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National Electrical Safety Code®

C2-2012

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3 Park Avenue, New York, NY 10016-5997, USA

Accredited
Standards
Committee
C2-2012

National Electrical Safety Code®

Secretariat
Institute of Electrical and Electronics Engineers, Inc.

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2012 Edition

Abstract: This Code covers basic provisions for safeguarding of persons from hazards arising from the installation, operation, or maintenance of (1) conductors and equipment in electric supply stations, and (2) overhead and underground electric supply and communication lines. It also includes work rules for the construction, maintenance, and operation of electric supply and communication lines and equipment. The Code is applicable to the systems and equipment operated by utilities, or similar systems and equipment, of an industrial establishment or complex under the control of qualified persons. This Code consists of the introduction, definitions, grounding rules, list of referenced and bibliographic documents, and Parts 1, 2, 3, and 4 of the 2012 Edition of the National Electrical Safety Code.

Keywords: communications industry safety; construction of communication lines; construction of electric supply lines; electrical safety; electric supply stations; electric utility stations; high-voltage safety; operation of communications systems; operation of electric supply systems; power station equipment; power station safety; public utility safety; safety work rules; underground communication line safety; underground electric line safety

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Foreword

This foreword is not a part of Accredited Standards Committee C2-2012, National Electrical Safety Code.

This publication consists of the parts of the National Electrical Safety Code® (NESC®) (Accredited Standards Committee C2) currently in effect. The former practice of designating parts by editions has not been practical for some time. In the 1977 Edition, Parts 1 and 4 were 6th editions; Part 2 was a 7th edition; Part 3 was a revision of the 6th edition; Part 2, Section 29, did not cover the same subject matter as the 5th edition; and Part 3 was withdrawn in 1970. In the 1987 Edition, revisions were made in all parts, and revisions to all parts have been made in subsequent editions. It is therefore recommended that reference to the NESC be made solely by the year of the published volume and desired part number. Separate copies of the individual parts are not available.

Work on the NESC started in 1913 at the National Bureau of Standards (NBS), resulting in the publication of NBS Circular 49. The last complete edition of the Code (the 5th edition, NBS Handbook H30) was issued in 1948, although separate portions had been available at various times starting in 1938. Part 2—Definitions and the Grounding Rules, 6th edition, were issued as NBS Handbook H81, ANSI C2.2-1960, in November 1961, but work on other parts was not actively in process again until 1970.

In 1970 the C2 Committee decided to delete the Rules for the Installation and Maintenance of Electric Utilization Equipment (Part 3 of the 5th edition), now largely covered by the National Electrical Code® (NEC®) (NFPA 70®, 2011 Edition), and the Rules for Radio Installation (Part 5 of the 5th edition) from future editions.[①] The Discussion of the NESC, issued as NBS Handbook H4 (1928 Edition) for the 4th edition of the NESC and as NBS Handbook H39 for Part 2 of the Grounding Rules of the 5th edition, was not published for the 6th edition.

The 1981 Edition included major changes in Parts 1, 2, and 3, minor changes in Part 4, and the incorporation of the rules common to all parts into Section 1. The 1984 Edition was revised to update all references and to list those references in a new Section 3. Converted metric values, for information only, were added. Gender-related terminology was deleted. Section 1—Introduction, Section 2—Definitions, Section 3—References, and Section 9—Grounding Methods, were made applicable to each of the Parts 1, 2, 3, and 4.

The 1987 Edition was revised extensively. Definitions were changed or added. Requirements affecting grounding methods, electric supply stations, overhead line clearances and loading, underground lines, and work rules were revised.

The 1990 Edition included several major changes. General rules were revised. A significant change to the method for specifying overhead line clearances was made and the rationale added as Appendix A. Requirements for clearances of overhead lines from grain bins and an alternate method for determining the strength requirements for wood structures was added. Rules covering grounding methods, electric supply stations, underground lines, and work rules were changed.

In the 1993 Edition, changes were made in the rules applicable to emergency and temporary installations. In Section 9 and Parts 1, 2, and 3, rules were extended or clarified to include HVDC systems. The requirements for random separation of direct-buried supply and communications systems were modified for consistency and clarity, as was the rule in Part 4 on tagging electric supply circuits.

In the 1997 Edition, the most notable general change that took place is that numerical values in the metric (SI) system are shown in the preferred position, with customary inch-foot-pound values (inside parentheses)

[①] Information on references can be found in Section 3.

following. A bibliography, Appendix B, which consists of a list of resources identified in notes or recommendations, was added. Changes were made to rules affecting grounding, electric supply stations, and overhead lines, particularly with regard to clearance rules applicable to emergency and temporary installations. Strength requirements contained in Sections 24, 25, and 26 were revised completely. Underground line requirements for random separation for underground lines of direct-buried cables were modified. The requirement for cable identification marking by means of sequentially placed logos was introduced. Work rules added a requirement that warning signs and tags comply with applicable ANSI standards, tagging requirements were clarified with regard to SCADA, and extensive requirements for fall protection were added.

In the 2002 Edition, several changes were made that affected all or several parts of the Code. Particularly, this edition clarifies interfaces between the NEC and NESC with regard to Code jurisdiction in the area of street lights and area lights. Also included is clarification for situations between utility workers and their authorized contractors and installations on industrial complexes.

The major revisions for the 2007 Edition included grounding, moving sag calculations to Section 23, moving guy and span wires insulator rules to Section 21, phasing out of the alternate method for load factors and strength factors, flammable materials transported, phase-to-phase cover-up, and minimum approach distance tables.

In the 2012 Edition, major changes include an updated scope, application, and definitions; greatly simplified minimum approach tables and voltage exposure for arc flash; the addition of K factor for wire attention; and added clarification of the ungrounded portions of guys and swimming pools.

The Scope, Application, and Definition rules were extensively revised in 2012 to better reflect the historical application of the NESC—in large measure to clarify the relative applicability of the NESC versus the NEC. The changes in language in Rules 010—Purpose and 011—Scope are not changes in either scope or purpose; they are clear statements of the almost 100-year application of the requirements of the NESC to the specified circumstances. Additional rules were changed for clarity or to support changes made in other sections of the Code.

In Rule 091, revisions were made to clarify where rules require conductors or equipment to be effectively grounded, meeting the requirements of Section 9, plus the definition of *effectively grounded* must be met.

In Rule 094B7, the length and thickness requirements for using a directly embedded metal pole as an acceptable grounding electrode were deleted. Text was added to specify the distance required for a supplemental ground electrode to be installed with an embedded metal pole. Also, the Exception within the Rule added the words “or type metal” that recognize other length, configuration, and material may be allowed if supported by a qualified engineering study.

In Rule 099B, the grounding electrode conductor for grounding communication apparatus was changed from an AWG No. 14 to AWG No. 6.

The revisions in Part 1 consisted of improving Rule 110A2 to reduce clearance to live parts for an impenetrable fence and simplifying the Table 111-1 list of illumination levels for generating stations and substations.

Additional revisions were also made as follows:

— Updating the standard revision dates that contain information regarding safety signs.

— Storing material, equipment, and vehicles in supply stations.

— Outdoor lighting at unattended stations (not required).

— Noting that permanently installed fire-extinguishing equipment is not a requirement.
— Use of "taut-string distance" measurements for vertical clearances to energized part.

Rule 214A5 was revised; multiple change proposals attempted to add consistency to the application of the terms *grounded* and *effectively grounded*. Subcommittee 4 retained both terms and retained the requirement that guys be effectively grounded. Subcommittee 4 also revised Rules 215B1 and 215B2, applied a revision to the application of guy insulators, and clarified the voltage between line conductors.

A footnote to Table 251-1 was inserted to clarify the application of the K factor for wire tensions when a messenger supports multiple conductors using spaces. It states that when each conductor is separately loaded with ice and wind as described in Rule 251A3b, the K factor should be applied to all cables.

Rule 261H1 addresses tensions of overhead supply conductors and shield wires. One change proposal added tension limits when Rule 250C and Rule 250D loads apply. Similar to what already existed for splices and deadend fittings, conductors and shield wires will now be limited to 80% of the rated breaking strength when those extreme load conditions are applied along with a load factor of 1.0. Another change in the same rule modified the application of the secondary conductor tension limits from 16 °C (60 °F) to the applicable temperature listed in Table 250-1 for Rule 250B district loads. Reducing the temperatures at which tension limits are applied is in line with recommendations from conductor manufacturers and will reduce the risk of conductor damage due to aeolian vibration.

Rule 313 was reworded to include the recording and correction of conditions, not just defects, that affect compliance with the Code. In Rule 314B, the voltage level for grounding riser guards and ducts was deleted. Rule 320B5 now requires not less than 300 mm (12 in) separation from gas and other lines that transport flammable materials. New Rule 323E5 requires clearances based on Rule 110A2 for aboveground vaults with ventilation opening not protected with baffles or louvers. Figure 323-1 and Figure 323-2 were revised to comply with the latest figures in ASTM C857. The title for Section 35 was revised to include cable in duct not part of a conduit system. Recommendations concerning color coding for direct-buried cables and duct not part of a conduit system were added to Rules 350F and 350G. Installation rules for cable in duct were included in Rule 352. An Exception was added to Rule 354A2 to allow less than 300 mm (12 in) separation between supply conductors operating at not more than 300 V between conductors and gas and other lines that transport flammable materials where supplemental mechanical protection is provided. New Rule 355 contains rules for duct not part of a conduit system. Rule 384 was rewritten to require bonding between aboveground metallic communication and supply enclosures only.

Two significant changes were made to the work rules in Part 4, specifically in the Rule 441 minimum approach distanced tables, and also in Rule 410A3 on arc flash exposure. Revisions to IEEE Std 516™-2009 (NESC's source for calculated minimum approach distances) required changes to be made to the minimum approach distances in Part 4. Prior NESC editions included several tables containing minimum approach distances based on voltage levels and overvoltage levels. In the 2012 Edition, the minimum approach tables have been greatly simplified (accurate to the current IEEE 516 calculations) providing distances at the accepted historic maximum overvoltage levels. An engineering study of circuit overvoltage will have to be completed to use a reduced minimum approach distance.

Rule 410A3 was revised to recognize exposures at less than 1000 V. Significant testing was conducted by two separate major utilities and a research institute, providing the opportunity to establish appropriate incident energy levels for many common industry applications. The result of the review of the testing supported the development of new Table 410-1 that establishes arc energy thresholds for different equipment/exposures at voltage levels below 1000 V.

Table A-1 of Appendix A was revised only in the manner of presentation by the Overhead Clearances Subcommittee. However, the extreme wind calculations of Appendix C were revised by the Overhead Strengths and Loadings Subcommittee to reflect changes in Rule 250C.

Substantive changes in the 2012 Edition are identified by a bar in the left-hand margin. In several cases, rules have been relocated without substantive changes in the wording. In these cases, only the rule numbers have been indicated as having been changed.

The Institute of Electrical and Electronics Engineers, Inc., was designated as the administrative secretariat for C2 in January 1973, assuming the functions formerly performed by the NBS. Comments should be sent to the Secretary, National Electrical Safety Code Committee, through the following Contact Form:

Secretary
National Electrical Safety Code Committee
Institute of Electrical and Electronics Engineers, Inc.
http://standards.ieee.org/contact/form.html

A representative Committee on Interpretations has been established to prepare replies to requests for interpretation of the rules contained in the Code. Requests for interpretation should state the rule in question, as well as the conditions under which it is being applied. Interpretations are intended to clarify the intent of specific rules and are not intended to supply consulting information on the application of the Code. Requests for interpretation should be submitted using the NESC Interpretation Request Form on the NESC home page: http://standards.ieee.org/about/nesc/interps.html.

If the request is suitable for processing, it will be sent to the Interpretations Subcommittee. After consideration by the committee, which may involve many exchanges of correspondence, the inquirer will be notified of its decision. Decisions are published regularly and may be ordered or accessed online at no cost at http://standards.ieee.org/about/nesc/interps.html.

The NESC as written is a voluntary standard. However, some editions and some parts of the Code have been adopted, with and without changes, by some state and local jurisdictional authorities. To determine the legal status of the NESC in any particular state or locality within a state, the authority having jurisdiction should be contacted.

Change proposals and comments for the 2017 Editions of the NESC will be submitted to the NESC Secretary online via the Internet. For information on how this electronic revision process will take place and for updates and complete information on the NESC, please visit the National Electrical Safety Code Zone on the IEEE Standards Web site at http://standards.ieee.org/about/nesc/.

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At the time this Code was approved, Accredited Standards Committee C2 had the following membership:

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National Electrical Safety Code—Subcommittee 1
Sections 1, 2, and 3

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	Ewell T. Robeson	SC2	Progress Energy
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	Gary R. Engmann	SC3	Burns and McDonnell Engineering
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AEIC—Association of Edison Illuminating Companies
AISI—American Iron and Steel Institute
APPA—American Public Power Association
APTA—American Public Transit Association
ATIS—Alliance for Telephone Industry Solutions
AWPA—American Wood Preserves Assocation
BPA—Bonneville Power Admin., U.S. Dept. of Energy
EEI—Edison Electric Institute
EIA—Electronic Industries Association
IBEW—International Brotherhood of Electrical Workers
IEC—Independent Electrical Contractors
IEEE—Institute of Electrical and Electronics Engineers, Inc.
IMSA—International Municipal Signal Association
NARUC—National Association of Regulatory Utility Commissioners
NCTA—National Cable Television Association
NECA—National Electrical Contractors Association
NEMA—National Electrical Manufacturers Association
NSC—National Safety Council
NSPE—National Society of Professional Engineers
RUS—Rural Utilities Services, U.S. Dept. of Agriculture
SCTE—Society of Telecommunication Engineers
SEEX—Southeastern Electric Exchange
TVA—Tennessee Valley Authority
WAPA—Western Area Power Administration, U.S. Dept. of Energy

National Electrical Safety Code—Subcommittee 2—Grounding Methods
Section 9

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	Michael C. Pehosh	NRECA	National Rural Electric Cooperative Association
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	Robert Lash	RUS	USDA, Rural Utilities Service
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National Electrical Safety Code—Subcommittee 3—Electric Supply Stations
Sections 10–19

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James R. Tomaseski		IBEW	International Brotherhood of Electrical Workers
Gary R. Engmann		IEEE	Burns and McDonnell Engineering
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National Electrical Safety Code—Subcommittee 4—Overhead Lines—Clearances
Sections 20, 21, 22, 23

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National Electrical Safety Code—Subcommittee 5—Overhead Lines—Strength and Loading
Sections 24, 25, and 27

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	Christopher Austin	NCTA	Time Warner Cable, NYC–Liberty Division
	Steve Mace	NCTA	National Cable & Telecommunications Association
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	Michael C. Pehosh	NRECA	National Rural Electric Cooperative Association
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Thomas Haire		REMC	Rutherford EMC

Subcommittee 5 *(continued)*

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	Frank Agnew	SEEX	Alabama Power Company
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Douglas Hanson		WAPA	Western Area Power Administration, U.S. Dept of Energy
	Terry Burley	WAPA	Western Area Power Administration, U.S. Dept of Energy

National Electrical Safety Code—Subcommittee 7—Underground Lines Sections 30–39

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Donald Guinn		EEI	Progress Energy
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	Percy E. Pool	EIA	Verizon
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James Cowan		IEC	Wakker Engineering
Ewell T. Robeson		IEEE	Progress Energy
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Christopher Austin		NCTA	Time Warner Cable, NYC–Liberty Division
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	Robert D. Saint	NRECA	National Rural Electric Cooperative Association
O. Chuck Amrhyn		OPEC	OPEC
Trung Hiu		RUS	Rural Development—Electric Program

Subcommittee 7 *(continued)*

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National Electrical Safety Code—Subcommittee 8—Work Rules Sections 40–43

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	Kevin Dody	APPA	City Utilities of Springfield
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	Dennis Henry	ATIS	Telcordia
Michael Granata		EEI	Appalachian Power Company
Tommy Russell		EEI	Southwestern Electric Power
Samuel Stonerock		EEI	Southern California Edison Co.
	Patrick Geoffrey	EEI	PG&E
	Alan Kuipers	EEI	Consumer Energy
	J. Hilton Lester	EEI	Dominion
	Larry Nash	EEI	Dominion Virginia Power
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	James C. Tuggle	IEC	Malpaso Group Inc.
	Robert W. Baird	IEC	Independent Electrical Contractors
Lawrence Schweitzer		IEEE	The L. E. Myers Company
Thomas Verdecchio		IEEE	PSE&G
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Brian Erga		NWPPA	ESCI Inc.
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Charles Shaw		SEEX	Alabama Power Company

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Larry Slavin	ATIS	Outside Plant Consulting Services, Inc.
Leon Kempner	BPA	Bonneville Power Administration
Ewell T. Robeson	EEI	Progress Energy
James R. Tomaseski	IBEW	International Brotherhood of Electrical Workers
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Ewell T. Robeson	Progress Energy	3	9
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Key:
A = All areas; 1 = Part 1; 2 = Part 2; 3 = Part 3; 4 = Part 4; 9 = Section 9

Grounding:
When a member has Section 9 and a part number, the member covers grounding and grounding for that part.

Contents

Letter symbols for units

This Code uses standard symbols for units. They have the following meanings:

A	ampere
C	degree Celsius
ft	foot
ft^2	square foot
ft^3	cubic foot
F	degree Fahrenheit
g	gram
Hz	hertz
h	hour
in	inch
in^2	square inch
k	kilo (10^3)
kg	kilogram
kPa	kilopascal
km^2	square kilometer
kV	kilovolt (1000 volts)
kVA	kilovoltampere
kW	kilowatt
m	meter
m^2	square meter
m^3	cubic meter
m	milli (10^{-3})
mA	milliampere
mi	mile (international)
mm	millimeter
min	minute (time)
N	newton
Pa	pascal
lb	pound
s	second (time)
V	volt
W	watt

Section 1.
Introduction to the
National Electrical Safety Code®

The National Electrical Safety Code (NESC®) is American National Standard C2. It is a consensus standard that has been prepared by the National Electrical Safety Code Committee under procedures approved by the American National Standards Institute (ANSI). The membership of the NESC Committee is composed of national and international organizations and is certified by ANSI as having an appropriate balance of the interests of members of the public, utility workers, regulatory agencies, and the various types of private and public utilities.

The NESC is used in whole or in part by statute, regulation, or consent as the standard (or basis of the standard) of safe practice for public and private utilities in the United States, as well various jurisdictions and industries in other countries.

010. Purpose

A. The purpose of the NESC is the practical safeguarding of persons, utility facilities, and affected property during the installation, operation, and maintenance of electric supply and communication facilities, under specified conditions.

NOTE: NESC rules are founded upon the fundamental principles used for safety of utility facilities, and the NESC is globally accepted as good engineering practice.

B. NESC rules contain the basic provisions, under specified conditions, that are considered necessary for the safeguarding of:

1. The public,
2. Utility workers (employees and contractors),
3. Utility facilities,
4. Electric supply and communication equipment connected to utility facilities, and
5. Other facilities or premises adjacent to or containing utility facilities.

C. NESC rules are intended to provide a standard of safe practices that can be adopted by public utilities, private utilities, state or local utility commissions or public service commissions, or other boards or bodies having control over safe practices employed in the design, installation, operation, and maintenance of electric supply, communication, street and area lighting, signal, or railroad utility facilities.

D. This Code is not intended as a design specification or as an instruction manual.

011. Scope

A. Covered

See Figure 011-1.

The NESC covers:

1. Supply and communication facilities (including metering) and associated work practices employed by a public or private electric supply, communications, railway, trolley, street and area lighting, traffic signal (or other signal), irrigation district or other community owned utility, or a similar utility in the exercise of its function as a utility.
2. The generation, transmission, and distribution of electricity, lumens, communication signals, and communication data through public and private utility systems that are installed and maintained under the exclusive control of utilities or their authorized representatives.