

Mechanical Evaluation of Axially Loaded Composite Insulators with Crimped End-Fittings

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Abstract

Composite insulators consist of a glass reinforced polymer (GRP) rod, with two metal end-fittings attached to the ends of the rod during assembly. This paper aims to evaluate the strength and design of mechanically crimped insulator end-fittings subjected to axial tensile or compressive loads during service. A non-destructive ultrasonic technique has been used to measure the extent of radial shortening applied to two composite substation insulators during crimping. The axial compressive strength of these insulators have been determined from destructive mechanical tests. In addition, detailed non-linear axisymmetric and three-dimensional finite element analyses have been performed to evaluate the effects of several design variables on the mechanical performance of the crimped joints subjected to axial loads. Results obtained from this study demonstrate that the insulators are likely to encounter failure due to sliding of the GRP rod (within the end-fittings) under excessive axial loads. Based upon the finite element results, semi-empirical relationships have been presented to predict the axial loading capacity of the crimped insulator ends, and the maximum internal stresses on the GRP rod surface.