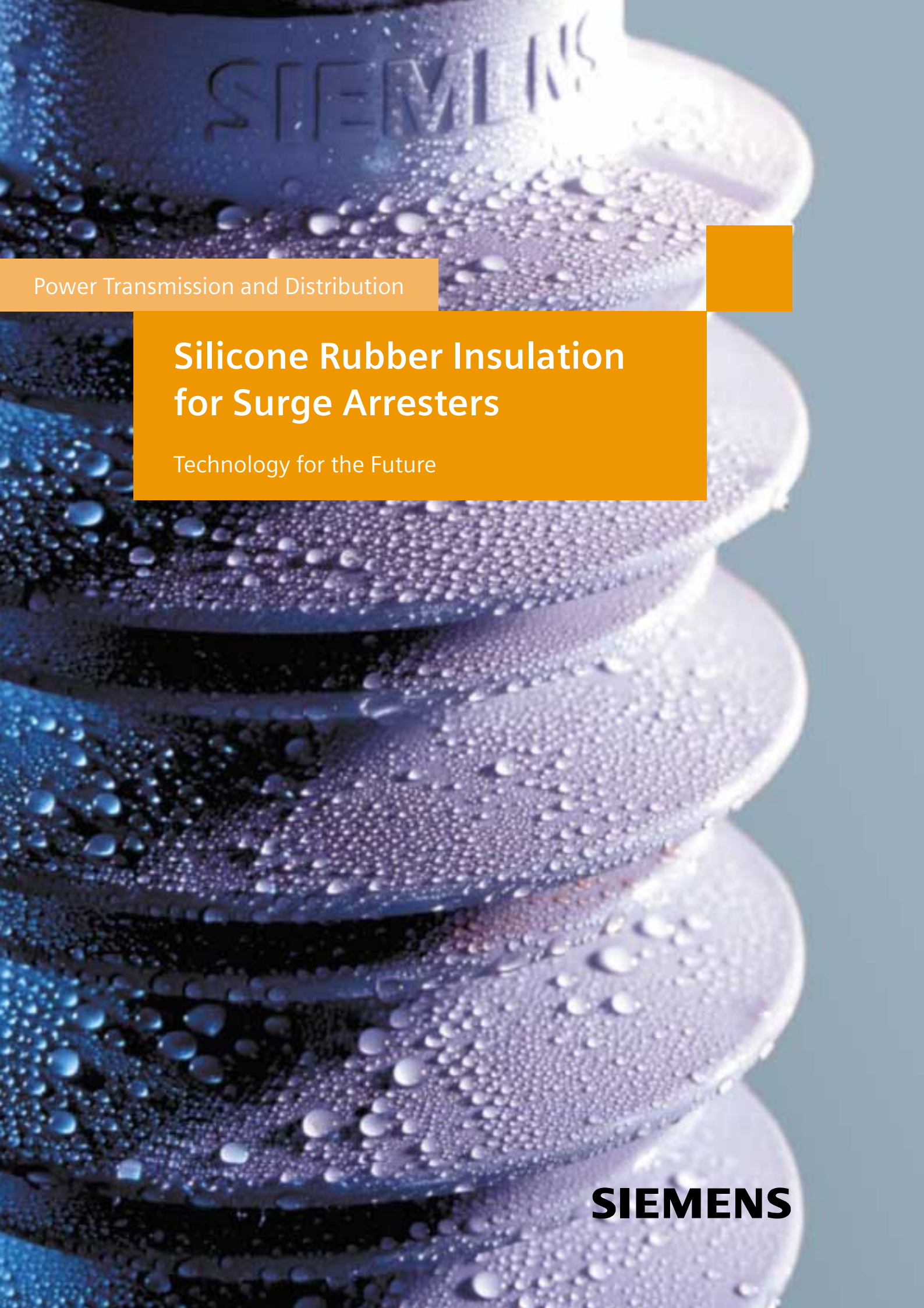


Power Transmission and Distribution

Silicone Rubber Insulation for Surge Arresters

Technology for the Future

SIEMENS

Silicone Rubber – The importance of a resistant surface

As power consumption increases worldwide, so does the need for forward-looking and assured technology that will help provide reliability to power systems. Indeed, the future of modern society depends on an efficient and reliable supply of electricity.

High-performance surge arresters play an indispensable role here. The Silicone Rubber (SR) insulation for arrester housing demonstrates excellent pollution layer characteristics.

Neither water nor dirt can cause flashovers, a significant factor in an arrester's reliability. The hydrophobic properties of the arrester housing made of SR prevent conductive moisture from forming on its surface, even when contamination is substantial.

Surface currents and discharges are ruled out. Even the most severe ambient conditions, such as salt fog in coastal regions or dust-laden air in an industrial area, cannot impair the hydrophobicity of SR.

Siemens have devoted considerable research and development towards ensuring that our Silicone Rubber arresters maintain their insulation characteristics throughout their service life.

Silicone Rubber: There is no insulating material quite like it

- Reliable long-term hydrophobicity
- Highly UV-resistant
- High dielectric strength
- Flame-retardant
- Long service life
- Roughly 50 % lighter than porcelain
- Non-toxic, ecologically sustainable
- Robust, largely unaffected by vandalism

Siemens Silicone Rubber (SR) housed surge arresters from the 3EL, 3EQ, 3EB and 3EK families – for use on both medium and high voltage levels – feature SR as insulating material. We decided to use exclusively SR for our polymer-housed arresters because, in our view, it is simply the best and confirmed by several researches. The following characteristics set silicone elastomers apart from other organic insulating material.

For our arresters we use only HTV[1)] or LSR[2)] silicone elastomers. These materials help maintain the aforementioned properties.

1) HTV: High-temperature vulcanizing
2) LSR: Liquid silicone rubber

The –Si–O– backbone of SR has a higher bonding energy than the –C–C– backbone of EPDM. SR has a lower carbon proportion than EPDM. Consequently, SR has inherently better chemical and physical resistance, better UV resistance and lower flammability than EPDM. Consider these facts:

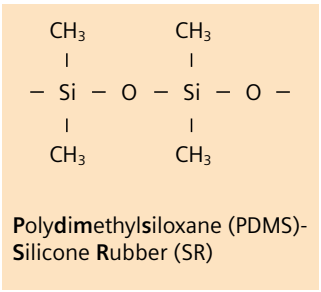
- SR is highly stable under influence of ultraviolet radiation (sunlight), ozone and nitrogen oxide – SR beats EPDM based alloy rubbers
- Hydrophobic (water-repellant) surface throughout arrester service life – SR's performance is excellent, whereas EPDM based alloy Rubber lacks this critical requirement
- Hydrophobicity of SR returns after corona discharge – assured and reliable long-term performance
- Resistant to arcing much higher for SR
- SR Flame-retardancy complies with IEC 60707 and UL94 V-0 (i.e. self-extinguishing, no burning drips, probe does not burn)
- Resistant to all customary organic and non-organic cleaning agents and solvents
- SR performs well in ambient temperature range of –60 °C to +200 °C, no other polymeric material can beat SR

We invite your attention to the conclusions of the following technical papers comparing performance of SR and EPDM based rubber:

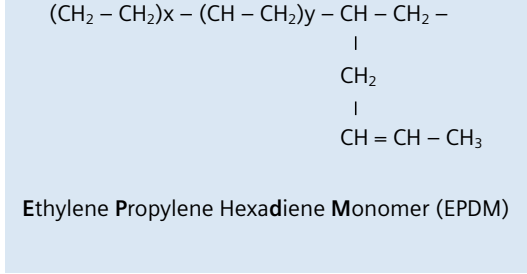
- Schneider, Guidi, Burnham, Gorur, Hall: Accelerated aging and flashover tests on 138 kV nonceramic line post insulators. IEEE Trans. On PD, 1993.
- Aging in outdoor insulating polymers due to UV and high temperature. IEEE CEIDP, 1991.
- Worldwide Service Experience with HV Composite Insulators. ELECTRA N° 191 August 2000.

3) Schmuck F.: Comparison between HTV-Silicone rubber and EPDM used for polymeric outdoor insulators, SEFAG AG, Malters

4) Straßberger W., Winter H.-J.: Siliconelastomere in der Mittel- und Hochspannungstechnik, Wacker-Chemie GmbH, Burghausen



Polydim**e**thyl**s**iloxane (PDMS)-**S**ilicone **R**ubber (SR)



Ethylene **P**ropylene Hexa**d**iene **M**onomer (EPDM)

Observed damage characteristics due to natural UV on EPDM insulators

Chalking[3)]

Crazing/Cracking[3)]

Chemical bond	Energy (kJ per mole)
–Si–O– (Silicone rubber backbone)	445
–C–C– (EPDM and Epoxies backbone)	348
Energy of UV radiation (300 nm)	398

The –Si–O– backbone of SR has a higher bonding energy than the –C–C– backbone of EPDM

Hydrophobic effect due to alignment of methyl groups of silicone polymers[4)]

Hydrophobic effect on 3EL surge arrester of Siemens

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If you have any questions about Power Transmission and Distribution, our Customer Support Center is available around the clock.

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