High voltage flashover of insulating barriers

by Paul Uhlrich

A THESIS Submitted to the Graduate Committee in partial fulfillment of the requirements for the degree of Master of Science in Electrical Engineering
Montana State University

Abstract:
Many investigation of high-voltage flashover in air have been recorded in the literature. Studies of various standard configuration such as rod gaps, needle gape, sphere gape, needle point to plane, sphere to plane, etc. are numerous. Studies of corona discharge, insulation creep age properties, and the potential breakdown of gases have been made under various conditions of pressure, temperature, and humidity. This paper is offered as an extension of these data to include the study of air breakdown over insulating barriers.

This paper presents information concerning the use of insulating barriers between adjacent live terminals or between a live terminal and ground. Curves are included showing the effect of various barriers upon d-c flashover voltages for altitudes up to 80,000 feet. Similar curves show the effect of 60-cycle a-c flashover voltages for altitudes up to 100,000 feet. High altitude conditions were simulated in the laboratory by use of a vacuum chamber. All tests were performed using the same insulating material (black laminated micarta) for the test blocks. This report is intended to determine the comparative effectiveness of various barriers; no attempt is made here to study the properties of insulating materials.

The necessity for adequate spacing between terminals of electrical equipment is fundamental. Sparkover between terminals or to ground normally causes the arcing part to fail with resulting circuit malfunction. Protection against sparkover is especially important in the design of aircraft electrical units because circuit failure in flight may be costly. The use of insulating barriers between points at different potential provides protection against sparking with small sacrifice of space and weight.

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Approved:

E. W. Schilling

Head, Major Department

E. W. Schilling

Chairman, Examining Committee

J. M. Nelson

Dean, Graduate Division

Bozeman, Montana
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Paul E. Uhlrich

ABSTRACT

Many investigations of high-voltage flashover in air have been recorded in the literature. Studies of various standard configurations such as rod gaps, needle gaps, sphere gaps, needle point to plane, sphere to plane, etc. are numerous. Studies of corona discharge, insulation creepage properties, and the potential breakdown of gases have been made under various conditions of pressure, temperature, and humidity. This paper is offered as an extension of these data to include the study of air breakdown over insulating barriers.

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INTRODUCTION

The major portion of this paper deals with the breakdown of dry air. The effect of humidity upon air breakdown has been reported in previous literature.[1,2] Some tests were made with saturated air (with and without moisture condensation on the test block) and the results seem to verify the conclusions of these writers. A qualitative study of the influence of ozone upon air breakdown is included.

For convenience, breakdown voltages are plotted here as a function of altitude. All curves are based on the United States standard atmosphere as established by the National Advisory Committee for Aeronautics.[3,4]

As seen in Figure 1, the temperature of the standard atmosphere decreases linearly with altitude from sea level to 35,000 feet and is isothermal at -67°F. from 35,000 feet to 105,000 feet. Since the data used here were taken at room temperature, correction is required in order to correlate these data with standard temperature conditions. At each

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2. Delerno, M.J. POTENTIAL BREAKDOWN OF SMALL GAPS UNDER SIMULATED HIGH-ALTITUDE CONDITIONS. AIEE Transactions, Volume 63, 1944, pages 109-12.

3. National Advisory Committee for Aeronautics, Technical Report No. 538, 1935. ALTITUDE-PRESSURE TABLES BASED ON THE UNITED STATES STANDARD ATMOSPHERE.

4. NACA Technical Report No. 837 and Supersonic Aerodynamics Handbook. STANDARD ALTITUDE TABLE.