



# IEEE Standard for Pad-Mounted Equipment—Enclosure Integrity

**STANDARDS**

IEEE Power and Energy Society

Developed by the  
Transformers Committee

**IEEE Std C57.12.28™-2023**  
(Revision of IEEE Std C57.12.28-2014)



# IEEE Standard for Pad-Mounted Equipment—Enclosure Integrity

Developed by the

**Transformers Committee**  
of the  
**IEEE Power and Energy Society**

Approved 6 December 2023

**IEEE SA Standards Board**

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**Abstract:** Conformance tests and requirements for the coating integrity of above grade pad-mounted enclosures that contain apparatus energized in excess of 600 V and that may be exposed to the general public. These include, but are not limited to, the following types of equipment enclosures: pad-mounted capacitors or inductors, pad-mounted distribution transformers, pad-mounted junction enclosures, pad-mounted metering equipment, and pad-mounted voltage regulators.

**Keywords:** coating integrity, enclosure integrity, IEEE C57.12.28™, pad-mounted equipment, transformers, voltage regulators

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## Introduction

This introduction is not part of IEEE Std C57.12.28-2023, IEEE Standard for Pad-Mounted Equipment—Enclosure Integrity.

The accredited standards committee on Transformers, Regulators, and Reactors (C57), originally developed and correlated standards on these products, together with the accredited Standards Committee on Power Switchgear (C37) through the Joint ASC C57/C37 working group on enclosures with Joseph Martin and then Robert C. Olen as chairman. This group is now the Enclosure Integrity working group of the IEEE Transformers Committee.

The data used in this work have been gathered from many sources, including the standards of the Institute of Electrical and Electronics Engineers and the National Electrical Manufacturers Association, reports of committees of the Edison Electric Institute, and others.

Significant changes in this revision of the standard are: the mandatory IEEE word usage clause was added, normative references were updated, carbon steel and gel coat definitions were removed, information was re-organized and separated into Enclosure design in [Clause 4](#) and Coating system requirements in [Clause 5](#), the pull and push tools ([4.3.1.2](#) and [4.3.1.3](#)) were updated, the purpose of each test was clarified, and each test was generally updated and clarified. The time frame of the simulated corrosive atmospheric breakdown (SCAB) procedure, [Annex A](#), was clarified to call for one week to be one cycle. Two informative annexes were added: [Annex B](#) – Commonly used substrate steels and [Annex D](#) – Substrate surface preparation. Pad-mounted switchgear was dropped from the scope as IEEE PC37.75, *Draft Standard for Pad-Mounted, Pole-Mounted and Submersible Switchgear Enclosures and Associated Control Enclosures—Coastal and Non-Coastal Environmental Integrity*, is in the final balloting stages. A warning was added to [4.2.3](#) about the possibility of burns from publicly accessible metal surfaces.

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# IEEE Standard for Pad-Mounted Equipment—Enclosure Integrity

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## 1. Overview

### 1.1 Scope

This standard covers conformance tests and requirements for the [enclosure](#) integrity of above-grade pad-mounted [electrical equipment](#) ~~enclosures~~ containing apparatus energized in excess of 600 V that may be exposed to the public including, but not limited to, the following types of equipment enclosures:

- Pad-mounted distribution transformers
- Pad-mounted capacitors or inductors
- Pad-mounted junction enclosures
- Pad-mounted metering equipment
- ~~— Pad-mounted switchgear~~
- Pad-mounted voltage regulators

This standard does not cover installations that are under the exclusive control of electric utilities and that are located in such a manner that access to the equipment is controlled exclusively by the utility.

## 1.2 Purpose

The purpose of this standard is to describe the requirements for a comprehensive [enclosure](#) integrity system for pad-mounted [equipment enclosures](#) providing long [service field](#) life with minimum maintenance and positive safety features.

## 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*).

<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.

## 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.

ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.<sup>§†</sup>

ASTM D523, Standard Test Method for Specular Gloss.

[ASTM D610, Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces.](#)

ASTM D660, Standard Test Method for Evaluating Degree of Checking of Exterior Paints ~~Paint~~.

ASTM D661, Standard Test Method for Evaluating Degree of Cracking of Exterior Paints.

ASTM D714, Standard Test Method for Evaluating Degree of Blistering of Paints.

ASTM D1654-05, Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

ASTM D2794, Standard Test Method for Resistance of ~~or~~ Organic Coatings to the Effects of Rapid Deformation (Impact).

ASTM D3170, Standard Test Method for Chipping Resistance of Coatings.

ASTM D3359, Standard Test Methods for Rating ~~Measuring~~ Adhesion by Tape Test.

ASTM D3363, Standard Test Method for Film Hardness by Pencil Test.

<sup>§</sup> [ASTM publications are available from the American Society for Testing and Materials \(https://www.astm.org/\).](https://www.astm.org/)

<sup>†</sup> ~~ASTM standards are available from American Society of Testing Methods, 100 Bar Harbor Drive, West Conshohocken, PA 19428, USA.~~

ASTM D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

ASTM D4585, Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.

ASTM D4587, Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.

[UL 94, Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.](#)<sup>9</sup>

[UL 746C, Polymeric Materials – Use in Electrical Equipment Evaluations.](#)

~~SAE J400, Test for Chip Resistance of Surface Coatings.~~<sup>2</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><sup>3</sup>

**above grade:** A term referring to an equipment use location above the high-water line not intended for partial or total submersion.

**axial force:** A force applied along the axis of the pry bar from its handle to its pry tip.

<sup>9</sup> [UL publications are available from Underwriters Laboratories \(https://www.ul.com/\).](https://www.ul.com/)

<sup>10</sup> [IEEE Standards Dictionary Online](http://dictionary.ieee.org) is available at: <http://dictionary.ieee.org>. An IEEE account is required for access to the dictionary, and one can be created at no charge on the dictionary sign-in page.

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<sup>3</sup> ~~IEEE Standards Dictionary Online subscription is available at http://www.ieee.org/portal/innovate/products/standard/standards\_dictionary.html.~~

~~carbon steel: A steel containing only residual quantities of elements other than carbon, except those added for deoxidation or to counter the deleterious effects of residual sulfur. Silicon is usually limited to about 0.60%, and manganese to about 1.65% by weight. Syn: mild steel, ordinary steel, plain carbon steel, straight carbon steel.~~

~~NOTE—See The Metals Black Book: Ferrous Metals [B2].<sup>4</sup>~~

**conformance tests:** Certain performance tests are conducted to demonstrate compliance with the applicable standards. The test specimen is normally subjected to all planned routine tests prior to initiation of the conformance test program.

NOTE—The conformance tests may, or may not, be similar to certain design tests. Demonstration of margins (capabilities) beyond the standard requirements is unnecessary. <sup>11</sup>

**design tests:** Tests made by the manufacturer to determine the adequacy of the design of a particular type, or model of equipment or its component parts to meet its assigned ratings and to operate satisfactorily under normal conditions and under special conditions if specified. These tests are used to demonstrate compliance with applicable standards of the industry.

NOTE—Design tests, sometimes called *type tests*, are made on representative apparatus or prototypes to verify the validity of design analysis and calculation methods and to substantiate the ratings assigned to all other apparatus of basically the same design. These tests may also be used to evaluate the modification of a previous design and to verify that performance has not been adversely affected. Test data from previous similar designs may be used for current designs, where appropriate. In theory ~~Once made~~, the tests need not be repeated unless the design is changed so as to modify performance. However, experience has demonstrated that unintended change creeps into manufacturing processes and thus design tests should be periodically repeated.

**dry film thickness:** Thickness of any applied coating(s) measured after curing.

<sup>11</sup> <sup>4</sup> Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this ~~the~~ standard.