NEMA Standards Publication

NEMA GR 1-2017

# Standard for Ground Rod Electrodes and Ground Rod Electrode Couplings

National Electrical Manufacturers Association

**NEMA Standards Publication GR 1-2017**

*Ground Rod Electrodes and Ground Rod Electrode Couplings*

*Published by*

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## NOTICE AND DISCLAIMER

During the development of this standard, the persons engaged in reaching consensus could not achieve consensus about what to name specific nominal trade size designations for zinc-coated ground rods in Tables 3.1, 3.2 and 6.1. A review during an appeal determined that the inability to achieve consensus was attributable to a commercial and competitive disagreement among manufacturers. The appeals decision directed that trade size designations for zinc-coated, copper-bonded, and stainless-steel ground rods be treated with consistency within the standard. When consensus could not be achieved again following the appeal, the Executive Committee of the NEMA Board of Governors resolved the disagreement by approving the nominal trade size designations shown in the "trade size" column in each of these three tables, and further directed, at the recommendation of NEMA's Codes & Standards Committee, that the foreword of this standard bring to the reader's attention the history of these changes to minimize potential confusion. Accordingly, Table 3.1 identifies zinc-coated ground rods of different dimensions by their finished mean diameter and the minimum and maximum diameters for a given "trade size" of zinc-coated ground rod. Table 3.2 contains corresponding dimensions for the end point configurations for each trade size, and Table 6.1 recites application diameters for threadless couplings for each trade size of zinc-coated ground rod. In addition to the information in the foreword and the standard, the user is encouraged to consult with the manufacturer about couplings and connectors to be used with specific grounding rods. In all other respects, the information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

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# Foreword

This standards publication provides practical information concerning construction, test, performance, and manufacture of ground rod electrodes and ground rod electrode couplings. This standard is intended for use by the electrical industry to provide guidelines for the manufacture and proper application of these products and to promote the benefits of repetitive manufacture and widespread product availability.

One of the primary purposes of this standards publication is to encourage the manufacture and utilization of products, which, in themselves, function in accordance with these standards. While some sections of this publication are intended to eliminate misunderstandings between manufacturers and users, all sections, when applied properly, contribute to safety in one way or another.

The proper manufacture of ground rod electrodes and ground rod electrode couplings is, however, only one consideration in promoting the safe utilization of electricity. Other safety considerations, including environmental conditions, system design, equipment selection and application, installation, operating practices, and maintenance, involve the joint efforts of the system designer, the various equipment manufacturers, the installer, and the user. Information is provided herein to assist in proper selection and use.

*Trade Sizes*. Trade sizes for copper-bonded, zinc-coated, and stainless steel ground rods and couplings have been a prominent feature of this standard since 1997. Trade size designations are often nominal in character and do not always reflect actual size dimensions.[1] Trade sizes for lumber are perhaps the most well-known example. That has been true over the history of this standard as well. Historically, the diameters of ground rods for copper-bonded, zinc-coated, and stainless steel ground rods have been smaller than their corresponding nominal trade size designations in the standard.

Trade size can serve an important function for manufacturers, customers, and users by providing a convenient means of identifying products and complementary products with certain attributes. In the case of ground rods and this standard, trade size facilitates the identification of ground rods with a certain diameter, the end point configuration of the ground rod, and the identification of couplings that fit with the ground rod sharing a corresponding trade size designation. There are safety and product compatibility interests in facilitating the identification of ground rods and appropriately sized couplings that are intended to work together. Since this standard was first developed in 1997, the tables relating to zinc-coated ground rods changed during each revision, while the tables relating to copper-bonded and stainless steel ground rods have remained relatively unchanged. The changes in the 2005/2007 versions of the standard, in addition to introducing metric measurements for the first time, deleted specific references to certain zinc-coated ground rods and couplings that were commercially available but had slightly smaller dimensions. This version of the standard restores references to those other commercially available zinc-coated ground rods as well as the corresponding couplings and restores the nominal trade size designations in a manner consistent with the nominal trade size designations for copper-bonded and stainless steel ground rods.

The tables below reflect the historical evolution of the trade size designations for zinc-coated ground rods in this standard since 1997. As the reader can see, this standard has historically recognized that trade size designations do not exactly match the actual diameter dimension of the ground rod. The tables for copper-bonded ground rods and stainless steel ground rods demonstrate that the same is true for those ground rods as well. What is new for this version of the standard is that Table 3.1 for zinc-coated ground rods recognizes commercially available zinc-coated ground rod electrodes reflecting a greater variety of

[1] For example, The National Electric Code at Article 90.9 (units of measurement)(2014 ed.) notes that trade size and actual sizes can deviate: Where the actual measured size of a product is not the same as the nominal size, trade size designators shall be used rather than dimensions. Trade practices shall be followed in all cases.

diameters compared to the 2005/2007 version of the standard. This version of the standard also introduces a new measurement for all ground rods: finished rod mean diameter. These additional zinc-coated ground rods and their dimensions (minimum and maximum diameters, end point configuration) and the new finished mean diameter measurement reflect the consensus of NEMA members who developed this version of the standard for each category in Table 3.1. For the benefit of the reader, here are the historical trade size designations since 1997 found in this standard:

**NEMA GR1-1997, Table 3.1—Zinc-Coated Ground Rod Electrodes**

| TRADE SIZE | Diameter Range Inches | |
|---|---|---|
| | Minimum | Maximum |
| 1/2 | 0.50 | 0.514 |
| 5/8 | 0.60 | 0.614 |
| 3/4 | 0.725 | 0.739 |
| 1 | 0.975 | 0.989 |

**NEMA GR1-2001, Table 3.1—Zinc-Coated Ground Rod Electrodes**

| TRADE SIZE | Diameter Range Inches | |
|---|---|---|
| | Minimum | Maximum |
| 1/2 | 0.484 | 0.50 |
| 5/8 | 0.539 | 0.555 |
| 3/4 | 0.657 | 0.675 |

**NEMA GR1-2005, Table 3.1—Zinc-Coated Ground Rod Electrodes**

| TRADE SIZE | Diameter Range Inches and Millimeters | | | |
|---|---|---|---|---|
| | Minimum | | Maximum | |
| | mm | in. | mm | in. |
| 5/8 | 15.88 | 0.625 | 16.26 | 0.640 |
| 3/4 | 19.06 | 0.750 | 19.43 | 0.765 |
| 1 | 25.40 | 1 | 25.78 | 1.015 |

**NEMA GR1-2017, Table 3.1—Zinc-Coated Ground Rod Electrodes**

| TRADE SIZE | Finished Rod Mean Diameter (inches) | Diameter Range Inches and Millimeters | | | |
|---|---|---|---|---|---|
| | | Minimum | | Maximum | |
| | | mm | in. | mm | in. |
| 5/8 | 0.547 | 13.690 | 0.539 | 14.10 | 0.555 |
| 5/8F | 0.633 | 15.880 | 0.625 | 16.26 | 0.640 |
| 3/4T | 0.666 | 16.690 | 0.657 | 17.15 | 0.675 |
| 3/4 | 0.735 | 18.260 | 0.719 | 19.05 | 0.750 |
| 3/4F | 0.758 | 19.05 | 0.750 | 19.43 | 0.765 |
| 1 | 1.008 | 25.40 | 1 | 25.78 | 1.015 |

The evolution of the 2017 nominal trade size designations for zinc-coated ground rod electrodes from NEMA GR1-2001 to NEMA GR1-2005 to NEMA GR1-2017 can be seen in the table immediately below:

| 2017 (now) | 2005 (previously) | 2001 (previously) |
|---|---|---|
| 5/8 | Not included | 5/8 |
| 5/8F | 5/8 | Not included |
| 3/4T | Not included | 3/4 |
| 3/4 | Not included | Not included |
| 3/4F | 3/4 | Not included |
| 1 | 1 | Not included |

What is new to Table 3.1 in the 2017 version of the standard, in addition to the additional rows of zinc-coated ground rods, is the use of a suffix, “F” or “T” to identify a variation in diameter among zinc-coated grounds that manufacturers refer to as either “5/8” or “3/4” trade size. Trade sizes without a suffix are nominal trade sizes. The suffix “F” designates a full-minimum diameter size zinc-coated ground rod, and the suffix “T” designates a thinner diameter than the nominal trade size zinc-coated ground rod. Introducing new trade size fractions would have introduced more change from existing commercial practices and created more confusion. The revisions to the nominal trade size designations in Table 3.1 for zinc-coated ground rods may require each manufacturer of zinc-coated ground rods choosing to conform to the standard to make some change to their current trade size designations without causing any one of them to change all their designations. Similar manufacturer changes may occur with respect to designations of ground rod electrode couplings. These changes are a function of expanding the

standard's recognition of all zinc-coated ground rods available in the market. Manufacturers should be able to educate their customers and users about these changes and explain how the trade size designations facilitate identification of ground rods with a particular diameter and the corresponding couplings that should be used with that ground rod.

This standards publication covers design and performance requirements for ground rod electrodes and ground rod electrode couplings, and provides recommendations for their selection and use under normal or certain specific conditions. These standards have been promulgated with a view of promoting safety to persons and property when products conforming to them are selected, installed, and maintained in accordance with the *National Electrical Code*® and/or the *National Electrical Safety Code*.

Publication NEMA GR 1 2017 revises and supersedes Publication ANSI/NEMA GR1 2007. NEMA standards publications are periodically reviewed to meet changing conditions and technical progress, and the latest edition should be utilized. Purchasers will be notified as to when revisions take place and will be provided an opportunity to acquire these when available.

Comments from users of this standards publication are welcome. They should be sent to:

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This standards publication was developed by the Electrical Connector Section of the National Electrical Manufacturers Association.

Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the Electrical Connector Section was composed of the following members:

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# Section 1
# General

## 1.1 Scope

This standards publication applies to ground rod electrodes and ground rod electrode couplings that function in accordance with the *National Electrical Code*® (NFPA 70-2014) and/or the *National Electrical Safety Code* (ANSI C2-2012). Included are materials, construction, and performance of copper-bonded ground rod electrodes, zinc-coated ground rod electrodes, and stainless steel ground rod electrodes. This standards publication also includes information for electrode products that have been successfully used for many years but are not defined within the *National Electrical Code*® or the *National Electrical Safety Code*. The items described in this standards publication are defined in Section 1.

## 1.2 Normative References

This NEMA standards publication represents the results of research and investigation by the members of NEMA, its sections, and its committees. It has been developed through consultation among manufacturers, users, and national engineering societies. This publication references the following standards (all referenced documents use the latest document date):

**American Society for Testing and Materials**

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| | |
|---|---|
| ASTM A123/A123M-13 | *Standard Specification for Zinc (Hot Dip Galvanized) Coatings of Iron and Steel Products* |
| ASTM A153/A153M-09 | *Standard Specification for Zinc Coatings (Hot-Dip) on Iron and Steel Hardware* |
| ASTM A276-06 | *Standard Specification for Stainless Bars and Shapes* |
| ASTM A370-12a | *Standard Test Methods and Definitions for Mechanical Testing of Steel Products* |
| ASTM E376-11 | *Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods* |

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|---|---|
| ANSI/IEEE C2-2012 | *National Electrical Safety Code* |