Volcanic ash contamination of high voltage (HV) power networks compromises the reliability of society’s electricity supply. Ash-induced insulator flashover is a common problem on transmission networks that is attributed to the high conductivity (or low resistivity) of volcanic ash. We have used a testing methodology to characterise the electrical resistivity of volcanic ash samples of varying composition, grain size, soluble salt content, compaction and water content. These variables have been analysed to better understand the properties influencing the electrical conductivity of volcanic ash. This has allowed the creation of physically, chemically and electrically equivalent ash proxies to be used for current and future laboratory experimentation. Results indicate that dry volcanic ash is non-conducting (rho = >2x10⁷ ohm·m, sigma = <1x10⁻⁹ S·m⁻¹), however, the resistivity of volcanic ash decreases abruptly with the first absorption of water. Further reduction of resistivity has been observed with increasing soluble salt content, water content, and compaction. This study is the first to provide a comprehensive understanding of the key variables influencing the conductivity of volcanic ash. Preliminary insulator contamination testing in the University of Canterbury’s HV lab has shown that the flashover voltage for porcelain insulators contaminated with 2-3mm of fine-grained (<105 µm) 0.18M NaCl basalt wetted by a hand sprayer is reduced by nearly 40%.