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DESIGN TEST REPORT

Bayonet Fuse Holder

Testing was performed using the following IEEE Standards as a guide

ANSI C37.41-2000
ANSI C119.2

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I. HEAT RUN TESTING

Description:

The purpose of this test is to verify the temperature rise levels detailed in IEEE C57.12.00, which allows a maximum 15° C rise above the other conductors' average temperature.

The continuous operating current level is the maximum current which the device can carry continuously without exceeding the maximum allowable temperature rise specified in the standards.

In this test we will verify both temperature rise characteristics and determine continuous operating current levels as per the aforementioned standard.

Procedure

Chardon Bayonet Fuse Holder Assemblies (CHBON) were mounted in an oil filled tank as specified in the installation instructions. The test samples were assembled with a copper shorting bar inserted in the fuse cartridge. This assembly was then inserted into the bayonet fuse holder outer tube. Thermocouples were placed at specific points to verify temperature rise levels. Testing was performed using IEEE C37.41 – 2000 as a guide. The test results for the two (2) samples tested are as follows:

Current(A)	Sample #	Temperature of Contacts	Temperature of Conductor	Result
300	#1	100.5℃	101.6℃	PASS
300	#2	101.0℃	101.6℃	PASS

Description:

The Chardon Bayonet Fuse Holder Assembly meets the temperature rise requirements for a continuous current rating of 300 amps.

II. RIV TESTING

Description

Corona and RIV (radio influence voltage) tests measure partial discharge activity. The purpose of this test is to prove that the Chardon Bayonet Fuse Holder has a corona (partial discharge) level of 3 picocoulombs or less at 29 kV, and a RIV voltage level below 100 microvolts at 110% rating (25.3 kV).

Procedure

Chardon Bayonet Fuse Holder assemblies were mounted in a steel, oil filled tank. Testing was performed as described in IEEE C37.41-2000. The tank and oil were at room temperature. The Chardon Bayonet Fuse Holder was tested by itself, and also with the cartridge assembly having both “blown” and unblown (new) fuse links. The assemblies were tested for both corona and RIV level. Measurements for the RIV level were taken at inception, extinction, rating of the fuse link, and at 110% of the fuse link rating. Corona and partial discharge levels were determined at 125% of rating (29 kV).

Results & Conclusion

The Chardon Bayonet Fuse Holder assembly passed both tests with corona values less than 3 picocoulombs at 34.5 kV. RIV levels were < 2 microvolts at 110% rating (25.3 kV) for both the holder and the complete assembly with “blown” and unblown (new) fuse links. The Chardon Bayonet Fuse Holder Assembly meets the requirements of IEEE C37.41-2000.

III. IMPULSE WITHSTAND VOLTAGE (BIL)

Description

The purpose of this test is to prove that the Chardon Bayonet Fuse Holder, mounted in an oil filled tank, can withstand a 1.2 x 50 microsecond150 kV impulse at both polarities.

Procedure

Chardon Bayonet Fuse Holder assemblies were mounted in a steel, oil filled tank. The tank was grounded. Voltage was applied to the lower contact on the bayonet fuse holder outer tube. A 1.2 x 50 microsecond impulse test was performed on three (3) Chardon Bayonet Fuse Holder assemblies.

Results & Conclusion

The results were as follows:

	Fuse Holder Assembly with unblown (new) fuse link	Fuse Holder Assembly with "blown" fuse link
Positive 3 shots	180kV without flashover	180kV without flashover
Negative 3 shots	180kV without flashover	180kV without flashover

The BIL (basic insulation level) of the Chardon bayonet Fuse Holder meets the requirements of IEEE C37.41-2000.

IV. 60 Hz WITHSTAND

Description

To verify that the Chardon Bayonet Fuse Holder can meet a 60kV, 60Hz withstand without any flashover or damage per IEEE standards.

Procedure

Chardon Bayonet Fuse Holder assemblies were mounted in a steel, oil filled tank. The tank was grounded. Voltage was applied to the lower contact on the bayonet fuse holder outer tube. Testing was conducted per IEEE C37.41, C37.71, C37.72, and C57.12. Three (3) Chardon Bayonet Fuse Holder assemblies were tested.

Results & Conclusion

The results were as follows:

	Fuse Holder Assembly with unblown (new) fuse link	Fuse Holder Assembly with "blown" fuse link
60kV 1min at 25℃	3 Samples - No flashover	3 Samples - No flashover
60kV 1min at 125℃	3 Samples - No flashover	3 Samples - No flashover

The Chardon Bayonet Fuse Holder meets IEEE C37.41, C37.72, C37.47, and C571.2 requirements.

V. MECHANICAL STRENGTH TESTING

Description

To verify that both torque and cantilever forces exerted on the Chardon Bayonet Fuse Housing during handling, assembly to the tank wall and lead attachment will not damage the product.

Procedure

The Chardon Bayonet Fuse Holder was attached to the tank wall. Fifteen (15) fuse holders were selected at random for each test. The installation instructions specify that the Chardon Bayonet Fuse Holder be attached to the tank wall by tightening the retaining nut to level of 5-10 ft lbs. to properly seat and compress the gasket for proper seal.

Maximum torque levels were determined by placing the holders into the test fixture. The fastening nut was tightened to 10 ft lbs. using a digital torque wrench. Holders were examined for any damage. Torque was then increased using the digital torque wrench. The force was applied at a steady rate until breakage occurred.

Cantilever force was applied to the Chardon Bayonet Fuse Housing by applying force to the lower contact with the unit held in a horizontal position. Force was applied until breakage occurred. Testing was then performed in a similar manner on the complete assembly while mounted in the same test fixture. A third test was performed similar to test number two, except with force applied at 90° to determine lateral strength

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Results & Conclusion

All fifteen (15) Chardon Bayonet Fuse Holder assemblies exceeded a torque of 3 times recommended maximum tightening level before breakage occurred. Cantilever forces on the Chardon Bayonet Fuse Housing exhibited breakage in excess of 50 ft lbs. The complete assembly exhibited breakage in excess of 150 ft lbs. The Chardon Bayonet Fuse Holder provides excellent strength required for handling, assembly and lead attachment.

VI. THERMAL CYCLE SEAL TESTING

Description

The purpose of this test in to evaluate the effect of extreme temperature cycling on the flange gasket and inner fuse cartridge holder assembly to insure that the Chardon Bayonet Fuse Holder can meet temperature and pressure forces that may be realized during extreme operating conditions.

Procedure

Six (6) Chardon Bayonet Fuse Holder assemblies were subjected to this test. Each assembly was mounted to a test fixture, which was designed to simulate the typical tank wall application. First, the assemblies were placed in a pressure vessel. The vessel was filled with water and pressurized to 15 psi. The samples were held at this pressure, during which time visual examination was done to verify integrity of both seals.

Second, the assemblies were placed in a thermal cycle chamber (in air). The temperature ranged from -32°C to 130°C for a total of 10 cycles. Each cycle lasted 6 hours. The units were held at the lower and upper temperature extremes for a period of 1 hour.

Following conclusion of 10 cycles, the samples were again placed in the pressure vessel and pressurized to 15 psi. The samples were held at this pressure, during which time visual examination was done to verify seal integrity.

Results & Conclusion

Sample No.	1	2	3	4	5	6
Before thermal cycle	PASS	PASS	PASS	PASS	PASS	PASS
After thermal cycle	PASS	PASS	PASS	PASS	PASS	PASS

All Chardon Bayonet Fuse Holder assemblies passed the thermal cycle sealing test requirements.

VII. INTERRUPTION TESTING

Description

The Chardon Bayonet Fuse Holder is required to operate and isolate other pieces of apparatus on the utility's distribution system when over current conditions occur. The interruption test verifies that the Chardon Bayonet Fuse Holder can meet interrupting current ratings up to and including the following:

3,500A RMS symmetrical at 8.3 kV
2,500A RMS symmetrical at 15.5 kV
1,000A RMS symmetrical at 23 kV

Procedure

A variety of Cooper (RTE) current sensing, dual sensing, and dual element fuse links, ranging from 3A to 140A were installed in Chardon Bayonet Fuse Holders mounted on a steel, oil filled tank per installation instructions. Circuits were created using IEEE C37.41-2000 as a guide.

Testing was conducted at room temperature, rated voltage, with the current set at low, intermediate, and rated symmetric current levels. Circuits were created at each voltage and current level. The fuse link was installed in the cartridge, attached to the inner fuse cartridge holder assembly, and inserted into the fuse holder outer tube. The circuit was energized remotely. The fuse link operated, and the current was interrupted by the Chardon Bayonet Fuse Holder.

All testing was done at Powertech Labs, in Vancouver, Canada.

Results & Conclusion

The fuse links operated, cleared, and withstood voltage following interruption of current up to 3,500A. The Chardon Bayonet Fuse Holder performed as required.

VIII. SWITCHING TESTING

Description

This test will verify that the Chardon Bayonet Fuse Holder assembly can be used to energize and de-energize load current without electrical and/or physical damage to the fuse holder. Test were conducted at the following switching current ratings:

. 50 operations at 160 amps at 10.0KV
. 50 operations at 150 amps at 17.2KV
. 50 operations at 80 amps at 27.0KV
. 50 operations at 50 amps at 38.0KV

One operation is defined as an insertion (make) of the inner fuse cartridge holder assembly into the outer housing and one withdrawal (break).

Procedure

Chardon Bayonet Fuse Holders were mounted on a steel, oil filled tank per installation instructions. A solid copper element was installed in the fuse holder cartridge, attached to the inner fuse cartridge holder assembly, and inserted into the fuse holder outer tube. The circuits used in these tests followed IEEE C119.2 and C37.41-1988 standards as a guide. There was 10% series impedance for circuits of 27kV or lower and 17% for the 38kV circuit. The X/R ratio between series reactance and series resistance was in the range of 5-7. Power factors were in the 70~80% range. The inner fuse cartridge holder assembly was used to make the circuit by closing the assembly into the outer housing with a hydraulic cylinder. After making the circuit, the same sample was used to interrupt the circuit by withdrawing the inner fuse holder assembly from the outer housing. Two (2) Chardon Bayonet Fuse Holders were tested consecutively at 10.0 kV, 17.2 kV, and 27.0 kV. One (1) Chardon Bayonet Fuse Holder was tested at 38.0 kV. Fifty (50) make/break operations were performed on each of the fuse holder assemblies.

All testing was done at Powertech Labs, in Vancouver, Canada.

Results & Conclusion

The Chardon Bayonet Fuse Holder successfully passed all current and voltage levels tested. The holder, contacts, and cartridge assembly were in good condition following the tests.

. 50 operations at 160A at 10.0KV Passed (2/17/07)
. 50 operations at 150A at 17.2KV Passed (8/30/07)
. 50 operations at 80A at 27.0KV Passed (4/19/08)
. 50 operations at 50A at 38.0KV Passed (9/24/08)