

Electrical breakdown strengths of various gasses and gas mixtures

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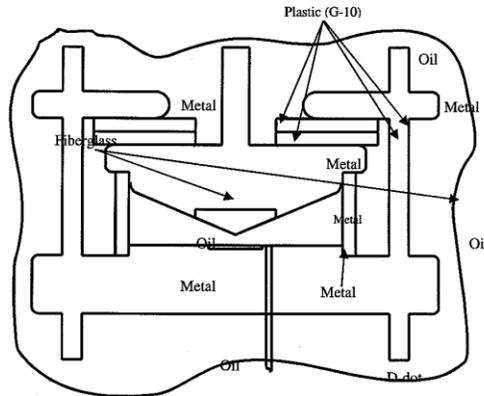
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In this paper we have characterized the electrical breakdown strengths and risetimes of various gasses such as air, nitrogen, hydrogen SF6 and SF6 mixes under conditions of fast charging (20 ns or less) and high pressures (20 to 100 atmospheres). It is an experimental effort and the results reported here are expected to be of great value for pulse power designers. Such gasses are widely used in spark gap switching of transient energy into various loads for many applications. We have studied many aspects such as: a) breakdown field versus pressure, b) polarity effects, c) varying stress times, d) uniform field, and e) point-plane. In addition, we have compared actual risetimes to known empirical formulae. A mono-cone design was chosen to evaluate the gas characteristics. This provides a well-defined geometry of calculable and constant load impedance. This is unobstructed for a sufficient clear time in order to measure the arc risetime and compare it to known empirical relationships. The test fixture is shown in Figure 1.



The cone can safely be pressurized to 100 atm, of all gasses including hydrogen. The mono-cone impedance is 16.5 Ohms and the flat ground plate is fitted with (1/8) inch thick and 2" diameter strike plate. D-dot sensors are introduced in the ground plate to measure risetimes. A TDS 684C with a bandwidth of 1 GHz was used in recording charge times and amplitudes.

Figure 1. Mono-cone test fixture

An SCD 5000 was used in measuring output waveform, especially the amplitude and risetime within the clear time of measurement. The data collected is very extensive and reported in [V. Carboni, H. Lackner, D. V. Giri and J. M. Lehr, "Breakdown Fields and Risetimes of Select Gasses under Conditions of Fast charging (20 ns or less) and High Pressures (20 -100 atmospheres)," Switching Note 32, 1 May 2002]. We have also shown that faster risetimes are possible when the mono-cone tip is negative. Illustrative samples of our measured data will be presented.