### **19-2. Electrostatic Discharge (ESD) of Aerospace Vehicles**

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This project is a follow-on work to a Science Innovation Fund (SIF) project to develop a new form of Paschen’s law that could relax current triboelectrification launch criteria by considering the effect of the flow of gas past aerospace vehicle surfaces. Paschen’s law, derived in 1889 by F. Paschen, calculates the minimum voltage required to create an electrical spark or discharge between two electrodes. A new wind tunnel experiment was designed to provide more reliable data than the previous work. Inconsistencies with the new experimental data and the model equation necessitated a revision of the theoretical model equation to account for the effect of humidity in the semi-enclosed wind tunnel facility. The revised theoretical model better matches the experimental data.

The team presented a re-derivation of Paschen’s law that considers the flow of gas between the electrodes as a mitigating factor on the concentration of electron–ion pairs created by the potential. Aerodynamic properties such as the Mach number and relative humidity were used in this re-derivation. Wind tunnel experiments were designed, fabricated and performed at three air velocities (Mach 0.5, Mach 1.5, and Mach 2.0) at two electrode separations (1.0 cm and 1.5 cm). Higher values of *Vs*, as would be expected if the concentration of electron–ion pairs were reduced by a rapid gas velocity, were recorded in the wind tunnel which is consistent with the prediction of the model equation. Poor to moderate agreement with the model equation was obtained; however, as in all experiments, the sparking voltage was higher under gas flow than static (no gas flow) sparking voltage which is consistent with the model equation. Further work should focus not only on environmental factors such as humidity, but also to use a variable pressure wind tunnel so that data points at lower pressures can be developed.