



ANSI/CAN/UL 1446:2019

JOINT CANADA-UNITED STATES
NATIONAL STANDARD

STANDARD FOR SAFETY

Systems of Insulating Materials – General



Standards Council of Canada
Conseil canadien des normes



SCC FOREWORD

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UL Standard for Safety for Systems of Insulating Materials – General, ANSI/CAN/UL 1446:2019

Eighth Edition, Dated November 13, 2019

Summary of Topics

This new edition of ANSI/UL 1446 has been issued to reflect the latest ANSI and SCC approval dates, and to incorporate the proposals dated June 7, 2019.

The requirements are substantially in accordance with Proposal(s) on this subject dated June 7, 2019.

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Standard for Systems of Insulating Materials – General

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Fifth Edition – May, 1997
Sixth Edition – February, 2007
Seventh Edition – November, 2016

Eighth Edition

November 13, 2019

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The most recent designation of ANSI/UL 1446 as an American National Standard (ANSI) occurred on November 13, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This standard has been designated as a National Standard of Canada (NSC) on November 13, 2019.

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Preface

This is the Eighth Edition of the ANSI/CAN/UL 1446 Standard for Systems of Insulating Materials – General.

UL is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL 1446 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

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This Edition of the Standard has been formally approved by the UL Standards Technical Panel (STP) on Insulating Systems, STP 1446.

This list represents the STP 1446 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

STP 1446 Membership

Name	Representing	Interest Category	Region
Barta, D.	Rea Magnet Wire Co.	Producer	USA
Barth, J.	Regal Beloit America Inc	Supply Chain	USA
Beninca, M. R.	Shawflex - A Div of Shawcor	Producer	Canada
Birk, J.	Wurth Electronics	Supply Chain	USA
Bishop, T.	Electrical Apparatus Service Association	General Interest	USA
Bockes, B.	Johnson Electric Coil Company	Supply Chain	USA

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Brown, J.	Cramer Coil & Transformer Co., Inc.	Supply Chain	USA
Bucaneg, Jr., D.	Hawaiian Electric Co.	General Interest	USA
Chung, J. J.	X-FIPER New Material Co., Ltd.	Producer	China
Clough, J.	New England Wire Technologies	Producer	USA
Cormier, C.	Alberta Municipal affairs	AHJ	Canada
Fernando, N.	Manitoba Hydro	General Interest	Canada
Foisey, A.	Elektrisola Inc.	Producer	USA
Frost, N.	Gerome Technologies	General Interest	USA
Harding, J.	The Transformer Association	General Interest	USA
Horimizu, M.	Chemitox, Inc.	Testing and Standards	Japan
Jordan, D. P.	Underwriters Laboratories Inc.	Chair (Non-Voting)	USA
Masri, K	NEMA	Non-voting	USA
McKeiver, M.	DuPont Specialty Products USA, LLC	Producer	USA
Mendoza, E.	Signify North America Corporation	Supply Chain	USA
Monsen, M.	Underwriters Laboratories Inc	Project Manager (Non-Voting)	USA
Nova, L.	Marcus Transformer of Canada	Supply Chain	Canada
Oden, L.	self	General Interest	USA
Pham, T.	XP Power	Supply Chain	USA
Quagliana, C.	Von Roll USA Inc.	Producer	USA
Raymond, M.	UL LLC	Testing and Standards	USA
Ruggieri, J.	General Machine Corp.	General Interest	USA
Schafer, D.	SATA GmbH	Commercial/Industrial User	Germany
Stankes, D.	3M	Producer	USA
Taubenberger, S	Buerkert Werke GmbH	Supply Chain	Germany
Ulcár, J.	Crosslink Technology Inc.	Producer	Canada
Van Vooren, E	ELTEK International Laboratories	Testing and Standards	USA
Von der Heide, H	SYNFLEX Elektro GmbH	Testing and Standards	Germany
Welsh, S.	Rubadue Wire Company	Producer	USA
Winkeler, M.	ELANTAS PDG, Inc.	Producer	USA
Wong, W.	Hammond Power Solutions, Inc	Producer	Canada
Yu, Lonhying	Guilin Electrical Equip. Scientific Research Inst. Test Center	Testing and Standards	China

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This Standard is intended to be used for conformity assessment.

The intended primary application of this standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

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INTRODUCTION

1 Scope

1.1 These requirements cover test procedures to be used in the evaluation of Class 120(E) or higher electrical insulation systems (EIS) for use in the United States, and Class 130(B) or higher EIS for use in Canada, where the thermal factor is the dominating aging factor. These requirements also cover the investigation of the substitution of non-electrical insulating materials (NIM) components of insulation in a previously evaluated insulation system and also the test procedures to be used in the evaluation of magnet wire coatings, magnet wires, and varnishes.

1.2 These requirements for the evaluation of an EIS do not establish thermal ratings for/ or alter established thermal ratings for individual components.

1.3 These requirements do not cover insulation systems exposed to radiation or operating in oils, refrigerants, soaps, or other media that potentially degrade insulating materials.

1.4 When any performance aspect of an end-product requirement is not covered by this standard, the applicable standard shall be used.

1.5 These requirements do not cover electrical insulation systems where transient overvoltages or partial discharge are present. Such electrical insulation systems shall be evaluated to the appropriate standard for the application. Such standards include, but are not limited to the following:

- a) IEEE C57.12.60;
- b) IEC 60034-18-31; or
- c) IEEE 1776.

2 Units of Measurement

2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

3 Referenced Publications

3.1 The following standards are referenced in this standard, and portions of these referenced standards may be essential for compliance. Electrical insulation systems covered by this standard shall comply with the referenced installation codes and standards as appropriate for the country where the electrical insulation system is to be used. When the electrical insulation system is intended for use in more than one country, the electrical insulation system shall comply with the installation codes and standards for all countries where it is intended to be used.

ASTM Standards

ASTM D1676, *Standard Test Methods for Film-Insulated Magnet Wire*

ASTM D1932, *Standard Test Method for Thermal Endurance of Flexible Electrical Insulating Varnishes*

ASTM D2307, *Standard Test Method for Thermal Endurance of Film-Insulated Round Magnet Wire*

ASTM D2519, *Standard Test Method for Bond Strength of Electrical Insulating Varnishes by the Helical Coil Test*

ASTM D3145, *Standard Test Method for Thermal Endurance of Electrical Insulating Varnishes by the Helical Coil Method*

ASTM D3251, *Standard Test Method for Thermal Endurance Characteristics of Electrical Insulating Varnishes Applied Over Film-Insulated Magnet Wire*

ASTM D5374, *Standard Test Methods for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation*

ASTM D5423, *Standard Specification for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation*

ASTM D5642, *Standard Test Method for Sealed Tube Chemical Compatibility Test*

ASTM E178, *Standard Practice for Dealing with Outlying Observations*

CSA Standards

CSA C22.2 No. 0.17, *Evaluation of Properties of Polymeric Materials*

IEC Standards

IEC 60034-18-31, *Rotating Electrical Machines – Part 18-31: Functional Evaluation of Insulation Systems – Test Procedures for Form-Wound Windings – Thermal Evaluation and Classification of Insulation Systems Used in Rotating Machines*

IEC 60172, *Test Procedure for the Determination of the Temperature Index of Enamelled and Tape Wrapped Winding Wires*

IEC 60317, *Specifications for Particular Types of Winding Wires*

IEC 60455-2, *Resin Based Reactive Compounds Used for Electrical Insulation – Part 2: Methods of Test*

IEC 60455-3, *Resin Based Reactive Compounds Used for Electrical Insulation – Part 3: Specifications for Individual Materials*

IEC 60493-1, *Guide for the Statistical Analysis of Ageing Test Data – Part 1: Methods Based on Mean Values of Normally Distributed Test Results*

IEC TR 60493-2, *Guide for the Statistical Analysis of Ageing Test Data – Part 2: Validation of Procedures for Statistical Analysis of Censored Normally Distributed Data*

IEC 60505, *Evaluation and Qualification of Electrical Insulation Systems*

IEC 60851, *Winding Wires – Test Method*

IEC 61033, *Test Methods for the Determination of Bond Strength of Impregnating Agents to an Enamelled Wire Substrate*

IEC 61857-1, *Electrical Insulation Systems – Procedures for Thermal Evaluation – Part 1: General Requirements – Low-Voltage*

IEC 61857-21, *Electrical Insulation Systems – Procedures for Thermal Evaluation – Part 21: Specific Requirements for General-Purpose Models – Wire-Wound Applications*

IEC 61858-1, *Electrical Insulation Systems – Thermal Evaluation of Modifications to an Established Electrical Insulation System (EIS) – Part 1: Wire-Wound Winding EIS*

IEEE Standards

IEEE 1, *Recommended Practice – General Principles for Temperature Limits in the Rating of Electrical Equipment and for the Evaluation of Electrical Insulation*

IEEE 99, *Recommended Practice for the Preparation of Test Procedures for the Thermal Evaluation of Insulation Systems for Electric Equipment*

IEEE 101, *Guide for the Statistical Analysis of Thermal Life Test Data*

IEEE 1776, *Recommended Practice for Thermal Evaluation of Unsealed or Sealed Insulation Systems for AC Electric Machinery Employing Form-Wound Pre-Insulated Stator Coils for Machines Rated 15 000 V and Below*

IEEE C57.12.60, *Test Procedure for Thermal Evaluation of Insulation Systems for Dry-Type Power and Distribution Transformers, Including Open-Wound, Solid-Cast, and Resin-Encapsulated Transformers*

NEMA Standards

NEMA MW 1000, *Magnet Wire*

UL Standards

UL 746A, *Polymeric Materials – Short Term Property Evaluations*

UL 746D, *Polymeric Materials – Fabricated Parts*

4 References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

4.2 IEC test methods are the preferred test methods with the ASTM methods presented as technically equivalent except where noted in [Table 4.1](#). If a designation for a test method is followed by an alternate or equivalent designation, in [brackets], the latter method can be considered technically equivalent, though not necessarily identical, and might yield somewhat different numerical test results.

Table 4.1
Test methods

ASTM Standards
ASTM D1676
ASTM D2307
ASTM D2519

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ASTM D3145
ASTM D3251
ASTM D5642
ASTM E178
IEC Standards
IEC 60172 [ASTM D2307]
IEC 60317 (all parts) [ASTM D1676]
IEC 60455-2
IEC 60455-3 (all sheets for individual resins) [ASTM D3251]
IEC 60493-1
IEC TR 60493-2 [ASTM E178]
IEC 60505
IEC 60851 (all parts)
IEC 61033 [ASTM D2519]
IEC 61857 (all parts)
IEC 61858-1 [ASTM D5642]
IEEE Standards
IEEE 1
IEEE 99
IEEE 101
NEMA Standards
NEMA MW 1000

5 Glossary

5.1 For the purpose of this standard, the following definitions apply:

5.2 **APPARENT THERMAL INDEX** – The unadjusted thermal index of an insulation system derived from a regression analysis of that system's thermal aging data, usually higher in value than the system's rated temperature class.

5.3 **CATALYST** – A substance that alters (usually increases) the rate at which a reaction occurs without being consumed into the reaction.

5.4 **CURING AGENT** – A substance or mixture of substances that promote or control the reaction process and is consumed in the reaction.

5.5 **CYCLE** – A time period of heat exposure, which is used to induce deterioration at the specific aging temperature, followed by conditioning and diagnostic testing.

5.6 **DEAD METAL** – Metallic part that is at no electrical potential. With respect to the requirements in this Standard, dead metal parts are to be considered the same as if they were at ground potential.

5.7 **EIS – ELECTRICAL INSULATION SYSTEM** – Electrical insulating structure containing one or more electrical insulating materials (EIM) together with associated conducting parts employed in an electrotechnical device.

5.8 **ELECTRICAL INSULATION SYSTEM CLASS** – An agreed upon classification; refer to 7.5.5(c).