2017 NESC® Handbook

Premier Edition

A presentation of contributor commentary on the 2017 NESC, including a representation of the Code




IEEE

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Contributor commentary on the 2017 NESC.
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This Handbook is published by IEEE as a resource for NESC users and contains historical background information about the NESC as well as commentary and opinions on the standards. While the historical background information and commentary has been prepared and reviewed by individuals with experience and knowledge of the subject matter, the IEEE does not warrant the completeness or accuracy of the historical information or assert that the commentary and opinions are preferred interpretations of any standard. For interpretations of rules, see decisions of the NESC C2 representative Subcommittee on Interpretations at http://standards.ieee.org/about/nesc/interps.html.

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The quality of the presentation of information contained in this publication reflects not only the obvious efforts of the contributors, but also the work of these peer reviewers. The IEEE Press acknowledges with appreciation their dedication and contribution of time and effort on behalf of the IEEE.

Acknowledgment

With thanks and appreciation to
Allen L. Clapp, P.E., P.L.S.
Editor, *NESC® Handbook*, First through Seventh Editions

For more than 50 years, Allen Clapp has been involved in the NESC in one manner or another. In 1964, Allen began using the NESC as a draftsman with a consulting engineering firm, while working his way through engineering school. He first participated on NESC Subcommittee 5 (covering strength and loading) as well as on NESC Subcommittee 4 (covering clearances) in 1971, pioneering early Code changes on building and water clearances.

Allen's role as editor of the NESC handbook has beginnings rooted in reviewing early interpretation requests for the NESC, as chair of the Interpretations Subcommittee. The concept of developing a handbook to better educate Code users about the NESC history is history itself, which includes decades of Allen's personal experience and dedication as the backbone to the handbook's evolution. Allen spent more than 3000 hours in compiling the first handbook edition using information transferred from the National Bureau of Standards to the IEEE when Secretariat for the NESC was transferred in 1972. He researched available papers and documents from the 1968 Code and earlier, passed down from retired subcommittee members, while acknowledging that some of the oldest data had been lost to antiquity. Thus, the need to keep the NESC handbook alive as a continuing resource to Code users increased in importance over time.

Allen has had the opportunity to serve more time on NESC subcommittees than any person in its history. Allen joined the NESC Main Committee in 1973, served as its chair from 1984 to 1993, and served on the Executive Subcommittee from the mid-1970s until the mid-1990s. He became secretary for Subcommittee 5 in the mid-1970s and served in that role for the better part of four decades. In addition to serving on Subcommittees 4 and 5, he also served as chair on Subcommittee 1 (covering coordination, scope, purpose, definitions, and references) and as chair of the Interpretations Subcommittee.

In Allen's own words, he expresses "pride in the accomplishments of the NESC subcommittee members over the past decades and belief in the NESC's capability to make the United States and other user countries a safer place for utility workers and the public alike, as the utility industries and the challenges that they face change in the future."

Any NESC subcommittee member can identify with Allen's thoughts that there have been "spirited discussions about issues, and good give-and-take from all. However, there can be no doubt about the fervor with which the NESC participants search for ways to make the NESC better."

Allen has expressed his personal hope "that the IEEE NESC Handbook can be expanded and continue to serve to help both code users and the future subcommittee members who must consider the appropriateness of future changes. The more explanations that are added to it over time—particularly about *why* changes are made—the better able it will be to serve our future."

Finally, with Allen's long tenure as its editor, he writes: "I have had the wise counsel of many subcommittee members in crafting language for inclusion in the Handbook. Many of these folks are not listed as a formal reviewer, but they have gladly donated their time and some have spent many hours helping to make this a better publication. Thank you all for your help and your many best wishes."

Thank you, Allen, for your dedication and service to the NESC and the industries that it serves. You are heartily wished all the best in your well-deserved retirement.

About the Premier Edition Handbook

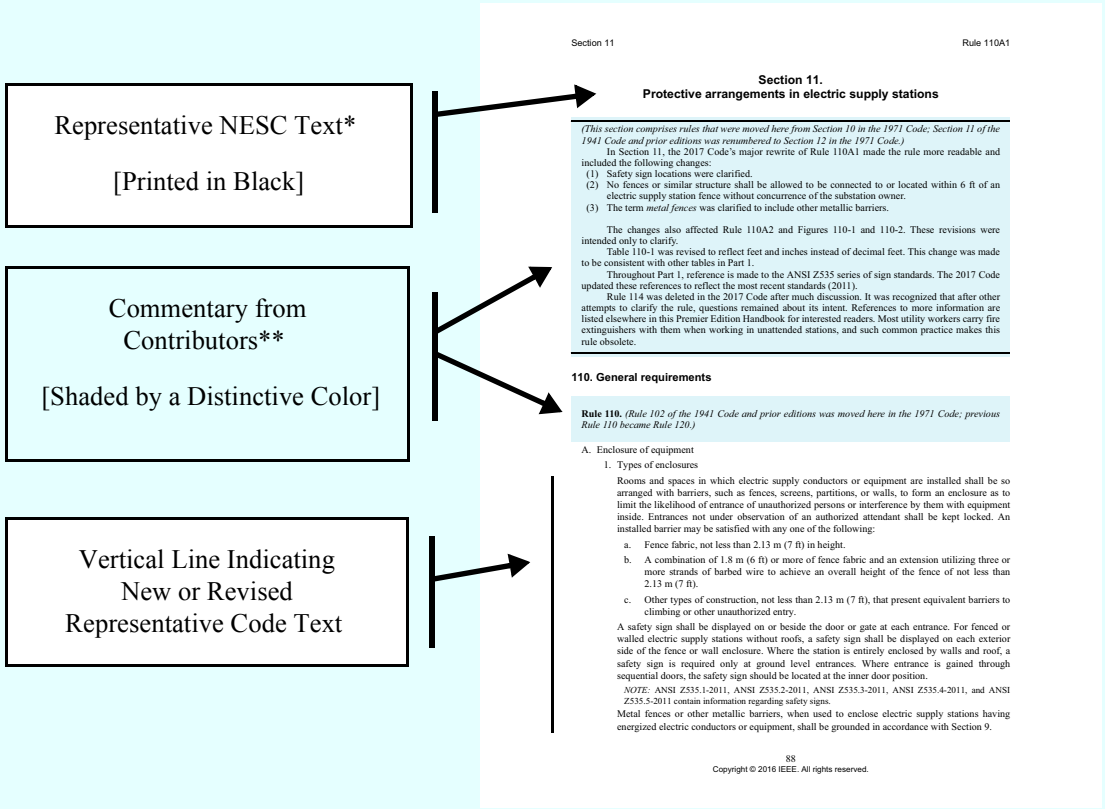
Welcome to the Premier Edition of the *2017 NESC® Handbook*.

The Premier Edition Handbook represents a next-generation tool for the professional who needs to understand the NESC. Contributor commentary gives users insight into what lies behind the NESC rules and how users might apply them. Unlike earlier handbooks, this new edition includes a representation of the Code*, with history and commentary** interspersed and coincident with the representative Code.

Discussed in the history and commentary are the development of the rules in the Code and the response to change proposals during the past 90 years. This commentary allows users to understand how questions they may encounter were dealt with in the past.

This Handbook includes input from contributors who are NESC committee members as well as the strong foundation developed by previous NESC handbook editor, Allen Clapp. The culmination of this effort is truly a collaborative effort, aimed at bringing to the NESC user the most comprehensive information regarding the evolution and content of the 2017 NESC.

How to Use the Premier Edition Handbook



* The Premier Edition Handbook provides a representation of the NESC text; however, the definitive text is found in the Code itself, the *National Electrical Safety Code®, 2017 Edition*.

** Commentary from contributors provides a historical perspective on the development of the Code but is not text from the Code. Commentary does not constitute an interpretation of the Code and does not replace the NESC process for obtaining formal interpretations of the Code. (For information on that process, see http://standards.ieee.org/about/nesc/interps.html.) The combination of Code and commentary is provided for user convenience only.

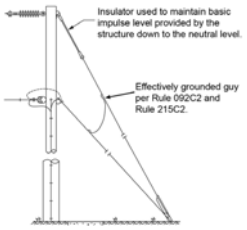


Figure 279-1—Insulator used for BIL insulation

Rule 279A2. *(This rule was added as Rule 279A3 [Corrosion protection] in the 1977 Code and was revised and renumbered to Rule 279A2 in the 2007 Code.)*

Insulators placed in a guy solely to prevent electrolysis are not required to meet the requirements for guy insulators, but they may not reduce the strength of the guy. See Rule 217A (Rule 280A of the 1987 Code and prior editions).

In 2007, insulators used for BIL insulation purposes were specifically added to the rule, along with a reference to new Rule 215C7. The 2017 Code revised Rule 279A2b(2) to further address this issue. In essence, by insulating the pole end of guys, the pole ground wire that otherwise would have run up the pole in the area of the energized phases can be removed, and the BIL level of the top of the pole can be increased on wood or FRP poles. Quite often the desire is to create a ground-free work zone in the area of the phase conductors. If the guys were grounded in that area, Rule 441A3 would require them to be covered with insulation while work was performed; thus guys are increasingly insulated on the pole end—particularly for the 25 kV and 35 kV distribution class voltages. Even though the insulation may be primarily for work efficiency in this case, it still increases the BIL capability of the top of the pole. Neither insulators used to limit galvanic corrosion nor insulators used for BIL insulation are required to meet the electrical strength requirements for guy insulators, but both are required to meet the mechanical strength requirements (see Rule 279A1c).

279A2. Use of guy insulators (2002 Code and prior editions) *(Rule 279A2 of the 2002 Code was moved to Rule 215C; see Rules 215C2, 215C3, and 215C5.)*

279A3. Corrosion protection *(This rule was added in the 1977 Code and was revised and renumbered to Rule 279A2 in the 2007 Code.)*

New or Revised Diagrams and Photos within the Representative Code Text

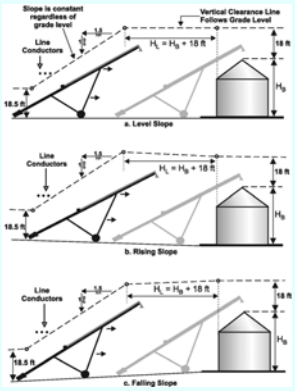


Figure H234-4(b)
Vertical clearance above flat or sloping ground near grain bin filled with portable augers

G. Additional clearances for voltages exceeding 22 kV for wires, conductors, cables, and unguarded rigid live parts of equipment

Greater clearances than specified in Rules 234B, 234C, 234D, 234E, 234F, and 234J shall be provided where required as follows:

1. For voltages between 22 and 470 kV, the clearance specified in Rules 234B, 234C, 234D, 234E, 234F, and 234J shall be increased at the rate of 10 mm (0.4 in) per kV in excess of 22 kV. For voltages exceeding 470 kV, the clearance shall be determined by the method given in Rule 234H. All clearances for lines over 50 kV shall be based on the maximum operating voltage.

   EXCEPTION: For voltages exceeding 98 kV ac to ground or 139 kV dc to ground, clearances less than those required above are permitted for systems with known maximum switching-surge factor. (See Rule 234H.)

Diagrams and Photos from Handbook Contributors

About the Contributors and Reviewers

IMPORTANT NOTICE: No part of the commentary is intended to represent the view of any company with which a contributor or reviewer is or has been affiliated. Any opinions expressed are the personal opinions of the contributors. No particular section of the commentary necessarily represents the view of any individual contributor or reviewer. The commentary does not represent the official position of the IEEE or any NESC Technical Committee.

Nelson G. Bingel III
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- Member, NESC Executive Subcommittee
- Member, NESC Subcommittee 1, Coordination, Scope, Purpose, Definitions, and References
- Chair, NESC Subcommittee 5, Overhead Lines—Strength and Loading

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- Member, NESC Subcommittee 1, Coordination, Scope, Purpose, Definitions, and References
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Nelson G. Bingel III, *Contributor*, has worked for 30 years at Osmose Utilities Services, where he is responsible for engineering and other technical aspects of wood, steel, concrete, and fiberglass utility poles and structures. This responsibility covers a wide range of activities such as inspection, maintenance, restoration, and repair along with mitigation of deterioration and corrosion. Nelson designed unique software used during structure inspections and developed the O-Calc pole loading program used by companies nationwide for calculating comprehensive pole loading analysis. In addition, he has been granted three U.S. patents for unique designs of pole restoration systems.

Nelson has been active with the NESC for more than 25 years and currently serves as chair of NESC Subcommittee 5 (Overhead Lines—Strength and Loading) and member of NESC Subcommittee 1 (Coordination, Scope, Purpose, Definitions, and References), the NESC Executive Subcommittee, and the NESC Main Committee. He also chairs the American Standards Committee O5 (Specifications and Dimensions for Wood Poles), which develops the standards for new wood poles and crossarms.

Nelson earned a bachelor's degree in mechanical engineering from Purdue University.

Charles C. (Charlie) Bleakley, *Contributor* and *Reviewer*, retired from Georgia Power Company with more than 34 years of service. His last position was distribution manager of Construction Distribution Services where he was directly responsible for the planning, testing, designing, and publishing the company's *Distribution Specification Book*. Other responsibilities included developing and field testing new specifications and training engineers and line crews to use the specifications. Charlie also has engineering and managerial experience with distribution system engineering and operation, line crew and engineer staff supervision, and power delivery system management. Since retirement, he works as a consultant for Georgia Power Company to participate in NESC subcommittee work and keep the company up-to-date on the Code.

Charlie's NESC activities include serving as member (since 1981) and chair (since 1997) of Subcommittee 7 (Underground Lines); member (1984–1993 Code) of Subcommittee 6 (Overhead Lines—General and Insulation); member (since 1994) of Subcommittee 4 (Overhead Lines—Clearances); and member (since 1997), secretary (2002–2012), and chair (since 2013) of Subcommittee 1 (Coordination, Scope, Purpose, Definitions, and References). He has also served as a member of the NESC Interpretations Subcommittee since 1987.

Allen L. Clapp, *Contributor* and *Reviewer*, is a Professional Engineer and Professional Land Surveyor who has been involved in the design and evaluation of electric supply and communication facilities for more than 50 years. Allen has provided consulting services for more than 500 utilities and industries. At least 28,000 people have attended Allen's seminars on the NESC, pole line design, and utility accident investigation. Allen has investigated more than 1,000 accidents and testified before courts and commissions many times over the past 45 years.

Allen has served continuously on NESC technical subcommittees since 1971: member (1973–2006) and chair (1984–1993) of the NESC Main Committee; member (1976–1993) of the Executive Committee; member (1978–2011), secretary (1981-1984), and chair (1993–2011) of Subcommittee 1 (Coordination, Scope, Purpose, Definitions, and References); member (1972–2015) and acting secretary (more than 20 times) of Subcommittee 4 (Overhead Lines—Clearances); and member (1971–2015) and secretary (1978–2010) of Subcommittee 5 (Overhead Lines—Strengths and Loadings). Allen has also been a member of the NESC Interpretations Subcommittee since 1976 and served as its chair for 10 years (1980–1990).

Allen was the principal editor for the previous editions of the *NESC® Handbook* and is a contributor to the *Standard Handbook for Electrical Engineers* published by McGraw-Hill. He has also served as IEEE representative on the ANSI Z535 Safety Signs and Colors Committee (1994–2013) and as chair of the Z535.2 Subcommittee on Environmental and Facility Safety Signs (1995–2013).

John B. (Johnny) Dagenhart, *Contributor*, has more than 38 years of experience in the electrical engineering industry. John is President of Dagenhart Consulting Services, PC, in Durham, North Carolina. In 2015 he purchased sole ownership of Clapp Research Associates, PC, where he had worked for more than 27 years. At the end of 2015, he merged Clapp Research Associates, PC, with Dagenhart Consulting Services. Prior to working with Clapp Research, Johnny worked as a distribution engineer for Duke Energy.

Johnny has been involved on various NESC subcommittees since 1990. He currently serves as chair of NESC Subcommittee 2 (Grounding Methods), member of NESC Subcommittee 1 (Coordination, Scope, Purpose, Definitions, and References), and member of the NESC Interpretations Subcommittee.

Johnny provided research and served as a reviewer for the previous editions of the *NESC Handbook*, is a contributor to the *Standard Handbook for Electrical Engineers* published by McGraw-Hill, and has authored articles on electrical power quality issues and on both the NESC and the National Electrical Code® (NEC®).

Mark A. Konz, *Contributor*, is a Professional Engineer who has worked 25 years with Gulf Power Company in Pensacola, FL. Mark's experience includes designing electrical distribution systems, operating electrical distribution systems in the Distribution Control Center, and specifying the materials and construction standards for all engineers. He gained electric substation experience working as system protection engineer. Mark is currently the Customer Service Organization training supervisor and has taught numerous NESC classes for the company.

Since 2001, Mark has served on the Southeastern Electric Exchange (SEE) section on the NESC where he participates in revising all parts of the Code. For almost as long, he has been representing SEE as a principal member of NESC Subcommittee 3 (Electric Supply Stations) and has participated in three Code revision cycles.

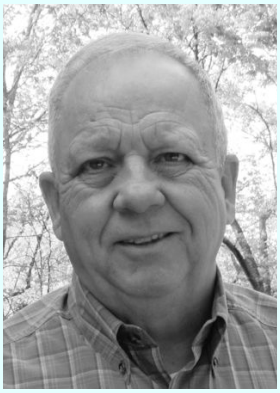
Mark earned a bachelor's degree in electrical engineering from Florida State University and a master's degree in management from Troy State University in Alabama. He is a registered continuing education provider in Florida. He also serves on the advisory boards for the electrical and computer engineering programs at both the University of West Florida and the Florida State University College of Engineering.

Lauren E. Gaunt, *Contributor*, has more than 35 years of experience in the planning, engineering, construction, and operation of electric power distribution, transmission, and substation systems. Lauren has been employed within the Eversource Energy System in Connecticut since 1987 and currently serves as a principal engineer and the company's primary technical communicator with Connecticut's Public Utilities Regulatory Authority.

For more than 25 years, Lauren has participated nationally in developing electric power system safety standards for the NESC. He currently serves as member of NESC Subcommittee 2 (Grounding Methods), secretary of NESC Subcommittee 7 (Underground Lines), and alternate member of NESC Subcommittee 1 (Coordination, Scope, Purpose, Definitions, and References). Lauren is also a long-time member of the national committee responsible for ANSI C84.1-2011 [American National Standard for Electric Power Systems and Equipment — Voltage Ratings (60 Hertz)].

Lauren has taught electrical engineering courses at the University of New Haven since 1984. He is a senior member of the IEEE, a registered Professional Engineer in Connecticut, and a member of several industrial advisory boards promoting electrical and other technology education. Lauren earned a bachelor's degree in electrical engineering from the University of Michigan in 1980 and a master's degree in electric power engineering from Rensselaer Polytechnic Institute in New York in 1987. He also holds an extra class amateur radio license from the Federal Communications Commission.

Mickey B. Gunter, *Contributor* and *Reviewer*, has more than 38 years of experience in distribution engineering design, standards, and training and spent the majority of his career with Georgia Power Company.



Mickey has been active with the NESC since 1993 and participated in six Code revision cycles. He presently serves on four NESC subcommittees: secretary of Subcommittee 1 (Coordination, Scope, Purpose, Definitions, and References), secretary of Subcommittee 4 (Overhead Lines—Clearances), member of Subcommittee 7 (Underground Lines), and member of the NESC Interpretations Subcommittee. He also serves as chair of the Southeastern Electric Exchange (SEE) section on the NESC and as chair of the Edison Electric Institute (EEI) NESC Subcommittee 4.

Mickey earned a bachelor's degree in industrial engineering from Georgia Institute of Technology in 1966.

Mark F. Jurgemeyer, *Reviewer*, has experience in project management, design, and construction administration for distribution transmission systems for utilities worldwide. Mark is the engineering manager for Intermountain Rural Electric Association. His previous experience includes working for Stanley Consultants, Inc.; Morrison Knudsen/Washington Group International; Behrent Engineering Co.; and GEA Integrated Cooling Technologies, Inc. He presented "Transmission Line Design" and "Substation Physical Design" at T&D World University in 2007 and 2008 in Dallas, TX.

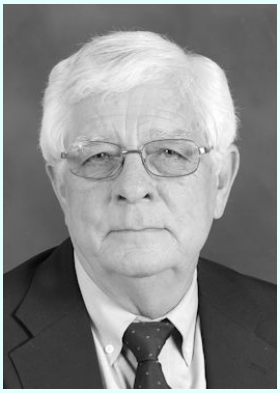
Mark has been a principal member of NESC Subcommittee 5 (Overhead Lines—Strength and Loading) since 2009. He has also been involved in the development of several standards as part of the IEEE Power and Energy Society's Towers, Poles, and Conductors Subcommittee since 2007. He is also a member of the American Society of Civil Engineers (ASCE).

Mark earned a bachelor's degree in civil engineering from University of Colorado in 1995.

Ernest H. (Ernie) Neubauer, *Reviewer*, is a registered Professional Engineer in three states. Ernie began his career in 1972 with Alabama Power Company as a distribution engineer. In 1976 he switched to the electric cooperative world and since then has worked for four electric cooperatives in Ohio, Florida, and Georgia.

Ernie has been representing the National Rural Electric Cooperative Association (NRECA) as a member of NESC Subcommittee 4 (Overhead Lines—Clearances) since the 2002 Code revision cycle.

Ernie earned a bachelor's degree in electrical engineering, specializing in the power area, from the University of Tennessee in 1972 and a master's in business administration from Wright State University in Ohio in 1997.



Ewell T. (Tim) Robeson, *Reviewer*, is a registered Professional Engineer in North Carolina, South Carolina, and Florida with 46 years of experience in electrical distribution line design. As a contractor for Duke Energy, Tim works on overhead and underground distribution teams to integrate design, construction, and material standards among the legacy companies that compose Duke Energy.

In 1970, Tim started as a field engineer with Carolina Power and Light Company before spending most of his career developing design and construction standards for underground distribution systems. He also worked as a lead engineer for distribution design and materials for the Carolinas and Florida before retiring in 2012 from Progress Energy.

Tim serves as secretary and Edison Electric Institute (EEI) representative on NESC Subcommittee 2 (Grounding Methods) and is a member of NESC Subcommittee 1 (Coordination, Scope, Purpose, Definitions, and References) and the NESC Interpretations Subcommittee. He is also a past member of the NESC Executive Subcommittee, past EEI representative on the NESC Main Committee, past principal member and IEEE representative on NESC Subcommittee 7 (Underground Lines), and past chair of the EEI NESC Utilities Representative Coordinating Task Force.

Tim is also a senior member of the IEEE. He earned a bachelor's degree in electrical engineering from North Carolina State University.

Charles A. (Charlie) Shaw, *Reviewer*, is a registered Professional Engineer with 35 years of experience in the electric utility industry working in a variety of roles in engineering, operations, and safety.

Charlie is actively involved in several industry groups and serves as a principal member on NESC Subcommittee 8 (Work Rules) representing the Southeastern Electric Exchange.

Charlie earned a bachelor's degree in electrical engineering from Auburn University.

Samuel Stonerock, *Contributor*, is a 30-year employee of Southern California Edison (SCE) and a senior project manager in the Transmission and Distribution (T&D) Department. He is a member of NESC Subcommittee 1 (Coordination, Scope, Purpose, Definitions, and References) and the secretary of NESC Subcommittee 8 (Work Rules) representing the Edison Electric Institute.

Samuel also represents SCE while serving as member and first vice chair of ASTM International's Committee F18 and represents ASTM International as a member of the National Fire Protection Association's Committee 70-E. He is also a member of IEEE's Power and Energy Society, the ESMOL Subcommittee, and the Industry Applications Society.

With his experience in distribution field construction and maintenance, compliance inspections, and join-use contract administration, Samuel serves as member and chair of California's General Order 95/128 Rules Committee and as an internal technical advisor on regulatory, legal, and legislative matters related to T&D policies, practices, procedures, and safety standards.

Greg Wolven, *Reviewer*, is a licensed Professional Engineer in both Indiana and Virginia with more than 35 years of experience working for rural electric cooperatives. Greg has worked for two electric cooperatives in Virginia and is currently director of engineering for WIN Energy REMC in Vincennes, IN. He is in charge of staking, mapping, system planning, advanced metering infrastructure (AMI), information technology, and telecommunications.

Greg is a member of the IEEE, the National Society of Professional Engineers (NSPE), the National Rural Electric Cooperative Association (NRECA) Substation Design Subcommittee, and NESC Subcommittee 1 (Coordination, Scope, Purpose, Definitions, and References); secretary of NESC Subcommittee 3 (Electric Supply Stations); and chair of NRECA's Software Integration Initiative task force.

Greg earned a bachelor's degree in electrical engineering from the Virginia Military Institute in 1981. In his spare time he enjoys reading, working on old homes, and martial arts. He is a third degree black belt and a volunteer assistant instructor in Tae Kwon Do.

Contents

Figures

Premier Edition Handbook figures are listed flush left and usually have an "H" at the beginning of their numbers. Code figures are listed here with an indent and in italics. Most figures are numbered based on the Code rules to which they relate. For example, Figure H092B1 is a Handbook figure that relates to Rule 092B1, and Figure 110-1 is a Code figure that relates to Rule 110. (Numbers on figures in the definitions in Section 3 start with a "D.")

Code Appendices

Handbook Appendices

Tables

Premier Edition Handbook tables are listed flush left and usually have an "H" at the beginning of their numbers. Code tables are listed here with an indent and in italics. Tables are numbered based on the Code rules to which they relate. For example, Table H234-1 is a Handbook table that relates to Rule 234, and Table 441-1 is a Code table that relates to Rule 441.

Code Appendices

Handbook Appendices

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 V)
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.

(This section was created in the 1981 Code; Rules 010–015 were generally contained previously in the introductory rules of each separate part of the Code (Rules 100, 102, 103, 200, 201, 202, 210, 211, 300, 301, 302, 303, 310, 311, and 400). When all parts of the Code were simultaneously revised for the first time in the 1981 Code, these rules were collected in one place and revised for uniformity to eliminate redundant language, and to increase the clarity and specificity of requirements so as to increase the understandability of the NESC.)

The rules in Section 1 apply to all of the parts and sections in the NESC. Rule 010 (Purpose) says whom and what the NESC rules are to safeguard. The "whom" includes people, both the public and utility workers. The "what" refers to utility facilities, which include all utility-owned and -operated electric power generation systems, overhead and underground lines and equipment that deliver electric power to the end users, and communication overhead and underground lines and equipment that transmit electronic and voice data and signals.

The word "practical" is used to describe rules that are written to safeguard the public and the utility facilities. This phrasing means that requirements of the NESC rules must be *doable* and will create the *level of safety required for the activity or installation*. For example, the work rules require protective insulating equipment be used when workers are within reach of electric power lines; this requirement is practical, or doable, and protects the worker from injury; therefore, the requirement fulfills the rule's intent. As another example, the clearance above ground for overhead wires, cables, and conductors must be high enough to safeguard the activity under the overhead lines and, to be practical, vary according to the activity under the lines. The clearance over railroad tracks is greater than the clearance over a road due to the height of a railroad boxcar compared to the height of a trailer truck. It is practical that the clearances are different and at the same time provide the desired level of safety to avoid contact between overhead lines and the objects or activity below the lines.

Rule 010 also states that the Code is not a design specification or an instruction manual. The NESC is a performance standard. It does not specify materials to be used for certain installations, nor does it provide instructions on how to meet the Code requirements. The Code recognizes that design specifications and work methods vary from utility to utility depending on many factors such as location, typical climate conditions, terrain, etc. The most common example of this rule is that the Code requires clearances above ground over which the overhead lines pass, but the Code does not require the use of a certain type of structure to support the overhead lines. Metal lattice-type towers, wood, concrete, fiberglass, or metal poles may be used as long as the structure meets the Code's strength requirement and is high enough to provide the required clearance.

The clearances and strength requirements are basic requirements. The rules stating clearance and strength requirements use the words "not less than" where a clearance or strength requirement is specified. If so desired, utilities may exceed these requirements, but failing to meet the specified clearance or strength requirements creates a condition affecting compliance with this Code. If a utility constructs a system that meets the basic requirements, it provides the practical safeguarding of persons and utility facilities specified in the Code.

Rule 011 (Scope) describes, in detail, what is covered by the Code and what is not covered by the Code. Generally every function performed by a public or private electric supply utility is covered. The NESC coverage stops at the customer or user service point. Also covered by the NESC are independent

electric generators that supply electricity to electric supply utilities only. Communication utilities including telephone, TV cable, and data transmission utilities that use overhead and underground lines to transmit or receive signals, as well as overhead trolley lines and street and area lighting system controlled and operated by public or private utilities that are supplied from lines on the line side of the service point, are also covered. Similar utility systems that are not operated by utilities such as large industries or government-owned systems (military bases) are covered by these rules.

Electric supply stations are covered by this Code. The building wiring, i.e., ceiling lights and wall sockets in offices that are not part of the generation or substation bus work or wiring, is not covered by this Code. It is covered by the National Electrical Code® (NEC®).

Not covered by the Code is all wiring beyond the service point. The service point for overhead lines is usually at the weatherhead. In underground service areas, the service point may be in an underground vault, at a pad-mounted transformer, at the building wall, or inside the building in the main switch equipment. In residential areas where the utilities are underground, the service point is usually at the residence metering point. However, the metering equipment is covered by this Code regardless of its location.

Rule 012 (General rules) requires all electric supply and communication lines and equipment to be designed, constructed, operated, and maintained to meet the rules in the Code. It also requires all entities designing, constructing, maintaining, and operating electric supply or communication lines and equipment covered by the Code to be responsible for meeting the applicable requirements. For example, if a utility contracts with a construction company to build or maintain an overhead line, the contractor is responsible for making sure the work is done according to the NESC safety rules for over line work.

Rule 012C is a rule that requires practical safeguarding for situations that are not specifically covered by the Code. This rule is referred to when it is not practical to meet a Code requirement or the situation is not specifically covered by the Code although it is within the scope of normal Code requirements. Safeguarding must be done based on the known conditions at the time and should be comparable to the level of safety that the Code would normally provide. For example, when an overhead line is to be constructed along a road that passes through a ravine, the vertical clearance above ground will be determined and met based on the ground clearance rules. The Code does not specify diagonal or horizontal clearances to ground. If the side of the ravine is accessible to persons or will be maintained by roadway maintenance crews, doing nothing is not an option. Appropriate clearance should be determined and the line constructed to provide the needed safe clearance for the activity on the side of the ravine.

Rule 013 (Application) requires all new installations and extensions or additions to utility installations to meet the Code unless the governmental agency that oversees the enforcement of the Code waives the rules. Again, the requirement to provide safeguarding for the public and utility workers does not go away; equivalent levels of safeguarding are required by this rule.

The application rules also allow utilities to experiment with different types of construction and methods that are specified by the Code if qualified supervision is provided, the level of safety is maintained, and, when joint-use structures are involved, all affected joint users are notified.

The application rules include extensive rules covering existing installations. The first application rule states that if an existing installation meets or is altered to meet this Code edition, then it meets the Code and is not required to meet earlier editions of the Code.

The second application rule says that if an existing installation, including maintenance replacements, meets an earlier edition, then it meets the Code. However, if the government agency that administers the Code requires updating for safety reasons, then this rule does not apply. This situation may occur where the building clearance allowed by earlier editions is less than the clearance specified in the current edition. Also if the structure is being replaced, this rule and Rule 202 require the structure to meet Rule 238C of the current edition.

The third application rule allows the addition, alteration, or replacement of lines or equipment on an existing structure without replacing or modifying the structure if (a) the installation meets the applicable Code edition in effect when the installation was originally constructed, or (b) the structure and the attached facilities were modified after the original construction date and updated to the Code in effect at that time, or (c) the structure meets the present Code when the work is finished.

For example, an overhead line was constructed meeting the 1984 Code. Work was done on the structure during the time when the 1990 Code was in effect. If the installation was updated to meet the 1990 Code, then the 1990 Code becomes the applicable Code for this installation. If the installation still met the 1984 Code and was not modified to meet the 1990 Code, then the 1984 Code is still the applicable Code. Additions or modifications may be done on this structure while the present Code is in

effect. After the additions and modifications are made, the structure must meet the applicable Code requirements. If the structure was not modified to meet the present Code, then the structure must be in compliance with the applicable Code that resulted from the previous work done when the 1990 Code was in effect. If the installation was updated to meet the rules in the present Code, then the present Code is the applicable Code. Neither the 1984 Code nor the 1990 Code may be used as the applicable Code for this installation.

A new rule was added in the 2017 Code to the application rules to allow addition or modifications to a structure that does not comply with the applicable rules. If the addition or modification does not create a structural, clearance, or grounding noncompliance or will make an existing noncompliance worse, then the addition or modification is allowed before the noncompliant condition is corrected. The rules requiring inspections, testing, and correcting noncompliant conditions are still in effect and are not affected by this rule.

The application rule also requires the current inspection and work rules to be used on new and existing installations. This rule was added to require work on existing lines and equipment be done using the up-to-date work rules instead of the work rules in effect when the installation was constructed or modified. Inspection and work rules shall always be applicable to the current edition even though the applicable edition for the installation may be a previous edition of the Code.

Rule 014 (Waiver for emergency and temporary installations) specifies what can be done to restore service during an emergency or to provide service during an emergency and what are the requirements for temporary installations.

The rule allows emergency installations to meet lower clearances for overhead lines and the use of underground cable to be laid on the ground to provide or restore service quickly and safely. Generally emergencies occur when disastrous storms cause severe damage to overhead lines and equipment that necessitates abnormal yet safe construction to restore service to the affected area. The emergency installations must be replaced as soon as practical after the emergency has ended.

Temporary installations are done to provide service during construction of residences, buildings, or other large construction projects where utility service is required for construction. Temporary lines may be required to provide clearances for roadway or bridge construction. Temporary lines may be built using less than normally specified strength materials, but the overhead lines must meet the clearance requirements. There are no time constraints on temporary installations.

Rule 015 (Intent) explains what is required when the Code uses the action words “shall” and “should,” which can be found in the rules throughout the Code. The rule also defines the effects of footnotes, *EXCEPTION*s, *RECOMMENDATION*s, *EXAMPLE*s, and *NOTE*s that may be added to the rules.

Rule 016 (Effective date) states the date that this Code edition will become effective. This date is 180 days after the publication date which is usually August 1. Therefore, the effective date is usually the following February 1. The Code may be used during this six-month period if desired. The 180 days provides time for utilities to update their design standards and for regulatory authorities to review and approve the Code.

Rule 017 (Units of measure) explains that numerical measurements in the Code are stated in the metric system and the customary inch, foot, and pound measurements. The metric measurements are shown first, and the customary measurements are shown next in parentheses. Tables that are relatively large are separated into metric tables, which are labeled with the letters **m** or **mm**, and the customary unit tables are labeled with the letters **in** and **ft**. The numbers in the tables are not exactly the same since the values are rounded off to convenient numbers; generally 1 decimal place is used in the customary unit tables, and 2 decimal places are used in the metric tables. For example, the clearance between an overhead electric supply conductor energize at 120 volts and a communication cable is 1 meter in the metric table and 40 inches in the customary unit table; the difference between the actual measurements is less than 0.5 inches. Both are considered equivalent and safe.

Rule 018 (Method of calculation) requires the resultant of calculations to be rounded off to the nearest significant digit unless the rule specifies a different method.

The rules of the NESC detail the requirements that are practical and necessary to reduce exposure to known or expected hazards to personnel or equipment. To that end, the NESC Subcommittees have been diligent in the development and analysis of data concerning (1) the construction, operation, and maintenance of lines and equipment and (2) the problems and benefits of each method.

The Code is prepared by a diversified group of active participants; they represent a wide variety of public and industry viewpoints and bring to the codification process a great depth of experience covering the entire field of utility system construction, operation, maintenance, and use. The process is public, and proposed changes are widely distributed, so that interested parties may comment and

provide additional data. These rules, therefore, reflect the considered judgment of a wide body of expertise. The rules are reviewed on a regular basis; they are revised, as necessary, to reflect changes in materials or methods and, as experience indicates, to recognize changes in the nature and degree of problems presented.

010. Purpose

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

NOTE: NESC rules are globally recognized and intended to provide a practical 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.

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), and
3. Utility facilities.

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

Rule 010. *(This rule was formed in 1981 from previous Rules 100, 200, 202, 210, 211, 300, 310, 311, and 400.)*

In the 1977 Code and later editions, it is made clear by choice of wording that the purpose of these rules is the practical safeguarding of persons during the installation, operation, or maintenance of overhead and underground supply and communication lines and their associated equipment. The NESC Subcommittees made every effort to emphasize that it is not merely enough that an installation be *possible*—it must be *practical* as well—to qualify as a requirement of the Code. It is unfortunate that earlier editions sometimes used the word "practicable" and that some individuals instigating legal actions have tried to infer that the word was intended to convey the meaning "possible." It is clear from the official Discussion of the very earliest codified edition, the 1916 Code, that general practicality of installation was intended. This emphasis on "practicality," as opposed to the extreme requirement of "possibility," is especially noted in Rule 202 (Design and Construction) of the 1916 Code and its Discussion. The language of that rule is as follows: "*202—Design and Construction. All electrical supply lines and equipment shall be of suitable design and construction for the service and conditions under which they are to be operated, and all lines shall be so installed and maintained as to reduce the life hazard as far as practicable*."

The language of the 1916 Code Discussion is as follows: "*This rule…strikes the keynote of the code. There is no intention of requiring or even recommending more expensive construction than good practice requires and good business justifies. But it must be remembered that the public in the end pays whatever extra cost is caused by requiring safer and better construction, and hence the public may rightly require a good degree of safety in the construction…*"

Rules 101, 201, and 301 of the 1920 Code and later editions included either exactly or substantially the following language: "*The rules shall apply to all installations except as modified or waived by the proper administrative authority. They are intended to be so modified or waived whenever they involve expense not justified by the protection secured, or for any other reasons are impracticable; or whenever equivalent or safer construction can be more readily provided in other ways.*"

It is clear that the original codifiers intended to achieve a reasoned balance between the public's needs for both safe and economical utility service, reflecting both the expected degree of a problem and the degree of difficulty in solving the problem. That balance has been continued in the intervening years, as operating conditions have changed and new equipment and installation types have become available. Although these words no longer appear in the NESC, their effect does. The practical experience of the intervening years has led to the inclusion of more stringent requirements in some

areas and more relaxed requirements in others. As a result, the NESC is itself the compilation of design, installation, operation, and maintenance requirements that have been shown over the entire history of utility construction to be appropriate to "reduce the life hazard as far as practicable."

The NESC comprises specific actions required in recognition of specific conditions. These actions are based upon the potentially conflicting activity that is normally encountered or reasonably anticipated. For example, in all areas except those limited to pedestrians or restricted-height vehicles, the clearances above grade plan for a 4 m (14 ft) high truck (see NESC Appendix A). Vertical clearances are based upon the reference distance based on potentially conflicting activity plus the clearance building block that includes appropriate mechanical and electrical components based upon the part, conductor, or cable above the area. Where the conditions encountered in a given local situation are those specified within the NESC, the required actions constitute good practice for the specific conditions.

Where the local conditions differ in some particular way from those specified in the NESC, it is the responsibility of the appropriate party to recognize the differences in conditions with actions that constitute good practice under such differing conditions. Such practice may be reflected in the design of the installation, the construction practices, the maintenance practices, the operating practices, or some combination of the above, as applicable for the given local conditions. An example of such an area is a lumber yard, where fork lifts are normally encountered or reasonably anticipated with vertical extensions exceeding a 4.0 m (14 ft) truck. In such a case, the expected height of the forklift can be added to the appropriate mechanical and electrical component from Table A-1 of NESC Appendix A to produce the appropriate clearance. However, the better way to perform the same task would be to add the difference between the expected conflicting activity and the applicable reference dimension from NESC Appendix Table A-1 (i.e., a 4.0 m [14 ft] truck in this case) to the clearance in the applicable table, thus recognizing the difference in conditions. The result is the same, but it avoids any problem with pulling the wrong mechanical and electrical component from NESC Appendix Table A-2, which is a more complicated table than Table A-1.

It is important to note that the NESC recognizes the limitation on expected activities around electrical facilities required under federal and state regulations, Occupational Health and Safety Administration (OSHA) regulations, and high-voltage line safety acts. Those performing acts around power lines have a personal responsibility to plan and control their actions so as to avoid contact with power lines.

The rules for lines differ from those for stations. In stations, the apparatus, equipment, and wires are confined to limited areas where access is restricted to trained personnel. In these latter cases, the safeguarding of persons by (1) actual enclosure of the current-carrying parts, (2) use of barriers, or (3) elevation of such parts beyond reach is not only desirable but generally feasible.

With overhead lines, on the other hand, the wires and equipment are not confined to limited areas and, with few exceptions, are not under constant observation by trained personnel. Safeguarding by enclosure is feasible with underground lines and, in fact, is in most cases essential to operation. For overhead lines, however, isolation by elevation generally must be depended upon for the safety of persons in the vicinity. The elevations required for effective isolation of overhead lines must be greater than ordinarily would be required inside buildings; the voltages are usually higher, and the height of expected traffic is usually greater.

Practice and experience have determined reasonable limits for elevation of lines and equipment and for the necessary strength of their construction. These rules are intended to include the more important requirements from the standpoint of safety, both to the public and to utility workers. Clearance requirements are determined relative to the degree of hazard involved, and strength requirements necessary to meet the required clearances are determined by (1) the degree of safety problem presented by the installation and (2) the mechanical loads to which it is assumed the lines may be subjected.

The NESC is a performance code, not a set of design specifications. The NESC construction rules specify *what* is to be performed, not *how* it is to be accomplished. For example, to meet the vertical clearance required above a corn field, either (1) taller structures spaced farther apart or (2) shorter structures spaced closer together may be used. The NESC is indifferent to what type of structures or materials are used, as long as applicable clearances and strength requirements are met.

In essence, the rules of the NESC give the basic requirements of construction that are necessary for safety. If the responsible party wishes to exceed these requirements for any reason, he may do so for his own purpose, but need not do so for safety purposes. For example, if the combination of required pole placement and overhead clearance requirements indicated that a 11.4 m (37.5 ft) pole would be needed, a 12.2 m (40 ft) pole could be used. Because poles are inventoried in 1.50 m (5 ft) increments

for economy purposes, the additional 0.8 m (2.5 ft) of conductor attachment height would be for economy purposes; it is not required for safety. Thus, even though older editions of the Code sometimes used the word "minimum" for clearance or other requirements, the wording generally used in later editions is "not less than" to indicate the basic amount that is required for *safety* purposes.

The 1990 Code was specifically editorially revised to delete the use of the word "minimum" because of intentional or inadvertent misuse of the term by some to imply that the NESC values were some kind of minimum number that should be exceeded in practice; such is not the case. The NESC is the best information that we have available about what needs to be done for safety and what must not be done in various circumstances; it is based on the experiences of hundreds of thousands of installations located in and serving areas with a variety of conditions in a variety of ways. The NESC is *the* national standard for safety in the installation, maintenance, and operation of electric supply and communication system facilities.

Rule 010 is a general statement of the purpose of the Code; the bulk of the rules are concerned with applying this principle in detail to the various construction situations. Where a specific rule provides detailed requirements for particular conditions, the general "purpose" rule is considered to be superseded by the specific requirements.

> *NOTE:* Where an individual rule or subrule consists of an overarching paragraph and several distinctive subparts, both the overall requirements and the applicable subrequirements must be met.

The 2012 Code significantly revised the language of Rule 010 by adding "affected property" and "utility facilities" to the purpose rule as a result of a joint NESC/NEC Task Force that addressed the Purpose and Scope rules of both the NESC and the NEC to limit confusion as to which code applies in different circumstances. The 2017 Code further clarified the language by removing the verbiage "affected property" from the purpose rule due to its being vague and not fully understood.

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.
3. Utility facilities and functions of utilities that either (a) generate energy by conversion from some other form of energy such as, but not limited to, fossil fuel, chemical, nuclear, solar, mechanical, wind, or hydraulic or communication signals or accept energy or communication signals from another entity or (b) provide that energy or communication signals through a delivery point to another entity.
4. Street and area lights that provide a supply of lumens where these facilities are supplied from the line side of the service point by underground or overhead conductors maintained and/or installed under the exclusive control of utilities (including their authorized contractors or other qualified persons).
5. Utility facilities and functions on the line side of the service point supplied by underground or overhead conductors installed and/or maintained under exclusive control of utilities located on public or private property in accordance with legally established easements or rights-of-way, contracts, other agreements (written or by conditions of service), or as authorized by a regulating or controlling body.

NOTE: Agreements to locate utility facilities on property may be required where easements are either (a) not obtainable (such as locating utility facilities on existing rights-of-way of railroads or other entities, military bases, federal lands, Native American reservations, lands controlled by a port authority, or other governmental agency) or (b) not necessary (such as locating facilities necessary for requested service to a site).

6. Wiring within a supply station or in an underground facility that is (a) installed in accordance with Part 1 or Part 3 of this Code and maintained under the exclusive control of utilities and (b) necessary for the operation of the supply station or underground facility.
7. Utility facilities installed, maintained, and controlled by utilities on surface or underground mine sites, including overhead or underground distribution systems providing service up to buildings or outdoor equipment locations on the line side of the service point.
8. Similar systems to those listed above that are under the exclusive control of qualified persons and authorized by a regulating or controlling body, including those associated with an industrial complex or utility interactive system.

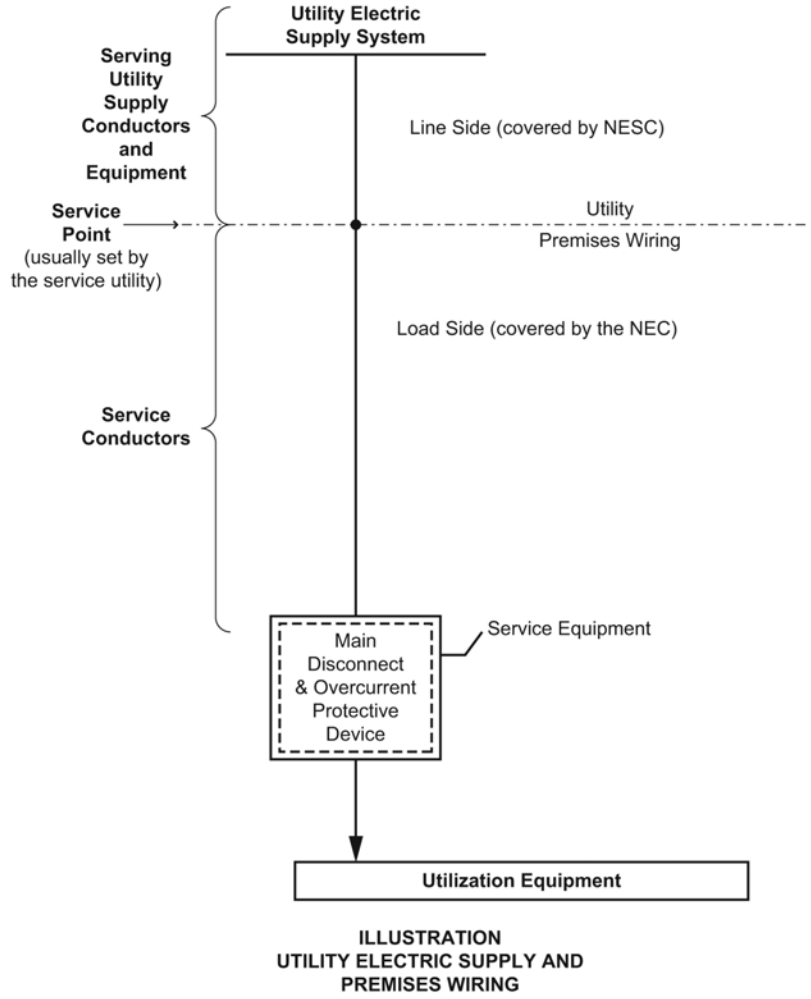


Figure 011-1—Service point—General illustration of what is covered and not covered by the NESC

B. Not covered

See Figure 011-1.

NESC rules do not cover:

1. Utilization equipment or premises wiring located beyond utility service points to buildings or outdoor installations, or
2. Underground mine wiring or installations in ships, railway rolling equipment, aircraft, or automotive equipment, or
3. Luminaires not installed or maintained under exclusive control by utilities, or
4. Industrial complex or utility interactive systems that are not controlled exclusively under utilities or qualified persons or are located on the premises wiring side of the service point.

NOTE: The National Electrical Code® (NEC®) (NFPA 70®, 2011 Edition) covers utilization wiring requirements beyond the service point and luminaires that are not controlled exclusively by utilities.[1]

C. Types of requirements

1. These rules specify:
   a. Loadings and factors related to required strength of utility structures and supported facilities;
   b. Clearances and spacings between: (1) facilities of different utilities, (2) facilities of same utility, and (3) utility facilities and public facilities;
   c. Grounding; and
   d. Other requirements related to the safeguarding of persons and facilities, including associated safe work practices, to be employed by a utility in the exercise of its function as a utility up to the service point.
2. Utilities operating under the NESC are required to maintain control over the system up to the service point such that:
   a. The system is designed to meet the requirements of specified conditions, and
   b. The personnel installing, maintaining, and operating the system and its components are qualified to do so, are adequately supervised, use appropriate tools, and follow safe work procedures.

Rule 011. *(This rule was formed in 1981 from previous Rules 101, 201, and 301.)*

This rule details the coverage of the NESC. The Code covers supply and communication lines, equipment, and associated work practices employed by a *public* or *private* electric supply, communications, railway, or similar utility in the exercise of its function as a utility. The NESC no longer covers electric fences, radio installations, or utilization equipment [see the National Electrical Code® (NEC®)] except as covered in Part 1 or Part 3. It does not cover mines, ships, aircraft, automotive equipment, or railway rolling stock. (Refer to the edition of the NEC called out in the applicable edition of the NESC.)

The difference between the facilities involved in the *utility* function (covered by the NESC) and those involved in the *utilization* function (covered by the NEC) was amplified in the 1990 Code. This language was again revised in the 1993 Code to clearly state that these requirements apply to *public* and *private* utility systems.

In the 1980s and early 1990s, electricians started a controversy over whether area lights installed by an electric utility and fed off the distribution system could only meet the NESC or had to meet the NEC. Such installations have always been covered by the NESC and exempted from the NEC. The 1996 NEC revised its Article 90-2(b)(5) to exclude lighting associated with an electric distribution system that is under the exclusive control of an electric utility and is located on or along public highways, streets, roads, etc., or outdoors on private property by established rights such as easements. As a practical matter, customers generally grant either specific or "blanket" easements to utilities when applying for area lighting. If the electrical system feeding the lighting comes directly off the utility distribution system, it is clear that the NESC applies to such installations. However, if the lights are fed off the customer service entrance equipment, or if the customer has access to a switch to control the lightning, the NEC will govern. This was clarified in Rule 011C of the 2002 NESC.

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

Both the NESC and the NEC cover some equivalent facilities, such as service drops, because they could be maintained by the customer or the utility. Depending upon local ordinances, if the installation is under qualified control (such as in some large industrial and large commercial complexes), the utility delivery system portion of such installations would be entirely under the NESC until such point as they connected to the utilization wiring system (such as at a building weatherhead on an aerial service), at which point the NEC would take over.

> *Historical NOTE from Editor Allen Clapp:* The utility functions of private utilities have always been covered by the NESC since its inception. Ralph M. Lee, my predecessor as chair of the NESC, was employed by DuPont and nationally recognized as an expert in application of the NESC to the internal generation and distribution of power (and signals) in large industrial plants, as well as an expert in appropriate safety rules for work on distribution and transmission voltage systems. Mr. Lee is the foremost example of many employees of large industries who have (1) designed, constructed, operated, and maintained their private utility facilities to meet the requirements of the NESC, (2) regularly contributed to the scientific improvement of safe utility system designs and work methods, and (3) contributed to the improvement of the NESC throughout its history.

In 2002, the NESC added an explanatory note under Rule 011B referencing the *service point* as the point where the NEC picks up from the NESC. The service point (point of delivery) between the NESC- and the NEC-covered facilities is easy to determine for overhead service. The connectors form the service point between the NESC-covered utility service drop conductors and the NEC-covered premises-wiring service entrance conductors located at the weatherhead. The NEC allows the NESC-covered utility meter to be located in the NEC-covered service entrance conductor run and, in a fine print note (FPN), exempts the metering from NEC application.

In an underground service, the underground service cable can be under either code, depending upon ownership and control. In a typical installation where the utility installs the service drop cable underground from the transformer (or underground secondary bus cable) to the building and brings it up to the meter base, the service drop is covered by the NESC. If the customer ran the cable from the building out to the utility transformer *and maintained ownership and control over the service drop*, the NEC would govern. In some situations, the customer's electrical workers will initially install the underground service cable out to a utility transformer pad and the customer will transfer ownership to the utility which will own, control, and maintain the service drop from then on. In such cases, the NESC applies.

The 2012 Code significantly revised the language of Rule 011 to more fully reflect the practical scope of the NESC that has existed since its inception. These revisions were the result of considerations by a joint NESC/NEC Task Force that addressed the Purpose and Scope rules of both the NESC and the NEC to limit confusion as to which code applies in different circumstances. By fleshing out the language of each of the codes with more detail about the respective scopes, each of the codes will aid its users in better understanding the differences in intended application.

The NESC addresses utility system installations under the exclusive control of utilities. The NEC addresses utilization wiring and premise wiring systems, as well as other systems not under the exclusive control of a utility.

Part of the confusion results from the fact that both codes must address certain types of facilities and installations, because those facilities might be under the exclusive control of a public or private utility in one instance (in which case, the NESC applies) and might *not* be under exclusive control of a utility in another instance (in which case, the NEC applies).

For example, consider the question of whether the NESC or the NEC applies to service drops in a situation in which a utility secondary cable runs from a line pole out at the road to a center pole in a farm yard and individual service drops run from the center pole to each barn or other building. If the utility installs and maintains the service drops under its exclusive control, the NESC applies to the service drops. However, if the center pole is a meter pole and the farmer runs service drops to the farm buildings, those service drops are not under exclusive utility control and the NEC applies to the service drops.

Similarly, if a utility installs and maintains area lighting under its control, the NESC applies. However, if the customer requests that 120 V outlets be placed at the base of each luminaire structure to allow the use of electric weed trimmers, etc., the system is not under exclusive control of a utility and the NEC applies.

The 2012 Code language revisions also recognized that provision of lumens from luminaires is different from provision of electricity; the systems for each are subject to NESC requirements if under the exclusive control of a public or private utility and on the line side of the *service point*. Extensive

revisions, including lists of applicable utilities and facilities and a new Figure 011-1 were added to Rule 011 to clearly indicate what is covered by the NESC and what is not covered by the NESC to help limit confusion between the codes. These revisions are not changes in scope; rather, they are clarifications to answer questions that have arisen in the past few years. The 2017 Code further clarified that the NESC applies to underground and overhead facilities located on the line side of the service point under exclusive control of utilities.

The 2017 Code modified Rule 011A3 in response to IR 572 issued 28 May 2013 to clearly show that solar and wind farm generation under exclusive control of a public or private utility are included along with more traditional forms of generation in the scope of the NESC.

012. General rules

A. All electric supply and communication lines and equipment shall be designed, constructed, operated, and maintained to meet the requirements of these rules.

B. The utilities, authorized contractors, or other entities, as applicable, performing design, construction, operation, or maintenance tasks for electric supply or communication lines or equipment covered by this Code shall be responsible for meeting applicable requirements.

C. For all particulars not specified, but within the scope of these rules, as stated in Rule 011A, construction and maintenance should be done in accordance with accepted good practice for the given local conditions known at the time by those responsible for the construction or maintenance of the communication or supply lines and equipment.

Rule 012. *(This rule was formed in 1981 from previous Rules 102, 200, 201, 202, 210, 211, 300, 303, 310, and 311.)*

Rules 012A and 012C were in one paragraph until Rule 012B was added in 1993. The required construction is intended to be in accordance with good practice and, indeed, to set a standard of good practice in many respects: see Rule 012A. Safety is promoted by uniformity in practice; this, in turn, tends to avoid confusion and misunderstanding, both in construction and operation.

It is not sufficient to provide only against possible hazards in new construction. Deterioration in materials of construction makes it essential that adequate safety be preserved by inspection and maintenance. Certain rules in Section 26 specify quantitatively the amount of deterioration permissible before replacement but, in general, this must depend upon the good judgment of those in charge. This subject is further considered in Rule 214.

When Rule 012 was created in the 1981 Code from prior similar rules located in the different parts of the Code, it was specifically reworded to the current language to remove references to "conditions under which the line is to be operated." The previous language had been misinterpreted by some to mean that utilities, as agents of the ratepayers, were required to provide clearances for any activity that could possibly occur. It must be recognized that it is not only impractical but absolutely impossible to provide special clearances or other construction for every location where it is *possible* for a negligent or impaired human to contact a utility installation with a vehicle or with a crane, antenna, metal ladder, extended paint-roller handle, irrigation pipe, portable conveyor, or other special apparatus. See additional discussion under Rule 010.

The 1997 Code further clarified this issue in Rule 012C by requiring good practice for the *conditions known at the time* by those responsible for the construction or maintenance of the communications or supply lines and equipment. In essence, if the utility has knowledge that a condition not specified in the Code will be normally encountered or is reasonably anticipated, the utility should use good practice to reflect the differences (if any) in those conditions and those specified in the Code. On the other hand, the utility cannot be expected to be clairvoyant.

The requirements of the NESC apply to the entity performing the work. Rule 012B recognizes that many public and private utilities contract with another party to perform some or all work, often including supervision and inspections, relating to a particular job. Although recognized by the codifiers for decades, the responsibilities of contractors (rather than owners or operators in many cases) to meet NESC requirements was explicitly stated for the first time in the 1993 Code.

The 2017 Code clarified that Rule 012C applies to particulars not specified in the NESC but within the scope of the Code that is stated in Rule 011.

013. Application

Rule 013. *(This rule was formed in 1981 from previous Rules 102, 202, and 302).*

A. New installations and extensions

1. These rules shall apply to all new installations and extensions, except that they may be waived or modified by the administrative authority. When so waived or modified, safety shall be provided in other ways.

   EXAMPLE: Alternative working methods, such as the use of barricades, guards, or other electrical protective equipment, may be implemented along with appropriate alternative working clearances as a means of providing safety when working near energized conductors.

2. Types of construction and methods of installation other than those specified in the rules may be used experimentally to obtain information if:

   a. Qualified supervision is provided,

   b. Equivalent safety is provided, and

   c. On joint use facilities, all affected joint users are notified in a timely manner.

Rule 013A. Rule 013A directly recognizes that *if* there is a controlling authority such as a state public utility commission, such authority *may* have the right to waive or modify NESC rules in their jurisdiction. The provisions now found in Rule 013A have changed over the years as more specificity has been added in the NESC as to expected actions under various conditions. For example, the limits imposed on clearances and strengths of emergency and temporary installations are now specified in Rule 14 and Rule 230A. The requirements of the NESC have been well planned to consider the full effects of these actions under the specified circumstances; Rule 013A1 thus requires equivalent safety to be achieved using other methods, systems, work methods, etc., when an NESC rule is modified by an administrative authority. The *EXAMPLE* was added in the 1993 Code.

Rule 013A2 is not intended to allow a utility system operator to disregard these rules. It recognizes the need for experimentation with new methods, systems, etc. It requires qualified supervision. The 2002 Code required equivalent safety and agreement between all parties involved for experimentation to occur in or on a facility.

The 2012 Code revised Rule 013A2c to *notify* all *joint-users* in a timely manner when experiments will be performed on joint-use facilities. Agreement is no longer required, as a result of issues relating to competitors being able to delay each other for reasons other than safety. Notification allows a joint user who believes that it may be adversely affected in the way of safety to work with the experimenting utility to limit adverse safety impacts.

B. Existing installations

1. Where an existing installation meets, or is altered to meet, these rules, such installation is considered to be in compliance with this edition and is not required to comply with any previous edition.

2. Existing installations, including maintenance replacements, that currently comply with prior editions of the Code, need not be modified to comply with these rules.

   EXCEPTION 1: For safety reasons, the administrative authority may require compliance with these rules.

   EXCEPTION 2: When a structure is replaced, the current requirements of Rule 238C shall be met, if applicable.

3. Where conductors or equipment are added, altered, or replaced on an existing structure, the structure or the facilities on the structure need not be modified or replaced if the resulting installation will be in compliance with either (a) the rules that were in effect at the time of the original installation, or (b) the rules in effect in a subsequent edition to which the installation has been previously brought into compliance, or (c) the rules of this edition in accordance with Rule 013B1. When an existing installation is brought into compliance with a subsequent edition, earlier editions no longer apply.

4. For structures that currently do not comply with Rule 013B3, if adding a new item, or replacing or rearranging existing items would not in itself, either (1) create a structural, clearance, or grounding non-conformance, or (2) worsen an existing non-conformance, then the addition, replacement, or alteration may be performed prior to correcting existing non-compliance items. For existing non-compliance items, see Rules 214A4 and A5.

Rule 013B. If the existing installation is old enough, the Code edition in effect at the time of the original construction may no longer be allowed to apply. (Before the addition of the so-called *grandfather clause* in the 1970s, each new edition required all existing installations to meet the new edition or be guarded—which effectively made it meet the new edition.) Further, if a later edition has been applied to an existing installation, the earlier edition has effectively been removed from the available choices, because the intention is to move forward in application, not backward.

As increased experience with supply and communication installations has matured the Code over the years, and as formerly nonconforming installations have been retired or replaced, the Code requirements relating to reconstruction of facilities have reflected these changes. For example, Rule 201B (Realization of intent) of the 1968 Code and prior editions indicated that the new rules should be applied "in full to all new installation, reconstructions, and extensions, except where for special reasons any rule is shown to be impracticable or where the advantage of uniformity with existing construction is greater than the advantage of construction in conformity with" the new rules. The obvious intention was to discontinue outdated construction practices and to apply the new Code when adding or altering conductors or equipment, except in special cases. As in previous editions, the 1968 Code continued the use of Rule 201A (Intent, modification), which stated the intention that the rules should be "modified or waived whenever they involve expense not justified by the protection secured or for any other reasons are impracticable; or whenever equivalent or safer construction can be more readily provided in other ways." See the discussion of Rule 010.

One of the reasons for the particular wording of old Rules 201A and B (and the similar rules in the other parts) was that lines that dated from the pre-Code era still existed in many areas of the country. As a result, essentially all overhead facilities built before the 1977 Code should be expected to be in conformance with the requirements of the 1968 Code.

The revision of Part 1 (Installation and Maintenance of Electric Supply Stations and Equipment) in the 1971 Code required application of the rules "in full to all new installations, alterations, reconstructions, and extensions." In short, the new edition was intended to apply to any installation that was not limited to maintenance replacement, except that this was the first revision that allowed the so-called *grandfather clause* to be applied to existing electric supply station installations when the code edition changed (see Handbook Appendix E).

When the 1973 Code created Part 3 (Installation and Maintenance of Underground Electric Supply and Communication Lines), it also added a grandfather clause for underground lines. Similarly, the 1977 Code added the grandfather clause for overhead lines (see Handbook Appendix E).

The revision of Part 2 in the 1977 Code recognized the maturing character of the utility industries. Although Rule 202B of the 1977 Code continued to use language similar to that of old Rules 201A and 201B, the 1977 Code restricted the use of waivers with Rule 0601813801202C (Waiver), which only allowed waiver "in cases of emergency, temporary installations, or installations which are soon to be discarded or reconstructed…"

In the 1981 Code, the applicability rules of the various parts of the NESC were consolidated into a new Section 1 (Introduction to the National Electrical Safety Code) and several word changes were made. In Rule 013A, the successor to old Rule 202B1, the word "reconstruction" was dropped; this word had only caused confusion between maintenance replacements (which are not intended to be required to be subject to a new code provision) and new installations and extensions (which are subject to new code requirements). In Rule 013B, the successor to old Rule 202B2, a new paragraph 013B2 was added.

Rule 013B3 (Rule 013B2 of the 1981–1987 Codes) was intended to state the intention of the Code with respect to *other* facilities when conductors or equipment of the Code are added, altered, or replaced on an existing structure. This entire area of the Code was editorially revised in the 1990 Code to clearly indicate the requirements that have been intended since 1977. Rule 013B1 now reflects that the latest edition contains the best knowledge of appropriate requirements. If an installation meets the present requirements, it is acceptable—regardless of what provisions may have been in effect at the time of its construction. Thus, when work on an existing structure is completed, it may meet the current edition requirements or those of a previous applicable edition.

The addition of new facilities does not require changing the existing line facilities, as long as the existing facilities (including the structure itself), *after the new addition*, still meet the strength, clearance, and other requirements of an earlier edition of the Code that is applicable *even if the existing facilities do not meet present code requirements*. However, if for example, the structure or the supply conductors would not, after the addition of communication cable, meet the grade of construction and strength requirements of the edition of the Code that was in effect at the time of their installation, the addition would not be allowed. If a problem exists in obtaining required clearances from existing facilities, nonconforming existing facilities may be moved on the existing structure. If the latter is the case, the modification is required to meet the Code requirements of the applicable edition unless the structure is replaced with a larger, stronger, or taller unit (see below).

The language of Rule 013B3 was carefully chosen to require that the *resulting installation* meet the applicable edition whenever conductors or equipment are added, altered (rearranged), or replaced on an *existing structure*. The two key issues are:

(1) The rule only applies whenever an existing structure is being modified by the addition or replacement of conductors or equipment or facilities on an existing structure are being moved around (such as moving a neutral up or communication cable down to accommodate another communication cable). If a new structure is required to provide the necessary strength or clearances, Rule 013A applies and the current edition must be used. If an existing structure is being replaced as a maintenance replacement under Rule 013B2 as a matter of convenience while the other work is being performed, the previously applicable edition may still be used for the resulting installation.

(2) When the work is complete, the entire *resulting installation* must meet the applicable edition of the NESC.

This language was added to address two issues. First, one code edition must be used for the whole structure, including all of its supported facilities; installers cannot selectively pick code provisions from different editions.

Second, the whole installation needs to be inspected for potential problems, such as conductors with excess sag/pulled too tight or out of place, broken insulators, loose guys, etc., that might affect code compliance and present a potential safety hazard to public personnel around the installation or the next workers on the installation. This requirement is a complement of Rules 121A, 214A2, and 313A2, as well as Rule 230I, and it helps to limit the opportunity for changes or damage that occur after initial installation to cause a later problem.

If the existing structure is replaced in kind, regardless of the reason, it is generally considered maintenance; it may be replaced without affecting other existing facilities, if the resulting installation would conform to the applicable edition of the Code. Existing transformers may be replaced with larger transformers if the strength requirements of the applicable Code edition are met. The fact that several structures or other installations within an existing line or section are replaced at one time does not negate this allowance, except that Rule 202 requires a replaced structure to meet the current edition of Rule 238C.

However, replacement with stronger, larger, or taller units to meet strength or clearance requirements related to an addition(s) to the structure(s) is not considered maintenance and, therefore, requires conformance to the current Code requirements. Existing facilities may be rearranged on an existing or maintenance replacement structure as long as they meet the requirements of the applicable edition.

A frequent question concerns the appropriate edition for facilities that are temporarily relocated for highway reconstruction work. If trenches are dug beside the poles and the pole butts are kicked over to the new location, the previously applicable edition applies; if new structures are used, the current edition applies.

This rule plainly states the intentions of the Code with respect to application of new or revised rules to existing installations. It should be stressed that, in general, the edition of the NESC that is applicable to a given installation is the edition that was in effect at the time of construction (see Rule 016). In later years, a subsequent edition will be applicable if the facilities are “upgraded.” A change of voltage of an existing line does not affect the applicable edition unless the change cannot be made under the applicable older edition; if the structures need to be changed out to accommodate the voltage change, the current edition would then apply. The utility always has the option of meeting current requirements, whether current requirements are the same, greater, or lesser than those in effect at the time of original construction or a subsequent applicable edition.

In the 1993 Code, the word *currently* was added to Rule 013B2 to eliminate confusion with the so-called "grandfathering" of existing installations. See the discussion of Rule 230I and Handbook Appendix E for more detail.

The intention of the Code is that good practice be met for the conditions in place. For example, the designer of a line crossing a roadway can either install the line with enough extra clearance to allow for future road resurfacing or can plan to raise the line when the resurfacing occurs. A line over water must meet the requirements for sailboat clearances, if sailing is expected. If such a line originally was over pasture land that is now flooded, and the original structures were tall enough to allow the installation to meet good practice for sailboating areas, the previously applicable edition can remain applicable if so desired. Otherwise the structure would need to be changed out to meet the present edition.

Interpretation Request 548 issued 26 March 2009 reinforced the discussion of the intent of *resulting installation* given above and also addressed whether planned work can be performed before an identified noncompliant facility is corrected. Rule 013B3 was amended in the 2017 Code to clarify that such work can only be performed before correction of the noncompliant defect or condition if (1) it would not make the original noncompliance worse or create a new noncompliance and (2) the identified noncompliance was not a structural issue of a significant nature. If the identified problem is a significant structural issue, it must be corrected before the planned work is performed. In the 2017 Code, Rule 013B3 was also modified in response to IR 548 to clearly indicate that, when an installation is brought into compliance with a later edition of the NESC, the provisions of the later edition then apply and any previous edition to which the installation may have earlier complied no longer applies.

C. Inspection and work rules

Inspection rules and work rules in the current edition of the NESC shall apply to inspection of or work on all new and existing installations.

Rule 013C. The 2007 Code added this rule to clarify which inspection rules and work rules apply to both existing and new facilities. Rule 013A requires the use of the current edition for physical construction attributes of new facilities. Rule 013B1 allows the current edition to be used for the physical construction attributes of existing facilities built before the current edition, if so desired, but it does not mandate using the current edition. Rule 013B3 allows a choice of the current edition or the previously applicable edition for the physical construction attributes when adding, altering, or replacing facilities on existing installations. However, regardless of which edition of the NESC is being used for the physical construction requirements (such as location, clearances, grounding, loadings, strengths, etc.) against which existing facilities are inspected, the inspection requirements contained in the current edition shall be used to determine the responsibilities of the utility(ies) involved. Similarly, the work rules in the current edition must always be used, regardless of whether the work is on an existing or new installation. The grandfather clause of Rule 013B2 applies only to the physical attributes of the installations, not to the inspection or work methods.

014. Waiver for emergency and temporary installations

The person responsible for an installation may modify or waive rules in the case of emergency or temporary installations.

A. Emergency installations

1. The clearances required in Section 23 may be decreased for emergency installations. See Rule 230A.
2. The burial depth requirements in Part 3 may be waived for the duration of the emergency. See Rule 311C.
3. The strength of material and construction for emergency installations shall be not less than that required for Grade N construction. See Rule 263.
4. Emergency installations shall be removed, replaced, or relocated, as desired, as soon as practical.

B. Temporary overhead installations

When an installation is temporary, or where facilities are temporarily relocated to facilitate other work, the installation shall meet the requirements for non-temporary installation except that the strength of material and construction shall be not less than that required for Grade N construction. See Rule 263.

Rule 014. *(This rule was formed in 1981 from previous Rules 102, 202, and 302.)*

Although earlier editions of the Code allowed waivers to be given for the use of different construction requirements than those in the Code, the 1977 Code and later editions have specifically limited waivers to emergency or temporary installations. Before the 1977 Code, the Code was updated on a sporadic basis and an expanded waiver allowance was appropriate. However, with the maturation of the Code and its scheduled, frequent revisions, such waiver is no longer appropriate. Rule 013A2 allows experimentation; if the results are favorable and convincing, it is expected that such methods or conditions would be recognized by the Code as part of the frequent revision process.

In the 1990 Code, the limits of the waiver authority given under both emergency and temporary conditions were completely specified.

In both emergency and temporary conditions, strengths are required to meet Grade N. This recognizes that these installations are not expected to be in place long enough for significant deterioration to occur. In some cases, seasonal design loadings may not be expected. Grade N requires consideration of the loadings that are expected to occur during the life of the installation.

In *emergency* installations only, certain clearances are allowed to be reduced during the term of the emergency. The reduced clearances are specified for cables and for open supply conductors of 0–750 V. For *temporary* installations, no decrease in clearances is allowed.

Specifications for the reduced clearances allowed during emergencies were added in the 1990 Code; they were moved to Rule 230A in the 1993 Code. For open conductors above 750 V, the utility is allowed some flexibility; Rules 014A1b and 014A1c allow unspecified reductions, but *appropriate recognition to the difference in voltage* is required. This recognizes that the safety afforded by traffic signals and highway lighting during emergency times is often so great that it is worth the short-lived clearance changes to decrease the time required to reinstate these services.

The 2012 Code specifically allowed a waiver of burial depth requirements for underground cables during the term of an emergency, thus matching provisions in the existing Rules 230A2d and 311C.

015. Intent

A. The word “shall” indicates provisions that are mandatory.

B. The word “should” indicates provisions that are normally and generally practical for the specified conditions. However, where the word “should” is used, it is recognized that, in certain instances, additional local conditions not specified herein may make these provisions impractical. When this occurs, the difference in conditions shall be appropriately recognized and Rule 012 shall be met.

C. Footnotes to a table are designated by a circle surrounding the footnote number. Footnotes to a table have the same force and effect that is required or allowed by the rule that specifies the use of the table.

D. The word “*EXCEPTION”* indicates a specified option that may be substituted for one or more of the requirements stated in the rule or table, at the option of the utility. *EXCEPTION*s to a rule have the same force and effect that is required or allowed by the rule to which the *EXCEPTION* applies.

*NOTE: EXCEPTION*s recognize alternatives to generally applied requirements that are safe under the specified conditions. In some cases, an *EXCEPTION* may merely be a less frequently used safe option that may be preferable under the particular constraints of the site or work.

E. The word *“RECOMMENDATION”* indicates provisions considered desirable, but that are not intended to be mandatory.

F. The word *"NOTE"* or the word *"EXAMPLE"* used in a rule indicates material provided for information or illustrative purposes only. *NOTE*s and *EXAMPLE*s are not mandatory and are not considered to be a part of Code requirements.

G. A *RECOMMENDATION*, *EXCEPTION*, or *NOTE* applies to all text in that rule above its location that is indented to the same level.

Rule 015. *(This rule was formed in 1981 from previous Rules 102, 202, and 302.)*

This rule clarifies the intent of the use of "shall," "should," "*RECOMMENDATION*," "*NOTE*," and "*EXAMPLE*."

The difference between a "shall" requirement and a "should" requirement is, in essence, the difference between "possible" and "practical." For a "shall" requirement, the requirement is expected to be met in all specified conditions. A "should" requirement recognizes that the requirement may not be practical in all cases; it is intended to be mandatory where practical. Where a "should" requirement is not practical, the installation should be designed, installed, and maintained in a manner that is consistent with the prevailing conditions and in accordance with Rule 012. The 2002 Code clarified that *EXCEPTION*s have always been intended to have the same force and effect as the main rule. Similarly, footnotes to tables are an integral part of the table. It is only *NOTE*s to rules and *EXAMPLE*s to rules or tables that are purely informative and not considered to be part of the code.

The 2012 Code added explanatory information about footnotes in tables and *EXCEPTION*s.

016. Effective date

This edition may be used at any time on or after the publication date. Additionally, this edition shall become effective no later than the first day of the month after 180 days have elapsed following its publication date for application to new installations and extensions where both design and approval were started after the expiration of that period, unless otherwise stipulated by the administrative authority. *EXAMPLE:* If the NESC is published on August 1, 2016, then it will become effective on February 1, 2017.

NOTE: A period of not less than 180 days is allowed for utilities and regulatory authorities to acquire copies of the new edition and to change regulations, internal standards, and procedures as may be required. There is neither an intention to require or imply that this edition be implemented before 180 days from the publication date, nor an intention to prohibit earlier implementation.

Rule 016. *(This rule was new in 1981.)*

This rule recognizes that the design and approval processes may be so lengthy for major facilities that it is impractical to make a change in design or construction in response to a revision of the NESC. Obviously, where responsive changes can be made before construction without undue burden, they should be made, but it must be recognized that they are not required if either design or approval was started before the effective date of the revision. This rule was initiated in the 1981 Code. The 180-day period before the effective date recognizes that a time lag is often required to obtain copies of the new editions, review standards, train workers, and implement the change. Previously no effective date was specified.

The 2012 Code relieved the user from having to calculate exact dates by moving the effective date to the first day of the month after the 180-day period has expired. It also prevented the often-asked question of whether the effective date was the 180th day or the 181st day (it is the next day after the 180 days, including the issue date, expired). This will be especially helpful if the Code is ever issued on a different date.

The new editions of the Code have always been intended to be able to be used when they are issued. The rule was revised in the 1990 Code to clarify that a new edition *may* be used on and after its publication date, but is not required to be used until the 180-day grace period has elapsed. On occasion, a greater lag time is given to allow for full implementation; such was the case with the cable-marking requirements of Rule 350G of the 1993 Code, which were initially delayed until 1 January 1994**,** and subsequently delayed until 1 January 1996.

Table H16-1 shows the publication dates and effective dates of various editions of the NESC. Many early editions were revised piecemeal; that is, individual Parts were issued when revised, rather than waiting until all were revised. This table omits the dates of the several National Bureau of Standards handbooks that reprinted the various parts of editions in groups.

Table H016-1 Effective Dates

Parts	Code	Publication Date	Effective Date
Work Rules	1	1 Aug 1914	NS*
1–4	2	15 Nov 1916	NS
1–4	3	31 Oct 1920	NS
1	4	5 Feb 1926	NS
2	4	15 Apr 1927	NS
3	4	12 Mar 1926	NS
4	4	15 July 1926	NS
5	4	15 July 1926	NS
1	5	8 May 1940	NS
2	5	23 Sep 1941	NS
3	5	23 Jan 1940	NS
4	5	13 Oct 1938	NS
5	5	1 Dec 1939	NS
6	5	17 Apr 1940	NS
2 only	6	1 Nov 1961	NS
2 (Supp. 1)	6	15 Dec 1965	NS
2 (Supp. 2)	6	Mar 1968	NS
3, 5, 6	Deleted	1970	NS
1	(6) 1971	Jun 1972	NS
3,† 4	1973	20 Jul 1973	NS
2	1977	28 Feb 1977	NS
1–4	1981	5 Sep 1980	180 days
1–4	1984	26 Sep 1983	180 days
1–4	1987	1 Aug 1986	180 days
1–4	1990	1 Aug 1989	180 days
1–4	1993	1 Aug 1992	180 days
1-4	1997	1 Aug 1996	180 days
1-4	2002	1 Aug 2001	180 days
1-4	2007	1 Aug 2006	180 days
1-4	2012‡	1 Aug 2011	180 days (1 Feb 2012)

*This is the year that underground rules moved from Section 29 to Part 3. The previous Part 3 had been title Utilization Wiring; those requirements are now contained in the National Electrical Code (NEC).

†1,2 not specified.

‡The 2012 Edition changed the effective date to the first day of the month after 180 days from the date of publication.

017. Units of measure

A. Numerical values in the requirements of this Code are stated in the metric system and in the customary inch-foot-pound system. In text, the metric value is shown first with the customary inch-foot-pound (inside parentheses) following. Extensive detailed tables are duplicated. The first, marked **m**, contains metric (SI) values; the second, marked **in**, **ft**, or **lb**, contains the inch-foot-pound values. Tensions and wind loads are stated in newtons, the SI unit of force.

The SI values and the customary inch-foot-pound values are not, nor are they intended to be, identical measures. The values shown in each system of measurement have been rounded to convenient

numbers in order to simplify measurement and to minimize errors. The values shown in each system are functional equivalents for safety purposes.

The values required in this Code have been carefully developed and evaluated to ensure that the intended levels of safety are provided in both systems; neither is distinguishable from the other for safety purposes. The values specified in either system of measurement may be used, or the values of the two systems may be intermixed, as desired.

NOTE 1: Le Système Internationale d'Unités (The International System of Units [or SI] in the modern version of the metric system). For basic information and conversion factors, see IEEE/ASTM SI 10™-2010 [B31].[2]

NOTE 2: It is recognized that many equivalent utility system components may be purchased in both SI and customary units.

B. Unless dimensions are specifically stated in this Code, the dimensions of physical items referenced in this Code, such as wires, are "nominal values" assigned for the purpose of convenient designation. Due to manufacturing limitations or other restraints, other standards may set tolerances, variations, or ranges for the dimensions of such items.

Rule 017. *(This rule was new in 1984.)*

Metric values were introduced in the 1984 Code for information only; the customary inch-foot-pound values governed with respect to rule requirements until 1990, when either system was allowed to be used. The metric values are not identical equivalents to the customary values; the metric values have been rounded to provide convenient working numbers.

In the 1993 Code, the intention of Rule 017B was originally clarified to indicate that the required dimensions of items such as ground rods be considered to be nominal dimensions, and that the tolerances allowed by applicable standards are acceptable by the Code. During that revision cycle, existing standards for ground rods were considered and the dimensions were found to be appropriate for utility grounding. However, at a later date, NEMA GR-1 was revised to allow lesser dimensions of ground rods. As a result, the grounding rules were revised in the 2007 Code to specifically state dimensional requirements and the language of this rule was also revised to delete the reference to ground rods and apply *nominal values* only to dimensions not specified in the NESC.

The 1997 Code reversed the order of the values to put metric first, but either may still be used.

018. Method of calculation

Where calculations are required by these rules, the resultant value shall be rounded off to the nearest significant digit, unless otherwise specified in the applicable rule(s).

Rule 018. *(This rule was new in 2007.)*

In 2007, a coordinated effort was made to use values with appropriate decimal places in rules, tables and calculations. Each of the areas of the NESC was reviewed and appropriate requirements were placed therein. For example, the results of calculations required by the overhead clearances rules in Section 23 must be rounded up to specified digits. If there is no specific requirement for rounding the results of calculations required by the NESC in a particular rule or section, the result is now required by Rule 018 to be rounded off to the nearest significant digit.

[2]The numbers in brackets correspond to the numbers in the bibliography in Appendix E.

Section 2.
Definitions of special terms

Section 2 contains definitions for terms and words applicable to the NESC. The terms are used in the Code to name or describe facilities or activities that are associated with electric supply and communication utilities. For example, to people outside the utility industry, the word *vault* usually means a secure room in a bank or large jewelry store that is used to store money, valuable records, or jewels and gold. In the electric supply and communication utility world, a vault is also a room, but it is usually underground and contains electric supply equipment and cables or communication cables and equipment.

The following list summarizes significant revisions and additions for this section:

(1) Before 1970, the Code included requirements relating to radio installations and included a definition of antenna conflict. This definition was carried forward in later editions as a result of an editing error. The Code was not specific about clearances or other construction requirements relating to antennas. Because the definition served no purpose, it was removed.

(2) This section includes several definitions relating to voltage. Unless otherwise indicated, the term *voltage* as used in the Code refers to root-mean-square (rms) voltage. Where crest voltage is specified, such as in the calculation of alternate clearances under Rule 232D, a voltage value of 1.414 times the rms value is intended to be used. Most of the tables in the Code use phase-to-ground voltages. Where circuits are not effectively grounded, the highest nominal voltage available between any two conductors is to be used. For example, if a 19.9/34.5 kV three-phase circuit is effectively grounded, 19.9 kV would be used in the tables; otherwise, 34.5 kV is to be used. The rules use nominal voltages through 50 kV to ground; above 50 kV, the maximum operating voltage is to be used.

(3) Line conductors and cables, as well as equipment, are classified as either *supply* or *communication* and are intended to be located accordingly in their respective spaces. Items not meeting the definition of a communication line are considered as supply.

(4) When fiber-optic cables began to be commonly used, they were not identified specifically as to their intended treatment. The difficulty in identifying appropriate treatment lay in the fact that, while the fibers themselves were of dielectric material and were not a safety concern from the voltage perspective, they were frequently accompanied by a metallic messenger or sheath or both, which obviously could form a path for the flow of current. Today, some fiber-optic cables have metallic “talk” pairs of ordinary, telephone type for use in trouble shooting. The wording of the definition and specific rules have been revised several times in an attempt to clarify the intended use of such systems. Although the definition of a fiber-optic supply cable would not appear to allow placement in the communication area of the pole, other rules allow treatment of fiber-optic supply as fiber-optic communication under specified conditions. In such cases, the fiber-optic supply cable cannot be placed between the supply and communication spaces on an overhead structure; any transition must occur on one structure and meet the requirements for a vertical conductor of its type. In the 1990 Code, the definitions of fiber-optic cables were revised and, in 1993, Rule 224 and Table 235-5 were revised to explicitly limit such placement. (see also Rule 230F).

(5) Definitions for **in service** and **out of service** were added in the 1993 Code to limit the opportunity for misinterpretation of Rule 214 and similar rules regarding inspection requirements.

(6) The requirements for “effectively grounded” are sometimes confused with the requirements for “multiple grounding” as used in Section 9. The multiple grounding requirements of Section 9 require not less than 4 or 8 ground connections in each 1.6 km (mile) of overhead, messenger, or underground line segment. However, the definition of effectively grounded does not depend upon a particular number of grounds but rather on the adequacy of the connected grounds and their ability to take surge current away fast enough to limit voltage buildup to required levels. Depending upon the type of electrodes used and the soil resistance, the number of ground connections required to meet multiple grounding requirements of Section 9 may be sufficient or insufficient to meet the effectively grounded definition.

(7) The 1997 Code revised the definition of **vault** to further differentiate a vault from an electric supply station. The 2002 Code further clarified the distinction between the enclosure systems. A

key requirement is limitation of access to vaults to *qualified* personnel, whereas the access to electric supply stations may also include *authorized* personnel. A main difference in the rules specifying conditions in vaults (Part 3) versus supply stations (Part 1) is that vertical clearances are *specified* for supply stations and are not specified for vaults. The requirements for guarding are similar, but less detailed in the vault rules of Part 3.

(8) Although no definition for *surge-protection wire* (or *overhead static wire)* was presented here until **shield wire/conductor** was added in 2002, there were and are definitions of supply lines and communication lines. Surge-protection wires are grounded conductors, but they are not considered to be line conductors. Many are not continuous or do not have a direct connection to a circuit or form a part thereof. However, an effectively grounded neutral line conductor can be used as an overhead shield wire. The rules specifying clearances or other requirements make this differentiation. Shield wires may, or may not, meet the multi-grounding and effective grounding that would allow them to be connected to co-function as a distribution neutral. In 2007, overhead ground wire, static wire, surge protection wire**,** and shield wire were all defined and related to each other.

(9) New definitions for ***neutral conductor*** and ***multiple grounded*****/multiple grounded system** were added in 2002.

(10) The 2002 Code redefined **de-energized** as **disconnected** and added an information note. This change was coordinated with changes in Part 4 to refer to **de-energized and grounded** to more specifically detail requirements. Merely disconnecting does not necessarily make it safe to touch.

(11) The definition of **readily climbable** was completely revised in 2002 to specify in detail what is or is not considered to be a readily climbable supporting structure. It was further revised in 2007 by defining both ***readily climbable*** and ***not readily climbable*** under ***supporting structure.***

(12) The definition of **qualified** was expanded in 2002 to require training and demonstration of knowledge.

(13) Single grounded, unigrounded, and ungrounded systems were defined in 2002.

(14) The 2012 Code added several definitions to support the revised language relating to scope and purpose of the NESC. Among them were area lighting, authorized person, exclusive control and exclusive control **of utility**, **premises** and **premises wiring (system)**, **restricted access**, **supervised installation**. Existing definitions of **service point**, **utility** (including new ***public utility*** and ***private utility***), and **utilization equipment** were also extensively revised. These definitions were prepared with the assistance of the NESC-NEC Task Force. The term **delivery point** distinguishes the point at which one public or private utility delivers energy or signals to another public or private utility from the **service point**, where the utility wiring connects to the ***premises wiring***.

(15) In 2012, a new definition of **vertical conductor** was added and the definition of **lateral conductor** was extensively revised to clarify which conductors are intended to meet rules using those terms. **Lateral conductors** are usually jumpers connecting items on a structure and may extend horizontally, vertically, diagonally, or any combination thereof. The term **vertical conductor** usually refers to a wire or cable riser attached to the structure, but it can also refer to a vertical portion of a **lateral conductor**.

(16) In 2012, the issue of what it means to be ***effectively grounded*** was clarified by revising that definition and adding a new definition of **effectively grounded neutral conductor**. To be an ***effective ground*** or to be ***effectively grounded***, the item must be *bonded to an effectively grounded neutral or to a grounding system designed to minimize hazard to personnel and having resistances to ground low enough to permit prompt operation of circuit protective devices.* The definition of an ***effectively grounded neutral conductor*** requires (a) a direct or high-impedance connection to the source transformer neutral, (b) not less than four grounds in each mile of line, and (c) sufficient size to carry the available fault current and permit prompt operation of circuit protective devices.

(17) The definition of **communication lines** was revised in 2012 to refer to those communication lines ***located in the communication space*** versus those ***located in the supply space***.

(18) The 2012 Code revised **electric supply lines** to clarify traffic signal lines of any voltage are supply lines. Signal lines of less than 400 V (which could be treated as ordinary communication) may be treated as supply lines if they are so run and operated throughout. Fiber-optic lines are always considered as communication lines, regardless of whether they are located in the supply space or communication space, but the electric supply conductors feeding light amplifiers are considered to be supply lines—unless they are (a) inside a communication cable and (b) meet the requirements allowed by the definition of **communication lines** and applicable rules.

(19) A new definition of **joint-use lines** was added in 2012. Two or more different utilities are required. Two different types of lines owned by only one utility are not enough to make the underground or overhead line be considered as a joint-use line.
(20) The 2017 Code added definitions of **communication equipment**, **communication space**, and **supply space**, along with new **Figures D-1 and D-5**. It also modified the definition of **electric supply equipment**. These changes illustrate the separation of the facilities in the supply space from those in the communication space by the *communication worker safety zone* created by the clearances of Rules 235C and 238. Communication facilities are allowed in the supply space only if they meet the requirements of Rule 224A: they must have permission to be there and all work on them must be performed using the supply space work rules by personnel qualified to work in the supply space. In addition, these 2017 Code changes clarified what is considered to be supply equipment versus communication equipment. See also Rules 235C4 and 238E.

NOTE: If permission is granted to place all communication facilities in the supply space and all personnel working on the communication facilities are qualified to work in the supply space and use supply work rules of NESC Sections 42 and 44, there is no requirement to have a communication space and communication worker safety zone. However, if ordinary communication workers will work on any of the communication lines and equipment, those facilities must be located in a separate communication space separated from the supply space by a communication worker safety zone.

(21) The 2017 Code added private toll operators to the entities that control **limited access highways**. This recognizes that many states now allow private companies to build and operate toll roads with limited access that functionally are equivalent to Interstate highways and other government operated non-toll and toll roads.
(22) Interpretation Request 565 issued 10 April 2012 discussed confusion existing between the multitude of sub-definitions of **sag** in the NESC. The 2017 Code simplified the definitions into two sub-definitions (**initial sag** and **final sag**), deleted the other sub-definitions, and revised the language used throughout the rules to match the simplified sub-definitions. Companion changes were made to the definition and use of **tension**.
(23) The 2017 Code added definitions of **span**, **wind span**, and **weight span** to help users understand the length to be used for different purposes. **Wind span** is used for transverse loading and **weight span** is used for vertical loading in the rules.
(24) The 2017 Code clarified that supply cable messengers and communication cable messengers are among the items considered as a **supported facility**.
(25) Over the couple of decades preceding the 2017 Code, the term "rural" has slowly been deleted from the code rules to reflect the fact that, with the increasing population and mobility of people seeking out remote places, there are few places where a fallen line would not present a personal safety hazard. Further, the character of land can change rapidly from formerly rural to urban, as farms are turned into residential, commercial, or industrial complexes, etc. The 2017 Code deleted the definitions of **urban districts** and **rural districts**.

The following definitions are for use with the National Electrical Safety Code. For other use, and for definitions not contained herein, the *IEEE Standards Dictionary Online* should be referenced.

NOTE: The *IEEE Standards Dictionary Online* is available at http://ieeexplore.ieee.org/xpls/dictionary.jsp.

administrative authority. The governmental authority exercising jurisdiction over application of this Code.

ampacity. The current-carrying capacity, expressed in amperes, of an electric conductor under stated thermal conditions.

anchorage. A secure point of attachment to which the fall protection system is connected.

area lighting. An electrical installation that provides lumens on public or private property.

NOTE: Area lighting installations under the exclusive control of a utility are covered by the NESC. All other area lighting installations are covered by the NEC.

authorized person. A person who has been authorized by the controlling utility or its designated representative to perform specified duties in, on, or in the vicinity of utility facilities, as applicable.

automatic. Self-acting, operating by its own mechanism when actuated by some impersonal influence—as, for example, a change in current strength; not manual; without personal intervention. Remote control that requires personal intervention is not automatic, but manual.

backfill (noun). Materials such as sand, crushed stone, or soil, that are placed to fill an excavation.

ballast section (railroads). The section of material, generally trap rock, that provides support under railroad tracks.

bonding. The electrical interconnecting of conductive parts, designed to maintain a common electrical potential.

cable. A conductor with insulation, or a stranded conductor with or without insulation and other coverings (single-conductor cable), or a combination of conductors insulated from one another (multiple-conductor cable).

cable jacket. A protective covering over the insulation, core, or sheath of a cable.

cable sheath. A conductive protective covering applied to cables.

NOTE: A cable sheath may consist of multiple layers, of which one or more is conductive.

cable terminal. A device that provides insulated egress for the conductors. *Syn:* **termination**.

circuit. A conductor or system of conductors through which an electric current is intended to flow.

circuit breaker. A switching device capable of making, carrying, and breaking currents under normal circuit conditions and also making, carrying for a specified time, and breaking currents under specified abnormal conditions such as those of short circuit.

clearance. The clear distance between two objects measured surface to surface, and usually filled with a gas such as air.

climbing. The vertical movement (ascending and descending) and horizontal movement to access or depart the worksite.

common use. Simultaneous use by two or more utilities of the same kind.

communication equipment. Equipment that produces, modifies, regulates, or controls communication signals. This equipment may also produce, modify, or safeguard a supply of electric energy for the exclusive use of communication devices as long as the equipment and communication devices being served are owned and operated by the same party. *See:* **electric supply equipment**.

communication lines. *See:* **lines.**

communication space. The space on joint-use structures where communication facilities are separated from the supply space by the communication worker safety zone. See Figure D-1.

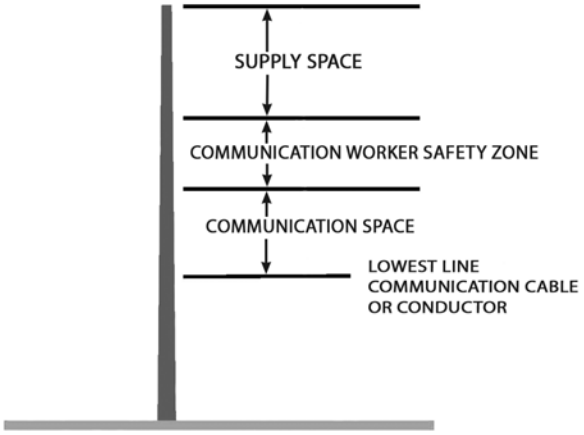


Figure D-1—Communication space

conductor.

1. A material, usually in the form of a wire, cable, or bus bar, suitable for carrying an electric current.
2. **bare conductor.** A metallic conductor without a covering.
3. **bundled conductor.** An assembly of two or more conductors used as a single conductor and employing spacers to maintain a predetermined configuration. The individual conductors of this assembly are called *subconductors*.
4. **covered conductor.** A conductor covered with a dielectric having no rated insulating strength or having a rated insulating strength less than the voltage of the circuit in which the conductor is used.
5. **fiber-optic conductor.** *See:* **fiber-optic cable—communication** or **fiber-optic cable—supply.**
6. **grounded conductor.** A conductor that is intentionally grounded, either solidly or through a noninterrupting current-limiting device.
7. **grounding conductor.** A conductor that is used to connect the equipment or the wiring system with a grounding electrode or electrodes.
8. **insulated conductor.** A conductor covered with a dielectric (other than air) having a rated insulating strength equal to or greater than the voltage of the circuit in which it is used.
9. **lateral conductor.** A wire or cable entirely supported on one structure and extending in a general horizontal, vertical or diagonal direction to make connections to line conductors, service drops, equipment, or other facilities supported on the same structure. Lateral conductors may be attached directly to the structure or supported away from the structure.
10. **line conductor.** (Overhead supply or communication lines.) A wire or cable intended to carry electric currents, extending along the route of the line, supported by poles, towers, or other structures, but not including vertical or lateral conductors.
11. **open conductor.** A type of electric supply or communication line construction in which the conductors are (a) bare, covered, or insulated, (b) do not have grounded shielding, and (c) are individually supported at the structure either directly or with insulators. *Syn:* **open wire.**
12. **vertical conductor.** Either a wire or cable riser attached to a pole or a vertical portion of a lateral conductor.

conductor shielding. An envelope that encloses the conductor of a cable and provides an equipotential surface in contact with the cable insulation.

conduit. A structure containing one or more ducts.

NOTE: Conduit may be designated as iron-pipe conduit, tile conduit, etc. If it contains only one duct, it is called *single-duct conduit;* if it contains more than one duct, it is called *multiple-duct conduit,* usually with the number of ducts as a prefix, e.g., *two-duct multiple conduit*.

conduit system. Any combination of duct, conduit, conduits, manholes, handholes, and/or vaults joined to form an integrated whole.

current-carrying part. A conducting part intended to be connected in an electric circuit to a source of voltage. Non-current-carrying parts are those not intended to be so connected.

de-energized. Disconnected from all sources of electrical supply by open switches, disconnectors, jumpers, taps, or other means.

NOTE: De-energized conductors or equipment could be electrically charged or energized through various means, such as induction from energized circuits, portable generators, lightning, etc.

delivery point. The point at which one utility delivers energy or signals to another utility.

designated person. A qualified person designated to perform specific duties under the conditions existing. *Syn:* **designated employee.**

disconnecting or isolating switch. A mechanical switching device used for changing the connections in a circuit or for isolating a circuit or equipment from a source of power.

NOTE: It is required to carry normal load current continuously as well as abnormal or short-circuit current for short intervals, as specified. It is also required to open or close circuits either when negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the switch poles occurs. *Syn:* **disconnector, isolator.**

duct. A single enclosed raceway for conductors or cable.

effective ground/effectively grounded: Bonded to an effectively grounded neutral conductor or to a grounding system designed to minimize hazard to personnel and having resistances to ground low enough to permit prompt operation of circuit protective devices.

effectively grounded neutral conductor: A conductor that is intentionally connected to the source transformer neutral directly or through an impedance to limit phase-to-ground fault current and has not less than four grounds in each 1.6 km (1.0 mi) of line. The conductor shall be of sufficient size to carry the available fault current and permit prompt operation of circuit protective devices.

electric supply equipment. Equipment that produces, modifies, regulates, controls, or safeguards a supply of electric energy for the electric power supply grid that is (1) transferred to supply lines, or (2) used to provide power and/or control for other electric supply equipment, or (3) used to provide power to the devices of another utility. *Syn:* **supply equipment.**

NOTE: *Electric supply equipment* does not include equipment whose purpose is to provide power to support locally mounted communication systems. For example, power supplies supporting CATV or communication amplifiers or repeaters are not considered to be supply equipment.

electric supply lines. *See:* **lines.**

electric supply station. Any building, room, or separate space within which electric supply equipment is located and the interior of which is accessible, as a rule, only to qualified persons. This includes generating stations and substations, including their associated generator, storage battery, transformer, and switchgear rooms or enclosures, but does not include facilities such as pad-mounted equipment and installations in manholes and vaults.

1. generating station. A plant wherein electric energy is produced by conversion from some other form of energy (e.g., fossil fuel, chemical, nuclear, solar, mechanical, wind, or hydraulic) by means of suitable apparatus. This includes all generating station auxiliaries and other associated equipment required for the operation of the plant. Not included are stations producing power exclusively for use with communications systems.
2. **substation.** An enclosed assemblage of equipment, e.g., switches, circuit breakers, buses, and transformers, under the control of qualified persons, through which electric energy is passed for the purpose of switching or modifying its characteristics to increase or decrease voltage or control frequency or other characteristics.
3. **switching station.** *See:* **substation.**

enclosed. Surrounded by case, cage, or fence designed to protect the contained equipment and limit the likelihood, under normal conditions, of dangerous approach or accidental contact by persons or objects.

energized. Electrically connected to a source of potential difference, or electrically charged so as to have a potential significantly different from that of earth in the vicinity. *Syn:* **live.**

equipment. A general term including fittings, devices, appliances, fixtures, apparatus, and similar terms used as part of or in connection with an electric supply or communications system.

exclusive control. Generally covers installation, ownership, restricted access, operation, and maintenance by qualified and authorized persons.

exclusive control of utility. Where (a) energized facilities are separated from public access by a spatial or a physical barrier and accessible only to qualified personnel authorized by the serving utility, and (b) the utility is responsible for connection/disconnection of such facilities to/from energized sources of energy or signals.

exposed. Not isolated or guarded.

fall arrest system. The assemblage of equipment, such as a line-worker's body belt, aerial belt, or full body harness in conjunction with a connecting means, with or without an energy absorbing device, and an anchorage to limit the forces a worker can experience during a fall.

fall prevention system. A system, which may include a positioning device system, intended to prevent a worker from falling from an elevation.

fall protection program. A program intended to protect workers from injury due to falls from elevations.

fall protection system (hardware). Consists of either a fall prevention system or a fall arrest system.

fiber-optic cable—communication. A fiber optic cable meeting the requirements for a communication line and located in the communication space of overhead or underground facilities.

fiber-optic cable—supply. A fiber-optic cable located in the supply space of overhead or underground facilities.

grounded. Connected to or in contact with earth or connected to some extended conductive body that serves instead of the earth.

grounded effectively. *See:* **effective ground/effectively grounded**.

grounded system. A system of conductors in which at least one conductor or point is intentionally grounded, either solidly or through a noninterrupting current-limiting device.

guarded. Covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats or platforms, designed to limit the likelihood, under normal conditions, of dangerous approach or accidental contact by persons or objects.

NOTE: Wires that are insulated but not otherwise protected are not normally considered to be guarded. See *EXCEPTION*s under applicable rules.

handhole. An access opening, provided in equipment or in a below-the-surface enclosure in connection with underground lines, into which personnel reach but do not enter, for the purpose of installing, operating, or maintaining equipment or cable or both.

harness. A component with a design of straps that is fastened about the worker in a manner so as to contain the torso and distribute the fall arrest forces over at least the upper thighs, pelvis, chest, and shoulders with means for attaching it to other components and subsystems.

NOTE: Wherever the word harness is used in this Code, it refers to full body harness.

in service. Lines and equipment are considered in service when connected to the system and intended to be capable of delivering energy or communication signals, regardless of whether electric loads or signaling apparatus are presently being served from such facilities.

insulated. Separated from other conducting surfaces by a dielectric (including air space) offering a high resistance to the passage of current.

NOTE: When any object is said to be *insulated,* it is understood to be insulated for the conditions to which it is normally subjected. Otherwise, it is, within the purpose of these rules, uninsulated.

insulation (as applied to cable). That which is relied upon to insulate the conductor from other conductors or conducting parts or from ground.

insulation shielding. An envelope that encloses the insulation of a cable and provides an equipotential surface in contact with the cable insulation.

insulator. Non-conductive device designed to provide mechanical connection and electrical separation between objects.

NOTE: Examples include but are not limited to pin, post, or suspension insulators supporting conductors; electrical bus support insulators; and guy strain insulators.

isolated. Not readily accessible to persons unless special means for access are used.

isolated by elevation. Elevated sufficiently so that persons may safely walk underneath.

isolator. *See:* **disconnecting or isolating switch.**

jacket. A protective covering over the insulation, core, or sheath of a cable.

joint use. Simultaneous use by two or more utilities.

lanyard. A flexible line or webbing, rope, wire rope, or strap that generally has a connector at each end for connecting the line-worker's body belt, aerial belt, or full body harness to an energy absorbing device, lifeline, or anchorage.

lightning arrester. *See:* **surge arrester.**

limited access highways. As used herein, *limited access highways* are fully controlled highways where access is controlled by a governmental authority or a private toll road operator for purposes of improving

traffic flow and safety. Fully controlled access highways have no grade crossings and have carefully designed access connections.

lines.

1. **communication lines.**
   a. **located in the communication space.** The conductors and their supporting or containing structures, equipment, and apparatus that are used for public or private signal or communications service, and which operate at potentials not exceeding 400 V to ground or 750 V between any two points of the circuit, and the transmitted power of which does not exceed 150 W. When operating at not more than 90 V ac or 150 V dc, no limit is placed on the transmitted power of the system. Under specified conditions, communication cables may include communication circuits exceeding the preceding limitation where such circuits are also used to supply power solely to communications equipment. Fiber-optic cables are considered as communication lines, regardless of whether they are installed in the communication space or supply space in accordance with applicable rules.

   NOTE: Public and private telephone, telegraph, railroad-signal, data, clock, fire, police-alarm, cable-television, and other systems conforming with the above are included. Lines used for signaling purposes, but not included under the above definition, are considered as supply lines of the same voltage and are to be so installed. Traffic signal light lines are considered as supply lines, not communication lines.

   b. **located in the supply space.** Communication lines located in the supply space and meeting Rule 224A may (a) operate at any voltage, (b) include supply circuits of any voltage, or (c) be included within a supply conductor or cable operating at any voltage.
2. **electric supply lines.** Those wires, conductors, and cables used to transmit electric or light energy and their necessary supporting or containing structures, equipment, and apparatus that are used to provide public or private electric supply or lighting service.

   Signal lines of more than 400 V and traffic signal lines of any voltage are always considered as supply lines within the meaning of the rules, and signal lines of less than 400 V may be considered as supply lines, if so run and operated throughout.

   Although fiber-optic lines are considered as communication lines, regardless of whether they are installed in the communication space or supply space in accordance with applicable rules, electric supply conductors to light amplifiers, etc., are considered as supply lines, unless contained within a communication cable in accordance with the definition of communication lines and applicable rules. *Syn:* **supply lines.**
3. **joint-use lines.** Overhead or underground lines containing or supporting facilities of two or more utilities. Lines containing or supporting facilities delivering two or more types of service by the same owner, such as electricity and lighting supply service or telephone and CATV communication service, are not considered as joint-use lines, unless also accompanied by one or more lines of another utility.

line-worker's body belt. A belt that consists of a belt strap and D-rings and which may include a cushion section or a tool saddle.

live. *See:* **energized.**

manhole. A subsurface enclosure that personnel may enter used for the purpose of installing, operating, and maintaining submersible equipment and cable.

manhole cover. A removable lid that closes the opening to a manhole or similar subsurface enclosure.

manhole grating. A grid that provides ventilation and a protective cover for a manhole opening.

manual. Capable of being operated by personal intervention.

minimum approach distance. The closest distance a qualified employee is permitted to approach either an energized or a grounded object, as applicable for the work method being used.

multi-grounded/multiple grounded system. A system of conductors in which a neutral conductor is intentionally grounded solidly at specified intervals. A multi-grounded or multiple grounded system may or may not be effectively grounded. *See:* **effective ground/effectively grounded.**

neutral conductor. A system conductor other than a phase conductor that provides a return path for current to the source. Not all systems have a neutral conductor. An example is an ungrounded delta system containing only three energized phase conductors.

out of service. Lines and equipment are considered out of service when disconnected from the system and when not intended to be capable of delivering energy or communications signals.

overhead ground wire. *See:* **shield wire.**

overvoltage. Voltage between two points of a system that is greater than the highest value appearing between the same two points under normal service conditions. Overvoltages include, but are not limited to, switching impulse (switching surge) overvoltages and temporary (transient) overvoltages.

pad-mounted equipment. A general term describing enclosed equipment, the exterior of which enclosure is at ground potential, positioned on a surface-mounted pad.

positioning device system. A system of equipment or hardware that, when used with its line-worker's body belt or full body harness, allows a worker to be supported on an elevated vertical surface, such as a pole or tower, and work with both hands free.

positioning strap. A strap with snap hook(s) to connect to the D-rings of a line-worker's body belt or full body harness.

premises. The land and buildings of a user located on the user side of the service point (sometimes called the *utility-user network point of demarcation* for communication wiring) to electric supply, communication, or signal premises wiring.

premises wiring (system). Interior and exterior wiring, including power, lighting, control, communication, and other signal circuit wiring together with all their associated hardware, fittings, and wiring devices, both permanently and temporarily installed either (a) from the service point or premises power source to the outlets, or (b) where there is no service point, from and including the non-utility power source to the outlets.

Such wiring does not include wiring internal to appliances, luminaires, motors, controllers, motor control centers, and similar equipment, nor does it include utility equipment and wiring on the utility side of the service point.

prestressed-concrete structures. Concrete structures that include metal tendons that are tensioned and anchored either before or after curing of the concrete.

pulling iron. An anchor secured in the wall, ceiling, or floor of a manhole or vault to attach rigging used to pull cable.

pulling tension. The longitudinal force exerted on a cable during installation.

qualified. Having been trained in and having demonstrated adequate knowledge of the installation, construction, or operation of lines and equipment and the hazards involved, including identification of and exposure to electric supply and communication lines and equipment in or near the workplace. An employee

who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training, and who is under the direct supervision of a qualified person, is considered to be a qualified person for the performance of those duties.

qualified climber. A worker who, by reason of training and experience, understands the methods and has routinely demonstrated proficiency in climbing techniques and familiarity with the hazards associated with climbing.

raceway. Any channel designed expressly and used solely for holding conductors.

random separation. Installed with less than 300 mm (12 in) separation and without deliberate separation.

remotely operable (as applied to equipment). Capable of being operated from a position external to the structure in which it is installed or from a protected position within the structure.

restricted access. Where exclusive control is maintained.

roadway. The portion of highway, including shoulders, for vehicular use. *See also:* **shoulder**; **traveled way.**

NOTE: A divided highway has two or more roadways.

sag.

1. The distance measured vertically from a conductor to the straight line joining its two points of support. Unless otherwise stated in the rule, the sag referred to is the sag at the midpoint of the span. See Figure D-2.
2. **initial sag.** The sag of a conductor prior to the application of any external load.
3. **final sag.** The sag of a conductor under specified conditions of loading and temperature applied, after it has been subjected for an appreciable period to the loading specified for the clearance zone in which it is situated or equivalent loading, and this loading is then removed. Final sag includes the effect of inelastic deformation.

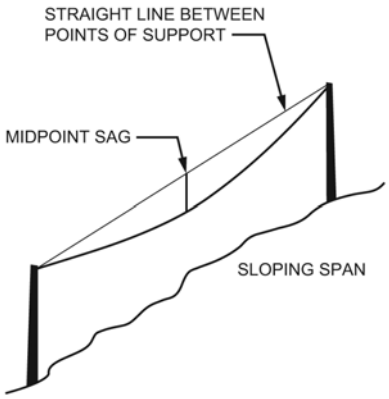


Figure D-2—Sag

separation. The distance between two objects, measured surface to surface, and usually filled with a solid or liquid material.

service drop. The overhead conductors between the electric supply or communication line and the building or structure being served.

service point. The point of connection between the facilities of the serving utility and the premises wiring.

NOTE: The service point is the point of demarcation between the serving utility and the premises wiring. The service point is the point on the wiring system where the serving utility wiring ends and the premises wiring begins. The serving utility generally specifies the location of the service point based on the utility's condition of service.

Because the location of the service point is generally determined by the utility, the service-drop conductors and the service-lateral conductors may or may not be part of the service covered by the NEC. For these types of conductors to be covered, they must be physically located on the premises wiring side of the service point. If the conductors are located on the utility side of the service point, they are not covered by the NEC definition of service conductors and are therefore not covered by the NEC.

Based on the definitions of the terms *service point* and *service conductors,* any conductor on the serving utility side of the service point generally is not covered by the NEC. For example, a typical suburban residence has an overhead service drop from the utility pole to the house. If the utility specifies that the service point is at the point of attachment of the service drop to the house, the service-drop conductors are not considered service conductors because the service drop is not on the premises wiring side of the service point. Alternatively, if the utility specifies that the service point is "at the pole," and the service-drop conductors are not under utility control, the NEC would apply to the service drop.

Exact locations for a service point may vary from utility to utility, as well as from occupancy to occupancy.

shield wire (also referred to as overhead ground wire, static wire, or surge-protection wire). A wire or wires, which may or may not be grounded, strung parallel to and above phase conductors to protect the power system from lightning strikes.

shoulder. The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles for emergency use and for lateral support of base and surface course.

side-wall pressure. The crushing force exerted on a cable during installation.

single-grounded system/unigrounded system. A system of conductors in which one conductor is intentionally grounded solidly at a specific location, typically at the source.

spacer cable. A type of electric supply-line construction consisting of an assembly of one or more covered conductors, separated from each other and supported from a messenger by insulating spacers.

spacing. The distance between two objects measured center to center.

span.

1. **span length.** The horizontal distance between two adjacent supporting points of a conductor.
2. **wind span.** The sum of half of the span lengths on either side of the supporting structures. See Figure D-3.

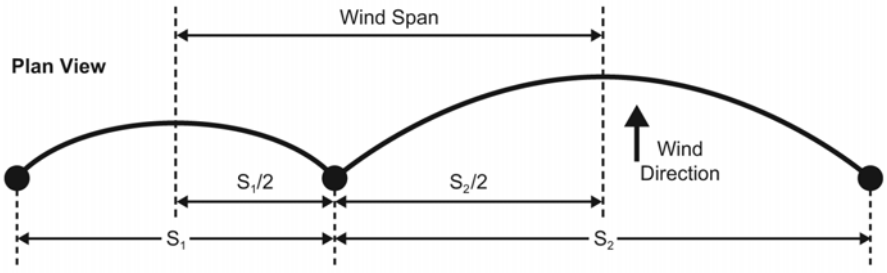


Figure D-3—Wind span

3. **weight span.** The sum of the horizontal distances from the supporting structure to the real or projected low point of conductor/cable sag in each supported span. See Figure D-4. *Syn:* **vertical span.**

NOTE: Where the projected low point is beyond the adjacent structure, the weight span may exceed the actual span.

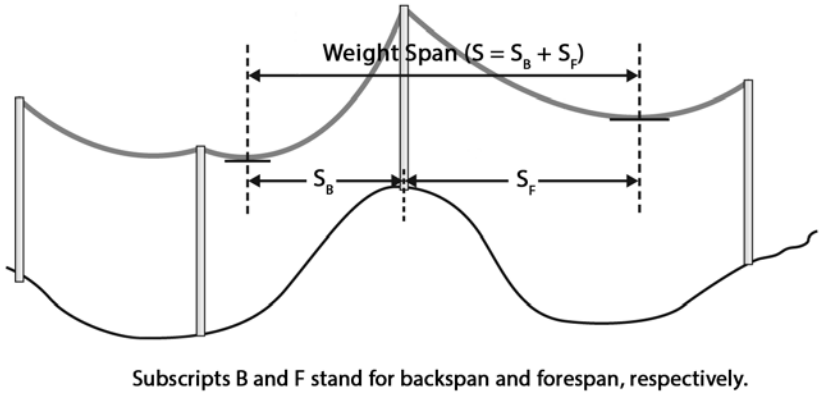


Figure D-4—Weight span

span wire. An auxiliary suspension wire that serves to support one or more trolley contact conductors or a light fixture and the conductors that connect it to a supply system.

static wire. *See:* **shield wire.**

structure conflict. A line so situated with respect to a second line that the overturning of the first line will result in contact between its supporting structures or conductors and the conductors of the second line, assuming that no conductors are broken in either line.

substation. *See:* **electric supply station.**

supervised installation. Where conditions of maintenance and supervision ensure that only qualified persons monitor and service the system.

supply equipment. *See:* **electric supply equipment.**

supply space. The space on joint-use structures where supply facilities are separated from the communication space by the communication worker safety zone. See Figure D-5.

NOTE: Communication facilities may be located in the supply space (see Rule 224A).

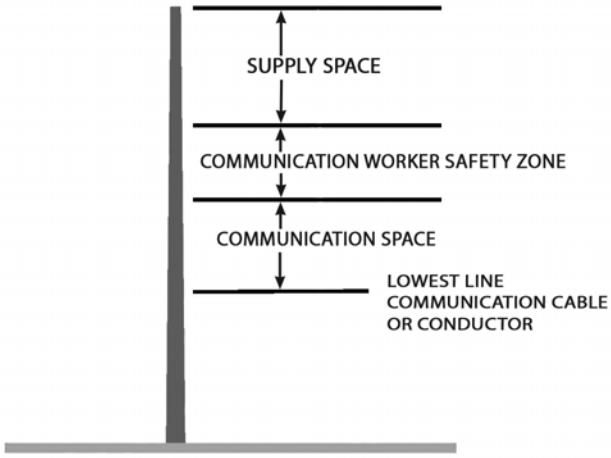


Figure D-5—Supply space

supply station. *See:* **electric supply station.**

supported facility. Any component of an overhead line system that is supported on, but is not intended to provide structural strength to, the supporting structure or mechanical support system.

NOTE: Examples of supported facilities include, but are not limited to, components such as messengers, conductors, line hardware, equipment hanger brackets, and switches.

supporting structure. The main supporting unit (usually a pole or tower) used to support supply and/or communication conductors, cables, and equipment.

NOTE: A supporting structure may consist of a single or multiple pole arrangement that supports supply and/or communication conductors, cables, and equipment at a line location.

1. **readily climbable.** A supporting structure having sufficient handholds or footholds so that the structure can be climbed easily by an average person without using a ladder, tools or devices, or extraordinary physical effort.
2. **not readily climbable.** A supporting structure not meeting the definition of a readily climbable structure, including but not limited to the following:
   a. supporting structures, including poles and tower legs, with handholds or footholds arranged so that there is not less than 2.45 m (8 ft) between either: (1) the lowest handhold or foothold and ground or other accessible surface, or (2) the two lowest handholds or footholds. Diagonal braces on towers are not considered to be handholds or footholds except at their points of attachment.
   b. guy wires

surge arrester. A protective device for limiting surge voltages.

surge-protection wire. *See:* **shield wire.**

susceptiveness. The characteristics of a communication circuit, including its connected apparatus, that determine the extent to which it is adversely affected by inductive fields.

switch. A device for opening and closing or for changing the connection of a circuit. In these rules, a switch is understood to be manually operable, unless otherwise stated.

switchboard. A type of switchgear assembly that consists of one or more panels with electric devices mounted thereon, and associated framework.

tag. Accident prevention tag (DANGER, PEOPLE AT WORK, etc.) of a distinctive appearance used for the purpose of personnel protection to indicate that the operation of the device to which it is attached is restricted.

tension.

1. **initial.** The tension in a conductor prior to the application of any external load.
2. **final.** The tension in a conductor under specified conditions of loading and temperature applied, after it has been subjected for an appreciable period to the loading specified for the loading district (zone) in which it is situated, or equivalent loading, and this loading removed. Final tension includes the effect of inelastic deformation (creep).

termination. *See:* **cable terminal.**

transferring (as applied to fall protection). The act of moving from one distinct object to another (e.g., between an aerial device and a structure).

transformer vault. An isolated enclosure either above or below ground with fire-resistant walls, ceiling, and floor, in which transformers and related equipment are installed, and which is not continuously attended during operation. *See also:* **vault.**

transitioning (as applied to fall protection). The act of moving from one location to another on equipment or a structure.

traveled way. The portion of the roadway for the movement of vehicles, exclusive of shoulders and full-time parking lanes.

ungrounded system. A system of conductors in which no conductor or point is intentionally grounded, either solidly or through a noninterrupting current-limiting device.

unigrounded system. *See:* **single-grounded system/unigrounded system.**

utility. An organization responsible for the engineering and supervision (design, construction, operation, and maintenance) of a public or private electric supply, communication, area lighting, street lighting, signal, or railroad utility system.

1. **public utility.** A public utility is an entity that performs or provides one or more utility services for the benefit of multiple customers (at retail, wholesale, or both), including utilities formed for a singular purpose (including but not limited to providing street and outdoor lighting, municipal traffic signal control, or distributed generation). Public utilities include investor-owned, municipality/government-owned, cooperative-owned utility, public utility districts, irrigation districts, lighting districts, traffic signal or other signal utilities, and similar utilities.
2. **private utility.** A private utility is an entity that (a) performs or provides one or more utility services to its own facilities, such as a large industrial complex, large campus, military complex, railroad system, trolley system, or extensive gas or oil field through its own electric supply, communication, street and area lighting, or signal system and/or (b) generates or transmits power that is delivered to another utility.

   NOTE: Although many private utilities only operate a distribution level system, others operate generation and transmission systems.

utility interactive system. An electric power production system that is operating in parallel with and capable of delivering energy to a utility electric supply system.

utilization equipment. An electrical installation that uses electric or light energy for electronic, electromechanical, chemical, heating, lighting, testing, communication, signaling, or similar purposes on the premises wiring side of the service point.

NOTE: Utilization equipment and premises wiring on the load side of the service point is intended to be performed under the NEC, regardless of whether a utility has exclusive control.

vault. A structurally solid enclosure, including all sides, top, and bottom, that is (1) associated with an underground electric supply or communication system, (2) located either (a) above or below ground or (b) in a building, and (3) where entry is limited to personnel qualified to install, maintain, operate, or inspect the equipment or cable enclosed. The enclosure may have openings for ventilation, personnel access, cable entrance, and other openings required for operation of equipment in the vault.

voltage.

1. The effective (rms) potential difference between any two conductors or between a conductor and ground. Voltages are expressed in nominal values unless otherwise indicated. The nominal voltage of a system or circuit is the value assigned to a system or circuit of a given voltage class for the purpose of convenient designation. The operating voltage of the system may vary above or below this value.

2. **voltage of circuit not effectively grounded.** The highest nominal voltage available between any two conductors of the circuit.

   NOTE: If one circuit is directly connected to and supplied from another circuit of higher voltage (as in the case of an autotransformer), both are considered to be of the higher voltage, unless the circuit of the lower voltage is effectively grounded, in which case its voltage is not determined by the circuit of higher voltage. Direct connection implies electric connection as distinguished from connection merely through electromagnetic or electrostatic induction.

3. **voltage of a constant-current circuit.** The highest normal full-load voltage of the circuit.
4. **voltage of an effectively grounded circuit.** The highest nominal voltage available between any conductor of the circuit and ground unless otherwise indicated.
5. **voltage to ground of:**
   a. **a grounded circuit.** The highest nominal voltage available between any conductor of the circuit and that point or conductor of the circuit that is grounded.
   b. **an ungrounded circuit.** The highest nominal voltage available between any two conductors of the circuit concerned.
6. **voltage to ground of a conductor of:**
   a. **a grounded circuit.** The nominal voltage between such conductor and that point or conductor of the circuit that is grounded.
   b. **an ungrounded circuit.** The highest nominal voltage between such conductor and any other conductor of the circuit concerned.

wire gauges. Throughout these rules, the American Wire Gauge (AWG) is the standard gauge for copper, aluminum, and other conductors, excepting only steel conductors, for which the American Steel Wire Gauge (Stl WG) is used.

worksite (as applied to fall protection). The location on the structure or equipment where, after the worker has completed the climbing (horizontally and vertically), the worker is in position to perform the assigned work or task.

Section 3.
References

Section 3 lists all of the standards referred to by the rules in the Code. These standards are referenced in the rules as standards to be followed when purchasing equipment, designing utility facilities, and working in and on utility facilities.

The following standards form a part of the NESC to the extent indicated in the rules herein.

ANSI C29.1-1988 (R2012), American National Standard Test Methods for Electrical Power Insulators. [Rules 272, 273, and Table 277-1]

ANSI C29.2 (Superseded) (1.2 standard deviation M&E), American National Standard for Wet-Process Porcelain and Toughened Glass Insulators (Suspension Type). [Rules 272, Table 277-1, 441B4b, and 441B4c]

ANSI C29.2A-2013, American National Standard for Distribution Class Insulators.

ANSI C29.2B-2013 (3.0 standard deviation M&E), American National Standard for Transmission Class Insulators.

ANSI C29.3-2012, American National Standard for Wet-Process Porcelain Insulators (Spool Type). [Rule 272 and Table 277-1]

ANSI C29.5-2012, American National Standard for Low- and Medium-Voltage Pin Type Wet-Process Porcelain Insulators. [Rule 272 and Table 277-1]

ANSI C29.6-2012, American National Standard for High-Voltage Pin Type Wet-Process Porcelain Insulators. [Rule 272 and Table 277-1]

ANSI C29.7-2012, American National Standard for High-Voltage Line-Post Type Wet-Process Porcelain Insulators. [Rule 272 and Table 277-1]

ANSI C29.8-2012, American National Standard for Wet-Process Porcelain Insulators—Apparatus, Cap, and Pin Type. [Table 277-1]

ANSI C29.9-2012, American National Standard for Wet-Process Porcelain Insulators—Apparatus, Post Type. [Table 277-1]

ANSI C29.12-2012, American National Standard for Insulators—Composite Suspension Type. [Table 277-1]

ANSI C29.13-2013, American National Standard for Insulators—Composite-Distribution Deadend Type. [Table 277-1]

ANSI C29.17-2002, American National Standard for Insulators—Composite-Line Post Type. [Table 277-1]

ANSI C29.18-2013, American National Standard for Insulators—Composite-Distribution Line Post Type. [Table 277-1]

ANSI O5.1-2015, American National Standard Specifications and Dimensions for Wood Poles. [Rule 261A2b(1)]

ANSI O5.2-2012, American National Standard for Wood Products—Structural Glued Laminated Timber for Utility Structures. [Rule 261A2b(2)]

ANSI O5.3-2008, American National Standard for Solid Sawn-wood Crossarms and Braces—Specifications and Dimensions. [Rule 261A2b(2)]

ANSI Z535.1-2011, American National Standard for Safety Colors. [Rules 110A1 NOTE, 112B NOTE, 124C1 NOTE, 146B NOTE, 180B11 NOTE, 180D2 NOTE, 217A1c NOTE, 217A2a NOTE, 323C4a NOTE, 323E3 NOTE, 381G2 NOTE, and 411D]

ANSI Z535.2-2011, American National Standard for Environmental and Facility Safety Signs. [Rules 110A1 NOTE, 112B NOTE, 124C1 NOTE, 146B NOTE, 180B11 NOTE, 180D2 NOTE, 217A1c NOTE, 217A2a NOTE, 323C4a NOTE, 323E3 NOTE, 381G2 NOTE, and 411D]

ANSI Z535.3-2011, American National Standard for Criteria for Safety Symbols. [Rules 110A1 NOTE, 112B NOTE, 124C1 NOTE, 146B NOTE, 180D2 NOTE, 180B11 NOTE, 217A1c NOTE, 217A2a NOTE, 323C4a NOTE, 323E3 NOTE, 381G2 NOTE, and 411D]

ANSI Z535.4-2011, American National Standard for Product Safety Signs and Labels. [Rules 110A1 NOTE, 112B NOTE, 124C1 NOTE, 146B NOTE, 180D2 NOTE, 180B11 NOTE, 217A1c NOTE, 217A2a NOTE, 323C4a NOTE, 323E3 NOTE, 381G2 NOTE, and 411D]

ANSI Z535.5-2011, American National Standard for Safety Tags and Barricade Tapes (for Temporary Hazards). [Rules 110A1 NOTE, 112B NOTE, 124C1 NOTE, 146B NOTE, 180B11 NOTE, 180D2 NOTE, and 411D]

ANSI/ASME B15.1:2000, ASME Standard for Mechanical Power Transmission Apparatus. [Rule 122A]

ANSI/SIA A92.2-1992, American National Standard for Vehicle Mounted Elevating and Rotating Aerial Devices. [Rule 446B1]

ASCE 7-2010, ASCE Standard for Minimum Design Loads for Buildings and Other Structures. [Rule 250C and Tables 250-2 and 250-3]

ASCE 74-2010, Guidelines for Electrical Transmission Line Structure Loading. [Rule 250C]

ASTM D 178-01 (2010), ASTM Standard Specification for Rubber Insulating Matting. [Rule 124C4]

IEEE Std 4™-1995, IEEE Standard Techniques for High-Voltage Testing. [Tables 410-2 and 410-3]

IEEE Std 516™-2009, IEEE Guide for Maintenance Methods on Energized Power-Lines. [Rules 441A4 NOTE 2, 446B1, and 446D3]

IEEE Std 1427™-2006, IEEE Guide for Recommended Electrical Clearances and Insulation Levels in Air-Insulated Electrical Power Substations.

IEEE Std 1584™-2002, IEEE Guide for Performing Arc Flash Hazard Calculations. [Table 410-1, Footnotes 1, 3, 6, and 14]

IEEE Std C62.82.1™-2010, IEEE Standard for Insulation Coordination—Definitions, Principles, and Rules.

NFPA 30-2000, Flammable and Combustible Liquids Code. [Rule 127C, 127D, and 127F]

NFPA 30A-2000, Flammable and Combustible Liquids Code. [Rule 127E]

NFPA 58-2001, Storage and Handling of Liquefied Petroleum Gases. [Rule 127K]

NFPA 59-2001, Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants. [Rule 127K]

NFPA 59A-2001, Production, Storage, and Handling of Liquefied Natural Gas (LNG). [Rule 127L]

NFPA 70®, 2011 Edition, National Electrical Code® (NEC®). [Rules 011B4, 099C, 124C6a, and 127]

NFPA 496-1998, Standard for Purged and Pressurized Enclosures for Electrical Equipment. [Rule 127H]

NFPA 8503-1997, Standard for the Installation and Operation of Pulverized Fuel Systems. [Rule 127A5]

NOTE 1: The standards listed here were the editions used in this revision of the Code. In some cases, newer editions may be in effect. Contact the publisher for information about availability.

NOTE 2: ANSI publications are available from the American National Standards Institute (http://www.ansi.org/).

NOTE 3: ASCE publications are available from ASCE Publications (http://www.asce.org).

NOTE 4: ASTM publications are available from the American Society for Testing and Materials (http://www.astm.org/).

NOTE 5: IEEE publications are available from The Institute of Electrical and Electronics Engineers (http://standards.ieee.org).

NOTE 6: The IEEE standards or products referred to in this section are trademarks of The Institute of Electrical and Electronics Engineers, Inc.

NOTE 7: NFPA publications are available from the National Fire Protection Association (http://www.nfpa.org/).

Section 3. *(This section was added in the 1984 Code.)*

From 1981 through 1993, Section 3 included in one place the standards that are referenced within various other sections of the Code. They form a convenient reference for checking library copies for up-to-date versions of other standards that are specified in the current edition of the Code.

In 1997, the references were split into two parts. Section 3 includes only standards that form a part of the NESC to the extent called out in the rules. Other standards that are cited for information or documentation purposes are shown in a bibliography, originally designated as the Code's Appendix B. (It moved to the Code's Appendix E in 2007).

Both Section 3 and the bibliography appendix are updated with each new edition.

Section 9.
Grounding methods for electric supply and communications facilities

The methods covered in Section 9 of the NESC are intended to deliver a desired safe performance level. The methods in Section 9 outline required and recommended methods for making connections, selecting appropriate materials, and installing those materials to create an appropriate grounding system when "effective grounding" is required. Specific grounding levels (such as, but not limited to, particular ohm values) are rarely indicated in Section 9. As in other parts of the Code, it is recognized that a certain level of safe performance can be achieved in a variety of ways. There is no desire to tie the hands of the user of the Code on achieving safe performance.

090. Purpose

The purpose of Section 9 of this Code is to provide practical methods of grounding, as one of the means of safeguarding employees and the public from injury that may be caused by electrical potential.

Rule 090. The purpose of Section 9 is to provide practical *methods* of grounding for use where grounding is required as a means of safeguarding employees and the public from injury that may be caused by electrical potential on electric supply or communications facilities. The *requirements* to ground items are found in Parts 1–4.

The object of protective grounds on electric circuits or equipment, as required by the rules of the NESC, is to keep some point in the electric circuit or equipment at, or as near as practical to, the potential of the earth in the vicinity. Grounding helps to prevent harm to persons or damage to property in the event of accidental contact by persons with conductive equipment casings or enclosures, guys, conduit, etc.; direct or near hits by lightning; accidental contact of high-voltage conductors with low-voltage conductors; breakdown between primary and secondary windings of transformers; etc.

In order of descending effectiveness, ground systems serve to (1) enhance prompt operation of system fault-protective devices and (2) minimize the exposure of personnel to electrical potential.

The ideal condition would be to have a grounding electrode with a resistance to ground so small that the voltage to ground would be held to a small value under any condition. In many situations, however, this is not practical due to either high soil resistivity or very low circuit impedance. In such cases, a high degree of protection is obtained if the grounding electrode has a low enough resistance to ground to ensure the current flow required to promptly operate protective devices and remove the source of the potential (see Rule 096 [Ground resistance]).

Under high-capacity ground fault or lightning conditions, substantial voltages may develop between locations on the earth's surface only a few feet apart, due principally to the very appreciable resistance of the earth itself. Good grounding alone will not remove this hazard; additional means are required. Where there is a high probability that personnel may be exposed to large step potentials resulting from the operation of fault-current or other protective devices, such as in a supply substation, the effective potential may be minimized by the use of properly spaced buried grid conductors and by covering the earth with coarse crushed rock in the critical areas.

091. Scope

Section 9 of this Code covers methods of protective grounding of supply and communication conductors and equipment. The rules requiring grounding are in other parts of this Code. For rules requiring conductors or equipment to be effectively grounded, methods described in this section shall be used and the definition of effectively grounded shall be met.

These rules do not cover the grounded return of electric railways nor those lightning protection wires that are normally independent of supply or communication wires or equipment.