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IEEE Standard General Requirements and Test Code for Dry-Type and Oil-Immersed Smoothing Reactors and for Dry-Type Converter Reactors for DC Power Transmission

STANDARDS

IEEE Power and Energy Society

Developed by the
Transformers Committee

IEEE Std 1277™-2020
(Revision of
IEEE Std 1277-2010)

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Approved 6 May 2020

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Abstract: The electrical, mechanical, and physical requirements of oil-immersed and dry-type air-core smoothing reactors and dry-type air-core converter reactors for high-voltage direct current (HVDC) applications are specified. Test code is defined and appropriate technical background information is presented or identified.

Keywords: construction, converter reactors, dry-type air-core, HVDC, IEEE 1277™, oil-immersed, rating, smoothing reactors, test code application

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Introduction

This introduction is not part of IEEE Std 1277-2020, IEEE Standard for General Requirements and Test code for Dry-Type and Oil-Immersed Smoothing Reactors and for Dry-Type Converter Reactors for DC Power Transmission.

In 1986, the Transformers Committee of the Institute of Electrical and Electronic Engineers created the HVDC Converter Transformers and Smoothing Reactors Subcommittee. This committee developed from the working group that prepared paper 85 SM 375-1, "Recommended Dielectric Tests and Test Procedures for Converter Transformers and Smoothing Reactors." Although smoothing reactors for HVDC application have been built and operated for over 30 years, prior to IEEE Std 1277™ there were only a limited number of papers, guides, and standards available that presented suggested dielectric tests for the HVDC equipment (see Annex D for a list of some of the most relevant documents). The IEC reactor standard IEC 60076-6:2007 [B10] also covers smoothing reactors in a specific clause; focus is not, however, application-specific.[1] With the increased activity in HVDC transmission, there was a significant need for a standard specifically covering the requirements and testing of smoothing reactors for HVDC applications, and the first responsibility of the new subcommittee was to create proposed standards for converter transformers and smoothing reactors for HVDC application. Two separate standards were developed—one for oil-filled converter transformers, and one for both dry-type and oil-filled smoothing reactors. IEEE Std 1277 was originally released in 2000 as "trial use" and, approximately two years later in 2002, was granted "full use" status.

The revision in 2020 was focused to upgrade test code, design considerations, and application information based on feedback from manufacturers and "end users"—dry-type or oil-immersed specific when required. The designation "oil-immersed" is kept, as at time of writing, smoothing reactors with alternative insulation liquid have not been available. Test code methodology has been modified to reflect current technology. The main purpose of this current revision is the introduction of the air-core dry-type converter reactors for the VSC (voltage sourced converter) HVDC schemes. Furthermore, the document has been cleaned up as, for example, oil-immersed smoothing reactors are rarely used in today's HVDC schemes. As HVDC smoothing reactors according to this standard are used for all voltage levels, the present standard is also valid for so called UHVDC (ultra-high voltage direct current with nominal dc voltage of 800 kV and higher) applications.

[1]The numbers in brackets correspond to those of the bibliography in Annex D.

Contents

IEEE Standard General Requirements and Test Code for Dry-Type and Oil-Immersed Smoothing Reactors and for Dry-Type Converter Reactors for DC Power Transmission

1. Overview

1.1 Scope

The scope of this standard is the definition and specification of the functional requirements and test code for dry-type and oil-immersed smoothing reactors and dry-type converter reactors for high-voltage direct current (HVDC) power transmission. This standard only applies to smoothing reactors for dc transmission and converter reactors for dc transmission located at the converter arms.

1.2 Purpose

The purpose of this standard is to provide those in the HVDC industry, manufacturers, and "end users" a document that defines and specifies the electrical, mechanical, and physical requirements of dry-type and oil-immersed smoothing reactors for HVDC applications. Furthermore, the document defines and specifies electrical, mechanical, and physical requirements of dry-type converter reactors used for voltage-sourced HVDC converters (VSC HVDC) that are located at the converter arms and loaded with dc and ac current. Test code is also defined and specified. Converter reactors are usually built in dry-type air-core and air-cooled design. Thus, only this type of converter reactor design is considered in this standard.

In addition, appropriate technical background information, that will facilitate the use of this standard, is presented or identified.

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).[2,3]

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