# IEEE Guide for Test Methods and Procedures to Evaluate the Electrical Performance of Insulators in Freezing Conditions

Sponsor

**Standards Committee**
of the
**IEEE Dielectrics and Electrical Insulation Society**

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**IEEE-SA Standards Board**

## Acknowledgments

Table 1 adapted and Figure B.1, Figure B.2, Figure B.3, Figure B.4 reprinted from "Insulator icing test methods and procedures—A position paper prepared by the IEEE Task Force on Insulator Icing Test Methods," 2003 [B45].

Figure 1 and Table 4 adapted from IEEE Std 4-1995.

Figure 2 reprinted from "Investigation of flashover performance of snow-covered breakers," 2007 [B73].

Figure B.5 reprinted with permission from CIGRÉ, "Influence of ice and snow on the flashover performance of outdoor insulators—Part II: Effects of snow," 2000 [B11].

**Abstract:** Since 1999, test methods for freezing conditions, including ice and snow, have been refined by the IEEE Dielectrics and Electrical Insulation Society and IEEE Power and Energy Society Task Forces on insulator icing. In this guide, the discussion is consolidated, and specific, appropriate, and reproducible test methods for selecting adequate insulators are recommended. Test methods for substation and line insulators at distribution and transmission voltage levels are included in the scope. Special measures to reproduce the environmental and insulator parameters that influence the risk of flashover in freezing conditions are detailed in the test methods. Statistical methods are also recommended to assist in the insulator selection process.
**Keywords:** cold fog, contamination, high-voltage testing, ice, icing, insulators, salt fog, snow

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## Introduction

This introduction is not part of IEEE Std 1783-2009 IEEE Guide for Test Methods and Procedures to Evaluate the Electrical Performance of Insulators in Freezing Conditions.

In many cold climate regions, overhead transmission and distribution lines as well as their substation equipment are subjected to ice and snow accumulations that may be contaminated in the same ways that affect natural rain. Insulator standards presently call for a wet test at a controlled rain rate but do not recommend icing test methods. While the electrical withstand in a wet test is well above typical service voltage stress, this may not be the case in cold conditions.

Certain sequences of ice or snow accumulation and melting may cause a drastic decrease in electrical insulation strength. Especially of highly stressed, extra high-voltage and ultra high-voltage insulators, this can lead to insulator flashovers at normal service voltage and power outages. Flashover problems on ice- and snow-covered insulators have been reported in North America and many countries including China, Czech Republic, England, Finland, Japan, Norway, Switzerland, Sweden, and the former Yugoslavia.

The industry need for insulation coordination in the affected countries was a source of motivation to establish an IEEE Task Force on Insulator Icing Test Methods in 1999. In 2003, this Task Force recommended icing test methods and procedures in "Insulator icing test methods and procedures—A position paper prepared by the IEEE Task Force on Insulator Icing Test Methods," [B45].[a] Their scope covered all insulators, including ceramic and nonceramic types, because both have similar problems in the presence of ice. Test parameters were adapted from IEEE Std 4™, IEC 60060, IEC 60129, and IEC 60507 in a joint development effort with a CIGRE Ice and Snow Task Force.[b] After additional ice and snow testing experience using the Task Force recommendations led to positive industry response, it is now reasonable to formally endorse the test methods as an IEEE standard.

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# IEEE Guide for Test Methods and Procedures to Evaluate the Electrical Performance of Insulators in Freezing Conditions



## 1. Overview

### 1.1 Scope

The guide specifies procedures for testing equipment when external insulation of the test object is subjected to combinations of contamination, ice, snow, or cold fog. The methods are applicable only to tests on equipment with a rated voltage above 1 kV.

### 1.2 Purpose

The test methods recommended in this guide supplement the general requirements regarding equipment, objects, and procedures for standard high-voltage testing. The guide also describes some recommended methods evaluating the test results.