

This is a preview of "NECA 409-2015". [Click here to purchase the full version from the ANSI store.](#)



## NECA 409-2015

Standard for

# Installing and Maintaining Dry-Type Transformers

AN AMERICAN NATIONAL STANDARD



Published by  
National Electrical Contractors Association

# NECA 409-2015

Standard for

## Installing and Maintaining Dry-Type Transformers

**An American  
National Standard**



Published by  
National Electrical  
Contractors Association



<b>Revision History</b>	
NECA 409-2002 originally published	04/2002
NECA 409-2009 revised	12/2009
NECA 409-2015 revised	08/2015

## **NOTICE OF COPYRIGHT**

*This document is copyrighted by NECA*

Reproduction of these documents either in hard copy or soft (including posting on the web) is prohibited without copyright permission. For copyright permission to reproduce portions of this document, please contact NECA Standards & Safety at (301) 215-4549, or send a fax to (301) 215-4500.

OR

National Electrical Contractors Association  
3 Bethesda Metro Center, Suite 1100  
Bethesda, Maryland 20814  
(301) 657-3110

# Table of Contents

<b>Foreword</b> .....	<b>v</b>
<b>1. Scope</b> .....	<b>1</b>
1.1 Products and Applications Included .....	1
1.2 Products and Applications Excluded .....	1
1.3 Regulatory and Other Requirements .....	1
1.4 Mandatory Requirements, Permissive Requirements, Quality and Performance Recommendations, Explanatory Material, and Informative Annexes.....	1
<b>2. Definitions</b> .....	<b>3</b>
<b>3. Safety Procedures</b> .....	<b>4</b>
3.1 General.....	4
3.2 Safe Work Practices .....	4
3.3 Personal Protective Equipment (PPE) .....	5
3.4 De-Energizing Electrical Equipment .....	5
<b>4. Receiving, Handling, and Storage</b> .....	<b>6</b>
4.1 Receiving.....	6
4.2 Handling .....	6
4.3 Storage.....	7
4.4 Pre-Installation Checks .....	7
<b>5. Installation</b> .....	<b>8</b>
5.1 General.....	8
5.2 Environmental Conditions .....	8
5.3 Coordination with Other Trades.....	8
5.4 Supporting Transformers.....	9
5.5 General Installation Requirements.....	9
5.6 Disconnecting Means, Conductor Ampacity, and Overcurrent Protection.....	10
5.7 Electrical Circuit Connections .....	10
5.8 Grounding and Bonding.....	10
5.9 Transformer Accessories .....	11
<b>6. Cleaning, Testing, and Commissioning</b> .....	<b>12</b>
6.2 Visual and Mechanical Inspection .....	12
6.3 Transformer Acceptance Testing.....	13
6.4 Energizing Transformers.....	13

**NECA 409** Standard for Installing and Maintaining Dry-Type Transformers

<b>7.</b>	<b>Site Cleanup.....</b>	<b>15</b>
7.1	Restoring Transformer Finishes .....	15
7.2	Test Data and Manuals.....	15
7.3	Training.....	15
7.4	Spare Parts and Special Tools .....	15
<b>8.</b>	<b>Inspections and Maintenance .....</b>	<b>16</b>
8.1	Frequency of Inspections and Maintenance.....	16
8.2	Routine Inspections .....	16
8.3	External Cleaning, Inspection, and Maintenance .....	17
8.4	Internal Cleaning, Inspection, and Maintenance .....	18
8.5	Transformer Maintenance Testing.....	19
8.6	Re-energizing Transformers.....	19
8.7	Final Infrared Scan .....	19
<b>9.</b>	<b>Inspection and Re-energization After Adverse Operating Conditions.....</b>	<b>20</b>
9.1	Inspection and Testing Following a Short-Circuit or Ground-Fault.....	20
9.2	Transformers Soaked By or Submersed Under Water.....	20
9.3	Inspecting and Re-energizing Transformers Sprayed or Splashed with Clean Water.....	20
<b>10.</b>	<b>Drying Transformers.....</b>	<b>21</b>
10.1	General.....	21
10.2	Drying by Internal Heat.....	21
10.3	Drying by External Heat .....	21
10.4	Drying by Internal and External Heat .....	22
10.5	Determining Drying Time.....	22
11.1	General.....	23
11.2	Contact Resistance Test.....	23
11.3	Insulation Resistance Test .....	23
11.4	Turns Ratio Test.....	23
11.5	Excitation Current Test .....	24
11.6	Winding Resistance Test.....	24
11.7	Core Insulation Resistance Test .....	24
11.8	High Potential Test .....	24
11.9	Infrared Scan .....	25
11.10	Insulation Power Factor Test .....	25
	<b>Annex A: Transformer Troubleshooting Guide.....</b>	<b>26</b>
	<b>Annex B: Recommended Tightening Torque Tables.....</b>	<b>32</b>
	<b>Annex C: Reference Standards.....</b>	<b>35</b>

*(This foreword is not a part of the standard)*

# Foreword

*National Electrical Installation Standards™ (NEIS™)* are designed to improve communication among specifiers, purchasers, and suppliers of electrical construction services. They define a minimum baseline of quality and workmanship for installing electrical products and systems. *NEIS* are intended to be referenced in contract documents for electrical construction projects. The following language is recommended:

Dry-type transformers should be installed and maintained in accordance with NECA 409-2015, *Standard for Installing and Maintaining Dry-Type Transformers* (ANSI).

Use of *NEIS* is voluntary, and the National Electrical Contractors Association assumes no obligation or liability to users of this publication. Existence of a standard shall not preclude any member or non-member of NECA from specifying or using alternate construction methods permitted by applicable regulations.

This publication is intended to comply with the edition of the National Electrical Code® (NEC®) in effect at the time of publication. Because they are quality standards, *NEIS* may in some instances go beyond the minimum safety requirements of the NEC. It is the responsibility of users of this publication to comply with applicable federal, state, and local electrical codes when installing electrical products and systems. Installers should also follow all manufacturer's installation instructions and ensure conformity to electrical ratings marked on such equipment.

Suggestions for revisions and improvements to this standard are welcome. They should be addressed to:

NECA Standards & Safety  
3 Bethesda Metro Center, Suite 1100  
Bethesda, MD 20814  
(301) 215-4549  
(301) 215-4500 Fax  
[www.neca-neis.org](http://www.neca-neis.org)  
[neis@necanet.org](mailto:neis@necanet.org)

To purchase *National Electrical Installation Standards*, contact the NECA Order Desk at (301) 215-4504 tel, (301) 215-4500 fax or [orderdesk@necanet.org](mailto:orderdesk@necanet.org). *NEIS* can also be purchased in .pdf download format at [www.neca-neis.org/standards](http://www.neca-neis.org/standards).

Copyright© 2015, National Electrical Contractors Association. All rights reserved. Unauthorized reproduction prohibited.

*National Electrical Installation Standards*, *NEIS*, and the *NEIS* logo are trademarks of the National Electrical Contractors Association. *National Electrical Code* and *NEC* are registered trademarks of the National Fire Protection Association, Quincy, MA.

*<This page intentionally left blank>*

# 1. Scope

## 1.1 Products and Applications Included

This standard describes the installation and maintenance procedures for single- and three-phase general purpose dry-type transformers and associated accessories rated 1000 Volts AC or less, and 0.25 kVA or more.

This publication applies to indoor and outdoor, ventilated and non-ventilated, two-winding transformers used for supplying power, heating, and lighting loads for commercial, institutional, and industrial use in nonhazardous locations both indoors and outdoors.

It also covers periodic routine maintenance and troubleshooting procedures for transformers, and special procedures used after adverse operating conditions such as a short-circuit, ground-fault, or immersion in water.

## 1.2 Products and Applications Excluded

This standard does not include:

- Transformers with one or more windings rated greater than 1000 Volts AC.
- Liquid-filled transformers.
- Autotransformers.
- Current transformers.
- Control transformers and transformers used with Class 2 and Class 3 circuits.
- Dry-type transformers that constitute a component part of other apparatus and comply with the requirements for such apparatus, including an X-ray, high-frequency, or electrostatic-coating apparatus.

- Transformers for sign and outline lighting, including electric-discharge lighting.
- Transformers used for power-limited fire alarm circuits.

## 1.3 Regulatory and Other Requirements

All information in this publication is intended to conform to the National Electrical Code® (ANSI/NFPA Standard 70). Installers shall follow the NEC®, applicable state and local codes, and manufacturer instructions, and contract documents when installing dry-type transformers.

Only qualified persons as defined in the NEC familiar with the construction and installation of dry-type transformers shall perform the technical work described in this publication. Administrative functions such as receiving, handling and storing required in Section 4, and other tasks may be performed under the supervision of a qualified person. All work shall be performed in accordance with NFPA 70E, *Standard for Electrical Safety in the Workplace*.

General requirements for installing electrical products and systems are described in NECA 1, *Standard for Good Workmanship in Electrical Construction* (ANSI). Other *NEIS* provide additional guidance for installing particular types of electrical products and systems. A complete list of *NEIS* is provided in Annex B.

## 1.4 Mandatory Requirements, Permissive Requirements, Quality and Performance Recommendations, Explanatory Material, and Informative Annexes

**Mandatory Requirements.** Mandatory requirements in manufacturer instructions, or of Codes or other mandatory Standards that may or not be