# EVALUATION OF HIGH VOLTAGE BREAKDOWN PROPERTIES OF ZYLON SERVERD KAPTON INSULATION SYSTEM UNDER CYCLIC COMPRESSION

C.A. Swenson, W.S. Marshall, E.L. Miller, K.W. Pickard, (NHMFL-FSU)

## Introduction

A modified electrical insulation system has been developed for pulsed magnets. The insulation system is comprised of heat sealed kapton™ tape together with a serving of zylon fiber. The objective of the insulation structure is to protect the insulating film from mechanical abrasion and punch through failures resulting from cyclic compressive loading during pulsed magnet operation. We report the preliminary high voltage breakdown results with this system.

## Experimental Geometry and Design

A two wire composite was bonded together using a wet lay-up epoxy construction. The conductor was stainless steel. The geometry modeled the turn to turn insulation in a magnet winding. (See Fig. 1) A standardized form defines critical sample surfaces at the epoxy matrix cures. Compression is applied to each sample inside a hydraulic press. The test protocol simulates cyclic mechanical compression load scenarios encountered during pulsed magnet operation. Typical axial compressive stress between turns is approximately 250-MPa. A DC voltage was applied across the insulation at peak mechanical stress to simulate the electrical fields present inside the windings. Voltage was applied for 10-sec. to 30-sec. time intervals while each sample was under compression. Mean compressive stresses were applies up to 600-MPa. Voltage breakdown measurements were up to 10-KV.

**Figure 1.** Two wire composite after epoxy cure.

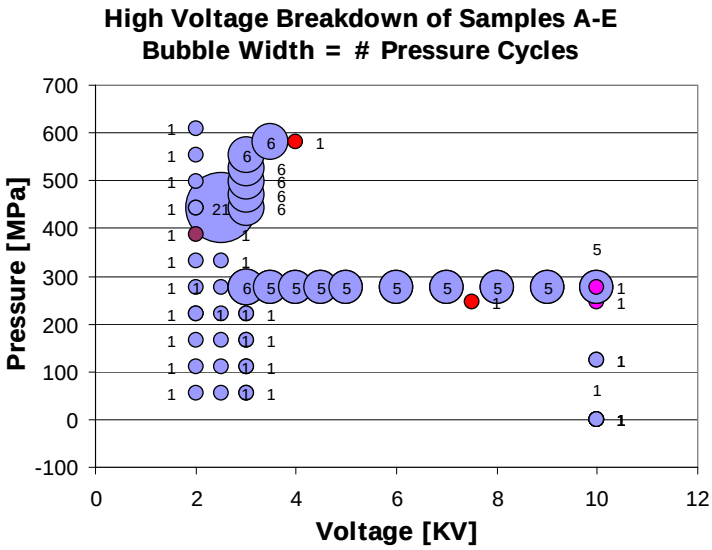


**Figure 2.** Summary of breakdown data in bubble plot.

## Experimental Results

We observed no voltage breakdown failures up to 6 KV at 300 MPa average compressive stress. (See Fig. 2) We observed breakdown failures at higher mechanical stresses and voltage. Qualification at higher levels will require further study to improve statistics to allow a full reliability analysis. The data set presented is from a protocol that is under development.

## Summary

The zylon-kapton insulation system is acceptable for pulsed magnet application. This study is pilot investigation to determine the system's ultimate durability. Future investigation will examine higher cycle lifetimes. This reliability data is critical to our technology development for pulsed magnet systems.