DRYWELL FUSEHOLDER TESTING

Introduction:

This paper presents the results of laboratory tests performed on various Drywell Fuseholders / Canisters provided by the ERMCO Components, Inc. of ERMCO, Dyersburg, Tennessee. Throughout this paper the Drywell Fuseholder will be referred to as (DWFH).

The following tests were performed using ANSI transformer standards and Ontario Hydro requirements as guidelines:

(1) Thermal Cycling and Leak Test.
(2) Impulse Withstand.
(3) Voltage Withstand.
(4) Partial Discharge.
(5) Load Break/ Make.
(6) Fault Closure.
(7) Seal Integrity.

Testing was performed at the GE Test Labs in Pittsfield, MA and Hickory, NC, and the Ontario Hydro Research Division in Toronto, Ontario, Canada.

Due to the similarity of design, not every combination was individually tested. However, results are indicative of the performance of each design.

Test Procedure:

(1) Thermal Cycling and Leak Test:

Testing was performed in an environ-mental chamber with an air atmosphere. The samples were subjected to a minimum of ten (10) thermal cycles. Each thermal cycle consisted of temperature extremes from -40°C to +150°C, with a minimum two (2) hour transition time and a minimum of one (1) hour dwell time at each temperature extreme. The actual times were dependent upon the sampling quality and mass within the chamber.

Following thermal cycling, each sample was subjected to a leak test to ensure the seal integrity. Leak testing was performed using a Helium mass spectrometer, with a setting of 1 x 10^{-7} atm-cc/sec, with a specifically designed test vessel to contain the DWFH.

For the following electrical tests, each sample was mounted in an oil-filled test vessel, to simulate actual mounting practices, with a ground plane 4.5 inches from the center line of the sample.

(2) Impulse Test:

Each sample was tested until flash-over or failure occurred, using a 1.2 x 50 micro-second wave shape.

(3) Voltage Withstand Test:

Each sample was connected to a 60 hertz power supply. The voltage was increased in 5 kV increments, with a one minute withstand at each level, until flash-over or failure.

(4) Partial Discharge Test:

Voltage was applied to each sample until corona was established, then decreased until corona extinction was reached.

(5) Load Break/ Make Test:

This test is applicable only to the loadbreak designs. Samples were subjected to test currents of 80, 160, 205 and 220 amperes with test voltages of 8.3 kV and 15.2 kV. Each DWFH was subjected to a minimum of ten operations. Each operation consisted of a make followed by a momentary pause, then a break.

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(6) Fault Close Test:

The female loadbreak contact used in the DWFH is not mounted on a movable piston assembly as used in separable connector products. This is due to the DWFH application utilizing a current-limiting fuse. When closing in on a 10,000 ampere fault the current-limiting fuse clears in less than a half cycle. This limits arcing at the probe and contact and controls the amount of gas produced.

(7) Seal Integrity:

Six DWFH's were mounted in a special oil-filled test vessel using standard hardware and mounting procedures. The test vessel was placed in an environmental chamber and cycled between -40°C and +150°C for ten cycles with each cycle lasting twenty-four hours. After thermal cycling, each DWFH was subjected to a 200 micron vacuum for twenty-four hours. After
each phase of the testing, each DWFH was examined for oil ingress.

Test Results:

(1) Thermal Cycling and Leak Test:

Catalog numbers tested:

7559ZB1299, 7559ZE0199,
7559ZE1199, & 7559ZB8299

Due to the nature of this test, only a pass/fail criterion can be used.

All assemblies passed test.

(2) Impulse Test:

Catalog numbers tested:

7559ZB8299, 7559ZF8299,
7559ZB8399, & 7559ZF8399

(95 kV Non-Loadbreak)
Three of three passed 115 kV

(125 kV Non-Loadbreak)
Three of three passed 145 kV

(95 kV Loadbreak)
Three of three passed 115 kV

(125 kV Loadbreak)
Three of three passed 145 kV

(3) Voltage Withstand Test:

Catalog numbers tested:

7559ZB8399 & 7559ZF8399

All four samples passed 45 kV with a 60 second withstand.
C1-2 1/99

(4) Partial Discharge Test

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Catalog numbers tested:

7559ZB8399 & 7559ZF8399

All four assemblies recorded less than 3 picocoulombs at 21.5 kV.

(5) Load Break/ Make Test:

Catalog numbers tested:

7559ZF8299 & 7559ZF8399

8.3 kV passed 80 amperes, 10 operations.

8.3 kV passed 220 amperes, 10 operations.

15.2 kV passed 205 amperes, 10 operations.

(6) Fault Close Test:

Catalog numbers tested:

7559ZF8299 & 7559ZF8399

8.3 kV passed 10, 426 ampere fault close when properly fused.

(7) Seal Integrity:

Catalog numbers tested:

955ZB8299

Due to the nature of this test, only a pass/fail criterion can be used.

All six samples passed test.

Noted Observations:

[Loadbreak]

During the ten (10) operations the set screws that hold the fuse holder together indicated a tendency to loosen. A thread bonder has been added to each set screw to negate this problem.

There was some indication of mechanical damage to the contacts during the ten load break/make operations, however there were no electrical failures during testing even when the canisters were partially filled with water or transformer oil, or when the ablative material was entirely removed.

When Fault Closing using a current-limiting fuse that is not damaged, the assembly works properly. However, a potential hazard exists when attempting to fault close with a damaged fuse.

R.D. Jergenson,
Design Engineer,
Component Products Operation.

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