HV Type Testing Extruded-Dielectric Cable Systems for North America

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What’s in a Name?  

- AEIC – Qualification Test
- IEC – Type Test
- ICEA – Qualification Test
- IEEE – Design Test

The name of a thing does not matter as much as the quality of the thing. (From Shakespeare's play, Romeo and Juliet.)
AEIC Qualification Test

- Tests made before supplying on a general commercial basis a type of cable, accessory, or a cable system.
- To demonstrate satisfactory performance characteristics for the intended application.
- Per AEIC, these are also called “type tests” and “design tests”. They take about 3 months.

Note: the Pre-Qualification (PQ) test is different. The PQ test demonstrates the long-term performance of a cable system, and lasts about 1 year.
IEC Type Test

- Tests made before supplying on a general commercial basis a type of cable system or cable or accessory.
- Intended to demonstrate satisfactory performance characteristics.
ICEA Qualification Test

- Intended to demonstrate the adequacy of designs, manufacturing, and materials to be used in high quality cable with the desired performance characteristics.
IEEE Design Test

- Performed to qualify a particular product design, materials, and production process.
- Shall be performed on prototype and preproduction units to shake out problems, but also on final production units for the purpose of certifying that the process, materials, and design comply with the requirements.
HV Type Testing for North America

- Most utilities in North America who require a Type Test will specify one of the following:
  - In accordance with IEC 60840 or 62067, or
  - In accordance with AEIC CS9
- IEC 60840 and 62067 are standards developed internationally by industry, government, laboratories, academia – one vote per country
- AEIC CS9 is a specification developed by North American utilities
- ICEA S-108-720 is a standard developed by North American cable manufacturers
- IEEE 48 & 404 are standards developed by the ICC
AEIC/IEEE vs IEC – not exactly straightforward

- **AEIC CS9 includes §6.0 – Qualification Tests on Complete Cable System**
  - Calls out §12 of IEC 60840/62067 (Type Test on Cable Systems), but with the high temperature tests to be performed at the emergency operating temperature.

- **AEIC CS9 §2.8, 3.4, and 4.4 – Qualification Tests on Cable, Terminations, and Joints**
  - These sections are not referenced in §6.0. Is it required for systems?
  - AEIC CS9 §2.8, 3.4, and 4.4 call out ICEA S-108-720, IEEE 48, and IEEE 404 (assuming it is referring to the “Design Tests” for the latter two), as well as a seismic requirement.
Accessories: AEIC CS9 + IEEE 48 and 404

- AEIC CS9 and ICEA S-108-720 load cycle requirement:
  - 20 heating cycles
  - Heat applied for 8 hrs, with at least 2 hrs at 100-105°C
  - 16 hrs of natural cooling to within 10K of ambient

- IEEE 48 Design requirement for load cycles:
  - 30 load cycles, each 24 hrs in duration
  - Heat applied, with 6 hrs at 100-105°C.
  - Natural cooling to within 5°C of ambient

- IEEE 404 Design requirement for load cycles:
  - 30 load cycles, 4 joints, 2 in air and 2 under water (under water not required if there’s a metallic casing welded or soldered to the sheath)

- IEEE 48 & 404 have a number of other tests specific to just the accessories
Cable: AEIC CS9 + ICEA S-108-720

- AEIC CS9 §6.0 (Qualification Test of Cable System) is not the same as AEIC CS9 §2.8 (Qualification Test of Cable)
- CS9 §6.0 calls out IEC 60840/62067
- CS9 §2.8 calls out ICEA S-108-720
- Some differences:
  - IEC has the tan δ measurement after bending test, ICEA it’s next to last
  - ICEA heat cycles 2 samples – 1 is used for Hot Impulse and Withstand, but 2\textsuperscript{nd} is given a 2-hr 2\textsubscript{U\textcircled{o}} Withstand test prior to PD, tan δ, and dissection. With IEC, it’s just 1 sample, and it then sees hot & ambient PD, Hot Impulse, and Withstand.
  - ICEA has different tests for Jacket, Insulation, Semicon
To date, it would seem that most North American utilities require Type Testing in accordance with AEIC CS9 §6.0 – Qualification Tests on Complete Cable System

- Calls out §12 of IEC 60840/62067 (Type Test on Cable Systems), but with the high temperature tests to be performed at the emergency operating temperature.
- Possible addition of seismic requirements, depending on location.

AEIC CS9 §2.8, 3.4, and 4.4 are mostly ignored for the complete system (i.e., IEEE 48 and 404 Design Tests, and ICEA Qualification Tests are not included.)
In Summary...

- If you follow the standards as currently written, Type Testing the cable + accessories + system would likely take longer than 3 months, cost considerably more, and it would be much more complicated.