

# 27 kV Polymer Cutouts NEETRAC

Frank C. Lambert  
Georgia Tech / NEETRAC

High Voltage Fuse Subcommittee  
Asheville, N. C.  
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# Test Plan Development Process

- Individual meetings held in February and March with ABB, Cooper Power Systems, Hubbell Power Systems, S & C Electric, and Balestro to solicit input for our draft test plan.
- Joint conference call with utility advisors in April to solicit input for our draft test plan.
- First draft test plan shared with Technical Advisors 5/1/2009.

# Water Penetration

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	Hardness must not change from the pre-boiled specimen by more than 20%
Steep-front impulse voltage test - min 1000 kV / $\mu$ s (10 positive & 10 negative)	All impulses must cause external flashover. Punctures 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.	No puncture shall occur. 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.

Once the samples are removed from the boiling water, all remaining tests on each sample must be performed in a forty-eight hour period.





# Water Penetration

Steep-front Impulse Voltage Test after 100 hour boiling

- 10 positive and 10 negative impulse waves with a voltage steepness of at least  $1000 \text{ kV}/\mu\text{s}$  per Clause 9.2.6.2 of IEC 62217
- The test is considered successful if all impulse applications result in an external flashover of the insulator samples and no punctures are observed.



# Water Penetration

## Sample Requirements:

- Six cutout body samples from each manufacturer will be included in these water penetration tests. One additional cutout body will be set aside to determine the reference ac flashover value.
- The first three samples will be subjected to the steep front impulse voltage tests without a copper band around the mounting pin.
- If no failures occur, then the remaining three samples will also be tested without the copper band.
- If failures occur during the first three sample tests, the remaining three samples will be tested with a copper band (max. 20 mm wide and less than 1 mm thick) attached around the insulator and connected to the mounting pin. The band shall be in the plane of the mounting pin and perpendicular to the insulator axis.

# 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:

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

Visual appearance and STRI hydrophobicity measurements will be made on samples initially, at 1,000 hours, at 2,000 hours and at 3,000 hours.



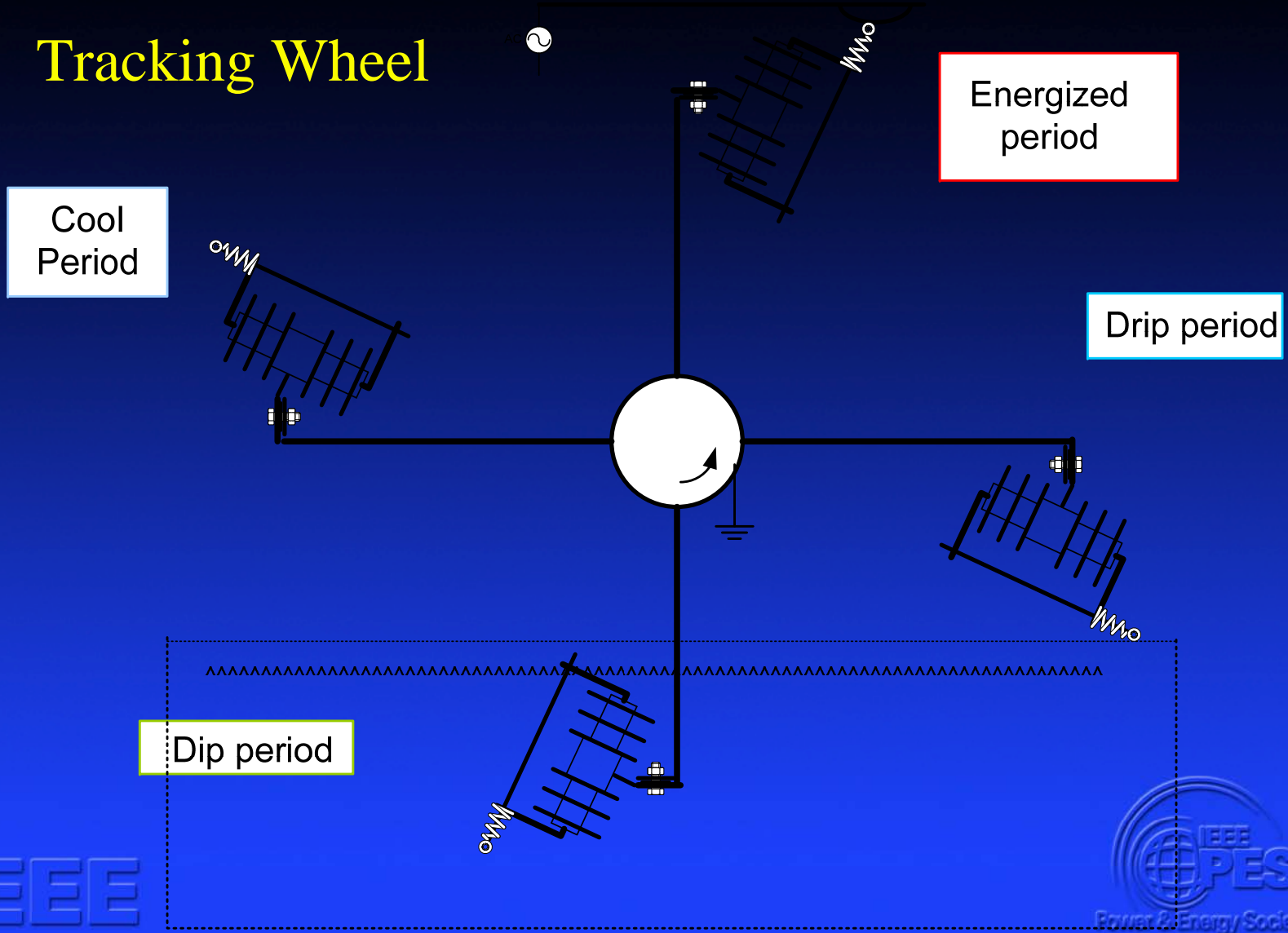
# Tracking & Erosion

- 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  $1.40 \pm 0.06$  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.



# Tracking & Erosion

## Tracking Wheel



# Tracking & Erosion

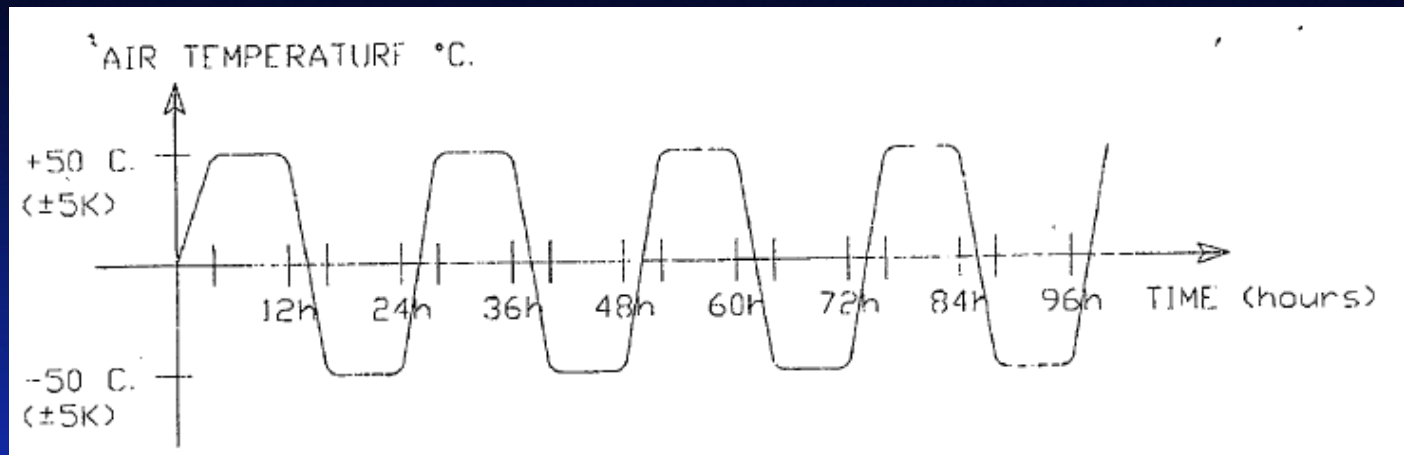
- Samples – One UV-aged and three new
- The applied voltage during the energized period will be 150% of the maximum single phase-to-ground value listed in Table 2, Col 2 of C37.42. ( $15.5 * 1.5 = 23.25$  kV)

Manufacturer	Creepage	Stress
ABB	480 mm	48 V/mm
Balestro	435 mm	53 V/mm
Cooper	566 mm	41 V/mm
Hubbell	434 mm	54 V/mm
S&C Electric	432 mm	54 V/mm

- Post tests will be as described in CSA C310 with the addition of an STRI Hydrophobicity test immediately after removal from the wheel.

# Thermal - Mechanical

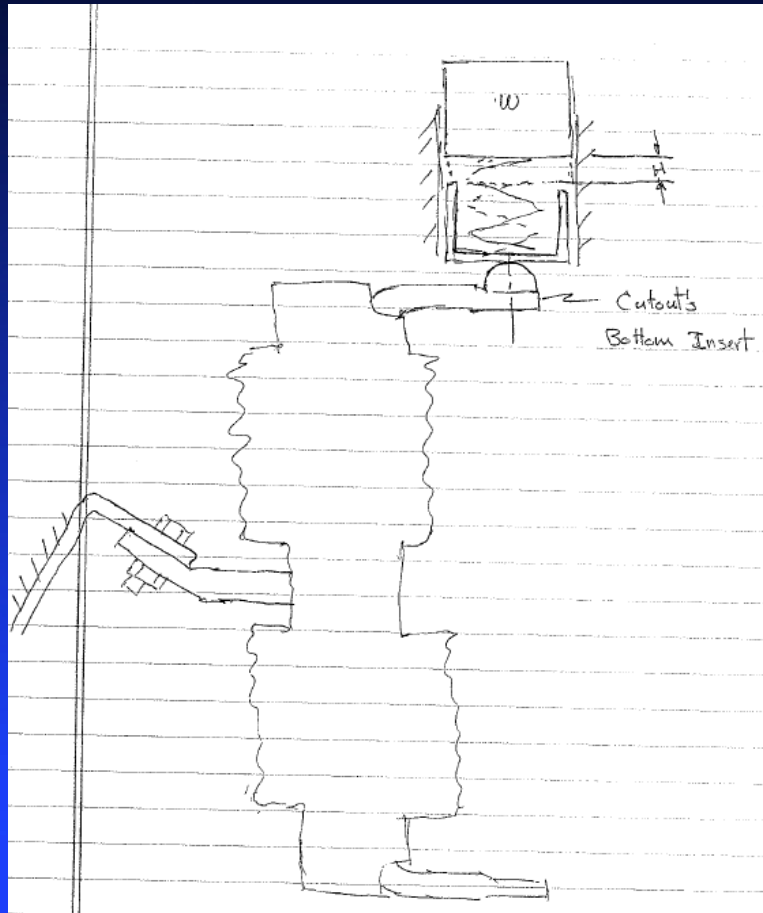
- Perform thermal cycle from ANSI C29.13-2000, Figure 4, 96 hours, time at each temperature 8 hours,  $-40\text{ }^{\circ}\text{C}$  to  $+50\text{ }^{\circ}\text{C}$ .



- Drop tup (60 ft-lb) three times at each temperature cycle extreme.
- Two sets of three samples each.
- Take one sample set to Interruption Test Series 1 and one set to Dye Penetration.

# Thermal - Mechanical

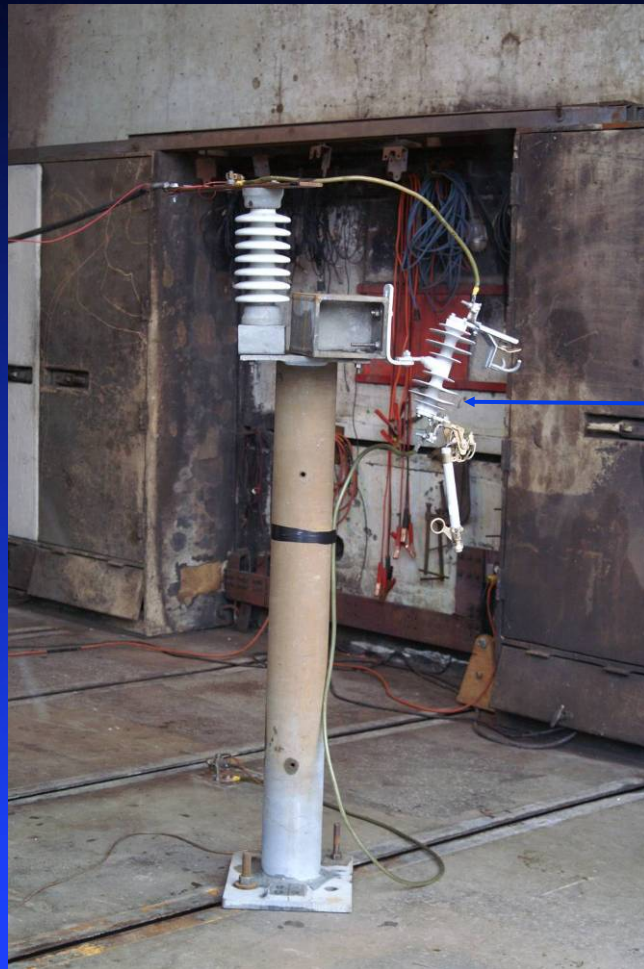
- Develop method for application of impact force.
- Options – Drop tup on upper and lower contacts directly  
Drop tup on upper and lower contacts thru spring  
Drop tup on mounting pin in three point bend mode





# Interruption Tests

- Interruption Tests as required in C37.41, Section 6.4, Test Series 1 and Test Series 5.



Cutout  
Under Test

# Interruption Tests

- Perform Test Series 1 on samples from Thermal – Mechanical Tests. If failure results, substitute new cutout body and repeat tests.
- Perform Dye Penetration tests after Test Series 1 to compare with Thermal – Mechanical samples.



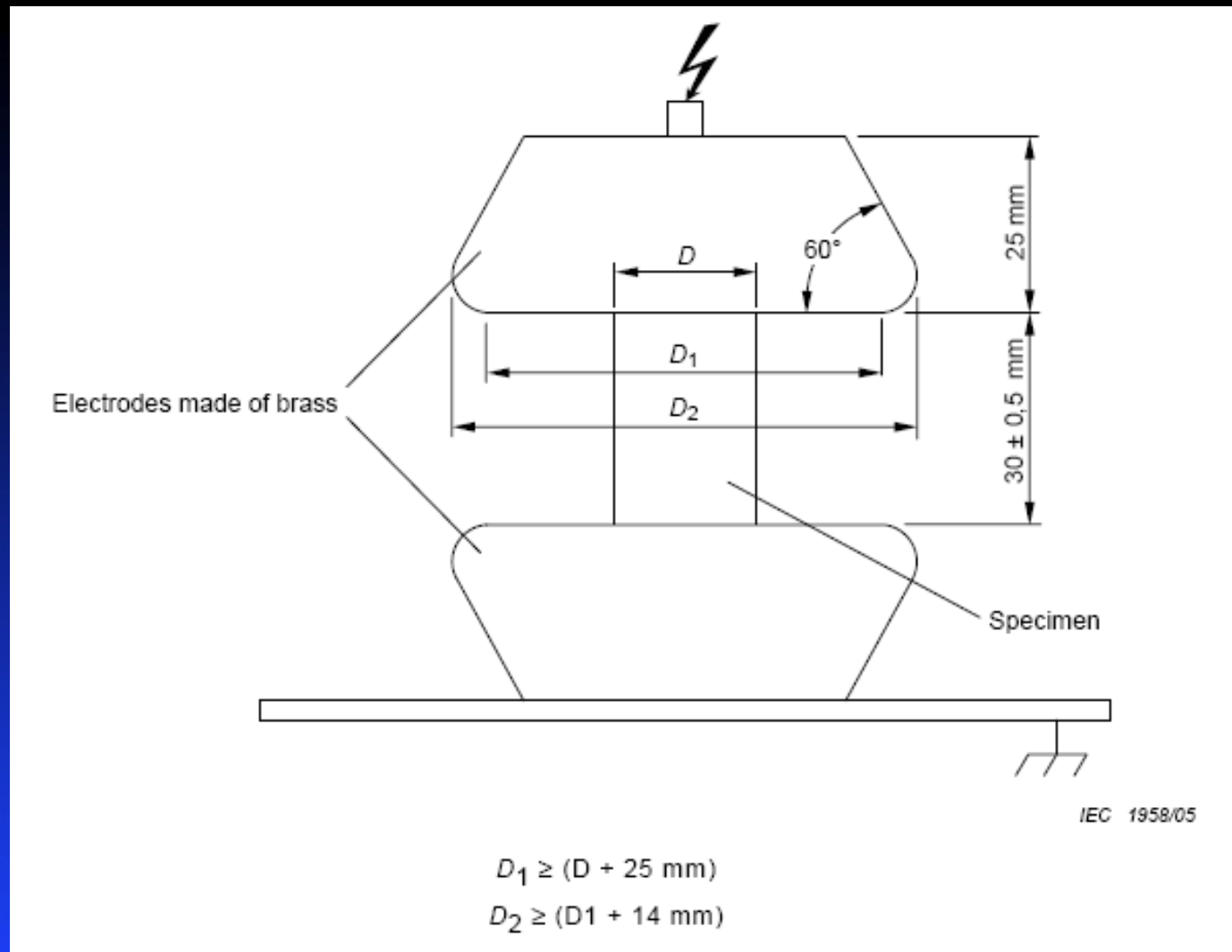
Fiberglass Core 11.4x

# Water Diffusion Tests

- Four samples shall be cut from a production line insulator. The length of the samples shall be  $30 \pm 0.5$  mm. The cut ends shall be clean and parallel.
- The samples shall be boiled in a suitable container (e.g., made of glass or stainless steel) for a minimum  $100 \pm 0.5$  h in deionized water with 0.1 % by weight of NaCl.
- 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 per s, up to 12 kV. The voltage shall be kept constant at 12 kV for 1 min and then decreased to zero.
- 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).



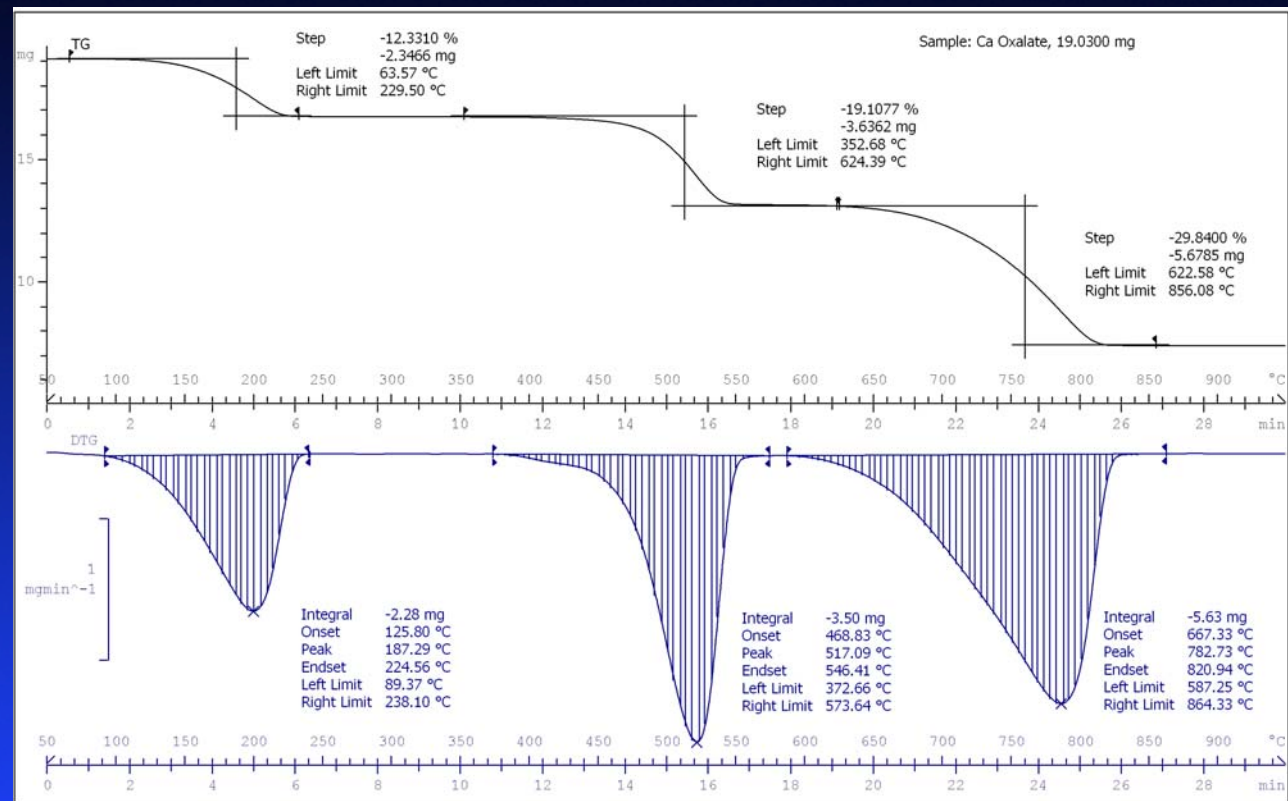
# Water Diffusion Tests





# Other Tests

- Perform glass transition temperature test to evaluate cure of the fiberglass rod polymer.



# Comments / Contact Info

Frank C. Lambert (email)

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404-675-1855

