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**IEEE Guide for Testing Turn Insulation
of Form-Wound Stator Coils for
Alternating-Current Electric Machines**

IEEE Power Engineering Society

Sponsored by the
Electric Machinery Committee



3 Park Avenue, New York, NY 10016-5997, USA

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Electric Machinery Committee
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Abstract: Suggestions are made for testing the dielectric strength of the insulation separating the various turns from each other within multiturn form-wound coils to determine their acceptability. Typical ratings of machines employing such coils normally lie within the range of 200 kW to 100 MW (270 hp to 135 000 hp). The test levels described do not evaluate the ability of the turn insulation to withstand abnormal voltage surges, only surges associated with normal operation. The suggestions apply to: (1) individual stator coils after manufacture; (2) coils in completely wound stators; (3) coils and windings for rewinds of used machinery; and (4) windings of machines in service to determine their suitability for further service (preventive-maintenance testing). Coil service conditions, test devices, and test sequence are discussed.

Keywords: ac machines, impulses, surges, testing turn insulation, transients

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Introduction

(This introduction is not part of IEEE Std 522-2004, IEEE Guide for Testing Turn Insulation of Form-Wound Stator Coils for Alternating-Current Electric Machines.)

Many alternating-current, rotating electric machines are designed to have multiturn form-wound stator coils. In these cases, the winding has two separate but interrelated insulating barriers:

- One between the various turns (turn insulation), and
- One between the turns and ground (ground insulation).

Failure of either of these barriers will prematurely terminate the service life of the machine. A test level for the ground insulation of twice-rated voltage plus 1 kV has been in existence for many years. This guide suggests methods and test levels for the turn insulation.

Experience has shown that turn insulation failures can be precipitated by abnormal steep-front surges caused by factors such as lightning strokes, faulty breaker closures, or the malfunction of various types of switching devices. However, turn insulation failures can also be caused by surges during normal breaker operations when the circuit conditions are such that the rise time of the surge at the machine terminals is less than a few microseconds. A measure of protection from such surges may be provided by installation of devices such as surge capacitors at the machine terminals and surge arrestors, or by designing the coils with suitable turn insulation capability. When used for this purpose, capacitor ratings are usually chosen to extend the rise time of voltage surges to 5 μ s or longer.

The bibliography (Annex C) contains references that discuss the general surge environment and surge strength of electric machines.

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***We all wish to express our sorrow that Tom Kluk passed away before this standard was published. His input to this document was very valuable and much appreciated by everyone on the working group.**

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IEEE Guide for Testing Turn Insulation of Form-Wound Stator Coils for Alternating-Current Electric Machines

1. Overview

1.1 Scope

This guide makes suggestions for testing the dielectric strength of the insulation separating the various turns from each other within multiturn form-wound coils to determine the acceptability of the coils. Typical ratings of machines employing such coils normally lie within the range of 200 kW to 100 MW (270 to 135 000 hp). Test voltage levels described herein do not evaluate the ability of the turn insulation to withstand abnormal voltage surges, as contrasted to surges associated with normal operation. The repetitive voltage surges (spikes) associated with adjustable frequency drives (AFD) are also not addressed here. This guide applies to

- a) Individual stator coils after manufacture.
- b) Coils in completely wound stators of original manufacture.
- c) Coils and windings for rewinds of used machinery.
- d) Windings of machines in service to determine their suitability for further service (preventive-maintenance testing).

1.2 Purpose

The purpose of this guide is to

- a) Define surge/impulse testing as applied to the windings of an electric machine.
- b) Review the service conditions that affect voltage levels in a coil.
- c) Recommend devices suitable for measuring surges, with precautions to avoid erroneous results.
- d) Describe various points where surge testing may be performed.
- e) Present suggested surge test levels for various types of electric machines.

2. References

ASTM D1711-02, Standard Terminology Relating to Electrical Insulation.¹

¹ASTM publications are available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA (<http://www.astm.org/>).