A Short Guide to the Application of the NEC and the NESC

Abstract

The use of standards ensures that the "requirements of interconnectivity and interoperability can be assured." [1] Two popular electrical standards are the National Electrical Code (NEC) and the National Electrical Safety Code (NESC). This document seeks to aid in the differentiation in the application and the scope of these two standards. The NEC covers the minimum safety requirements for electrical system installations in private and public compounds, to ensure the minimization of the associated risks to persons and property. [2] The NESC however, covers the minimum safety codes for personnel involved in the installation, operation and maintenance of electric and communication utility equipment as well as the vertical line clearances. [3]

Introduction

Electrical standards or codes are recommended rules to be followed when designing or constructing an electrical system [4] and "establish best practices for safety in trades and industry." [3]. The understanding of these electrical standards is necessary:

- To be able to effectively apply them to the design or installation of an electrical system.
- To understand when to apply a specific standard.
- To understand the limitations of each standard/code.
- To ensure the compliance with safety requirements.

Two frequently used and confused electrical standards are the National Electrical Code (NEC), also known as the NFPA 70 and the National Electrical Safety Code (NESC).

Sponsored by the National Fire Protection Association (NFPA) of the United States, the NEC "protects the public by establishing requirements for electrical wiring and equipment in virtually all buildings." [4] The code is used by "electrical contractors and workers"…"for estimating, designing and installing electrical systems. Excellence in electrical contracting, services and safe installations are the results of staying current with the NEC requirements." [4] The code is reviewed and revised every three years based on changes in technology and industry needs, with the NEC 2014 being the latest edition. [4]

The NESC, administered by the IEEE, "sets the ground rules for practical safety codes for people involved in the installation, operation, or maintenance of electric supply and communication lines and equipment" and "NESC is designed to bring consistency and safety to the design, construction, operation, and use of electric supply and communication installations". [3] It has been revised every 3 years from 1973 to 1993, then every 5 years commencing from the 2002 edition.

NEC

The NEC outlines the minimum safety requirements to "ensure that electrical systems are installed in a manner that protects people and property by minimizing the risks associated with the use of electricity". [2] The code focuses on safety and not on efficiency, adequacy, energy management, power quality, maintenance or future expansion. It addresses "the fundamental safety principles contained in the International Electrotechnical Commission (IEC) standards, including protection against electric shock, adverse thermal effects, overcurrent, fault currents, and overvoltage" [2].

Within the NEC are the necessary requirements for the installation of the conductors and equipment for electricity as well as signalling and communications in:

- Public and private compounds;
- Conductors and equipment that are connected to electric utility;
- Buildings used by the electric utility that are not an integral part of generation, control or a substation;
- Industrial substations, yards, lots and parking lots. [2]

Figure 1: Illustration of the Purpose of the NEC [2]

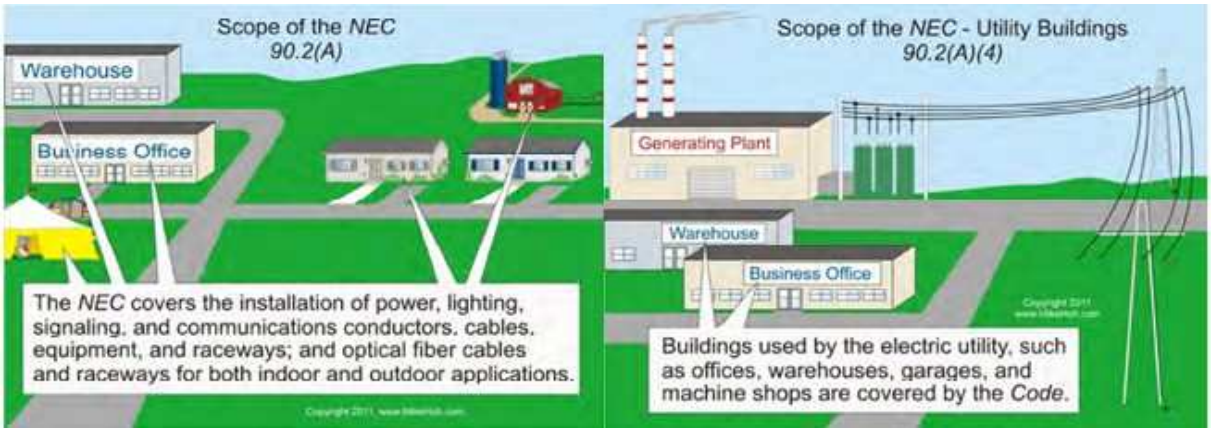


Figure 2: Illustration of the Scope of the NEC. [2]

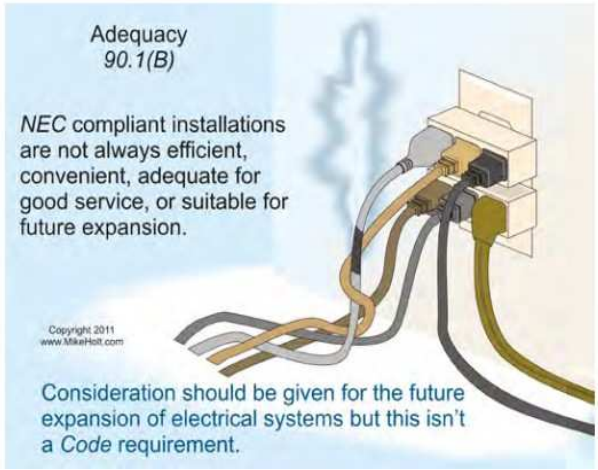
In relation to electric utilities, the scope of the NEC does not apply to "installations under the exclusive control" [2] of the electric utility where the installations:

"a. Consist of service drops or service laterals and associated metering.

b. Are on property owned or leased by the electric utility for the purpose of generation, transformation, transmission, distribution, or metering of electric energy.

c. Are located on legally established easements, or rights-ofway.

d. Are located by other written agreements either designated by or recognized by public service commissions, utility commissions, or other regulatory agencies having jurisdiction for such installations; limited to



installations for the purpose of communications, metering, generation, control, transformation, transmission, or distribution of electric energy where legally established easements or rights-of-way can't be obtained." [2]

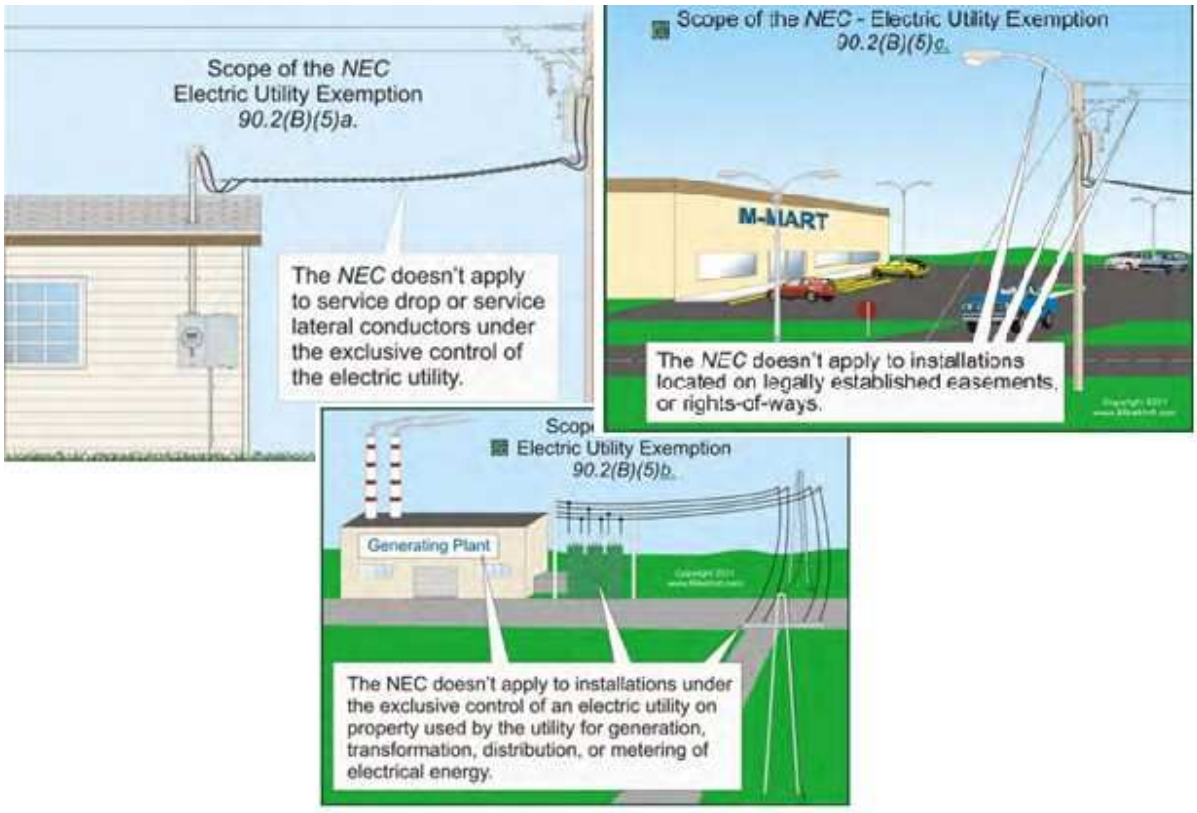


Figure 3: NEC Electric Utility Exemptions [2]

NESC

"The purpose of the NESC is to provide practical safeguard methods for both utility workers and the public during the installation, operation, and maintenance of electric supply and communication lines and equipment" [3]

Within the NESC are the necessary guidelines for:

- Electric supply installations, the supply stations and the mechanical parts located within. It also entails the "required clearances to the energised parts in the and electric supply station" [3]
- The protection, grounding and disconnection of short-circuit protection for current and voltage transformers
- Suitability of conductors within the supply station
- The use of surge protectors and where they should be located in respect to the devices they protect
- Clearance requirements between power and communication lines, the installation, maintenance and protection of these communication lines
- The grounding of overhead power lines as well as the grounding or insulation of guys and other non-current carrying parts and their layout on the support structure
- The accessibility of the support structure to unauthorised persons

- Vertical clearance requirements of above ground conductors, wires, cables and conductors, including the sag and tension of conductors based on loading limits.
- Power utility worker safety guidelines and requirements regarding protective devices, equipment and guidelines for personal and public safety.
- Approach distance and protective clothing of other utility workers (example communication line workers), commercial and residential electricians, and other persons working within the vicinity of a power line
- The clearances between supporting structures and a variety of interferences [3]

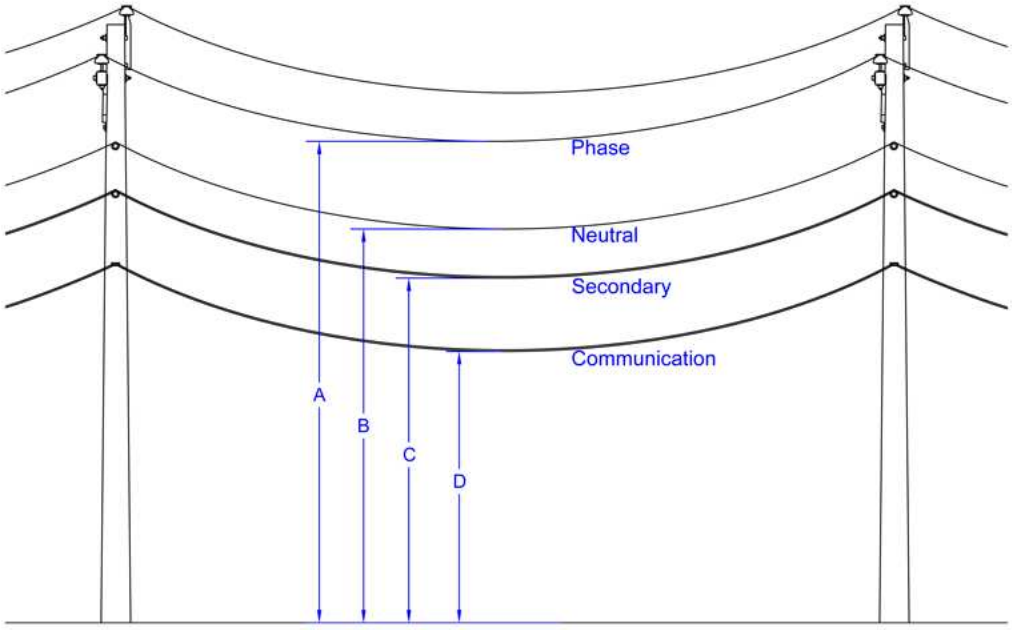


Figure 4: NESC Vertical Clearance above Ground or Roads [5]

Table 1: Table Accompanying Illustration of the NESC Vertical Clearance above Ground or Roads [5]

Item	Cable or Conductor	NESC Clearance	Comments
A	Phase	18.5 ft	Applies to phase wires 22kV and below. For voltages above 22kV phase-to-ground, see NESC Rules 232C and 232D.
B	Neutral	15.5 ft	Applies to neutrals meeting NESC Rule 230E1.
C	Secondary	16.0 ft	Applies to secondaries 750V or less meeting NESC Rule 230C2 or 230C3 (triplex, quadruplex, etc.).
D	Communication	15.5 ft	Applies to cable TV, phone, fiber optic cables, etc.

Insulation

Table 2: NESC Table 273-1 Insulation Level Requirements [6]

Nominal voltage	Rated dry flashover	Nominal voltage	Rated dry flashover

(between phases) (kV)	voltage of insulators (kV)[1]	(between phases) (kV)	voltage of insulators (kV)[1]
0.75	5	115	315
2.4	20	138	390
6.9	39	161	445
13.2	55	230	640
23.0	75	345	830
34.5	100	500	965
46	125	765	1145
69	175		

[1] Interpolate for intermediate values

Table 3: NEC Table 310.13(B) Thickness of Insulation for Nonshielded Typed RHH and RHW Solid Dielectric Insulated Conductors Rated 2000 Volts [7]

Conductor Size (AWG or kcmil)	Column A[1]		Column B[2]	
	mm	mils	mm	mils
14-10	2.03	80	1.52	60
8	2.03	80	1.78	70
6-2	2.41	95	1.78	70
1-2/0	2.79	110	2.29	90
3/0-4/0	2.79	110	2.67	90
213-500	3.18	125	2.67	105
501-1000	3.56	140	3.05	120
1001-2000	3.56	140	3.56	140

[1]Column A insulations are limited to natural, SBR, and butyl rubbers.
[2]Column B insulations are materials such as cross-linked polyethylene, ethylene propylene rubber, and composites thereof.

Table 4: NEC Table 301.13© Conductor Application and Insulation Rated 2001 Volts and Higher [7]

Trade Name	Type Letter	Maximum Operating Temperature	Application Provision	Insulation	Outer Covering
Medium voltage solid dielectric	MV-90 MV-105*	90°C 105°C	Dry or wet locations	Thermoplastic or thermosetting	Jacket, sheath, or armor

*Where design conditions require maximum conductor temperatures above 90°C

References

[1] IEEE Standards Association, "What are Standards? Why are they important?," 03 October 2011. [Online]. Available: http://standardsinsight.com/ieee_company_detail/what-are-standards-why-are-they-important. [Accessed 20 March 2016].

[2] M. Holt, "Article 90: Introduction to the National Electric Code".

[3] K. Keller, Electrical Safety Code Manual: A Plain Language Guide to National Electric Code, OSHA and NFPA 70E, Burlington: Elsevier Inc, 2010.

[4] NECA, "Electrical Codes and Standards," National Electrical Contractors Association, 2016. [Online]. Available: http://necaconnection.org/learn/electrical-codes-and-standards. [Accessed 20 February 2016].

[5] Coldrocks Utility Engineering, "National Electrical Safety Code (NESC)," Coldrocks.com, 2011. [Online]. Available: http://www.coldrocks.com/nesc/index.php. [Accessed 18 March 2016].

[6] IEEE, National Electric Safety Code C2-2007, New York: Institute of Electrical and Electronic Engineers, Inc., 2007.

[7] National Fire Protection Association, NFPA 70: National Electric Code, NFPA, 2008.

[8] M. J. Hyland and J. R. Tomasesk, "Clarifying the NESC/NEC boundary," CFE Media LLC., 1 December 2012. [Online]. Available: http://www.controleng.com/single-article/clarifying-the-nescnec-boundary/dd93338da0.html. [Accessed 16 February 2016].

[9] "NEC vs. NESC: Understanding the world of code," IAEI Magazine, 16 02 2001. [Online]. Available: http://iaeimagazine.org/magazine/2001/07/16/nec-vs-nesc-understanding-the-world-of-code/. [Accessed 17 February 2016].

Suggested Readings

K. Keller. Electrical Safety Code Manual: A Plain Language Guide to National Electric Code, OSHA and NFPA 70E

Mike Holt. Mike Holt's Illustrated Guide to Understanting the NEC Volumes 1 and 2

Charles Miller. Illustrated Guide to the NEC.

Allen L. Clapp. NESC Handbook: A Discussion of the National Electrical Safety Code

David Marne. National Electrical Safety Code 2012 Handbook.