



# IEEE Trial-Use Standard for Testing and Evaluating the Dielectric Performance of Celebratory Balloons in Contact with Overhead Power Distribution Lines Rated up to 38 kV System Voltage

IEEE Power and Energy Society

Developed by the  
Transmission and Distribution Committee

IEEE Std 2845™-2023

# IEEE Trial-Use Standard for Testing and Evaluating the Dielectric Performance of Celebratory Balloons in Contact with Overhead Power Distribution Lines Rated up to 38 kV System Voltage

Developed by the

**Transmission and Distribution Committee**  
of the  
**IEEE Power and Energy Society**

Approved 21 September 2023

**IEEE SA Standards Board**

**Abstract:** This standard is applicable to celebratory balloons that are comparable in size and shape to what are commonly referred to as *foil balloons* and are available in retail stores and filled with helium or a lighter-than-air gas. The dielectric performance of celebratory balloons in contact with simulated energized overhead distribution power lines with the intent of minimizing balloon-caused power system outages (or electrical faults) are evaluated by the test procedures. The scope is limited to distribution system voltages of 38 kV or less and only single balloons. The effects of having any moisture, contaminants, or string or ribbon attachments to the balloon(s) are not investigated under this procedure.

**Keywords:** balloon, foil balloon, IEEE 2845™, ignition, ionization, nonconductive balloon, standard

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At the time this trial-use standard was completed, the Distribution Reliability Working Group had the following membership:

**John McDaniel, *Chair***  
**Heide Caswell, *Vice Chair***  
**Christian Henderson, *Task Force Chair***  
**Katherine Cummings, *Secretary***

|                 |                   |                   |
|-----------------|-------------------|-------------------|
| Wendy al-Mukdad | Yamille Del Valle | Steve T. Johnston |
| Nicholas Babb   | Rob Hampton       | Tyler Jones       |
| Dean Borchardt  | Gene Hanes        | Thomas Kelly      |
| Mike Colburn    | Henry Hickman     | Anil Babu Poda    |
| Dallas Cormier  | Raymond Hill      | Tom Short         |

The following members of the Distribution Reliability Working Group contributed as primary authors to this work.

|                 |                     |                   |
|-----------------|---------------------|-------------------|
| Wendy al-Mukdad | Mike Colburn        | Raymond Hill      |
| Dean Borchardt  | Yamille Del Valle   | Steve T. Johnston |
| Heide Caswell   | Christian Henderson | Anil Babu Poda    |
|                 | Henry Hickman       |                   |

The following members of the individual Standards Association balloting group voted on this trial-use standard. Balloters may have voted for approval, disapproval, or abstention.

|                      |                     |                   |
|----------------------|---------------------|-------------------|
| John Ainscough       | Fredric Friend      | Haiying Lu        |
| Wendy al-Mukdad      | Shubhanker Garg     | Sal Martino       |
| Steven Alexanderson  | George Gela         | John McDaniel     |
| Saleman Alibhay      | Frank Goodman       | Bansi Patel       |
| Steven Bezner        | John Harley         | Howard Penrose    |
| Dean Borchardt       | Christian Henderson | Anil Babu Poda    |
| James Bouford        | Henry Hickman       | Ion Radu          |
| Gustavo Brunello     | Raymond Hill        | Caryn Riley       |
| Paul Cardinal        | Werner Hoelzl       | Bartien Sayogo    |
| Heide Caswell        | Richard Jackson     | Jerry Smith       |
| Suresh Channarasappa | Tyler Jones         | Clay Stocklin     |
| Katherine Cummings   | Piotr Karocki       | James Van De Ligt |
| Douglas Dorr         | Mark Konya          | John Vergis       |
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Karl Weber  
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## Introduction

This introduction is not part of IEEE Std 2845-2023, IEEE Trial-Use Standard for Testing and Evaluating the Dielectric Performance of Celebratory Balloons in Contact with Overhead Power Distribution Lines Rated up to 38 kV System Voltage.

Celebratory balloons are a source of joy for adults and children. These happy, shiny balloons make people smile involuntarily. For children, a balloon is the only thing they have ever held that goes up and never comes back down. Balloons are magical in that way.

Celebratory balloons refer to those balloons used for birthdays, graduations, and everyday festivities. There are two main categories of celebratory balloons: a) latex or rubber balloons that are usually sold uninflated in bulk packages and b) plastic balloons, typically metallic foil balloons that are sold individually and typically inflated with helium. Weather balloons, hot air balloons, and government or scientific balloons are excluded from this narrative, which is an important distinction when discussing this issue with policymakers or regulators.

Metallic foil balloons that are inflated with helium or a lighter-than-air gas pose a significant risk to overhead electric distribution power lines. These foil balloons are covered in a continuous thin layer of metal, which makes the balloons shiny and attractive to retail consumers. However, this same metallic foil can conduct electricity, which can result in a fault condition. An additional failure mechanism occurs if the helium gas ionizes under high enough voltage electric fields (due to its dielectric strength that is lower than air), which can also result in faults on electrical overhead power lines. These faults can result in power outages and also become a fire ignition risk. In recognition of the importance of the identified issue, the IEEE Distribution Reliability Working Group supported the establishment of a task force to advance study and efforts undertaken by utilities (largely based in California) with support and study performed by the Georgia Institute of Technology's National Electric Energy Testing, Research and Applications Center (NEETRAC).

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# IEEE Trial-Use Standard for Testing and Evaluating the Dielectric Performance of Celebratory Balloons in Contact with Overhead Power Distribution Lines Rated up to 38 kV System Voltage

## 1. Overview

### 1.1 Scope

This standard is applicable to celebratory balloons that are comparable in size and shape to what are commonly referred to as *foil balloons* and are available in retail stores and filled with helium or a lighter-than-air gas. This test procedure evaluates the dielectric performance of celebratory balloons in contact with simulated energized overhead distribution power lines with the intent of minimizing balloon-caused power system outages (or electrical faults). The scope is limited to distribution system voltages of 38 kV or less and only single balloons. The effects of having any moisture, contaminants, or string or ribbon attachments to the balloon(s) are not investigated under this procedure.

### 1.2 Purpose

This standard specifies the test conditions under which a celebratory balloon should be tested in order to determine whether the balloon design is likely to cause a fault when the balloon comes in contact with overhead electric distribution power lines. The common “foil” or “celebratory” balloon is widely available in retail stores and may have a thin layer of metal in the balloon material. Celebratory foil balloons are usually inflated with helium or a lighter-than-air gas, which causes them to rise, and they may drift into overhead power lines. When these celebratory balloons come into contact with energized distribution power lines, a system fault can occur, either from a short across the metal layer or from ionization of the lighter-than-air gas inside the balloon. New celebratory balloon designs have been created that have noncontinuous metalized designs or are without any metallization or have a different blend of gas. This standard provides the means to evaluate the effectiveness of these new balloons toward not causing distribution system outages.

### 1.3 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall* equals *is required to*).<sup>6,7</sup>

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (*should* equals *is recommended that*).

The word *may* is used to indicate a course of action permissible within the limits of the standard (*may* equals *is permitted to*).

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (*can* equals *is able to*).

## 2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). 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 4<sup>TM</sup>-2013, IEEE Standard for High-Voltage Testing Techniques.<sup>8,9</sup>

## 3. Definitions, acronyms, and abbreviations

### 3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.<sup>10</sup>

### 3.2 Acronyms and abbreviations

|       |                                        |
|-------|----------------------------------------|
| CMI   | customer minutes of interruption       |
| CPUC  | California Public Utilities Commission |
| DRWG  | Distribution Reliability Working Group |
| SDG&E | San Diego Gas and Electric             |

<sup>6</sup>The use of the word *must* is deprecated and cannot be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.

<sup>7</sup>The use of *will* is deprecated and cannot be used when stating mandatory requirements; *will* is only used in statements of fact.

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## 4. Introduction

Balloons in contact with electric utilities are not uncommon. Such interactions can be unfavorable to the electrical utilities and their customers. The utility industry can and does utilize some mitigations to avoid damaging the electric utility system, such as converting the overhead electric utility system to an underground electric system, replacing exposed bare overhead conductors with covered conductors, and potentially increasing spacing between conductors. The balloon industry also employs mitigations in attempts to reduce balloon/power line interactions by weighting balloons and by alerting the public of the dangers of balloon releases. However, recent advances in technology can enable celebratory balloons to become less conductive to the point of potentially avoiding line faults when such inflated balloons interact with the overhead electrical power lines.

This trial-use standard is meant to address the celebratory balloons directly. It presents a repeatable test that any balloon manufacturer or electrical testing laboratory can utilize. The standard simply provides a means to test whether a celebratory balloon will or will not potentially create a fault when contacting a typical overhead electric distribution system. It is not meant to be a comprehensive standard that covers every electric distribution voltage system in North America, nor is it meant to cover the worst-case scenarios or every corner case for how a balloon might interact with the overhead electric system. This standard presents a basic use case for how a balloon might contact an overhead system. The high-voltage system in the standard is a representation of a typical overhead electric distribution power line system set in a laboratory environment. As such, this trial-use standard specifies the conditions under which any celebratory balloon can be tested for the determination of potential line faults within overhead electric power distribution lines using system voltages up to 38 000 V (38 kV).

The typical non-latex celebratory balloon contains a thin continuous layer of metal within the balloon, thus referred to by the commonly known term *foil balloon* or also inadvertently called a *Mylar balloon*.<sup>11</sup> This thin continuous metal layer creates a very low impedance pathway and usually results in a near instantaneous disruptive discharge when contacting energized phase-to-phase or phase-to-ground conductors. Removal of the metal content can make the balloon envelope less conductive or even nonconductive; however, the dielectric strength of the gas contained within the balloon must also be considered with regard to the overall breakdown characteristics of the celebratory balloon.

The inflation gas for any lighter-than-air celebratory balloon will contain a component of helium: the readily available high-purity industrial or medical-grade helium (typically greater than 99% pure helium) or some lower purity level helium (such as “balloon grade” helium with purity levels between 95% and 99% helium) or other special helium gas blends (typically with 15% to 20% air for helium conservation measures). High-purity helium presents the greatest challenge since the dielectric strength of pure helium is only about 15% that of air. When a balloon filled with pure helium approaches energized power lines, partial discharges, called *streamers*, can form within the helium gas. At lower distribution voltages, the streamers are short and do not initiate a power fault. However, for power lines operating at higher voltages, streamers can become long enough to fully bridge the gap between conductors. When this occurs, the dielectric strength of the balloon walls can break down, resulting in a flashover between the conductors and creating a power system fault. The dielectric withstand testing with high-purity helium will be limited to a 15 kV voltage class at best, even with so-called nonconductive balloons with the helium fill gas becoming the limiting factor at higher distribution voltages. While tests with high-purity helium demonstrate a real-world “worst case” scenario for nonconductive balloons, the use of high-purity helium does not effectively demonstrate the dielectric strength capabilities of the balloon membrane.

<sup>11</sup>Mylar® is a registered trademark owned by DuPont Teijin Films for a specific family of plastic film products made from the resin polyethylene terephthalate (PET). Balloons can be made of various plastic polymers not inclusive to Mylar®, hence, the use of the word *mylar* should be avoided when discussing the topic of balloons. This information is given for the convenience of users of this standard and does not constitute an endorsement by the IEEE of these products. Equivalent products may be used if they can be shown to lead to the same results.

This standard requires a 95% helium, 5% oxygen (95/5 He/O<sub>2</sub>) admixture as the inflation gas. The addition of the electronegative gas, oxygen, to the helium can dramatically improve the dielectric strength of the inflation gas without significantly compromising the lifting ability of the inflation gas. The amount of added oxygen is sufficient to potentially avoid balloon-caused power faults within distribution systems up to 38 kV if using an appropriately designed balloon envelope.

This standard for testing celebratory balloons in overhead electric distribution power lines may be used by many different parties for different purposes. Primarily, the standard test is intended for use by high-voltage test laboratories or electric utilities to test celebratory balloons in a standard and repeatable method and conclude whether the balloon can or cannot cause a fault under the specified conditions. Balloon manufacturers may use the standard test to determine if their balloon designs, materials, gases, or combinations of these can or cannot cause a fault in typical overhead power lines. This standard may be referred to by lawmakers, legislators, or regulatory bodies to regulate the sale and use of lighter-than-air celebratory balloons in their areas of jurisdiction for the purposes of reducing the number of balloon-caused power outages, fire ignitions, or equipment replacement costs. All of these uses are directed toward one singular goal: to assist a variety of industries and users/stakeholders to develop and test celebratory balloons that will not cause faults on overhead electric distribution power lines. Additional background, supportive information and an example can be located within [Annex A](#), [Annex B](#), and [Annex C](#).

## 5. Safety awareness

### 5.1 General

This standard does not purport to address all the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

### 5.2 High-voltage warning

Lethal voltages are a potential hazard during the performance of this test. Special attention shall be paid to assist in ensuring the safety of all personnel. Personnel safety is of utmost importance during all testing procedures. It is essential that the test apparatus, and all associated equipment electrically connected to it, be properly designed and installed for safe operation. It is highly suggested to ground any parts that were at high voltage during the test or have the potential for acquiring an induced charge during the test or retaining a charge even after disconnection of the voltage source. Thoroughly instruct all operators about the correct procedures for performing tests safely. When performing high-voltage tests, it is possible for the energy released at breakdown to be sufficient to result in fire, explosion, or rupture of the test specimen or test apparatus. Design the test apparatus and test environment to minimize the possibility of such occurrences and to eliminate the possibility of personal injury. If the potential for fire exists, have fire suppression equipment available. Appropriate safety practices shall be followed.

### 5.3 Ozone caution

Ozone and other potential harmful gases can be generated during-high voltage testing. Use appropriate means to reduce concentrations to acceptable levels in working areas. High levels of ozone are known to be hazardous.