

IEEE Standard for Overhead-Type Distribution Transformers 500 kVA and Smaller: High Voltage, 34 500 V and Below; Low Voltage, 7970/13 800Y V and Below

IEEE Power & Energy Society

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Transformers Committee



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**Transformers Committee
of the
IEEE Power & Energy Society**

Approved 16 June 2011

IEEE-SA Standards Board

Abstract: Certain electrical, dimensional, and mechanical characteristics and safety features of single- and three-phase, 60 Hz, mineral-oil-immersed, self-cooled, overhead-type distribution transformers 500 kVA and smaller, high voltages 34 500 V and below, and low voltages 7970/13 800Y V and below are covered in this standard.

Keywords: distribution transformer, IEEE C57.12.20, mineral oil, overhead, transformer

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Introduction

This introduction is not part of IEEE Std C57.12.20-2011, IEEE Standard for Overhead-Type Distribution Transformers 500 kVA and Smaller: High Voltage, 34 500 V and Below; Low Voltage, 7970/13 800 Y V and Below.

In 1938 the Edison Electric Institute-National Electrical Manufacturers Association (EEI-NEMA) Joint Committee on Standards for Distribution Transformers was organized to develop standards for the various types of distribution transformers. For 23 years the continuous work of this Joint Committee was evidenced by a series of reports published jointly by the Edison Electric Institute (EEI) and the National Electrical Manufacturers Association (NEMA). The last report of overhead-type distribution transformers was the Seventh Report published in April 1961. The Joint Committee's last two reports on overhead-type distribution transformers were approved as American National Standards; the Seventh Report was reissued as ANSI C57.12.20-1962.

To avoid further duplication of effort and to simplify future revisions, the EEI-NEMA Joint Committee on Standards for Distribution Transformers was dissolved and replaced by new subcommittees of Accredited Standards Committee on Transformers, Regulators, and Reactors, C57. The work on standards for overhead-type distribution transformers was taken over by the Subcommittee on Distribution Transformers, Overhead and Pad-mounted, C57.12.2.

This standard was prepared by IEEE Subcommittee C57.12.2 on behalf of C57 and is a revision of IEEE Std C57.12.20-2005, IEEE Standard for Overhead Type Distribution Transformers, 500 kVA and Smaller: High Voltage, 34 500 Volts and Below; Low Voltage 7970/13 800Y Volts and Below. The 1981 edition included detailed requirements on relief of excessive pressure. The 1988 revision recognized the step-down and series-multiple designs in distribution transformers, and omitted the platform-type or station-type transformer. In recognition of the dramatic reduction in catastrophic failures of overhead transformers since the formulation of NEMA Standards Proposal Number TR-P7-1975, the 1988 revision included in Section 8, this updated NEMA proposal that was previously designated 2.02 of NEMA Standards Publication for Transformers, Regulators, and Reactors, NEMA TR 1-1980 [B4].^a The general industry consensus is that transformers that are built in conformance with this standard and that have adequate overcurrent protection, and recognizing the limitations included therein, will provide for enclosures with reasonable withstand capability. The 2011 revision includes significant revisions to Clause 9.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Transformers, Regulators, and Reactors, C57. Committee approval of the standard does not necessarily imply that all committee members voted for its approval.

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1. Overview

1.1 Scope

This standard covers certain electrical, dimensional, and mechanical characteristics and safety features of single-and three-phase, 60-Hz, mineral-oil-immersed, self-cooled, overhead-type distribution transformers 500 kVA and smaller, high voltages 34 500 V and below and low voltages 7970/13 800Y V and below.

1.2 Purpose

This standard is intended for use as a basis for determining the performance, interchangeability, and safety of overhead-type distribution transformers and to assist in the proper selection of this equipment.

~~NOTE—For polychlorinated biphenyl (PCB) contamination in transformers, refer to the latest federal regulations.~~

2. Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std C37.40™, IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.^{1, 2}

IEEE Std C37.41™, IEEE Standard Design Tests for High-Voltage (>1000 V) Fuses, [Fuse and Disconnecting Cutouts](#), Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and [Fuse Links and Accessories Used with These Devices](#).

IEEE Std C57.12.00™, IEEE ~~Standard~~ General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

IEEE Std C57.12.31™, IEEE Standard for Pole Mounted Equipment—Enclosure Integrity.

IEEE Std C57.12.70™, IEEE Standard Terminal Markings and Connections for Distribution and Power Transformers.

IEEE Std C57.12.80™, IEEE Standard Terminology for Power and Distribution Transformers.

IEEE Std C57.12.90™, IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers.

IEEE Std C57.91™, IEEE Guide for Loading Mineral-Oil-Immersed Transformers.

3. Definitions

For the purposes of this ~~standard~~ [document](#), the following terms and definitions apply. *The ~~Authoritative Dictionary of IEEE Standards~~ [Dictionary: Glossary of Terms, Seventh Edition \[B1\]](#)² & [Definitions and IEEE Std C57.12.80](#)³* should be referenced for terms not defined in this clause.⁴

3.1 back-up protection: Devices external to the transformer enclosure to limit the duration or the potential duration of the flow of current ~~to a fault~~.

3.2 enclosures: The complete transformer housing, tank, cover, band, etc., that contains the oil, the core and coil, the accessories, etc., of an overhead-type distribution transformer.

~~3.3 **fault:** An electrical condition designed to draw a specified value of current.~~

~~3.4 **internal fusible element:** An expulsion fuse that operates in the transformer oil.~~

~~3.5 **test:** Two faults in a given enclosure.~~

4. Ratings

4.1 Kilovolt-ampere ratings

Kilovolt-ampere ratings are continuous and are based on not exceeding either a 65°C average winding temperature rise or an 80°C hot~~test~~-spot temperature rise. The temperature rise of the insulating oil shall not exceed 65°C when measured near the top of the tank. Kilovolt-ampere ratings for single-phase and three- phase transformers shall be as shown in Table 1. These ratings are based on the usual temperature and altitude service conditions specified in IEEE Std C57.12.00~~TM~~.

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³ Information on references can be found in Clause 2.

~~⁴[The IEEE Standards Dictionary: Glossary of Terms & Definitions is available at http://shop.ieee.org/.](http://shop.ieee.org/)~~

4.2 Voltage ratings and tap ratings

Voltage ratings for single-phase and three-phase transformers shall be in accordance with Table 2, Table 3, and Table 4. No taps are to be provided unless otherwise specified.

When specified, tap ratings for single- and three-phase transformers shall be in accordance with Table 5. All tap ratings shall be at rated kilovolt-amperes, except as otherwise indicated. Voltages in Table 2, Table 3, and Table 4 are without taps.

5. Basic lightning impulse insulation levels and dielectric test levels

5.1 Basic lightning impulse

Basic lightning impulse insulation levels (BILs) shall be as shown in Table 2, Table 3, and Table 4.

5.2 Dielectric test

Dielectric test levels shall be in accordance with the distribution levels specified in IEEE Std C57.12.00.

6. Tests

6.1 General

Except as specified in 6.2, tests shall be performed as specified in IEEE Std C57.12.00 and in IEEE Std C57.12.90.

6.2 Dielectric tests

For single-phase transformers with a BIL of 150 kV or less that have one high-voltage bushing and a high-voltage terminal permanently connected to ground, no applied-voltage test is required. Induced-voltage tests shall be performed by applying between the terminals of one winding a voltage that will be developed from the high-voltage line terminals to ground. This voltage shall be 1000 V plus 3.46 times the rated transformer winding voltage, but in no case shall the line-to-ground voltage developed exceed 40 000 V for 125 kV BIL or 50 000 V for 150 kV BIL. For this test, the neutral terminal shall be grounded. An applied voltage test shall be applied on the low-voltage winding.

7. Construction

For the purpose of this standard, two principal reference locations have been established, as shown in Figure 1 and Figure 2. The first of these is a horizontal plane that passes through the top of the bolt slot in the upper support lug. For the second, the transformer cover has been divided into four segments. The segments are numbered in a clockwise direction with the centerline of segment 1 on the centerline of the low-voltage bushings, as shown in Figure 1 and Figure 2.

All dimensions contained in this standard are derived from U. S. Customary equivalents.

Unless otherwise noted, all dimensions will have a tolerance of ± 2 mm (0.063 in).

7.1 Bushings and terminals

7.1.1 Bushings

Electrical characteristics of transformer bushings shall be as listed in Table 6.

The number, location, and arrangement of bushings for single-phase and three-phase transformers shall be as shown in Figure 4, Figure 7 through Figure 14, and Table 7. The centerline of the high-voltage bushings shall be located within the shaded areas. The positions of high-voltage bushings for three-phase transformers need not be symmetrical. Low-voltage bushings shall be of the sidewall or cover type and shall be individually mounted.

Unless otherwise specified, the color of bushings shall match Light Gray Number 70, Munsell Notation 5BG 7.0/0.4 as described in IEEE Std 57.12.31 [TM](#).

7.1.2 Terminals

7.1.2.1 High-voltage terminals

Terminal details shall be as shown in Figure 5a. High-voltage bushings of transformers 200 kV BIL and below shall be equipped with tinned, copper-alloy solderless connectors. High-voltage terminal sizes shall be as shown in Table 8.

7.1.2.2 Low-voltage terminals

Terminal details shall be as shown in Figure 5a and Figure 5b. Low-voltage terminal sizes shall be as shown in Table 9. Terminals of low-voltage windings 600 V and below shall be arranged for vertical take off.

External spacing between low-voltage bushing terminals shall be such as to provide the maximum clearance between live metal parts in the working area. For low-voltage ratings above 600 V, the electrical characteristics of the bushings determine the spacing. For low-voltage ratings 600 V and below, spacing shall be within the limits of Table 10.

7.1.3 Neutral termination

On single-phase transformers having one high-voltage bushing, the H₂ end of the winding shall be securely connected internally to the grounded clamping structure or the tank. This connection shall be independent of all other electrical connections.

On all three-phase transformers, a fully insulated low-voltage neutral bushing, X₀, shall be provided when the low-voltage windings are wye-connected.

On three-phase transformers, a fully insulated high-voltage neutral bushing, H₀, and a fully insulated low-voltage neutral bushing X₀, shall be provided where wye-connected high-voltage windings are rated 8.32Y kV and below and low-voltage windings are rated 208Y/120 V or 480Y/277 V.

On three-phase transformers, a common fully insulated low-voltage type neutral bushing H0X0, shall be provided where wye-connected high-voltage windings are rated above 8.32Y kV and low-voltage windings are rated 208Y/120 ∇ or 480Y/277 V. The high-voltage and low-voltage neutrals shall be connected internally by a link that is accessible and capable of reconnection.

7.1.4 Terminal boards

On single-phase transformers with low-voltage ratings of 120/240 V or 240/480 V, the internal connections to the low-voltage bushings on sizes 100 kVA and smaller shall be arranged to serve in lieu of a low-voltage terminal board. These connections shall be in conformance with and arranged as shown in Figure 6.

7.2 Accessory equipment

Accessory equipment shall be provided and located as shown in Figure 7 through Figure 14.

7.2.1 Tap changer [for de-energized operation](#)

(See item 3 in Figure 7 through Figure 14.) Tap changers for de-energized operation shall be provided on tapped transformers. Each tap-changer position and the tap voltage or percentage associated with it shall be clearly identifiable by reference to nameplate information. All positions of the [de-energized](#) tap changer shall be operative positions. Transformers may have either an internal de-energized tap changer or an externally operated de-energized tap changer unless one or the other is specified.