

# PC57.154

## Standard for Liquid-Immersed Transformers Designed to Operate at Temperatures Above Conventional Limits Using High-Temperature Insulation Systems

IEEE/PES Transformers Committee  
Insulation Systems Subcommittee

October 15, 2018  
Jacksonville, Florida



# Working Group Agenda

- **Welcome & Chair's Remarks**
- **Call for patents**
- Roster Circulation – request for membership
- Introduction of Attendees
- Quorum
- Approval of previous meeting minutes
- Approval of agenda
- Review of Title, Scope & Purpose
- Suggestions for Revision Activities
- Review of Current Version of C57.154
- Adjourn

# Participants have a duty to inform the IEEE

- Participants shall inform the IEEE (or cause the IEEE to be informed) of the **identity of each holder of any potential Essential Patent Claims** of which they are personally aware if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents
- Participants should inform the IEEE (or cause the IEEE to be informed) of the identity of any other holders of potential Essential Patent Claims

**Early identification of holders of potential  
Essential Patent Claims is encouraged**

# Ways to inform IEEE

- Cause an LOA to be submitted to the IEEE-SA (patcom@ieee.org); or
- Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible; or
- **Speak up now and respond to this Call for Potentially Essential Patents**

If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance, please respond at this time by providing relevant information to the WG Chair

# Other guidelines for IEEE WG meetings

- All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.
  - Don't discuss the interpretation, validity, or essentiality of patents/patent claims.
  - Don't discuss specific license rates, terms, or conditions.
    - Relative costs of different technical approaches that include relative costs of patent licensing terms may be discussed in standards development meetings.
      - Technical considerations remain the primary focus
  - Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.
  - Don't discuss the status or substance of ongoing or threatened litigation.
  - Don't be silent if inappropriate topics are discussed ... do formally object.

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For more details, see *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and *Antitrust and Competition Policy: What You Need to Know* at <http://standards.ieee.org/develop/policies/antitrust.pdf>

# Patent-related information

The patent policy and the procedures used to execute that policy are documented in the:

- ***IEEE-SA Standards Board Bylaws***  
(<http://standards.ieee.org/develop/policies/bylaws/sect6-7.html#6>)
- ***IEEE-SA Standards Board Operations Manual***  
(<http://standards.ieee.org/develop/policies/opman/sect6.html#6.3>)

Material about the patent policy is available at  
<http://standards.ieee.org/about/sasb/patcom/materials.html>

**If you have questions, contact the IEEE-SA  
Standards Board Patent Committee  
Administrator at [patcom@ieee.org](mailto:patcom@ieee.org)**

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# PC57.154

- Title Revision

- New

Standard for Liquid-Immersed Transformers Designed to Operate at Temperatures **Above Conventional Limits** Using High-Temperature Insulation Systems

- Old

Standard for *the Design, Testing, and Application of* Liquid-Immersed *Distribution, Power, and Regulating* Transformers Using High-Temperature Insulation Systems and Operating *at Elevated* Temperatures

# PC57.154

- **Scope**

This standard applies to all liquid-immersed distribution, power, and regulating transformers that are designed to operate at temperatures that exceed the normal thermal limits of IEEE Std C57.12.00 under continuous load, in the designed average ambient, and at rated conditions.

# PC57.154

- Purpose

This standard provides specific requirements and guidance in the design, testing, and application of the transformers covered within its scope. These transformers incorporate high-temperature insulation systems or systems that use a combination of high-temperature and conventional insulation.

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# Liquid Thermal Class

## 5. Temperature limits

The many different types of dielectric insulating liquids available offer a range of thermal capabilities, and typical parameters are compared in Annex A. However, for simplification, this standard uses only three liquid thermal classes as examples: 105, 130, and 155. Each of these thermal classes is represented by mineral oil, ester, and silicone liquids, respectively. This standard does not make a distinction between ester liquids based on the source of the product. Consequently, both synthetic and natural ester liquids are considered thermally equivalent. Note that other liquids are not intended to be excluded, and limits appropriate to specific thermal capability shall be applied according to the thermal class of the liquid.

### Taken from Table A.3

NOTE—The values in this table are provided only as a general guide for comparison of the different liquids. For specific physical properties and acceptance limits, refer to the standard(s) noted for each liquid. Physical properties and acceptance limits for liquids with no reference standard should be verified with the liquid manufacturer.

# Liquid Thermal Class

## A.4 Insulating liquids

Table A.3 shows typical performance characteristics of dielectric liquids that are used in liquid-immersed transformers. Mineral oil insulating liquid complying with ASTM D3487 [B7] is the most common liquid used in transformers and is generally the performance reference to which all other liquids are compared. This liquid is also the reference for comparing high-temperature performance.

According to the rules for classifying liquids, a fire point greater than 300 °C, as determined according to ASTM D92 [B3], classifies the liquid as a less-flammable liquid. However, neither the flash point nor the fire point is sufficient to define high-temperature capability. The thermal capability of different types of dielectric liquids can differ based on their specific chemical reaction characteristics versus temperature. It is important to obtain the short- and long-term temperature limits recommended by the respective manufacturer. The liquid manufacturer should be contacted to determine if a specific product is suitable for use at higher temperatures than conventional mineral oil.

The maximum operating temperatures listed in Table A.3 are provided only as a starting point for further investigation, since there is no generally accepted procedure for establishing a thermal class for insulating liquids. These temperatures are estimated or generally accepted by the industry.

# Liquid Thermal Class

- Member Suggestion to form a Task Force/study group
  - Possible scope
    - Consider the background and historical applications
    - Consider options to prove (or develop) the temperature limits for transformer liquids
    - Propose tentative test procedure(s)
  - Discussion?
  - Task Force Duration
  - Chair
  - Members

# New Thermal Class?

**Table 3—Maximum continuous temperature rise limits for transformers with hybrid insulation systems**

	Conventional insulation system	Hybrid insulation systems				
		Mixed hybrid insulation winding	Full hybrid insulation winding <sup>a</sup>			
Minimum required high-temperature solid insulation thermal class	120	130	130	140	155	180
Top liquid temperature rise, (°C)	65	65	65	65	65	65
Average winding temperature rise, (°C)	65	65	75	85	95	115
Hottest spot temperature rise for solid insulation, (°C)	80	90	90	100	115	140

- Suggested by member
- This addition would match high temperature limits
- Discussion?

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