

Polymer Cutout Testing Recommendations

High Voltage Fuse Subcommittee

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Recommended Tests

1. Water Diffusion Tests (CAN/CSA-310-09 7.3)
2. Dye Penetration (ANSI C29.13 Section 7.3)
3. Interruption Test Series 1 (+50 °C and at -50 °C)
4. Long Term Deformation
5. Insulation Test
6. Weathering - UV Aging
7. Tracking & Erosion

1. Water Diffusion Tests (CAN/CSA-310-09 7.3)

7.3 Water diffusion test

7.3.1 General

This test is intended to check the resistance of the core material to water attack.

7.3.2 Samples

Four samples shall be cut from a production line insulator. The cuts shall be made approximately 90° to the long axis of the insulator with a diamond-coated circular saw blade under cold running water. The length of the samples shall be 30 mm \pm 0.5 mm (1.18 in \pm 0.02 in). The cut surfaces shall be smoothed by means of a fine abrasive cloth (grain size 180). The cut ends shall be clean and parallel.

1. Water Diffusion Tests (CAN/CSA-310-09 7.3)

7.3.3 Pre-stressing

The surfaces of the samples shall be cleaned with isopropyl alcohol and filter paper immediately before boiling. The samples shall be boiled in a suitable container (e.g., made of glass or stainless steel) for a minimum $100 \text{ h} \pm 0.5 \text{ h}$ in deionized water with 0.1% by weight of NaCl. Samples of only one core material shall be boiled together in the same container (see Figure 1 for an example of such a container). After boiling, the samples shall be removed from the boiling container and placed in another container (e.g., made of glass or stainless steel) filled with tap water at ambient temperature for at least 15 min. The voltage test shall be carried out within 3 h of the samples being removed from the boiling container.

1. Water Diffusion Tests (CAN/CSA-310-09 7.3)

7.3.4 Applied voltage

The voltage shall be applied using the assembly shown in Figure 2. Immediately before the voltage is applied, the samples shall be removed from the tap water container and their surfaces dried with filter paper. Each sample shall then be put between the electrodes. The voltage shall be increased at approximately 1 kV/s, up to 12 kV. The voltage shall be kept constant at 12 kV for 1 min and then decreased to zero.

7.3.5 Acceptance criteria

During the application of the voltage, no puncture or surface flashover shall occur. The current during application of the voltage shall not exceed 1 mA (rms).

1. Water Diffusion Tests

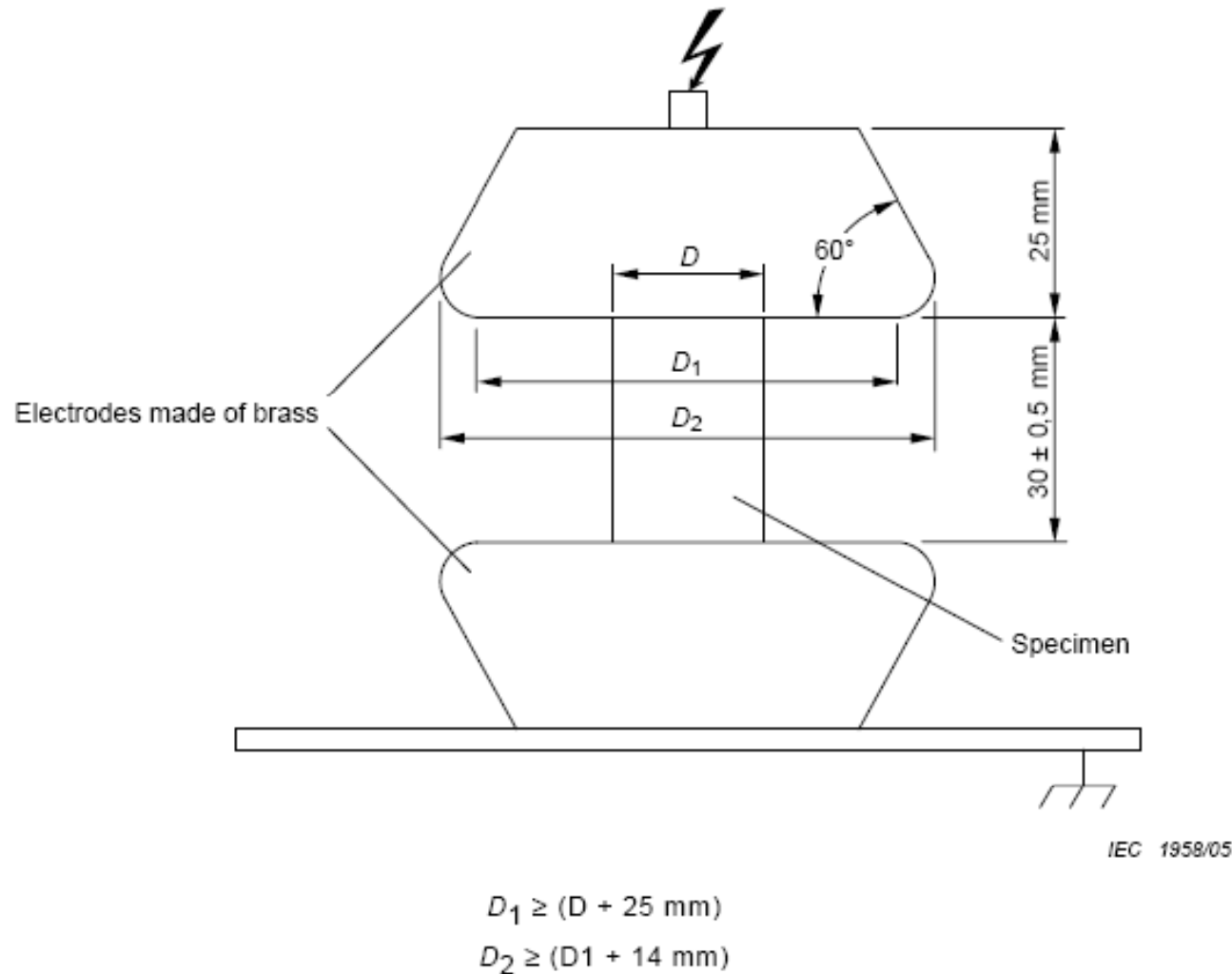


Figure 2

2. Dye Penetration (ANSI C29.13 Section 7.3)

7.3 Dye penetration test

7.3.1 Test specimens

Ten samples shall be cut from an insulator. The length of the samples shall be $10 \text{ mm} \pm 0.5 \text{ mm}$. They shall be cut 90 degrees to the axis of the core with a diamond coated circular saw blade under cool running water. The cut surfaces shall be smoothed with a 180-grit abrasive cloth. The cut ends shall be clean and parallel.

2. Dye Penetration (ANSI C29.13 Section 7.3)

7.3.2 Test

The samples shall be placed on a layer of steel or glass balls in a glass vessel with the fiber vertical. The balls shall be of the same diameter and in the range of 1 mm to 2 mm. The dye, composed of 1 gram of fuchsin in 100 grams of methanol, is poured into the vessel until its level is 2mm to 3mm above the top of the balls.

7.3.3 Evaluation

The time for the dye to rise through the samples by capillarity shall be more than 15 minutes.

3. Interruption Tests

- Interruption Tests as required in C37.41, Section 6.4, Test Series 1 should be performed at +50 °C (three samples) and at -50 °C (three samples) using a rigid mounting. Testing at ambient is not required.
- Pretests – Install thermocouples in cutout rod and precondition three samples at +50 °C and three samples at -50 °C for a minimum of 8 hours. Remove units from chamber and determine average time to cool down to +45 °C and time to warm up to -35 °C.



3. Interruption Tests

- Perform Test Series 1
 - Precondition three samples at +50 °C and three samples at -50 °C for a minimum of 8 hours.
 - Remove each sample from chamber in insulated container, transport to test cell, setup and test within the average time measured in the cool down / warm up pretests.
 - Perform dye penetration test (ANSI C29.13 Section 7.3) on all samples after Test Series 1.

4. Long Term Deformation

- Apply static load (3 to 4X normal spring loading) to three cutout samples for a total of 8 weeks.
- Remove samples from loading frame and perform Temperature rise test to determine if any permanent deformation has occurred which would cause over heating problems.



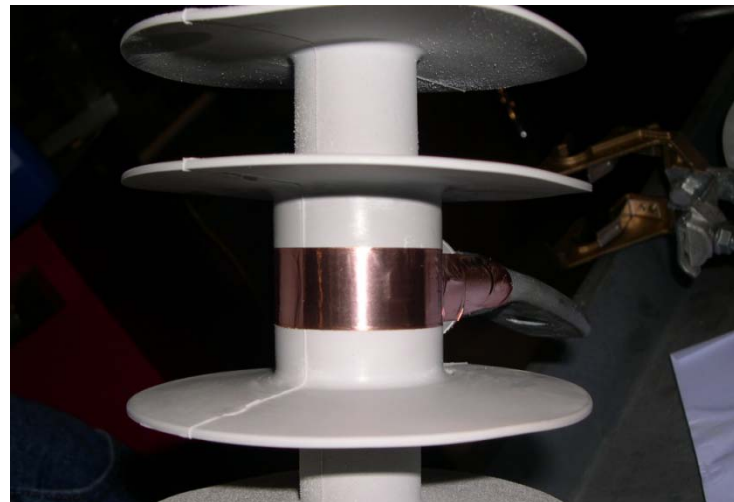
5. Insulation Test

Test Description	Pass/Fail Criteria
Hardness test – ASTM D2240	N/A
100 hour boiling water test - in water having 0.1% by weight of NaCl	N/A
Hardness test – ASTM D2240	Samples must cool to within 5 °C of the temperature where the initial measurement was made. Hardness must not change from the pre-boiled specimen by more than 20%
Steep-front impulse voltage test - min 1000 kV / μ s, max 3000 kV / μ s (10 positive & 10 negative) * OPTIONAL BANDS	All impulses must cause external flashover. Punctures that expose the insulating rod must not occur.
Low-frequency flashover test	Shall equal or exceed 90% of reference flashover value
Elevated AC withstand test @ 80% of reference flashover voltage for 30 minutes.	The maximum temperature rise of each cutout housing, between the sheds with respect to the temperature of the reference sample, shall be less than 10 °C.

5. Insulation Test

OPTIONAL – A copper band (max. 20 mm wide and less than 1 mm thick) may be attached around the cutout and connected to the mounting pin for the steep front impulse tests.

The band shall be in the plane of the mounting pin and perpendicular to the cutout axis.



Optional Copper Band

5. Insulation Test



Test Configuration without
copper band

6. UV Aging

One sample of each insulator design will be placed in an environmental aging chamber and aged using UVA-340 bulbs and the following cycle for 3,000 hours:

- 8 h UV at 60 (± 3) °C Black Panel Temperature;
- 0.25 h water spray (no light), temperature not controlled; and
- 3.75 h condensation at 50 (± 3) °C Black Panel Temperature.

Options for 5,000 hour Multi-Stress Test from IEC 61109 and UVB aging should be considered by the Working Group.

7. Tracking & Erosion

- Samples – three new samples
- The applied voltage during the energized period will be the maximum single phase-to-ground value listed in Table 2, Col 2 of C37.42.

7. Tracking & Erosion

- Each sample must complete 30,000 cycles lasting 200 seconds \pm 25 seconds each with the samples stationary no less than 80 % of the cycle time.
- Each cycle consists of the sample going through the four positions with approximately an equal period of time at each position.
- The saline solution in the tank will consist of de-ionized water with 1.40 ± 0.06 g/l of NaCl.
- After every four days of testing, the samples will be given a 24 hour recovery period. During this period, the test procedure will be the same except the dip tank will be empty.

7. Tracking & Erosion

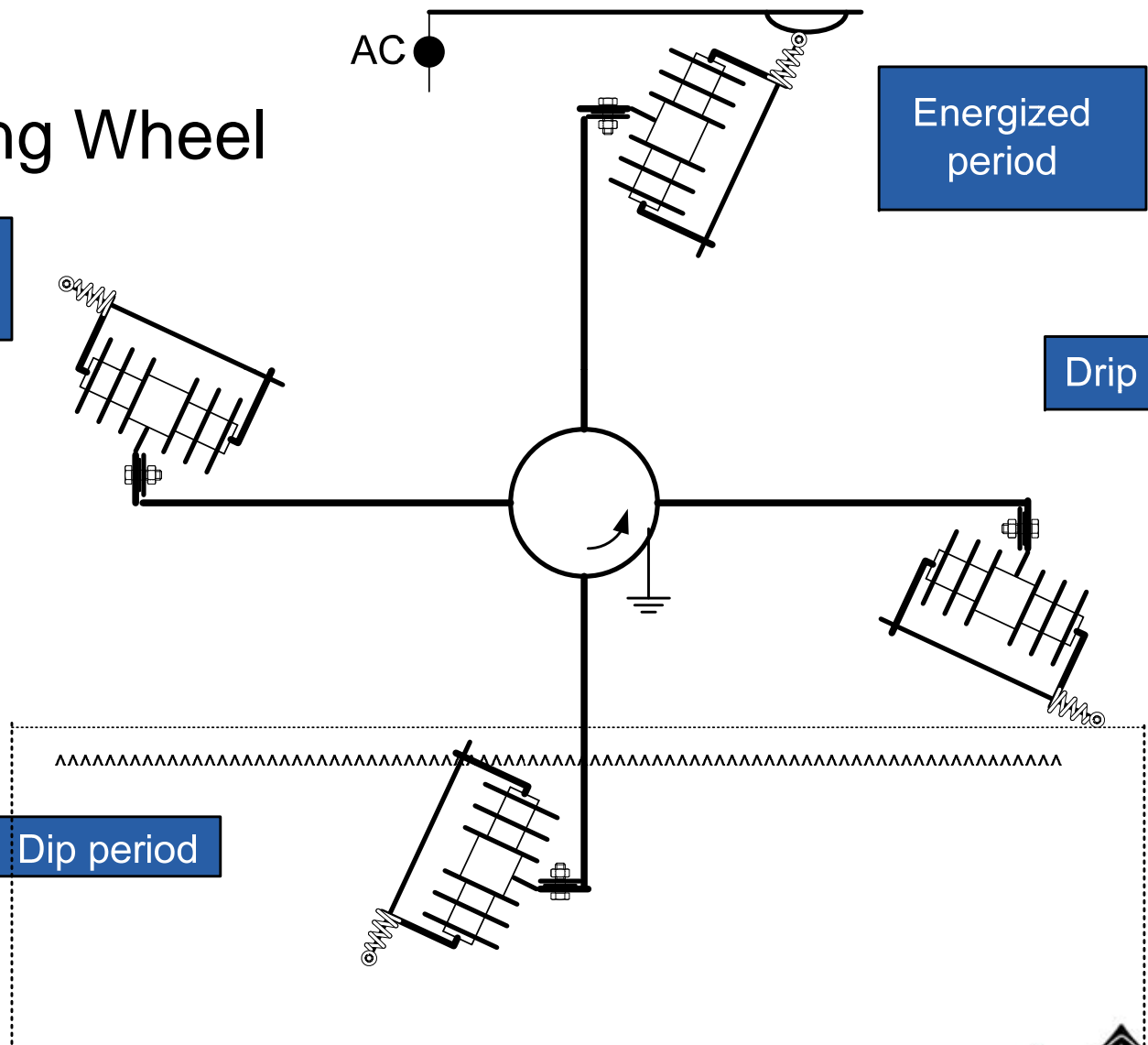
Tracking Wheel

Cool Period

Energized period

Drip period

Dip period



7. Tracking & Erosion

Within 48 hours of completion of 30,000 cycles:

- Rinse with de-ionized water and take resistance measurements from top to bottom, top to center and bottom to center. Compare these values to resistance of new units. If the after test resistances are less than 80% of the new, the units have failed.
- 80% AC withstand dry
- 80% BIL dry
- Thorough rinse with de-ionized water to remove all salt deposits followed by 80% AC withstand wet

Comments / Contact Info

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