Influence of expansion on electric field distribution of stress cones for high voltage cable accessories

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Modern accessories for extruded HV and EHV cables commonly make use of premolded stress cones made from elastomeric materials. This is widely established because of many benefits, like easy installation and the possibility of routine testing all stress cones in the factory.

A stress cone is made from insulating material on the outside and embeds a semi conductive layer or part, which is formed to create a field controlling contour. Silicone elastomers have won recognition in this field due to the good manufacturing properties and the outstanding dielectric performance. Computer aided calculation of the electrical stress in the accessory is used to determine the exact shape of the stress cone parts.

At joints and outdoor terminations the stress cones have to be installed on the cable with considerable expansion in a defined range. This expansion creates the surface pressure that is needed to withstand the electrical field stress in the gap between stress cone and cable surface.

By expanding the stress cone gets out of its original shape - the wall thickness is reduced and the deformation changes the outline of the semi conductive surface. Thus the original electrical field calculation is no longer valid. The electrical field stress is generally increased and the installed accessories may perform worse than calculated.

Today cable systems tend to use higher voltages, which are often combined with comparative less insulation thickness. As a result of this some cables have a very high electrical field in the insulation that is straining the accessory field control system. At the same time the use of very large conductor cross sections is increasing, ever raising the electrical field in outdoor terminations. Consequently the stress cones have to be designed in an optimal way and it is sensible to consider the deformation effect.

This paper describes an approach for this problem. The expanded outline of the surface contours are calculated by a simple method. This method is based on the assumption that the volume of the elastomeric part is not changed by expansion. The new surface contours are then used in the electrical stress calculation. Eventually the original contour of the stress cone is modified to give optimum performance after expansion.