



## TOPIC OF STUDY

Electricity Basics



## LESSON

Introduction to the National Electric Code (NEC) ([Lesson 711 NEC](#))

- NEC Responsibilities
- NEC 690 Solar Definitions

## OBJECTIVES

Students will:

- Explain the purpose of the NEC rules that govern how to safely install solar systems.

## BIG IDEA(S)

NFPA 70, National Electrical Code (NEC) is the benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards and includes rules for installing PV systems.

## TASK LIST SUBCATEGORY

- 710 Explain the purpose of the National Electric Code
- 711 Demonstrate how to use the National Electric Code Book as a reference guide

## OVERVIEW

The NEC is the book of rules that governs how to safely install solar systems. Remember, the NEC is the baseline for SAFETY when designing and installing solar systems. It is not about optimal design; those are two very different things.

The NEC is written by the [National Fire Protection Association](#) (NFPA, referred to as NFPA 70). It is the basis for most Authorities Having Jurisdiction (AHJ) codes and regulations. That said, every AHJ has its own rules that can supersede the NEC and utilities may have additional sets of rules and regulations that must be followed (For example there is the [PECO Yellow Book](#), with rules governing cogeneration on the PECO distribution grid).

In the BSF Solar Technician program, the teacher will provide examples of how and when to use the NEC reference. For example, when teaching Power Tolerance and Nominal Voltage for PV panels, the teacher will demonstrate how to find the definition:

*NEC defines nominal voltage in Article 100 as follows:*

*"A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g. 120/240 volts, 480/277 volts, 600 volts). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment."*

**IMPORTANT NOTE:** The NABCEP Associate Exam does not include the NEC code. However, it is important to be aware of the Code's impact on PV installation since many of the rules must be followed for safety.

## STANDARDS

### PA/SDP

**3.4.10.B2.** Demonstrate how humans devise **technologies** to reduce the negative consequences of other **technologies**.



## STANDARDS - CONTINUED

### NGSS STANDARDS

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

## IMPLEMENTATION (LESSON PLAN)

### ENGAGE

- Provide several copies of the NEC reference (or provide on-line access. Have pairs of students explore the references and share comments about something they have found.

### EXPLORE

- Review the Table of Contents and demonstrate how something is researched. Call attention to sections that would be used to explore topics in solar installation. What topics or related components or procedures do students predict would be covered?

### EXPLAIN

1. The NEC is the book of rules that governs how to safely install solar systems. Remember, the NEC is the baseline for SAFETY when designing and installing solar systems. It is not about optimal design; those are two very different things. The NEC is written by the [National Fire Protection Association](#) (NFPA, referred to as NFPA 70). It is the basis for most Authorities Having Jurisdiction (AHJ) codes and regulations. That said, every AHJ has its own rules that can supersede the NEC and utilities may have additional sets of rules and regulations that must be followed (For example there is the [PECO Yellow Book](#), with rules governing cogeneration on the PECO distribution grid).
2. The NEC book is very long and can be hard to understand. It deals mostly with topics that are not directly related to solar. It is important to try and read relevant sections even though you may not necessarily understand them. The more you read the code the more you will see how it's applied when you are in the field.
3. The NEC code book is updated every three years (for example: NEC 2011, 2014, 2017, 2020). It is very rare for the most recent code version to be approved by the AHJ, meaning that it is more likely the AHJ is using an older version of the NEC. For example, up until 2019 the City of Philadelphia was using NEC 2008, then in 2019 it approved NEC 2014 to be used with residential applications and NEC 2017 to be used with commercial applications. Usually Massachusetts adopts the most current version of the NEC and then all other states and municipalities follow after a number of years.

### EXTEND

1. The information about solar is mostly found in Article 690. 690.1 gives the scope of the entire article while 690.2 is about definitions. 690.3 is about "Other Articles" and basically says that if any other sections of the code conflict with Article 690 than Article 690 will supersede them. This makes Article 690 the authoritative location to find information about solar systems. In NEC 2014 Article 690 starts on page 623 and ends on page 638. It is very important that you read the entire article and have a firm understanding of the NEC as it pertains to solar.





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## IMPLEMENTATION (LESSON PLAN) - CONTINUED

### 2. Examples of Solar Rules in NEC:

- a. There are also a number of other articles and tables that are very important when it comes to solar energy:

**Table 310.15(n)(3)(a) Adjustment Factors for More Than Three Current-Carrying Conductors:** When there are more than 3 current carrying conductors in a raceway the ampacity of the conductor needs to be derated from what is listed in Table 310.15(B)(16).

**NOTE:** You may need to use multiple derate calculations on a single conductor. For example: if a conductor is used in 130°F heat and there are 5 conductors in a raceway then the conductor will need to be derated for the ambient temperature as well as the increased temperature in the raceway due to the fact that there are so many conductors.

**Table 110.28 Enclosure Selection:** This table deals with the enclosures and the minimum ratings for different use types. For example: NEMA 1 is for indoor use whereas NEMA 3R can be used outdoors. There are more classifications than you might think, so be sure to understand this table well.

**Section 352: Rigid Poly-Vinyl Chloride: Type PVC:** This section deals with all of the rules when using PVC conduit.

**Section 358: Electrical Metallic Tubing: Type EMT:** This section deals with all of the rules when using EMT conduit.

**Section 250: Grounding and Bonding:** This section spells out the rules for safely grounding all electrical equipment including the equipment grounding conductor (EGC) and the grounding electrode conductor (GEC).

## RESOURCES/LINKS

NEC Scope 2020

<https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70>

