

# Comparison between porcelain and silicone rubber for use as outdoor insulation on high voltage bushings

## Product information



ABB has been manufacturing bushings with porcelain as the main outdoor insulation since the beginning of this century. Silicone rubber has been in use as outdoor insulation for suspension insulators and in other applications for more than 25 years.

Today, silicone rubber together with EP-rubbers are the most used polymeric materials for medium and high voltage outdoor insulation. The silicone rubber used by ABB for high voltage equipment is made of a specially formulated HTV, High Temperature Vulcanising, silicone rubber which has several advantages compared to porcelain. This instruction lists the most important properties for outdoor insulation and a short comparison between the characteristics of ABB silicone rubber (SiR) and porcelain both as materials and as an integral part of the bushing.

### Hydrophobicity

The surface of silicone rubber maintains a high level of hydrophobicity even during severe environmental conditions. If the hydrophobicity of the surface is decreased, the surface will recover its hydrophobic properties in less than 12 hours since the silicone rubber continuously emits molecules of silicone oil to the surface. The layer of silicone oil is only a few molecules thick and provides the hydrophobic properties of the surface. The hydrophobicity of porcelain on the other hand is reduced already after a few days with medium severe pollution levels and will not recover unless the surface is cleaned. The design criteria for porcelain insulators according to standards is 31 mm/kV at severe pollution levels. In order to fulfil the standard requirements, the same design criteria for specific creepage distance for silicone rubber insulators as for porcelain is used which provides an even more robust design regarding the limitation of leakage currents.

### **Leakage currents**

Thanks to the improved performance during and after severe environmental conditions with ABB SiR, the leakage current level along the insulator is very low compared to porcelain. A typical value for porcelain is 10 mA and for silicone <1 mA. This property also reduces the risk for flash-overs and thus increases the reliability of the product and eliminates the disturbances in the power grid resulting from such events.

### **Lightweight**

The density of ABB SiR is 1530 kg/m<sup>3</sup> and 2500 kg/m<sup>3</sup> of porcelain. The electrical insulation inside the ABB SiR is made of resin impregnated paper. The high mechanical strength of the insulation material supports the silicone rubber, which need to be just 5 mm thick with the exception of the sheds. Thus the weight of the GSA bushings is reduced to approximately half of its equivalent oil impregnated bushings with porcelain as outdoor insulation. With a more light weight design, the ability to withstand earthquakes is increased as well.

### **Maintenance-free**

The need for cleaning the insulator is almost eliminated when using ABB SiR. Porcelain on the other hand might have to be cleaned more often in medium polluted areas as well. ABB SiR may need to be cleaned but only in extreme environmental conditions.

### **Non-shattering material**

The ABB SiR material has a non shattering failure mode if subjected to vandalism, mechanical shocks etc. The GSA bushings with ABB SiR insulators are well suited for applications where vandalism by for example stone or brick throwing can be expected. The risk for transport damage is almost eliminated as well. The safety of personnel is increased due to the non shattering material in the case of an unexpected failure on site.

### **Self-extinguishing**

Silicone rubber is proved to be self-extinguishing even if a test sample is held vertically over an open flame. With this feature the bushing with it's ABB SiR insulator will not cause fire, not even maintain or develop a fire. Porcelain will of course not burn but it can explode or crack by extensive heating from fire sources and consequently increase the fire when the oil is let out from the bushing.

### **Summary**

The advantages of ABB SiR compared to porcelain described above are unique to ABB SiR and are not valid for other polymeric materials like EP-rubbers or epoxy. The GSA bushings and the ABB SiR are thoroughly tested according to relevant standards and the outdoor SiR insulators have proven their good performance during long time testing at test stations in severe environmental conditions.