Inspecting Dwelling Unit Electrical Systems

Maine Building Officials and Inspectors Association

May 17, 2015 | Jeff Sargent, NFPA Regional Electrical Code Specialist
NFPA Resources
National Fire Protection Association
The authority on fire, electrical, and building safety

Codes and Standards

Table: NFPA Codes and Standards

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Code Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 1</td>
<td>Fire Code</td>
<td>Final NFPA Fire Code, standards for protection against fire, combustion, and</td>
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<tr>
<td></td>
<td></td>
<td>related hazards, established by consensus of safety professionals.</td>
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<tr>
<td>NFPA 2</td>
<td>Hydrogen Technologies Code</td>
<td>Sets minimum requirements for proper handling, use, and control of hydrogen</td>
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<td></td>
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<td>to prevent fires or serious injury.</td>
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<tr>
<td>NFPA 3</td>
<td>Recommended Practice for Commissioning of Fire Protection and Life Safety Systems</td>
<td>Provides guidance for the commissioning of fire protection systems.</td>
</tr>
<tr>
<td>NFPA 4</td>
<td>Standard for In-Habited Fire Protection and Life Safety Systems Testing</td>
<td>Establishes minimum standards for testing and inspection of fire protection</td>
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<td></td>
<td></td>
<td>systems to protect life and property.</td>
</tr>
<tr>
<td>NFPA 10</td>
<td>Standard for Portable Fire Extinguishers</td>
<td>Sets minimum requirements for portable fire extinguishers.</td>
</tr>
<tr>
<td>NFPA 11</td>
<td>Standard for Low, Medium, and High-Expansion Foam Systems</td>
<td>Establishes standards for the use and installation of low, medium, and</td>
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<tr>
<td></td>
<td></td>
<td>high-expansion foam systems.</td>
</tr>
<tr>
<td>NFPA 11A</td>
<td>Standard for Medium- and High-Expansion Foam Systems</td>
<td>Provides standards for the use and installation of medium- and high-</td>
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<tr>
<td></td>
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<td>expansion foam systems.</td>
</tr>
<tr>
<td>NFPA 12</td>
<td>Standard on Carbon Dioxide Extinguishing Systems</td>
<td>Provides standards for the use and installation of carbon dioxide</td>
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<td>extinguishing systems.</td>
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<tr>
<td>NFPA 12A</td>
<td>Standard on Halon 1301 Fire Extinguishing Systems</td>
<td>Establishes standards for the use and installation of Halon 1301 fire</td>
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<tr>
<td></td>
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<td>extinguishing systems.</td>
</tr>
<tr>
<td>NFPA 13</td>
<td>Standard for the Installation of Sprinkler Systems</td>
<td>Sets minimum requirements for the installation of sprinkler systems.</td>
</tr>
<tr>
<td>NFPA 13D</td>
<td>Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes</td>
<td>Provides standards for the installation of sprinkler systems in one- and</td>
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<tr>
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<td>two-family dwellings and manufactured homes.</td>
</tr>
<tr>
<td>NFPA 13F</td>
<td>Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems</td>
<td>Provides guidance for fire department operations in properties protected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>by sprinkler and standpipe systems.</td>
</tr>
<tr>
<td>NFPA 14</td>
<td>Standard for the Installation of Standpipe and Hose Systems</td>
<td>Establishes standards for the installation of standpipe and hose systems.</td>
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<tr>
<td>NFPA 15</td>
<td>Standard for Water Spray Fixed Systems for Fire Protection</td>
<td>Sets minimum requirements for fixed water spray systems for fire protection</td>
</tr>
<tr>
<td>NFPA 16</td>
<td>Standard for the Installation of Foam/Water Sprinkler and Foam/Water Spray Systems</td>
<td>Provides standards for the installation of foam/water sprinkler and foam/water spray systems</td>
</tr>
<tr>
<td>NFPA 17</td>
<td>Standard for Dry Chemical Extinguishing Systems</td>
<td>Establishes standards for the use and installation of dry chemical</td>
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<tr>
<td>NFPA 17A</td>
<td>Standard for Wet Chemical Extinguishing Systems</td>
<td>Provides standards for the use and installation of wet chemical</td>
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<td></td>
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<td>extinguishing systems.</td>
</tr>
<tr>
<td>NFPA 19</td>
<td>Standard for Water Additives for Fire Control and Vapor Mitigation</td>
<td>Sets minimum requirements for water additives used in fire control and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>vapor mitigation.</td>
</tr>
<tr>
<td>NFPA 20</td>
<td>Standard for the Installation of Stationary Pumps for Fire Protection</td>
<td>Provides guidance for the installation of stationary pumps for fire</td>
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<td></td>
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<td>protection.</td>
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NFPA® 70
National Electrical Code®
2014 Edition
### Free Account Inc. 2004 Edition of NFPA 70

**Chapter 210 — Branch Circuits**

**ARTICLE 210 Branch Circuits**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>210.3.1</td>
<td>Scope: This article covers branch circuits except for branch circuits for limited-use or emergency only smoke alarms, which are covered in Article 408. Provisions of this article and Article 430 apply to branch circuits with combination loads.</td>
</tr>
<tr>
<td>210.2.1</td>
<td>Other Articles for Specific-Purpose Branch Circuits: Branch circuits shall comply with the article and also with the applicable provisions of other articles of this Code. The provisions for branch circuits supplying equipment listed in Table 210.2.1(a) or (d) supplement the provisions in this article.</td>
</tr>
<tr>
<td>210.3</td>
<td>Rating: Branch circuits recognized by the article shall be used in accordance with the maximum permitted amperage rating of the overload device. The rating for other than individual branch circuits shall be 15, 20, 30, 40, and 50 amperes. Where conductors of higher ampacity are used for any reason, the ampere rating or rating of the specified overload device shall determine the circuit rating.</td>
</tr>
<tr>
<td>210.4.1</td>
<td>Multifamily Branch Circuits. (A) General: Branch circuits recognized by this article shall be permitted as multiple circuits. A multiconductor branch circuit shall be permitted to be considered as multiple circuits. All conductors of a multiple branch circuit shall originate from the same panelboard or similar distribution equipment.</td>
</tr>
</tbody>
</table>
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Electrical Inspection Manual with Checklists
CHAPTER 6

Dwelling Units and Mobile/Manufactured Home Sites

OVERVIEW

This chapter covers the general aspects of dwelling unit and mobile/manufactured home site inspections. Special systems and equipment such as swimming pools, electric deicing and snow melting, motors, air conditioners, dumbwaiters, wheelchair and stairway lifts, and communications wiring are not covered in this chapter but are discussed in other chapters of this manual and in specific articles of the National Electrical Code® (NEC®).

The NEC rules for dwelling units are more detailed than the rules for most other occupancy types. The detailed rules covering dwelling units make inspecting them both easier and more difficult than inspecting other types of occupancies. On the one hand, inspections are easier because the rules are more specific, more issues are covered, and fewer matters are left to design discretion. On the other hand, inspections can be more difficult because there are many more rules to remember and apply. Because many dwelling unit electrical installations are laid out by the electrician or the electrical contractor, it is necessary to provide specific prescriptive requirements that provide for a safe electrical plan and installation.

The inspection of the mobile or manufactured home site supply equipment is typically the extent of a field inspector's involvement with these types of dwelling units. Because their construction, including the electrical wiring, is performed within the manufacturing facility, these units are subject to inspection during the manufacturing process. In addition, manufactured homes are built in accordance with U.S. Department of Housing and Urban Development (HUD) construction standards, which supersede locally adopted codes. Thus, only the site supply equipment for these new homes is within the jurisdiction of local code enforcement officials.
### CHECKLISTS

**Checklist 6-1: Residential Rough Inspection: General Requirements (All Areas)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Inspection Activity</th>
<th>NEC Reference</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Check wiring methods (usually cable assemblies) for support and suitability for the conditions.</td>
<td>NEC Chapters 3, 7, and 8, Art 334, 314.17</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Check cable installation through or parallel to framing members and furring strips for 1 1/4-in. (32-mm) clearance or protective steel plates.</td>
<td>300.4</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Check boxes for suitability for the use.</td>
<td>314.15, 314.27</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Verify that boxes are installed in accessible locations for all junctions and outlets and pull points.</td>
<td>300.15, 314.29</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Check that cables are secured to boxes.</td>
<td>314.17(B) and (C)</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Check boxes for conductor fill.</td>
<td>314.16</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Check positioning of boxes that are intended to be flush with combustible and noncombustible finished surfaces.</td>
<td>314.20</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Check for splicing devices on all equipment grounding conductors within boxes and bonding connections to metal boxes.</td>
<td>250.8, 250.86, 250.146, 250.148</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Check equipment grounding conductors for suitability and size.</td>
<td>250.118, 250.122</td>
<td></td>
</tr>
</tbody>
</table>
Electrical Inspection Manual with Checklists

WORKING THROUGH THE CHECKLISTS

RESIDENTIAL ROUGH INSPECTIONS

Checklist 6-1: General Requirements (All Areas; Residential Rough Inspection)

1. Check wiring methods (usually cable assemblies) for support and suitability for the conditions.
   All wiring methods have specific support requirements and restrictions on their application. The most common type of cable used in residential wiring, Type NM cable, is required to be supported every 4½ ft (1.4 m) and within 12 in. (300 mm) of boxes and other enclosures (334.30). If the NM cable is not attached directly to a box (as is the case...
Key NEC Articles

• 100 Definitions
• 110 Requirements for Electrical Installations
• 210 Branch Circuits
• 230 Services
• 250 Grounding and Bonding
• 300 Wiring Methods
• 314 Outlet, Device, Pull and Junction Boxes
• 334 Nonmetallic Sheathed Cable
• 404 Switches
• 406 Receptacles, Cord Connectors and Attachment Plugs
• 410 Luminaires, Lampholders and Lamps
• 422 Appliances
• 440 Air-Conditioning and Refrigerating Equipment
Other NEC Articles

• 411 Lighting Systems Operating at 30 Volts or Less
• 445 Generators
• 550 Mobile Homes, Manufactured Homes and Mobile Home Parks
• 680 Swimming Pools, Fountains and Similar Installations
• 690 Solar Photovoltaic (PV) Systems
• 702 Optional Standby Systems
• 705 Interconnected Electric Power Productions Sources
• 725 Class 1, Class 2 and Class 3 Remote-Control, Signaling and Power-Limited Circuits
Basic Elements of a Dwelling Electrical System

- Service
- Circuit Wiring
  - Feeders
  - Branch Circuits
- Wiring Devices
- Utilization Equipment
- Limited-Energy Systems
Basic Elements of a Dwelling Electrical System

• **Service** - The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

• **Feeders** - All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device.

• **Branch Circuits** - The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).
Basic Elements of a Dwelling Electrical System
Basic Elements of a Dwelling Electrical System

• Wiring Devices - A unit of an electrical system that carries or controls electric energy as its principal function.

• Utilization Equipment - Equipment that utilizes electric energy for electronic, electromechanical, chemical, heating, lighting, or similar purposes.

• Limited-Energy Systems – Signaling circuits, communications circuits, data circuits, CATV
Inspecting the Dwelling Electrical System

- Rough-in inspection
- Service inspection
- Final inspection
Rough-in Inspection

- Wiring method
- Boxes
- Outlet location and spacing
- Switch-controlled lighting outlet location(s)
- Branch circuit requirements
- Specific outlet and/or circuit requirements
Rough-in Inspection

• What is an outlet?
  – A point on the wiring system where power is obtained to supply utilization equipment
    • Receptacle outlets
    • Lighting outlets
    • Specific purpose outlets
    • Switch locations are not outlets

• What is a receptacle?
  – A single contact device on one mounting strap is a single receptacle
  – Typical duplex device is two receptacles
Rough-in Inspection - Wiring Methods

- Typically Type NM cable (Art. 334)
  - **Securing and supporting**
    - Every 4.5 ft. & within 12 in. of entry to boxes (8 in. for single gang nonmetallic boxes)
  - **Unfinished basements and crawl spaces**
    - 14 – 10 AWG on running boards or through bored holes
  - **Installed through caulked holes and in contact with thermal insulation**
  - **Bored holes (300.4 (A))**
    - 1 ¼ in. clearance
  - **Parallel to framing members & furring strips (300.4 (D))**
    - 1 ¼ in. clearance
Rough-in Inspection - Boxes

- **Boxes (Art.334)**
  - **Size**
    - Metal
    - Nonmetallic
  - **Position in wall**
    - Combustible
    - Noncombustible
  - **Suitability for use**
    - Support of equipment
    - Fan boxes
  - **Securing wiring method to box**
  - **Equipment grounding conductors connected together (250.148)**
Rough-in Inspection - Receptacle Outlets

- Receptacle outlet location and spacing (210.52)
  - Wall receptacle outlets
    - No space measured along wall line more than 6 ft. from receptacle
    - Individual wall spaces 2 ft. or more are included
    - Floor outlets can be used if no more than 18 in. from wall
    - Receptacles over 5 ½ ft. above floor are not counted
    - Switched receptacles are not counted
Rough-in Inspection - Receptacle Outlets

- Receptacle outlet location and spacing (210.52)
  - Wall receptacle outlets
Rough-in Inspection - Receptacle Outlets

- Receptacle outlet location and spacing (210.52 (C))
  - **Counter receptacle outlets**
    - No space measured along counter wall space more than 2 ft. from receptacle
    - Individual counter spaces 12 in. or more are included
    - Receptacles must be installed above counter
      - ADA compliance permits outlets below countertop
      - Islands and peninsulas without backsplash
    - Receptacles over 20 in. above counter are not counted
    - Spaces interrupted by rangetops, refrigerators and sinks are considered as separate spaces
      - See Figure 210.52(C) (1)
      - Peninsula and island spaces are separate if space behind interrupting item is less than 12 in.
Rough-in Inspection - Receptacle Outlets

- Receptacle outlet location and spacing (210.52 (C))
  - Counter receptacle outlets
Rough-in Inspection - Receptacle Outlets

• Receptacle outlet location and spacing (210.52(C))
  – Counter receptacle outlets
Rough-in Inspection - Receptacle Outlets

- Receptacle outlet location and spacing (210.50)
  - Receptacle for specific appliance or other utilization equipment
    - Must be installed within 6 ft. of equipment location
      - Disposals
      - Dishwashers
      - Ranges
      - Washing machines
      - Dryers
      - Garage door openers
      - Sump pumps
Rough-in Inspection - Switched Lighting Outlet Locations

• Switch-controlled lighting outlet locations (210.70)
  – Every habitable room & bathroom
    • Switched receptacle permitted in other than kitchens and bathrooms
    • Habitable rooms require wall switch
    • NEC does not specify switch location or multiple points of control (in general)
    • Neutral conductor required at every switch location w/some exceptions (404.2)
Rough-in Inspection

• Branch circuit requirements
  – General purpose 15- or 20-ampere, 125 volt branch circuits used to supply all required receptacle and lighting outlets unless otherwise specified
  – Required specific purpose or area branch circuits will be covered later
  – Branch circuit loading requirements contained in 210.22 & 210.23 with summary in 210.24 and Table 210.24
Rough-in Inspection

- Branch circuit requirements for multiple outlet circuits

<table>
<thead>
<tr>
<th>Circuit Rating</th>
<th>15 A</th>
<th>20 A</th>
<th>30 A</th>
<th>40 A</th>
<th>50 A</th>
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</thead>
<tbody>
<tr>
<td>Conductors (min. size):</td>
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<tr>
<td>Circuit wires¹</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>6</td>
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<tr>
<td>Taps</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>12</td>
<td>12</td>
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<td>Fixture wires and cords — see 240.5</td>
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<td>Overcurrent Protection</td>
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<tr>
<td>15 A</td>
<td>20 A</td>
<td>30 A</td>
<td>40 A</td>
<td>50 A</td>
<td></td>
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<td>Outlet devices:</td>
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<tr>
<td>Lampholders permitted</td>
<td>Any type</td>
<td>Any type</td>
<td>Heavy duty</td>
<td>Heavy duty</td>
<td>Heavy duty</td>
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<tr>
<td>Receptacle rating²</td>
<td>15 max. A</td>
<td>15 or 20 A</td>
<td>30 A</td>
<td>40 or 50 A</td>
<td>50 A</td>
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<tr>
<td>Maximum Load</td>
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<td></td>
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<tr>
<td>15 A</td>
<td>20 A</td>
<td>30 A</td>
<td>40 A</td>
<td>50 A</td>
<td></td>
</tr>
<tr>
<td>Permissible load</td>
<td>See 210.23(A)</td>
<td>See 210.23(A)</td>
<td>See 210.23(B)</td>
<td>See 210.23(C)</td>
<td>See 210.23(C)</td>
</tr>
</tbody>
</table>
Rough-in Inspection - Kitchen

- Small appliance branch circuits (210.11 & 210.52 (C))
  - Two or more 20 ampere, 125 volt circuits for all receptacle outlets
  - The two small appliance branch circuits must both serve the counter receptacle outlets.
  - No other receptacle outlets permitted except for clock receptacle and receptacle for ignition and controls on gas range
  - Refrigeration equipment required to be on one of small appliance branch circuit unless an individual branch circuit is used
  - Switched receptacles in addition to required receptacles permitted to be supplied by general-purpose branch circuit
  - Lighting and specific equipment required to be on other than small appliance branch circuits
Rough-in Inspection - Kitchen & Dining Room

- Small appliance branch circuits (210.11 & 210.52 (C))
Rough-in Inspection - Bathrooms & Laundry Areas

- Laundry Branch Circuit (210.11 & 210.52 (F))
  - At least one, 20 ampere, 120 volt branch circuit for laundry receptacle (outlets)
  - Can supply no other outlets
  - Is not required to be exclusive to washing machine
  - Lighting outlets must be supplied by general-lighting circuit
  - Receptacle outlet to be within 6 ft. of intended equipment location

- Bathroom Receptacle Outlet Branch Circuit (210.11 & 210.52(D))
  - At least one, 20 ampere, 120 volt branch circuit for all bathroom receptacles
  - Alternative is to run a 20 ampere, 120 volt branch circuit to each bathroom
  - Receptacle outlet to be within 36 in. and not more than 12 in. below of basin location
Rough-in Inspection - Hallways & Foyers

• Hallways (210.52 (H))
  – One receptacle outlet for hallways 10 ft. or more in length
  – Lighting outlet
  – Both can be supplied by general-purpose branch circuit

• Foyers (210.52 (I))
  – Receptacle outlet required if greater than 60 ft.\(^2\) and not part of a hallway
  – Outlet must be installed on each separate wall space 3 ft. or greater in width.
  – Door sidelights extending to floor level not considered receptacle outlet
  – Supplied by general-purpose branch circuit
Rough-in Inspection - Stairways

• Interior Stairways (210.70)
  – At least one wall switch-controlled lighting outlet
  – Wall switch control must be at each level for stairways with six or more risers
  – Switch required at landing if there is an entry/exit

• Exterior Stairways (210.70)
  – At least one wall switch-controlled lighting outlet
Rough-in Inspection - Closets and Attics

• Closets (410.16)
  – Lighting outlet permitted
  – Clearance requirements depending on luminaire type
  – Does not have to be wall-switch controlled

• Attics (210.63, 210.70)
  – Lighting outlet required if used for storage or if equipment requiring servicing is installed
  – Does not have to be wall switch-controlled
  – Switch must be located near entry to space
  – If equipment requiring servicing is located in space, the lighting outlet must be near the equipment
  – If heating, refrigeration or air-conditioning equipment requiring servicing is located in space there must be a receptacle outlet installed with 25 ft. of equipment
Rough-in Inspection - Closets and Attics

- 300 mm (12 in.) or shelf width
- 1.8 m (6 ft) or rod height
- 600 mm (24 in.)
Rough-in Inspection - Basement, Garage, Outdoors

• Basement (210.52 (G))
  – At least one receptacle outlet required in addition to any installed for a specific purpose
  – Can be supplied by a general-purpose branch circuit
  – Lighting outlet require if used for storage or for utilization equipment requiring servicing
  – Basement stairway requires wall switch controlled lighting outlet at each level if stairway has 6 or more risers

• Garage (210.52 (G))
  – One receptacle outlet for each car space
  – Branch circuit supplying garage receptacle outlets cannot supply outlets located outside of the garage
  – At least one wall switch controlled lighting outlet required
  – Can be supplied by same circuit that supplies receptacles
• Outdoors (210.52 (E))
  – At least one receptacle outlet at the front and at the back
  – At least one receptacle outlet for each porch, balcony or deck
  – Does not have to be accessible while standing at grade but cannot be more than 6 ½ ft. above grade or platform
  – Receptacle outlet required within 25 ft. of heating, air-conditioning and refrigeration equipment
  – Wall switch controlled lighting outlet required at all outdoor entry/exits
Final Inspection - General for all areas

- Wiring method
- Boxes
- Outlet location and spacing
- Switch-controlled lighting outlet location(s)
- Branch circuit requirements
- Specific outlet and/or circuit requirements
- Device requirements
Final Inspection - General for all areas

- Wiring method (Art. 334)
  - Verify supporting and securing in all exposed locations
  - Wiring not exposed to physical damage
Final Inspection - General for all areas

• Boxes
  – Proper position in wall
  – No gaps greater than 1/8 in. around box perimeter
  – Cover plates installed
  – Unused openings properly closed
  – Equipment grounding conductors properly
Final Inspection - General for all areas

- Outlet location and spacing
  - Proper receptacle outlet spacing for walls, counter spaces, islands, and peninsulas
Final Inspection - General for all areas

• Switch-controlled lighting outlet location(s)
  – Wall or otherwise switch-controlled lighting outlets in all required locations
Final Inspection - General for all areas

• Branch circuit requirements
  – Proper rating of devices based on branch circuit rating

<table>
<thead>
<tr>
<th>Circuit Rating (Amperes)</th>
<th>Receptacle Rating (Amperes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Not over 15</td>
</tr>
<tr>
<td>20</td>
<td>15 or 20</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>40</td>
<td>40 or 50</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>
Final Inspection - General for all areas

• Specific outlet and/or circuit requirements
  – See room/area specific sections for specific branch circuit requirements
  – AFCI and GFCI requirements for specific locations (210.8(A) and 210.12)
    • AFCI protection required for all 15- and 20-ampere, 120 volt branch circuits supplying outlets in all areas except for bathrooms, garages, outdoors and basements
    • AFCI and GFCI devices are to be *readily accessible*
Final Inspection - General for all areas

• Device requirements
  – All 125 volt, 15 and 20 ampere receptacles required to be tamper-resistant
  • Exceptions for receptacles
    – Above 5 ½ ft.
    – Part of an appliance or luminaire
    – Receptacle(s) supplying appliance where appliance is not easily moved and prevents access to receptacle
Final Inspection - Kitchen

- GFCI protection for all 15- and 20-ampere, 125 volt receptacles serving countertops and those within 6 ft. of kitchen sink
- GFCI protection of dishwasher
- Proper application of small appliance branch circuits
- At least one wall switch-controlled lighting outlet
- Proper connection and circuit rating for appliances
Final Inspection - Dining Room

• Receptacle outlets supplied by at least one small appliance branch circuit
• Wall switch-controlled lighting outlet on other than small appliance branch circuit
Final Inspection - Bathrooms & Laundry Areas

• Laundry
  – Receptacle outlet(s) supplied by laundry branch circuit
  – Properly rated circuit and receptacle configuration for electric clothes dryer
  – GFCI protection for all 125 volt, 15- and 20-ampere receptacles

• Bathroom
  – Proper location of receptacle outlet
  – Bathroom receptacle outlet(s) supplied by dedicated 20 ampere, 120 volt branch circuit
  – GFCI protection for all 125 volt, 15- and 20-ampere receptacles
Final Inspection - Hallways & Foyers

• Proper receptacle outlet location
• Hallway requires at least one wall switch-controlled lighting outlet that is controlled from at least one location
Final Inspection - Stairways

- Interior stairways require at least one wall switch-controlled lighting outlet that is controlled from each level where stairway is 6 or more risers
Final Inspection - Closets and Attics

• Proper clearances for luminaires installed in clothes closet
• Proper location for switch-controlled lighting outlet depending on whether there is equipment requiring service
• If heating, air-conditioning or refrigeration equipment is installed in attic, there must be at least one, 15- or 20-ampere, 125 volt receptacle installed within 25 ft.
Final Inspection – Unfinished Basement, Garages, Outdoors

- Required receptacles outlets installed
- GFCI protection required for all 15- and 20-ampere, 125 volt receptacles
- For receptacles installed in wet locations “in-use” cover required and if of the hood type it must be marked “extra-duty” (406.9 (B))
- Receptacles installed in damp and wet locations required to be listed weather-resistant type.
- Dedicated branch circuit for central heating equipment (hot air and hydronic heating equipment and auxiliary equipment)
- Required wall switch-controlled lighting outlet
- Required disconnecting means for heating and air-conditioning equipment
Final Inspection – Unfinished Basement, Garages, Outdoors
Service Inspection

- Load calculation
- Location of service equipment
- Wiring method
- Working and dedicated space
- Illumination
- Grounding and bonding
Service Inspection

• Load calculation
  – Article 220 provides detailed standard & optional methods for calculating load
  – Several examples of one-family dwellings in Annex D
  – Service calculation determines minimum rating for service equipment and service conductors
  – Service calculation determines minimum number of branch circuits
  – Minimum service size for one-family dwelling is 100 amperes
  – Individual dwelling units in multi-family dwellings may be supplied by smaller services or feeders
Service Inspection

• Load calculation
  – How many general lighting and other 120 volt branch circuits are required for a two-story dwelling unit (built on a slab) with outside dimensions of 35 x 45?
Service Inspection

• Load calculation
  – Do the math:
    • $35 \text{ ft}^2 \times 45 \text{ ft}^2 \times 2 = 3150 \text{ ft}^2$
    • $3150 \text{ ft}^2 \times 3 \text{ VA ft}^2 = 9450 \text{ VA}$
    • $9450 \text{ VA}/1800\text{VA (120V x 15A)} = 5.25$ or $6 - 15\text{A BCs}$
    • $9450\text{VA}/2400\text{VA (120V x 20A)} = 3.94$ or $4 - 20\text{A BCs}$
    • Add in the 2 – 20A small appliance branch circuits, the 20A laundry branch circuit, and the 20A bathroom receptacle circuit:
      • $6 - 15\text{A ampere} + 4 - 20\text{ampere BCs} = 10 - 120\text{V BCs or}$
      • $8 - 20\text{A} - 120\text{V BCs}$
Service Inspection

- Location of service equipment (230.70)
  - Service equipment is permitted to be outside or inside nearest the point to where service conductors enter the building
  - Service disconnecting means required to be *readily accessible*
  - NEC does not specify amount of service conductor within a building or structure
  - Service conductors do not have the same level of overcurrent protection as feeders and branch circuits
  - Prohibited from being installed in a bathroom
  - Service disconnecting means can consist of up to 6 switches or circuit breakers grouped in the same location
  - Panelboards required to be protected by a single main overcurrent device
  - Utility meter enclosure and meter is not service equipment
Service Inspection

• Wiring method
  – Overhead
    • Raceway or service cable
    • Clearances from building openings
    • Clearances above roofs
    • Support of service masts that extend above roofline
    • Appropriate wiring method based on exposure to physical damage
Service Inspection

- Wiring method
  - Overhead
Service Inspection

• Wiring method
  – Overhead
Service Inspection

- Wiring method
  - Underground
    - Wiring method
    - Cover requirements (Table 300.5)
    - Warning ribbon place 12 in. above underground wiring methods that are 18 in. or more below grade
    - Protection of service conductors emerging from below grade
    - Compensation for ground movement where wiring method emerges from below grade
    - Appropriate wiring method based on exposure to physical damage
Service Inspection

• Working and dedicated space
  – Not required to be in a dedicated room
  – Height = 6 ½ ft.
  – Width = 30” or width of equipment whichever is greater
  – Depth = 36 in. (Table 110.26 (A))
  – Dedicated space = Clear space above and below footprint of equipment to a height of 6 feet or the structural ceiling
    • Equipment not associated with electrical installation prohibited from entering this space
  – Location must permit 90 degree swing of hinged enclosure covers
Service Inspection

- Illumination
  - Required for service equipment working space installed indoors
  - Not specific level of illumination specified
  - Illumination provide by general lighting in area can be used to meet this requirement
  - Cannot be controlled by automatic means only
Service Inspection

- Grounding and bonding (Article 250)
  - What types of grounding electrodes are available?
    - Underground metal water piping
    - Concrete encased
    - Structural steel
  - Is the water piping system metal or nonmetallic?
  - Size of grounding electrode conductor (250.66)
  - Protection of grounding electrode conductor
  - Bonding around water meter
  - Bonding to other metal piping systems
  - Bonding metal service raceways
  - Bonding service equipment and other service conductor enclosures
Service Inspection

- Grounding and bonding (Art. 250)
  - Proper connection to grounding electrodes
  - Installation of main bonding jumper
  - Intersystem bonding termination
Service Inspection

- Grounding and bonding (Art. 250)
Service Inspection

- Grounding and bonding (Art. 250)

### Size of Largest Ungrounded Service-Entrance Conductor or Equivalent Area for Parallel Conductors (AWG/kcmil)

<table>
<thead>
<tr>
<th>Copper</th>
<th>Aluminum or Copper-Clad Aluminum</th>
<th>Copper</th>
<th>Aluminum or Copper-Clad Aluminum</th>
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<td>1/0 or smaller</td>
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<td>6</td>
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<td>6</td>
<td>4</td>
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<td>2</td>
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<td>Over 250 through 500</td>
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<td>Over 500 through 900</td>
<td>1/0</td>
<td>3/0</td>
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<tr>
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<tr>
<td>Over 1100</td>
<td>Over 1750</td>
<td>3/0</td>
<td>250</td>
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</tbody>
</table>
Service Inspection

- Grounding and bonding (Art. 250)
Service Inspection

• Grounding and bonding (Art. 250)
Service Inspection

- Grounding and bonding (Art. 250)
Pie Chart...

Introductory text goes here
Questions?
Thank You