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Study of Partial Discharge Behavior at Flight-Altitude Pressures under 60 Hz and Impulse Voltages for Samples Related to Aircraft Motors

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Partial discharge (PD) is a common and detrimental phenomenon that can cause damage, and eventual breakdown for insulation systems. Currently there are several standards for PD detection and measurement at atmospheric pressure, with power frequency (up to 400 Hz) excitation voltage. In a gaseous medium, such as air, the partial discharge inception voltage (PDIV) will generally decrease with decreasing pressure, at power frequencies. However, similar standards for PD measurement under impulse excitation are not well established. The lack of literature on PDIV behavior under high dv/dt impulse voltage excitation, combined with the increasing usage of inverter-fed-drive motors in aircraft, makes the topic very relevant.

This paper presents experimental results and associated analysis for several samples of aircraft motor-related components in air at various pressures, either with 60 Hz ac voltage or with impulse voltage excitation. In the initial testing, PDIV values for both 60 Hz and fixed-risetime impulse excitation decreased with decreasing pressure, which is expected. However for some tests, especially at relatively low pressure conditions, PDIV values have been observed to show an abnormal trend. Several statements on appropriate testing procedures for PD testing under low pressure conditions will be put forth according to the test experiences.

Due to the limitation of the test samples and equipment, the effect of the impulse voltage rise rate (dv/dt) was not established. However, there will be additional discussion on research in progress to reproduce realistic voltage impulses similar to those seen by aircraft motors in inverter-fed-drive applications; this will enable further investigations on the effect of impulse voltage rise rate.

Authors: WEI, Zhuo (The Ohio State University); Dr KASTEN, Donald G. (The Ohio State University); Prof. WANG, Jin (The Ohio State University); GROSJEAN, Dennis (Innovative Scientific Solutions Inc); SCHWEICKART, Daniel (Air Force Research Laboratory)

Presenter: WEI, Zhuo (The Ohio State University)

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