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IEEE Guide for the Application of High-Temperature Insulation Materials in Liquid-Immersed Distribution, Power, and Regulating Transformers

STANDARDS

IEEE Power and Energy Society

Developed by the
Transformers Committee

IEEE Std 1276™-2020
(Revision of IEEE Std 1276-1997

IEEE

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Abstract: Technical information is provided in this guide related to liquid-immersed power, distribution, 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. Guidelines for applying high-temperature solid and liquid materials as insulation systems; guidelines for loading high-temperature liquid-immersed power, distribution, and regulating transformers; and guidelines on test procedures for qualifying new high-temperature solid and liquid insulating materials are included.

Keywords: high-temperature insulation, hybrid insulation system, IEEE 1276™, liquid-immersed, power transformer, distribution transformer, regulating transformer, loading guide, mixed hybrid, full hybrid

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Introduction

This introduction is not part of IEEE Std 1276-2020, IEEE Guide for the Application of High-Temperature Insulation Materials in Liquid-Immersed Distribution, Power, and Regulating Transformers.

Liquid-immersed transformers utilizing high-temperature insulation systems are being used increasingly by the industry. Standards including IEEE Std C57.154™ and IEEE Std C57.100™ have been developed to provide methods to evaluate new high-temperature insulation systems as well as to specify requirements for the design, testing, and application of transformers built with these high-temperature insulation systems.[1] This guide is intended to give the user some background information on the application and use of high-temperature insulation in power, distribution, and regulating transformers.

This revision of IEEE Std 1276 expands the scope of high-temperature insulation systems beyond those described in the 1997 version. The 1997 scope was limited to high-temperature insulation systems based on high-temperature solid materials in mineral oil power transformers. The revised scope includes a wider range of liquid insulation system options using high-temperature insulating liquids as well as to cover distribution and regulating transformer applications. Additionally, with the development of IEEE Std C57.154™-2012 [B27], this IEEE guide provides a place for additional guide-like information that was not suitable for a standard.[2] Some clauses from IEEE Std C57.154-2012 have been copied into this version of IEEE Std 1276 to provide a connection between the two documents. With this revision, an expanded discussion related to guidance for loading of transformers with high-temperature insulation systems is provided.

Additionally, as part of the revision of this document, some items from the 1997 version that have been placed in IEEE Std C57.154 that are more of a standardized nature have been removed. Examples of this include the temperature limits for different insulation systems, as well as nameplate and testing information. These have been expanded in IEEE Std C57.154 in part because the scope of transformers covered has been increased beyond power transformers and the insulating liquids covered are beyond just mineral oil.

To complete this document, there is a discussion on how to evaluate high-temperature insulation systems using the test methodology outlined in IEEE Std C57.100. Annex A provides guidance on how to conduct such testing, providing more detail than that provided within IEEE Std C57.100. This detail was needed to clarify how to conduct such testing to develop new life curves using higher temperature materials, as well as to provide more specific information developed as a result of the publication of IEEE Std C57.100™-2011 [B24], which makes implementation of this standard easier to understand. This detail is well suited to this document as it is an IEEE guide. Annex B provides examples of insulation system testing for two high-temperature insulation systems. Finally, Annex C discusses gas analysis for high-temperature insulation systems.

[1]Information on references can be found in Clause 2.
[2]The numbers in brackets correspond to those of the bibliography in Annex D.

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IEEE Guide for the Application of High-Temperature Insulation Materials in Liquid-Immersed Distribution, Power, and Regulating Transformers

1. Overview

The intent of this guide is to provide information on the application and use of high-temperature insulation in liquid-immersed distribution, power, and regulating transformers. It addresses only those areas where the application and use differ from the existing standards for these types of transformers.

1.1 Scope

This guide applies to 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.

1.2 Purpose

The purpose of this guide is to provide an informative technical background for the design, testing, and application of high-temperature transformers covered within the scope of IEEE Std C57.154.

1.3 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (shall equals is required to).[3,4]

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (should equals is recommended that).

The word *may* is used to indicate a course of action permissible within the limits of the standard (may equals is permitted to).

[3]The use of the word *must* is deprecated and shall not be used when stating mandatory requirements, *must* is used only to describe unavoidable situations.
[4]The use of *will* is deprecated and shall not be used when stating mandatory requirements, *will* is only used in statements of fact.