should be used with the ZORC?

The earth cable should not be less than 16mm² to 25mm². Braided copper is preferred although other types may be used.

Using a smaller cable size could result in local damage and possible failure of the ZORC when the discharge goes to ground via the mounting bracket

Where should the earth / grounding cable of the ZORC be terminated or connected to?

It is imperative that the earth / grounding cable from the ZORC be connected to the machine earth that it is protecting or switchgear panel earth in accordance with local regulations.

What is the life expectancy of the ZORC?

Under normal operating conditions the ZORC has an expected lifespan of approx. 20 years.

Is flexible terminal cable supplied with the ZORC unit?

Flexible terminal cable is only supplied for the 3.3kV and 6.6kV Compact ZORCs.

Does the ZORC have an internal discharge resistor?

The ZORC is not equipped with an internal discharge resistor and caution should be exercised when removing the unit from service. Proper safety discharge procedures should be followed before handling the ZORC unit.

Do you use non-inductive resistors in the ZORC?

In order for the ZORC to optimally perform its suppression function, the resistors in the ZORC units are classified as non-inductive resistors, thus resulting in the lowest possible impedance path to earth/ground during fast transient switching activities. Typical resistor inductance is in the range of between 3 to 5 µH @ 100kHz for the range of ZORCs. Tabulated model specific values are available upon request.

Why is a standard 0.2µF capacitor per phase used in most ZORC units?

The value of Capacitive Elements is optimised to minimise the heat dissipation and stressing of the resistive elements under normal mains frequency conditions while still performing its function as a "frequency dependent switch" and as a "wave sloping capacitor" under high frequency transient conditions.

Are HH Fuses required to be installed with the ZORC?

Installation of HH Fuses are traditionally not required and would be optional, unless specified by the relevant protection specialist / engineer or in the event that the installation risk assessment requires HH Fuses. The ZORC has multiple capacitor elements in series and a combination of series and parallel resistors. Detection of a single capacitor element failure can be detected by means of monitoring an increase in current beyond normal operating conditions. In the event that HH Fuses are used, fuse monitoring would be required in order to ensure that detection of a blown fuse is detected.

Are Routine Electrical Tests performed on each ZORC Unit?

Yes, routine tests are performed on every individual ZORC unit manufactured according to IEC60871-1:2014. Further information is available upon request.

Can the ZORC be subjected to vibration?

No, the ZORC should not be directly exposed to vibration (ex. Motor / Generator vibration) in order to potentially avoid shearing of the bushings from the metal tank which would result in oil leaks.

What is the typical Capacitive Reactance (Xc) of the ZORC between phase and Earth/Ground?

Under nominal system frequency the capacitive reactance is respectively, Xc_{50Hz} ≈ 16kΩ and Xc_{60Hz} ≈ 13kΩ between phase and Earth/Ground. $X_C = \frac{1}{2\pi fC}$

Note that the capacitive reactance significantly reduces with increased T(V)HD which increases heat dissipation in the resistors.

Are CAD drawings available?

Yes, CAD files can be provided upon request. Standard formats are .dwg or .stp.

Is the ZORC a power factor correction capacitor?

No, the ZORC is not a power factor correction capacitor but rather a high frequency transient over voltage surge suppressor, and must not be applied to provide power factor correction.

Why should the ZORC resistance value match the cables' surge impedance?

When the ZORC resistance R meets the criteria of $Zc \leq R \leq 3\ Zc$ (where Zc is the cable impedance) the ZORC unit minimizes voltage reflections / refractions and avoids voltage doubling and high frequency restrike current zeros.

What is the Time Constant (τ) of the ZORC?

The Time Constant of the 3 Phase Standard ZORC is: $\tau = RC = 30\Omega \cdot 0.2\mu F = 6\mu s$.
Refer to model specific capacitance values in the TECHNICAL SPECIFICATION SHEET. Noting that the time constant and attenuation changes when the pulse reaches the KPV of the MOV which is unique to the ZORC design.

What is the MOV Reaction Time in the ZORC?

Typical reaction time of the MOV is < 25ns.

What is the power and energy rating of the Resistor in the ZORC?

Power and energy ratings are model dependant. Model specific values are available upon request. We recommend using ZORC Phase Calculator Tool (for harmonic operating info) which includes ambient temperature factors.

Why is the ZORC superior to a discrete RC Suppressor?

The ZORC acts as a normal RC suppressor until the voltage reaches the knee-point voltage (KPV) of the MOV. For voltages exceeding the KPV, the MOV provides the functionality of effectively inserting only the capacitor in the circuit in order to perform optimum wave sloping in order to slow down the rise time and attenuate the transient wave more (wave sloping effect). If there are transients below the KPV of the MOV then the ZORC acts as a standard RC suppressor.