

IEEE

No. 266

MAR. 1969

IEEE Test Procedure for
EVALUATION OF INSULATION SYSTEMS for
ELECTRONICS POWER TRANSFORMERS

IEEE No. 266



PUBLISHED BY

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.



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Full document details: IEEE 266-1969

PREFACE

To implement the changes made in AIEE Standards Publication No. 1 (now IEEE Standard No. 1), the AIEE charged its technical committee with the responsibility for developing Test Procedures for the thermal evaluation and classification of insulation systems used in electric equipment. These are to be in general accord with IEEE Standards Publication No. 1 and its supplements. The principal objective is to enable the performance of new and old insulation systems to be compared directly in a practical way and in a reasonable time, plus providing a sound basis for introducing new insulation systems into service.

A number of Test Procedures have been developed and published. One is the "Proposed IEEE Test Procedure for Evaluation of Insulation Systems for Specialty Transformers," No. 259. A review revealed that the Procedure did not entirely satisfy the needs of electronics transformers and the Electronics Transformers Materials Subcommittee set out, in 1961, to modify it to apply better to electronics power transformers.

Specialty transformers generally have their primary windings connected to secondary distribution circuits of 600 volts or less, and they supply power to lighting systems, machine tools, and other power loads. Electronics transformers usually terminate into or are energized from electronic devices. Electronics transformers may be of the power type wherein their losses are significant and are dissipated as heat, or they may be circuit elements which handle relatively low currents but may be subjected to high-voltage stresses including direct current, pulses, and even transients. Most electronics transformers are small compared to specialty transformers and, in general, they are operated in significantly different and often varying environments.

ACKNOWLEDGMENT

The Institute wishes to acknowledge its indebtedness to those who have so freely given of their time and knowledge, and have conducted experimental work on which many of the IEEE publications are based.

This publication was prepared by the Insulation Systems Subcommittee of the Electronics Transformer Committee of the IEEE Parts, Materials and Packaging Group, whose membership was:

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INTRODUCTION

The intent of this Test Procedure is to establish a uniform method by which the life of electronics transformer insulation systems can be compared. Thermal degradation is generally one of the major factors affecting the life of most insulating materials. It was chosen to be the major environmental factor in this Test Procedure. Other environmental factors, such as vibration, thermal shock, and moisture, have been included to simulate operating conditions. These factors have been chosen in such a way as to develop and disclose promptly any significant weaknesses during the temperature aging of an insulation system.

This Test Procedure is offered as a guide for preparing samples, conducting tests, and analyzing results. This information is presented in the following three principal sections:

Section 1. Insulation Test Specimens. Describes the types of insulation specimens suitable for use in the evaluation tests.

Section 2. Test Cycle. Recommends the test cycle for use in the insulation evaluation tests. The cycle consists of a series of exposures to heat, vibration, thermal shock, moisture and voltages to which the test specimen may be subjected to represent the cumulative effects of long service, under accelerated conditions. Information is included for selecting varying test conditions for several different transformer applications.

Section 3. Interpretation of Data. Gives information on establishing the criteria of failure, methods for analyzing test results, and a guide for interpreting test results.

It is recognized that some transformers may have special requirements other than those included in the Procedure. In these cases, special tests should be added to the test cycle. It is all-important that when insulation systems are compared, the test samples must be subjected to precisely the same test cycle.

The Test Procedure provides a statistical method for establishing a life-temperature relationship of an insulation system. This life-temperature relationship is relative. To have any significance, it must be backed up with adequate field service data or be compared to similar life test data of insulation system with known service reliability.

This Test Procedure is intended to be an evaluation test and not a production inspection or acceptance test.

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SECTION 1

INSULATION TEST SPECIMENS

Whenever possible actual transformers should be used for the thermal evaluation of insulation systems. In the case of small electronics transformers, they are the simplest, most direct, and least expensive test specimens. Some guides that can be used in selecting these specimens are given in Section 3, Part IV.

In those cases where the actual transformer is too large to use it as a test specimen, a representative-size specimen may be used. The lack of experience with large transformers prevents the establishing of a standard test model. In the use of reduced-size specimens, adequate consideration should be given to all the conditions and environments affecting the life of the simulated transformer. Each situation may involve a number of different arrangements to cover adequately the various combinations of conditions affecting the performance of the insulation system. It shall be the responsibility of each testing laboratory to select and use suitable models. Full and complete design information on the model shall be published at the time of presenting test data.

Whether the test specimens are actual transformers or models, consideration should be given to the following items when designing and building the specimens:

1. The materials used for the various components of the specimen should be identical with those used for the actual transformers. It is suggested that only insulating materials on which life data are available be used in system evaluations. Everything possible should be done to assure that the individual components are uniform, and

representative of the materials used in actual service.

2. Insulation thickness and creepage distances should be appropriate for the voltage class and industry or equipment standards or practices. The presence of corona in an insulation system will have some effect on the system's life and its presence in the test sample may prejudice the temperature aging results.
3. The arrangement of the different components, such as conductors, insulations, supporting members, spacers, shields, and ground, should duplicate electrically, thermally, and mechanically the conditions existing in the actual transformer.
4. The design and construction of the specimens should be representative of the prevailing engineering practices and manufacturing procedures and processes.
5. Provisions should be made for making electrical tests on the various insulation components.
6. If self heating is used, provisions should be made for exciting and loading the specimen.

SECTION 2

TEST CYCLE

The test specimens shall be subjected to a repeated test cycle, consisting of the following parts, in the order given in Table I. Where indicated, specific values for some of the test conditions will be found in Table IV, which provides varying degrees of severity for different applications.

TABLE I
TEST SCHEDULE

<i>Parts</i>	<i>Paragraph</i>	<i>Test</i>	<i>Remarks</i>
Initial Test	I	Dielectric Proof Test	Beginning of first cycle only
Basic Test Cycle	II	Temperature Aging	See Table III
	III	Mechanical Stress	See Table IV
	IV	Thermal Shock (when specified)	See Table IV
	V	Moisture Exposure (or special atmosphere)	See Table IV
Complete Test	II thru V	Repeat the basic test cycle until failure occurs	