

Accelerated aging tests

SC D1 Materials and Emerging Test Techniques

PS2, Q2.04 - Is testing under high temperature representative enough for the determination of thermal index of insulating materials? Are the acceleration factors used for high temperature accelerated tests for different insulation systems well documented? How shall the change of properties and chemical characteristics of the insulating liquid itself be considered under such conditions?

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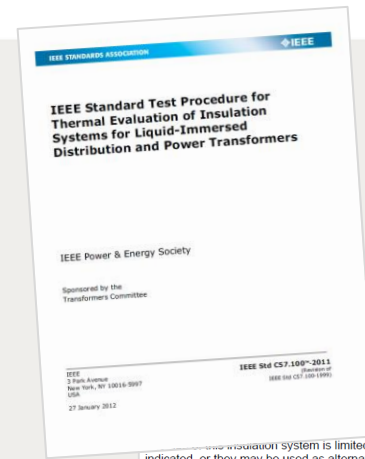
Summary

- Accelerated aging of insulation systems under high temperature **is representative for the determination of thermal index of insulating materials.**
 - There is long experience in thermal evaluation of dry-type or liquid immersed insulation systems and standard references for it exist.
 - Recently, a 3rd party certification of new insulation was performed, which confirms the validity of established methods for ensuring proper insulation system performance.
 - Proper evaluation method may be necessary depending on the application.
- Although, **majority of thermal evaluation methods focus on solid insulation materials**, while liquids are considered only an environment for aging of solid insulation.
 - Still missing procedures for evaluating liquids alone or evaluating liquid aging as part of insulation systems.

Accelerated aging tests

- Long experience in accelerated thermal evaluation of dry-type or liquid immersed insulation systems
- Standards existing, e.g. IEEE Std. C57.100.
- The first ever 3rd party UL certification for new liquid filled insulation system. (confirms the trust at the industry and validity of established methods)
- Choice of proper evaluation method is necessary for the application and equipment type:
 - **Complete equipment model** – the most precise but limited to specific design,
 - **Sealed tube** – the most simplified and practical; allowing long term evaluation in given environment and with other materials included,
 - **Dual temperature cell** – advanced model allowing for separating temperatures for solid insulation (insulated heating element) and liquid (bulk liquid temperature)

Group Discussion Meeting



System Component	System Designation	System Class
Nomex® 910	Nomex® + Ester 130	130(B)

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An Authorization Letter is Required for Adoption of this System

Construction Details (Table I)

indicated, or they may be used as alternates to one another. Functions designated "optional" are not necessarily required for every design. Insulation thicknesses and/or layers below indicated minimum.

Description: Liquid Immersed distribution transformer EIS
Note: Intended for use in liquid immersed distribution transformers evaluated to IEEE Std C57.154

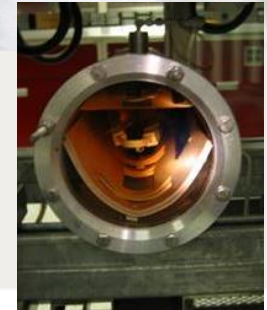
Bare Conductor - copper wrapped or interleaved with Nomex 910

Ground and Interwinding Insulations	
Designation	mil(mm) comments
A&A_Fratelli_Parodi_S.p.A Paryol Electra 7426®	Dielectric Fluid - Natural Ester
DuPont_Specialty_Products_USA_LL.C Nomex® 910	5 (0.13) Cellulosic/aramid paper

any sheet insulation or tape described in this table with no minimum thickness requirement may be used as a minor sheet material

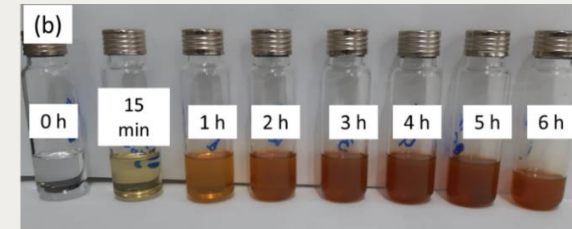
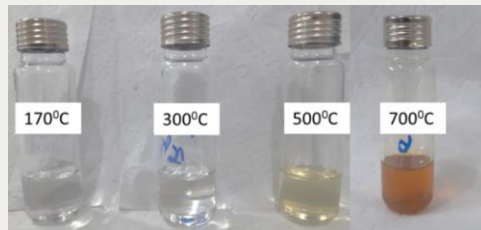
Spacer and Wedges	
Designation	comments
Various_Manufacturers Pressboard	pre-compressed or calendered cellulosic material
Weidmann_Electrical_Technology_AG Hival T4	Cellulosic Pressboard Cellulosic Pressboard

any material described in this table with no thickness requirement may be used as a spacer or a wedge



Missing procedures for liquids

- Today liquids considered to be **an environment for aging of solid insulation**.
- Missing procedures for evaluating liquids alone or evaluating liquid aging as part of insulation systems:
 - Understanding of thermal aging behavior,
 - Guidelines for accelerated aging tests,
 - Criteria for end-of-life determination.



- Developing of CIGRE guidelines for aging and evaluation proposed in 2014, but the topic was considered too complex at that time (too many factors to consider).
- An active IEEE Working Group investigates aging factors for liquids.

Group Discussion Meeting