National Electrical Code Changes for 2005

Developed and Presented by:
The Codes and Standards Group of Schneider Electric

The US Electrical Safety System

Installation Codes

Product Standards and Certification

Inspection and Enforcement

Safe Products and Safe Installations

NEC
NEC Adoption by State

Chapter 1 - General
Chapter 2 - Wiring and Protection
Chapter 3 - Wiring Methods and Materials
Chapter 4 - Equipment for General Use

Supplements or modifies Chapters 1 through 4

Chapter 5 - Special Occupancies
Chapter 6 - Special Equipment
Chapter 7 - Special Conditions

Chapter 8 - Communications Systems
Chapter 9 - Tables
Annex A through Annex G

Applies generally to all electrical installations

Chapter 8 is not subject to the requirements of Chapters 1 through 7 except as specifically referenced in Chapter 8

Applicable as referenced
Information only not mandatory
Article 80 (Moved to Annex G)

Administration and Enforcement

- Provides a set of model administrative rules to apply and enforce the NEC
- Covers
  - Inspection
  - Investigation of electrical fires
  - Review of construction plans, drawings and specifications
  - Design, alteration, modification, construction, maintenance and testing
  - Regulation and control of special events
- Annex G is informative only (not part of the Code) unless specifically adopted by the jurisdiction

90.2(B) – Scope

Not Covered

- New FPN to items (4) and (5) provides examples that describe a “utility”
- Designated or recognized by governmental law or regulation by a PSC
- Install, operate and maintain electric supply systems or communication systems
- May be required to comply with other codes or standards that are adopted by the law or regulation that covers them
- Additional info can be found from the FERC, FCC, state regulatory commissions, etc.
90.5(C) – Explanatory Material
Explanatory Material

- Brackets that show extracted text are for information only
- The standard and reference in the bracket show the source of the extracted material.
- Additional information can be gained from the reference, but the referenced document itself is NOT part of the NEC
- Examples can be found in:
  - 514.2 [NFPA 30A:3.3.11]
  - 517.31 [NFPA 99:4.4.2.2.4.2(B)]
  - 695.3(A)(1) [NFPA 20:9.2.2]
100 – Definitions

**Authority Having Jurisdiction (AHJ)**

- The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.
- New FPN gives examples
  - May be federal, state or local
  - Individual or organization
  - Electrical inspector
  - Building official
  - Fire chief
  - Fire marshal
  - Insurance company representative
  - Commanding officer

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100 – Definitions

**Coordination (Selective)**

- Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the choice of overcurrent protective devices and their ratings or settings.
- Definition is used in 700.27 and 620.62

Overcurrent device closest to the fault opens

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5
100 – Definitions

Device

A unit of an electrical system that is intended to carry or control but not utilize electric energy.

100 – Definitions

Dwelling Unit

A single unit, providing complete, and independent living facilities for one or more persons, including permanent provisions for living, sleeping, cooking, and sanitation.
100 – Definitions

Grounding Electrode

- A device that establishes an electrical connection to the earth.
- 250.52 and 250.53 addresses the types of electrodes

100 – Definitions

Grounding Electrode Conductor

The conductor used to connect the grounding electrode(s) to the equipment grounding conductor, to the grounded conductor, or to both, at the service, at each building or structure where supplied by a feeder(s) or branch circuit(s), or at the source of a separately derived system.
100 – Definitions

Guest Room – Guest Suite

- **Guest Room.** An accommodation combining living, sleeping, sanitary, and storage facilities within a compartment.
- **Guest Suite.** An accommodation with two or more contiguous rooms comprising a compartment, with or without doors between such rooms, that provides living, sleeping, sanitary, and storage facilities.

Handhole Enclosure

An enclosure identified for use in underground systems, provided with an open or closed bottom, and sized to allow personnel to reach into, but not enter, for the purpose of installing, operating, or maintaining equipment or wiring or both.
100 – Definitions

Outline Lighting

An arrangement of incandescent lamps, electric discharge lighting, or other electrically powered light sources to outline or call attention to certain features such as the shape of a building or the decoration of a window.

100 – Definitions

Qualified Person – New FPN

- One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training on the hazards involved.
100 – Definitions

Separately Derived System

A premises wiring system whose power is derived from a source of electric energy or equipment other than a service. Such systems have no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system.

100 – Definitions

Supplementary Overcurrent Protective Device

- Provides limited overcurrent protection
- Specific applications and utilization equipment
  - Luminaires
  - Appliances
- In addition to the required branch circuit overcurrent device
110.1 – General

Scope

- Scope modified to include “enclosures intended for personnel entry”
- Material moved from Article 314
- Part V of Article 110

110.12 – Mechanical Execution of Work

New FPN

- New FPN
- One example of a standard that covers some common industry practices
110.14 – General
Terminations

- References to Design E motors removed
- The Design E motor standard was rescinded by NEMA in February 2000
- This is the first of many places in the code text where references to Design E were removed

110.15 – General
High Leg Marking

- High leg is to be marked “orange”
- Now emphasizes that ONLY the high leg shall be marked by orange
- Must still be identified at each point on the system where a connection is made and the grounded conductor is also present
110.16 – Arc Flash Marking

- Adds “meter socket enclosures” to the list of items requiring the arc-flash marking
- Other items still on the list:
  - Panelboards
  - Switchboards
  - Industrial control panels
  - Motor control centers

110.26 – Working Space

Spaces About Electrical Equipment

- Revised to make it clear that enclosures can be controlled by various types of locks and is not limited to a “lock and key”
- 110.31 for over 600V equipment was also revised
Table 110.26(A)(1) – Working Space

Depth of Working Space

- Revised to remove redundancy with the definition of “exposed” and “live parts” in Article 100.
- Similar changes made to Table 110.34(A) – Over 600V - also revised for consistency.

<table>
<thead>
<tr>
<th>Condition 1</th>
<th>Depth of Working Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood or other insulating material</td>
<td></td>
</tr>
<tr>
<td>Concrete block wall</td>
<td></td>
</tr>
</tbody>
</table>

110.26(C)(2) – Entrance to Working Space

Large Equipment

- 6’ dimension for large equipment has been deleted
- “Two entrance” rule applies for any equipment 1200A or greater
- Double working space still permitted instead of two entrances to the space
200.6(D) - Identification of Grounded Conductors

Grounded Conductors of Different Systems

- Where installed in the same raceway, cable, box, auxiliary gutter or other enclosure
- One conductor must have an ID that meets 200.6(A) or 200.6(B).
- The other system conductor must use a different means that complies with 200.6(A), (B) or be white/gray with a colored stripe (not green)
- Other and different means of identification as allowed by 200.6(A) or (B) that will distinguish each system grounded conductor.
- This means of identification shall be permanently posted at each branch-circuit panelboard.

210.4(A) & (B) – Multiwire Branch Circuits

Multiwire Branch Circuits

- Requirement for simultaneous disconnect now applies to all locations, not just dwelling units.
- Where supplying more than one device or equipment on the same yoke.
- Disconnect must be located at the point where the branch circuit originates
210.5(C) – Identification for Branch Circuits

Ungrounded Conductors

- Must identify the ungrounded conductors of a branch circuit where:
  - There is more than one nominal voltage system in the building
  - The conductors are accessible
- Identification must be permanently posted at each branch circuit panelboard or similar distribution equipment
- ID can be color coding, marking, tagging, tape, etc.

210.6(D)(2) – Branch-Circuit Voltage Limitations

600 Volts Between Conductors

- Clarifies that luminaires supplies at over 277V to ground and less than 600V phase-to-phase are covered by the height requirements of 210.6(D)(1)
  - Mounted 22’ high on poles for parking lots, stadiums, etc.
  - Mounted 18’ high on tunnels
210.8(A)(7) – GFCI ( Dwelling Units)
Laundry, Utility and Wet Bar Sinks

- Laundry (utility) sink
- 6 feet or less

210.8(B)(2) – GFCI
Other than Dwelling Units

- Title changed to “Commercial and Institutional Kitchens”
- New definition – “For the purposes of this section kitchen is an area with a sink and permanent facilities for food preparation and cooking.
- Requirement remains as in the 2002 NEC
  - All 125V 15 and 20A receptacles in the kitchen
210.8(B)(4) – GFCI

Outdoors in Public Spaces

- Includes all outdoor spaces where the space is for use by or accessible to the public
- All 125V 15 and 20A receptacles are included
- Would not include restricted access areas such as an industrial facility

210.8(B)(5) – GFCI

Other than Dwelling Units

- GFCI protection required for outdoor receptacles where installed to comply with 210.63
- Now includes receptacles that may be installed for HVAC purposes, but not covered under item (4)
210.8(C) – GFCI

Boat Hoists

- Requires GFCI protection for the boat hoist
- Required whether permanently connected or cord- and plug-connected
- 125V, 15 and 20A branch circuits

210.12(B) - AFCI

- Will require a “combination” AFCI beginning January 1, 2008
  - UL 1699 defines types of AFCIs
  - Combination is NOT AFCI/GFCI
## AFCI Types and Detection Capabilities

<table>
<thead>
<tr>
<th>Arc Condition</th>
<th>Branch/Feeder (present device on market)</th>
<th>Outlet Circuit</th>
<th>Combination (proposed for 2005 NEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line to Neutral</td>
<td>Yes – 75A</td>
<td>Yes – 5A</td>
<td>Yes - 5A</td>
</tr>
<tr>
<td>Line to Ground</td>
<td>Yes – 0.050A</td>
<td>Yes – 0.050A</td>
<td>Yes – 0.050A</td>
</tr>
<tr>
<td>Series Arc</td>
<td>No</td>
<td>Yes – 5A</td>
<td>Yes – 5A</td>
</tr>
<tr>
<td>Protects entire branch circuit</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### 210.12(B) - AFCI

Install combination AFCI at the panel
Provides protection for:
- Branch Circuit Wires
- Branch Circuit Wires
210.12(B) Exception No.1 - AFCI

Portion of the circuit between the panel and the AFCI must be in metal conduit or metal sheathed cable.

Install regular CB at the panel

Provides protection for:

Install combination AFCI in outlet box not more than six feet away from the panel.

210.18 – Guest Rooms and Guest Suites

Guest Rooms and Guest Suites

- Rooms that meet the definition of guest room and/or guest suite (Article 100) AND
- Have permanent provisions for cooking
- Install branch circuits and outlets to meet the rules for dwelling units
210.19(A)(3) Exception No. 1 – Branch Circuit Ratings

Household Ranges and Cooking Appliances

- Taps may be made to a 50A branch circuit
- Tap conductors cannot be less than 20A
- Taps may supply electric ranges, wall-mounted electric ovens, and counter-mounted electric cooking units
- The taps include any conductors that are part of the appliance leads
- Taps shall not be longer than necessary for servicing the appliance

210.52(B)(1) – Small Appliances

Receptacle Outlets Served

- Clarifies that small appliance branch circuits must serve
  - ALL wall and floor outlets covered by 210.52(A)
  - ALL countertop outlets covered by 210.52(C)
  - Receptacles for refrigeration equipment

The whips are the branch circuit taps

Must be served by small appliance branch circuits
210.52(C)(1) Exception – Countertops

Wall Counter Space – Kitchens and Dining Rooms

- Receptacles are not required to be installed on a wall directly behind a range or sink where located behind a sink as shown below.

![Diagram of countertop space showing exceptions for outlets behind a sink or range extending from the face of the counter.]

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210.52(C)(1) Exception – Countertops

Wall Counter Space - Kitchens and Dining Rooms

- Outlets not required if X < 450 mm (18 in.)
- Outlet within 24 in.

![Diagram of countertop space showing exceptions for outlets behind a sink or range mounted in a corner.]

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210.52(C)(2) – Countertops
Wall Counter Space – Kitchens and Dining Rooms

If less 12 inches, the island is considered to be two counter spaces

210.52(C)(5) – Countertops
Wall Counter Space – Kitchens and Dining Rooms

Outlets that are placed in the zone where they are not required (X<18”), do not count as the “required” outlets.
**210.52(D) Exception – Dwelling Receptacle Outlets**

**Bathrooms**

- Permits receptacle mounting in the side or face of the basin cabinet
- Located not more than 12” below the countertop

**210.52(E) – Dwelling Receptacle Outlets**

**Outdoor Outlets**

- Receptacle required for each unit of a multifamily dwelling where the unit:
  - Is located at grade level
  - Has an individual exterior entrance/egress
- Outlet must be “accessible from grade level”
- Located not more than 6.5 ft above grade
210.63 – Heating, A/C, and Refrigeration

Equipment Outlet

- No outlet is required at one and two-family dwellings for an evaporative cooler

210.70(B) – Lighting Outlets Required

Guest Rooms or Guest Suites

- Now titled “Guest Rooms or Guest Suites”
- Requires at least one wall switch controlled lighting outlet in each habitable room and the bathroom
- Receptacle control permitted in other than kitchens and bathrooms
- Occupancy sensors permitted
  - In addition to wall switches or;
  - At the wall switch location where it will also function as a wall switch
215.2(A)(1) – Feeders

Feeders Not More Than 600 Volts

- Grounded conductor must be sized
  - To carry the load that will be imposed
  - Not smaller than that an equipment grounding conductor from 250.122
  - 250.122(F) does not apply to grounded conductors installed in parallel

Similar rule for over 600V feeders in 215.2(B)(1)

215.12 – New
Identification

- Must identify the ungrounded conductors of a feeder where:
  - There is more than one nominal voltage system in the building
  - The conductors are accessible
- Identification must be permanently posted at each feeder panelboard or similar feeder distribution equipment
- ID can be color coding, marking, tagging, tape, etc.
220.3 – Computations of Branch Circuit Loads

Reorganization

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220.14 Other Loads — All Occupancies (A-K)
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220.53 Appliance Load — Dwelling Unit(s)
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220.3 – Computations of Branch Circuit Loads

Reorganization

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V. Method for Computing Farm Loads Calculations

220.102 Farm Loads — Buildings and Other Loads
220.103 Farm Loads — Total

220.14(D) – Other Loads – All Occupancies

Luminaires

- Deleted the term “recessed” so that the rule applies to all luminaires
- Load calculation is determined based on the maximum VA rating of the equipment and lamps for which the fixture is rated
220.14(K) – Other Loads – All Occupancies

Banks and Office Buildings

- Adds a new item (K)
- Requires that receptacle loads for office buildings and banks be calculated to be the larger of:
  - Calculation of the actual receptacles installed at 180VA each (220.14) or
  - 1 VA/sq ft
- Material was previously located as a foot note to Table 220.3(A)

220.82(C) - Optional Calculations Feeder & Service Loads

Optional Calculations – Dwelling Unit

- Changes how the largest load is determined for the Heating and AC Load
- Use the largest of
  - 100% of the nameplate ratings of the AC/Cooling load
  - 100% of the nameplate rating of a heat pump when used without supplemental electric heating
  - 100% of electrical thermal storage and other systems
  - 100% of the heat pump and 65% of the supplemental electrical heating
    - If the heat pump compressor and the supplemental heat is interlocked to not operated at the same time, only add the supplemental heating load
  - 65% of the nameplate of space heating if less than four separately controlled units
  - 40% of the nameplate of space heating if four or more separately controlled units
225.17 – Masts as Supports
Feeders and Branch Circuits

Requirements parallel those in 230.28 for service drops

- Adequate strength mast or supported by braces or guys
- Must withstand the strain of the drop
- All raceway type fittings shall be identified for use with masts
- Masts can only support feeders and branch circuit conductors

225.22 – Raceways on Exterior of Building
Arranged to Drain

- Raceways on exteriors of buildings must be arranged to drain
- If in a wet location, the raceway must be raintight
- Parallels language in 230.53 for service raceways
225.30(A)(6) – Number of Supplies

Special Conditions

- New item (6)
- Additional feeder to a building is permitted for “the purpose of enhanced reliability”

Main-tie-main supplied by two services

230.2(A)(6) – Number of Supplies

Special Conditions

- New item (6)
- Additional service to a building is permitted for “the purpose of enhanced reliability”

Main-tie-main supplied by two services
**230.40 Exception #1 – Service Entrance Conductors**

**Number of Conductor Sets**

- **Normal Service**
  - Occupancy #1
  - Occupancy #2
  - Occupancy #3

Permits one set of service entrance conductors for each occupancy for each service permitted by 230.2

**230.44 – Cable Trays**

**Support of Service Conductors**

- **Service Conductors Only**
- **Service and Feeder Conductors**

Exception: Service and Feeder Conductors

- Solid fixed barrier
230.71 - Disconnects

TVSS Disconnect

- TVSS disconnect does not count as one of the six service disconnects where it is “installed as part of the listed equipment”

Disconnect is installed as part of the listed equipment

Also, see 230.82 for correlating language

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230.82 – Connected to Supply Side of Service Disconnect

Meter Disconnect Switch

- Meter disconnect switch
- Must have a short-circuit current rating equal to or greater than the available short circuit current
230.82 – Connected to Supply Side of Service Disconnect

TVSS

- Allows a TVSS to be installed with an “additional disconnect” as recognized by 230.71(A)
- Must be installed as part of the listed equipment
- Must be equipped with suitable overcurrent protection and disconnecting means
- A “suitable” disconnect must be one that is suitable for installation at “service” locations

240.5(B) – Protection of Flexible Cords

Branch Circuit Overcurrent Device

1. Supply cord of a listed appliance or portable lamp
2. Fixture Wire
3. Listed extension cord sets when applied within the listing requirements
4. Field assembled extension cords made up of listed components with #16 AWG or larger cord and supplied by not more than a 20A circuit
240.20(B) – Ungrounded Conductors  
**Overcurrent Device Required**

- Clarifies that a circuit breaker is intended to open all ungrounded conductors of the circuit both manually and automatically (common trip)
- Items 1, 2, 3 permit 1P breakers and identified handle ties in specific circuits/systems

![Diagram of handle ties]

(1) – Multi-wire branch circuit  
(2) – Line to line load  
(3) – Supply a line-to-line load

240.21(B) - Overcurrent Protection Location  
**Feeder Taps**

- Clarifies that the “round up” rule in 240.4(B) cannot be used for overcurrent devices at the end of tap conductors.

![Diagram of feeder taps]

4/0 Copper = 230A  
225A CB - OCP must be rated not greater than the rating of the conductors
240.21(C) - Overcurrent Protection Location

Transformer Secondary Conductors

- Clarifies that the “round up” rule in 240.4(B) cannot be used for overcurrent devices at the end of tap conductors.

Transformer secondary in accordance with 240.21(C)

4/0 Copper Conductors = 230A

225A circuit breaker – cannot round up to a 250A

240.21 – Overcurrent Protection Location

Tap Conductor Protection

- Rules revised to allow protection from physical damage to be in a raceway or by “other approved means”
- Previous code only allowed a raceway
**240.21(C)(6) – Transformer Secondary Conductors**

**Secondary Conductors not over 25’ Long**

- Primary conductors protected at their ampacity
- Conductors terminate in a single CB or set of fuses that limit load current to the ampacity of the secondary conductors

\[
I = \left( \frac{V_{pri}}{V_{sec}} \right) \times (A_{OCP_{pri}} \times \frac{1}{3})
\]

\[
I_{sec} = \frac{480}{240} \times (200 \times \frac{1}{3}) = 133A
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**240.21(C) – Transformer Taps**

**Transformer Secondary Conductors**

- Clarifies that a transformer can supply multiple sets of secondary conductors
- Apply a 240.21 rule to each set of secondary conductors
- The transformer must be able to physically handle the multiple connections
240.24(A) – Location on Premises

**Accessibility**

- Adds the “handle height” rule from 404.8 into 240.24 so that it is clear the rule applies to overcurrent devices.
  
  - Overcurrent devices installed on busway can be located higher in accordance with 368.12
  - Supplemental devices do not have to be “readily accessible
  - Where located next to utilization equipment they supply, the devices can be accessible by portable means

240.60 – Cartridge Fuses

**Renewable Fuses**

- Renewable fuses are only permitted for:
  - Replacement in existing installations and
  - Where there is no evidence of overfusing or tampering
### 240.86(A) – Series Ratings

**Selected Under Engineering Supervision in Existing Installations**

- Allows a series rating to be “engineered” under the following conditions:
  - By a licensed professional engineer engaged primarily in the design or maintenance of electrical installations
  - Selection shall be documented and stamped by the professional engineer
  - Documentation shall be made available
  - Rating shall be field marked on the end use equipment
  - Existing installations only

### 240.86 – Series Ratings

**Selected Under Engineering Supervision in Existing Installations**

- The “upstream” overcurrent device must:
  1. Reduce the let-through current to a value below the interrupting rating of the downstream circuit breaker.
  2. Clear the circuit before the contacts of the downstream circuit breaker begin to open.
  3. Items 1 and 2 are true for all current levels from the rating of the downstream circuit breaker through the rating of the series.
  4. Have an interrupting rating at or above the series rating.

- The problem is that circuit breakers begin to open before current limiting devices can open
  - Typical CL device opens in 4ms (1/4 cycle)
  - Typical contact separation time for a 65kA 480V, 60A circuit breaker is 0.7ms (this is even true for “older” circuit breakers)

- There is NO accurate way to “engineer” a rating in the field
Article 250 – Grounding and Bonding

- Adds “bonding” to the title to emphasize the topic within Article

250.8 – Connection of Grounding and Bonding Equipment

- Sheet metal screws are not permitted to connect grounding conductors or connection devices to enclosures
  
  Thread forming screws are acceptable
250.20 – System Grounding

Impedance Grounded Neutral Systems

- High-impedance grounded systems shall be grounded in accordance with
  - 250.36 (600V and less)
  - 250.186 (over 600V)

250.21 – System not Required to be Grounded

Ground Detectors (New)

- An ungrounded system must now have ground detectors installed on the system
- Systems of less than 120V are not required to have ground detectors
250.30 – Grounding Separately Derived AC Systems

- Entire section has been rearranged
- 250.30(A) includes specific requirement not to “reground” a grounded conductor on the load side of the “point of grounding”
- Uses the new term “system bonding jumper”
- Breaks down requirements for grounding electrodes
  - Single separately derived system
  - Multiple separately derived system

250.30(A)(4) – Grounding Separately Derived System

**Common Grounding Electrode Conductor Size**

- Allows a common grounding electrode for multiple separately derived systems
- Must use exothermic weld, irreversible compression or connect to copper bus bars
- Keep main grounding electrode conductor without a splice or joint

Size “tap” conductors using 250.66 based on the derived phase conductor size

The common grounding electrode conductor shall not be smaller than 3/0 AWG copper or 250 kcmil aluminum.
250.32(A) – Buildings Supplied by Feeder or Branch

Grounding Electrode

- Grounding electrode is **not** required at a second building where supplied by a single branch circuit
- Clarifies that a multi-wire branch circuit is a single circuit

250.34 – Portable and Vehicle Mounted Generators

- Clarifies that the frame of the generator and/or the frame of the vehicle are not considered grounding electrodes
- Continues to permit both types of portable units to be operated without connection to a grounding electrode under specified conditions
250.50 – Grounding Electrode System

- The words “where available” have been removed from the requirement of what electrodes have to be used.
- If the electrode “is present” then it must be bonded together to form the grounding electrode system.
- Means that a concrete encased electrode must now be used:
  - 20’ or more of steel reinforcing bars
  - Encased in at least 2” of concrete
  - Concrete is in a footing or foundation that is in contact with the earth
  - New exception exempts existing buildings where the reinforcing steel is not accessible without disturbing the concrete

250.52(A)(2) – Electrodes Permitted for Grounding

**Metal Frame of Building or Structure**

- Now provides details about what makes building steel “effectively grounded”
- Can use one of the following:
  1. 10 feet or more of a single structural member in direct contact with the earth or encased in concrete that is in direct contact with the earth
  2. Structural frame is bonded to metal underground water pipe, a concrete encased electrode or a ground ring
  3. Structural metal frame bonded to a rod, pipe or plate electrode that complies with 250.56
  4. Other approved means
250.52(A)(7) - Other Metal Underground Systems

Metal Well Casing

- Now recognizes a metal well casing for use as a grounding electrode where none of the items in (A)(1) through (A)(6) are available
- Usable where the casing is not already effectively bonded to a metal water pipe

250.64(C)(3) - Grounding Electrode Conductor Installation

Continuous

- Permits a grounding electrode conductor to be spliced using a busbar
- Busbar requirements:
  - Aluminum or copper
  - Not less than ¼” x 2”
  - Securely fastened in place
  - Installed in an accessible location
- Connections shall be made by a listed connector or by the exothermic welding process.
250.68(A) - Grounding Electrode Conductor Connection

**Accessibility**

- Revision makes it clear that accessibility is not required to a grounding electrode connect to structural steel where:
  - Connection is exothermic or irreversible compression
  - Steel has been fireproofed

250.104(D) – Bonding of Piping / Exposed Steel

**Separately Derived Systems**

- Requires bonding of the water pipe and structural steel to a separately derived system
- Bond at the same point (transformer or disconnect) where the grounding electrode system is connected
- Separate bonding not required where the water pipe and/or the building steel is used as a grounding electrode for the separately derived system
- Exempts bonding of steel (or water pipe) where the water pipe (or steel) is used as a grounding electrode and the two are bonded together
250.118 – Equipment Grounding Conductors

- Deletes flexible metal conduit “that is listed for grounding” because there is no FMC listed for grounding without limitations
- Recognizes the following as equipment grounding conductors
  - Listed continuous metal raceways and listed auxiliary gutters
  - Surface metal raceway listed for grounding.

250.119 – Identification of Conductors

Identification of Equipment Grounding Conductors

- Now prohibits conductors with insulation or individual covering that is green or green with yellow strips from being used for ungrounded or grounded conductors
250.122(G) – Size of Equipment Grounding Conductors

**Feeder Taps**

- Equipment grounding conductors run with a feeder tap shall:
  - Not be smaller than the size shown in Table 250.122 based on the rating of the overcurrent device protecting the feeder
  - Not be required to be larger than the tap conductors

![Diagram showing feeder taps](image_url)

250.126 – Identification of Wiring Device Terminals

**Grounding Terminal Identification**

- The terminal for a grounding conductor can be identified by:
  - Mark green or ground
  - Letters G or GR
  - Distinctive green color
  - A grounding symbol

![Grounding symbol](image_url)
250.146(A) – Connecting Receptacle Grd Terminal to Box

**Surface Mounted Box**

Remove at least one of the fiber washers to maintain metal-to-metal contact.

Removal of the washer is not required where a “self grounding” yoke that meets 250.146(B) is used.

---

280.4(A) – Surge Arresters

**Circuits Less Than 1000 Volts**

- Surge arrestors must now be marked with a short circuit current rating.
- The rating must be equal to or exceed the available short circuit current available at the point of installation.
- DO NOT confuse the Short Circuit Current Rating (SCCR) with the Surge Current (Capacity) Rating!!!
  - The Surge Current Rating is the maximum transient current level that can be suppressed by the TVSS.
  - The Short Circuit Current Rating is the available and sustainable power current level that can flow in the circuit, at the point of connection to the system, during a fault condition until the circuit is opened.
**280.4(A)(4) – Surge Arresters**

Circuits Less Than 1000 Volts

- Clarifies that surge arresters shall not be installed on
  - Ungrounded systems
  - Impedance grounded systems
  - Corner grounded delta systems
- Unless listed specifically for use on these systems.
  - The product standard currently does not address these installations and does not provide for a specific listing.

![Diagram of Ungrounded, Corner Grounded, and Impedance Grounded systems]

**285.3 – Transient Voltage Surge Suppressors (TVSS)**

Uses Not Permitted

- Clarifies that TVSS devices shall not be installed on
  - Ungrounded systems
  - Impedance grounded systems
  - Corner grounded delta systems
- Unless listed specifically for use on these systems.
  - The product standard currently does not address these installations and does not provide for a specific listing.

![Diagram of Ungrounded, Corner Grounded, and Impedance Grounded systems]
300.4(A) – Protection Against Physical Damage

Cables and Raceways Parallel to Furring Strips

- Cable or raceway wiring method installed parallel to framing members:
  - joists, rafters, or studs, or parallel to furring strips, the cable or
  - installed and supported with nearest outside surface of the cable or raceway is not less than 1-1/4 in. where nails or screws are likely to penetrate.
  - The distance permitted to be shorter when protected by a steel plate, sleeve, or equivalent at least 1/16 in. thick.

- Exception No. 2: A listed and marked steel plate less than 1/16 in. thick that provides equal or better protection against nail or screw penetration shall be permitted.

---

300.4(A) – Protection Against Physical Damage

Cables Through Raceways and Wood Members

- Steel nail plates that are less than 1/16” thick shall be permitted if
  - Listed
  - Marked
  - Provides equal or better protection against penetration of nails or screws
300.4(D) – Protection from Physical Damage

Cables and Raceways Parallel to Framing Members and Furring Strips

- Furring strips added to the text
- Cables must be kept at least 1.25” away from the edge of the furring strip
- If distance cannot be maintained, the cable must be protected by a steel plate or sleeve

300.5(B) – Underground Installations

Listing

Clarifies that wet location conductors are required whether in a raceway or not.
300.6 – Protection Against Corrosion & Deterioration

Suitable for the Environment

(A) Ferrous Metal Equipment.
   Exception: Stainless steel not required to have protection
   (1) Protected from Corrosion Solely by Enamel.
   (2) Organic Coatings on Boxes or Cabinets.
   (3) In Concrete or in Direct Contact with the Earth.

(B) Non-Ferrous Metal Equipment. *(New)*

(C) Nonmetallic Equipment. *(New)*
   (1) Exposed to Sunlight.
   (2) Chemical Exposure.

(D) Indoor Wet Locations.

UL 50 is one example of standard that provides requirements for organic coatings and other materials acceptable for various locations

300.11(A) - Securing and Supporting

Fire Rated Assemblies

[Diagram showing fire rated assemblies and identified support wires]

Identified support wires separate from the ceiling support wires

Change clarifies that the independent support wires can attach to the ceiling assembly
300.15(L) – Boxes, Conduits Bodies, & Fittings

Manhole and Handhole Enclosures

- Adds “handhole enclosures” to manholes
- Allows box or conduit body to be omitted where the manhole or handhole enclosure is accessible only to qualified persons
- Must comply with the provisions of Part V of Article 110 for manholes, and 314.30 for handhole enclosures.

300.18(A) – Raceway Installations

Complete Runs

Not required to be installed “complete”

Short section of raceway used for physical protection
300.22(B) – Ducts and Plenums

Wiring Methods

- Plenums are specifically fabricated to carry air
- LFNMC is no longer permitted in a duct or plenum
- MI, MC, EMT, IMC, RMC
- FMC is permitted in max of 4’ lengths

300.50 – Minimum Cover Requirements

Table 300.50

<table>
<thead>
<tr>
<th>General Conditions (not otherwise specified)</th>
<th>Special Conditions (use if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Buried Cables</td>
<td>Rigid Nonmetallic Conduit</td>
</tr>
<tr>
<td>Circuit Voltage</td>
<td>mm</td>
</tr>
<tr>
<td>Over 600 V through 23 kV</td>
<td>75/30</td>
</tr>
<tr>
<td>Over 23 kV through 40 kV</td>
<td>100</td>
</tr>
<tr>
<td>Over 40 kV</td>
<td>1000</td>
</tr>
</tbody>
</table>

1) Cover is defined as the distance in millimeters (inches) measured between a point on the top of the cross-section of any direct-buried conductor, cable, conduit, or other raceway and the top surface of finished grade, concrete, or similar cover.
2) Lesser depths shall be permitted where cables and conductors are for terminations or splices or where access is otherwise required.
3) Listed by a qualified testing agency as suitable for direct burial without encasement. All other nonmetallic systems shall require 50 mm (2 in.) of concrete or equivalent above conduit in addition to the table depth.
4) The slab shall extend a minimum of 150 mm (6 in.) beyond the underground installation, and a warning ribbon or other effective means suitable for the condition shall be placed above the underground installation.
5) Where solid rock prevents compliance with the cover depths specified in this table, the wiring shall be installed in a metal or nonmetallic raceway permitted for direct burial. The raceways shall be covered by a minimum of 100 mm (4 in.) of concrete extending down to rock.

Table revised and reformatted to integrate the exceptions into the table (>600V)
310.4 – Conductors in Parallel

Conductors in Parallel

- Clarifies that parallel conductors do not form a “single conductor”
- Same number of conductors must be in each conduit

![Diagram of conductors in parallel with violation](image)

310.6 - Shielding

Revision of Exception

- Basic rule requires that conductors operating at 2000V or above be shielded
- Exception allows nonshielded conductors up to 2400V where:
  - Listed
  - Have an insulation resistant to electrical discharge and surface tracking
  - If used in a wet location shall have an overall nonmetallic jacket or continuous metallic sheath
  - Insulation and jack thickness shall meet 310.63
- Previous exception applied up to 8000V

![Image of shielded conductor](image)
310.10 – Temperature Limitations of Conductors

FPN No. 2

Conductors installed in conduit exposed to direct sunlight

- Alerts the installer/designer to consider:
  - Conductors in conduit exposed to direct sunlight
  - In close proximity to rooftops
  - Have been shown, under certain conditions, to experience a temperature rise of 17 degrees C (30 degrees F) above ambient temperature

310.15(B)(2)(a) – Ampacity of Conductors

Adjustment Factors

- Clarifies that each current carrying conductor of a parallel set counts as a current carrying conductor

Two conductors per phase installed in parallel
Counts as six current carrying conductors
Requires that the ampacity be adjusted to 80%
312.2(A) – Damp, Wet, or Hazardous Locations

Damp and Wet Locations

Raceways or cables entering above the level of uninsulated live parts shall use fittings listed for wet locations.

Fitting listed for wet locations (hub, sealing locknuts, etc.)

312.4 – Repairing Plaster and Drywall or Plasterboard

Cover for flush-type Installation

- Plaster, drywall, or plasterboard surfaces that are broken or incomplete shall be repaired so there will be no gaps or open spaces greater than 3 mm (1/8 in.) at the edge of the box or fitting employing a flush-type cover.

Gap must be limited to 1/8” inch or less
**Article 314**
Outlet, Device, Pull and Junction Boxes; Conduit Bodies, Fittings and Handhole Enclosures

- Manholes deleted
  - Moved to Article 110
- Handhole Enclosures Added

---

**314.16(B)(1) – Outlet, Device, Pull and Junction Boxes**

**Number of Conductors**

A looped, unbroken conductor not less than twice the minimum length required for free conductors in 300.14 shall be counted twice.
314.21- Repairing Plaster and Drywall or Plasterboard

- Gaps greater than 1/8” must be filled or repaired
- Box with flush type cover or faceplate

314.27(D) – Outlet, Device, Pull and Junction Boxes

Boxes at Ceiling-Suspended Paddle Fan Outlets

- Requirements for boxes at ceiling fans have been moved from Article 422 to Article 314
- Box must be listed and marked as suitable for fan support
- Not permitted to support paddle fans that weigh more than 32 kg (70 lb).
- If intended to support more than 35 lb, the required marking shall include the maximum intended weight
Handhole Enclosures

- Must be designed and installed to withstand all loads likely to be imposed.
- Sized the enclosure in accordance with:
  - 314.28(A) for conductors operating at 600 volts or below
  - 314.71 for conductors operating at over 600 volts
  - For enclosures without bottoms, apply the measurement to the removable cover from the end of the conduit or cable assembly.

Handhole Enclosures

- Underground raceways and cable assemblies must extend into the enclosure
  - The cables or raceways are not required to be mechanically connected to the enclosure.
- Direct burial splices are not required for handhole enclosures (including those without bottoms)
- Covers must:
  - Identify the purpose of the enclosure (e.g. ELECTRIC)
  - Must require tools to remove or weigh more than 100 lb.
### 320.30(D) – Armored Cable: Type AC

**Unsupported Cables**

Type AC cable fitting is permitted as the last point of support.

6’ of unsupported AC cable is permitted between the last point of cable support and the fixture.

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### 320.80(A) – Ampacity

**Thermal Insulation**

AC cable must have conductors rated 90C, but the ampacity shall be based on 60C.

90C ampacity may be used for derating, but the final ampacity cannot exceed the 60C rating.
334.15(C) – Exposed Work

In Unfinished Basements

Must have a NM bushing or adapter at the point where the cable enters

Short section of raceway used for physical protection

334.80 – NM Sheathed Cable: Type NM, NMC, NMS

Ampacity

Two or more cables containing two or more current carrying conductors

#12 AWG = 30A @ 90°C
4 conductors = 80% derating
30A x .8 = 24A

Draft stopped or fire stopped with foam or thermal insulation
3XX.22 – Cables Permitted in Raceways

Number of Conductors

- 342 = IMC
- 344 = RMC
- 348 = FMC
- 350 = LFMC
- 352 = RNC
- 353 = HDPE
- 356 = LFNC
- 358 = EMT
- 360 = FMT
- 362 = ENT

Cables shall be permitted to be installed where such use is not prohibited by the respective cable articles.

342.30(B)(3) – Securing and Supporting

Supports

Permits IMC or Rigid (Art 344) to be installed without support for 20 feet.

Conduit must be “supported and securely fastened” at each end

Fixed equipment or industrial machinery
### 348.30(A) – Flexible Metal Conduit

**Securely Fastened**

Exception #4 - Permits FMC in up to a 6’ length from the last point of support for connect to luminaires or other equipment

Exception #2 – at terminals where flexibility is required, unsupported lengths are allowed as follows:
- 3’ for ½” thru 1.25”
- 4’ for 1.5” thru 2”
- 5’ for 2.5” and larger

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### 352.12 – RNC

**Number of Conductors**

Schedule 40 RNC – 90C conductors max.

Basic rule prohibits the installation of conductors operating at a temperature higher than the RNC listed operating temperature rating.

A new exception makes it clear that higher temperature rated conductors can be used provided they are not operated at a temperature higher than the RNC listing.
353 – HDPE Conduit

High Density Polyethylene

353.6 Listing Requirements. HDPE Conduit and associated fittings shall be listed.

353.10 Uses Permitted.

(1) In discrete lengths or in continuous lengths from a reel.
(2) In corrosive influence locations where subject to chemicals for which the conduit is listed.
(3) In cinder fill.
(4) In direct burial installations in earth or concrete.

353.12 Uses Not Permitted.

(1) Where exposed.
(2) Within a building.
(3) In hazardous locations, except as permitted in 504.20.
(4) Where subject to ambient temperatures in excess of 50°C (122°F) unless listed otherwise.
(5) For conductors or cables operating at a temperature higher that then HDPE conduit listed temperature rating.

356.30(4) – LFNC

Securing and Supporting

No securing or supporting required for up to 6’ lengths between the last point of support and a luminaire or fixed equipment in an accessible ceiling.

Similar change made in Article 362 for ENT
**356.42 – LFNC**

**Couplings and Connectors**

- Only fittings listed for use with LFNC shall be used
- Angle connectors shall not be used for concealed raceway installations
- Straight LFNC fittings are permitted for direct burial or concrete encasement

**366.58 – Auxiliary Gutters**

**Insulated Conductors**

- (A) Deflected Insulated Conductors
  - Use Table 312.6A (one wire per terminal)
  - Deflected conductors
368 – Busway

Busway Article Reorganized

Aligns busway numbering system with the common numbering format of other wiring means

Part I - General
  .1 Scope
  .2 Definitions
Part II - Installation
  .10 Uses Permitted
  .12 Uses Not Permitted
  .30 Supporting
Part III - Construction
  .120 Markings
Part IV – Over 600V

372.17 – Cellular Concrete Floor Raceways

Ampacity of Conductors

- The ampacity adjustment factors, in 310.15(B)(2), shall apply to conductors installed in cellular concrete floor raceways.
- Also applicable to Cellular Metal Floor Raceway (374.17)
376.23(A) – Metallic Wireways

**Insulated Conductors**
(A) Deflected Insulated Conductors
Use Table 312.6A (one wire per terminal)

(B) Wireways used as Pullboxes
- Not less than 6x the diameter of the largest raceway
- 8x for straight pulls

Also applies to Nonmetallic Wireways – Article 378

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376.56(B) – Splices, Taps, and Power Distribution Blocks

**Power Distribution Blocks**

- Blocks must be listed
- Enclosure Size
  - 373.56(A) and
  - Not smaller than required by the block installation instructions
- Wire bending space must comply with 312.6(B)
- Cannot have any exposed live parts in the wireway after installation
**392.10(A) – Cable Trays**

**Number of Single-Conductor Cables, 2000V or Less**

- Where all of the cables are 1000 kcmil or larger
  - The sum of the diameters of all single conductor cables shall not exceed the cable tray width
  - The cables must be installed in a single layer
- Conductors that are bound together to comprise each circuit group shall be permitted to be installed in other than a single layer.

**400.5 – Flexible Cords and Cables**

**Ampacities for Flexible Cords and Cables**

Flexible cord used above 30°C (86°F) must have the temperature correction factors from Table 310.16 applied
400.14 – Flexible Cords and Cables

Protection from Damage

Raceway not longer than 50’

New language permits flexible cord or cable to be installed in a raceway for protection from physical damage.

Industrial installations only where conditions of maintenance and supervision ensure that only qualified persons will service the installation.

404.6 – Position and Connection of Switches

Double Throw Knife Switches

- For a vertical throw switch a means must be provided to hold the blades in the open position
- Previous code stated a “locking means” was to be provided
- New text recognizes different designs of switches and now requires an “integral mechanical means” to hold the blades open
404.7 Exception No. 2 – Indicating

Busway Installation

For busway plugs that have a center pivoting handle
- Open or closed shall be with either end of the handle up or down
- Must be clearly indicating
- Must be visible from the floor or usual point of operation

404.9 (B) Exception – Provisions for General-Use Snap Switch

Grounding

Wiring method with no equipment ground
Snap switch with a metal faceplate
Must be supplied from a GFCI protected circuit

GFCI protection is not required if a nonmetallic faceplate is used.
406.4(D) – Receptacle Mounting

Position of Receptacle Faces

- Receptacle face must be flush with or project from the faceplate
- For metal faceplates, the receptacle face must project .015”
- Exception No. 1 allows a listed kit or assembly that encompasses the receptacle
- Exception No. 2 allows a listed nonmetallic faceplate to cover the receptacle. The plate thickness cannot exceed .040”

406.6(D) – Attachment Plugs, … Flanged Surface Devices

Flanged Surface Inlet

- Must be installed so that the prongs, blades or pins are not energized unless an energized cord connector is inserted into it
406.8(B) – Receptacles in Damp or Wet Locations

Wet Locations

- Now applies to receptacles in “wet locations” – “outdoors” removed
- 15 and 20A, 125 and 250V receptacles must have a weatherproof while “in use” cover installed
- Other receptacles
  - If used when “attended” an “in-use” cover is not required
  - If intended for use when “unattended” an “in-use” cover is required

408.4 – Switchboards and Panelboards

Circuit Directory or Circuit Identification

- Every circuit must be legibly identified
- ID must be clear, evident and specific purpose or use
- Must include sufficient detail to distinguish it from other circuits
- ID located on circuit directory for a panelboard or at each switch on a switchboard
Article 409
Control Panels

Article 409 – Industrial Control Panels
- Conductor Sizing
- Overcurrent Protection
  - Location and Rating
- Disconnecting Means
- Grounding
- Enclosures
- Busbar arrangement
- Wiring Space
- Service Entrance Requirements
- Markings
  - Short Circuit Current Rating

409.20 Conductor Sizing
125% FLC resistance heat + 125% FLC rating largest motor + sum of all other loads in operation at same time

409.21 (A) Overcurrent Protection – Location
1) Overcurrent protective device ahead of panel
2) A single main overcurrent protective device within panel
(B) Overcurrent Protection - Rating
   - The largest branch circuit short circuit protective device + 125% of the FLC rating of the resistance heating loads + sum of all the other loads in operation at same time
Article 409
Control Panels

409.30 Disconnecting Means -
- Comply with Part IX in Article 430

409.60 Grounding
- Conductor sized based on Table 250.122 to bond multiple sections

409.100 Enclosures
- Utilize Table 430.91 as the basis for selecting an enclosure

Article 409
Control Panels

409.102 Busbar arrangement
- Arranged A,B,C – front-to-back, top to bottom, left to right

409.104 Wiring Space
- Identical to NEC 312.6

409.108 Service Entrance Requirements
- Marked Suitable for Use as Service (Neutral Link, Terminal Spacings, …)

409.110 Markings
- Short Circuit Current Rating
  - UL 508A Supplement SB
Article 410 – Luminaires

Scope

- Scope now includes:
  - Decorative lighting products
  - Lighting accessories for temporary seasonal and holiday use
  - Portable flexible lighting products

410.4 – Luminaires in Specific Locations

Bathtub and Shower Areas

- Luminaires installed within the bathtub/shower zone shall be:
  - Listed for damp locations or
  - Listed for wet locations where subject to shower spray

Not permitted:
- Cord connected luminaires
- Chain, cable or cord suspended luminaires
- Lighting track
- Pendants
- Ceiling suspended paddle fans
410.4(E) – Luminaires in Indoor Sports Facilities

Luminaires Subject to Physical Damage

- Mercury vapor or metal halide luminaires installed in playing and spectator seating areas of
  - indoor sports
  - mixed use
  - all purpose facilities
- Required to be of the type that protects the lamp with a glass or plastic lens

410.18(B) Exception No. 2 – Exposed Luminaire Parts

Made of Insulating Material

- Replacement luminaire. Permitted to have conductive parts.
- GFCI Protected Circuit
- Grounding means not available at the outlet
410.30(C) – Electric-Discharge Luminaires

Cord Connected Installation

- Luminaire is located directly below the outlet or busway
- Flexible cord is:
  - Visible for its entire length
  - Not subject to strain or physical damage
  - Terminated in:
    - Grounding type attachment plug cap
    - Busway plug
    - Part of a listed assembly with a manufactured wiring system connector
    - Luminaire assembly with a strain relief and canopy

410.73(G) – Luminaires – Electric-Discharge

Disconnecting Means

Effective January 1, 2008

- Fluorescent luminaires that:
  - Use double ended lamps and contain ballasts that can be serviced in place
  - Contain ballasts that can be serviced in place and are supplied from a multi-wire circuit

- Not required:
  - On branch circuits with local disconnects that can be shut off without putting the space in total darkness
  - In industrial establishments with restricted public access
  - In hazardous locations
  - For emergency illumination
  - On cord and plug connected luminaires

Disconnect must be accessible to qualified persons
410.110 – Decorative Lighting and Similar Accessories

Listing of Decorative Lighting

- Requires listing of decorative lighting and accessories used for holiday lighting and similar purposes

411.4(A) – Lighting Systems Operating 30V and Less

Locations not permitted

- Not permitted concealed or extended through a building wall unless
  - Installed in a Chapter 3 wiring method or
  - Supplied from a Class 2 power source using 725.52 wiring methods
422.16(B) – Appliances - Flexible Cords

Range Hoods

- Receptacle is located to avoid physical damage to the cord
- Receptacle is accessible
- Supplied by an individual branch circuit
- Flexible cord identified for use on range hoods
- Terminates in a grounding type attachment plug
- Not less than 18” and not more than 36” long

422.51 – Appliances

Cord-and Plug Connected Vending Machines

- Must include GFCI protection
  - Integral part of the attachment cap or
  - Located in the cord within 12” of the attachment cap or
  - Supplied by a GFCI protected outlet
**422.31(B) – Disconnection of Permanently Connected Appliances**

**Appliances Rated Over 300VA or 1/8 HP**

- Locking provision shall remain in place with or without the lock installed.

---

**427.27 Exception – Fixed Heating for Pipelines**

**Voltage Limitations**

- Allows voltage to be increased to 132Vac where:
  - Industrial establishment with maintenance and supervision
  - GFPE is provided
  - Pipeline or vessel being heated is completely enclosed in a grounded metal enclosure
  - Isolation transformer secondary connections are completely enclosed in metal mesh or enclosure
430.2 – Motors, Motor Circuits, and Controllers

Definitions

- Adjustable Speed Drive
  - Combination of power converter, motor and motor mounted auxiliary devices

- Adjustable Speed Drive System
  - Interconnected combination of equipment
  - Means of adjusting speed of a mechanical load coupled to a motor
  - Usually the adjustable speed drive and auxiliary electrical apparatus

430.8 – Motors, Motor Circuits, and Controllers

Marking on Controllers

- Motor controllers must be marked with a short-circuit current rating (SCCR)
  - Not required on controllers for motors 1/8 HP and less or cord- and plug-connected motors of 1/3 HP and less
  - Not required when the SCCR is marked elsewhere on the assembly
  - Not required when the assembly has an overall SCCR
  - Not required for controllers rated less than 2 HP and 300V and used on general purpose branch circuits (i.e. snap switches)
430.53(C)(2) – Several Motors and Loads on One Branch Circuit

Other Group Installations

- Circuit breakers do not have to be “listed for group installation” for group motor loads
- Eliminates the need for a HACR marking
- A listed circuit breaker (without any special marking) is suitable for group motor installations

430.53(C)(6) – Other Group Installations

Non Motor Loads

- Suitable for group installation
- Marked “Suitable for Tap Conductor Protection in Group Installations”
- Not less than 1/3 the branch circuit conductor size
- Not less than 1/10th the rating branch SC device
- Other than Motor Load

Must be an overcurrent device that meets Article 240. Not a supplemental protector or motor circuit protector.
430.102(B) Exception - Location

Motor

- Locking provision shall remain in place with or without the lock installed.
- “Permanently” has been removed from the text

430.109(A)(7) – Type of Disconnect

System Isolation Equipment

Redundantly monitored
Contactor Isolating System
Verifiable operation
430 – Part X - New Drives

Article 430 – Part X - Adjustable Speed Drives

- Conductor Sizing
- Overload Protection
- Motor Overtemperature Protection
- Disconnection Means

Altivar 31 Adjustable Speed AC Drive, 400 - 460 Vac, 50/60 Hz, Three Phase, 10 Hp, 7.5 kW, 22 kA SCCR

430 – Part X - Drives

Adjustable Speed Drive Systems - Part X

- 430.122(A) - Conductors sized at 125% of the rated input current
- 430.122(B) – Where a bypass device is included, use the larger of 125% x input current OR 125% x motor FLC
- 430.124 Overload Protection
  - Additional overload protection is not required where it is included in the drive
  - When in “bypass” mode, the motor must be protected in accordance with Part III
- 430.126 Overtemperature Protection
  - Thermal Protector
  - Drive has load and speed overload protection and thermal memory
  - Thermal sensors embedded in the motor and meet 430.32(A)(2) or (B)(2)
  - Thermal sensors embedded in the motor that communicates with the drive
  - Multiple motors must have individual overtemperature protection
- 430.128 Disconnecting means for a drive must have a rating of not less than 115% of the rated input current to the drive
430 Part XIV – Tables

430.247 thru 430.251

- The tables for motor full load currents and locked rotor currents have been renumbered.
- Old Number plus 100
- 430.150 is now 430.250

440.4(B) – Marking on Hermetic Refrigerant Motor Compressors and Equipment

- Equipment must be marked with:
  - Makers name
  - Rating in Volts, Frequency and # Phases
  - Minimum supply circuit conductor ampacity
  - Maximum rating of the branch SC/GF device
  - Short circuit current rating of the motor controllers or the industrial control panel

- Not required on equipment for
  - 1 & 2 family dwellings
  - Cord and plug connected equipment
  - Equipment supplied by a branch circuit rated 60A or less
Classified Locations
Reorganized with Common Numbering Structure

Articles 501, 502, & 503
Part I
.1 – Scope
.5 – General
Part II
.10 - Wiring Methods
.15 – Sealing
.30 - Grounding and Bonding
Part III
.100 – Transformers and Capacitors
.115 – Switches and Circuit Breakers
.125 – Motors and Generators
.130 – Luminaires
.145 – Receptacles

501.5 – Class I Locations
General

- Equipment listed and marked in accordance with 505.9(C)(2) for use in Class I, Zone 0 locations shall be permitted in Class I, Division 1 or 2 locations
501.15(B)(2) – Class I Locations

Division 2 Boundary

Conduits must be sealed to minimize the amount of gas or vapor within the Div 2 portion of the conduit from being communicated to the conduit beyond the seal.

- Seals are not required to be explosionproof
- Shall be identified for minimizing passage of gas
- Shall be accessible

501.35 – Surge Protection

Transient Voltage Surge Suppressors (TVSS)

- Now permits TVSS devices to be installed in hazardous locations
  - Division 1
    - Must be installed in Class I Div 1 enclosures
  - Division 2
    - Enclosures permitted to be general purpose type
    - TVSS must be a non arcing type such as sealed MOV type
511.7 – Commercial Garages

Wiring Above Class I Locations

- Type AC cable has been added as an acceptable wiring method

513.12 – Aircraft Hangars

GFCI

- GFCI protection required on all 125V, 15 and 20A receptacles installed in areas for:
  - Electrical diagnostics
  - Electric hand tools
  - Portable lighting equipment
514.13 – Motor Fuel Dispensing Facilities
Provisions for Maintenance and Servicing of Dispensing Equipment

- Disconnecting means:
  - Must remove all external voltage sources (including feedback)
  - Is permitted to be located other than inside or adjacent to the dispenser
  - Must be lockable

516 – Spray Applications and Coating Processes
Classification of Locations

Zones system has been added as an option for classification.
517.17(A) – Ground Fault Protection

Applicability

If the main building service (or feeder) has GFP because of 230.95 or 215.10, all second level feeders must also have GFP – regardless of what type of occupancy they supply.

517.18(C) – Health Care Facilities

Pediatric Locations

- Adds additional locations for tamper resistant receptacles:
  - Rooms
  - Bathrooms
  - Playrooms
  - Activity Rooms
517.26 – Application of Other Articles

Essential Electrical System

The essential electrical system shall meet the requirements of Article 700, except as amended by Article 517.

517.30(C)(3) – Health Care Facilities

Essential Electrical System Wiring Requirements

- Mechanical Protection of the Emergency System
  - Jacketed metallic raceways and cables now permitted where incased in 2” of concrete
517.35(B)(4) – Health Care Facilities

Essential Electrical System Alternate Sources of Power

- Battery systems are now recognized as an alternate source
- Already permitted:
  - Generator
  - Another generator where the normal source is a generator
  - An external utility service where the normal source is a generator

525.11 – Power Sources

Multiple Sources of Supply

- Multiple sources shall be bonded to the same grounding electrode where:
  - Both supply rides, attractions or other structures and:
  - The structures are separated by less than 12 ft
525.23 – Carnivals, Fairs, and Similar Events

GFCI Protection

- Required on 15 and 20A, 125V receptacles
  - Non-locking type used for assembly and disassembly or ready access to public
  - Supplying equipment that is readily accessible to the general public
- Not required on:
  - Locking type receptacles that only facilitates quick disconnecting and reconnecting of electrical equipment
- Not permitted:
  - Egress Lighting

551.71 – RV Parks

Type Receptacles Provided

- Every RV site shall have at least one 20A, 125 V receptacle
- At least 20% will have 50A, 125/250 V receptacles
- At least 70% will have 30A, 125 V receptacles
590 – Temporary Installations

Relocated from 527 to 590

604.6(F) – Manufactured Wiring Systems

Flexible Cord - Luminaires (Fixtures)

- Listed electric discharge luminaires permitted
- Flexible Cord transition shall not exceed 6 ft between manufactured wiring system and utilization equipment
- Must comply with 410.30(C)
  - Be visible
  - Not be subject to strain
**605.6 and 7 – Office Furnishings**

**Fixed and Freestanding-Type Partitions**

- Partitions permitted to be connected to building electrical system
- Connection must be made using a Chapter 3 method
- Multiwire branch circuit shall have a disconnect that simultaneously opens all ungrounded conductors
- Disconnect located at the panel where the branch circuit originates

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**610.61 – Cranes**

**Grounding**

The metal wheels are not considered to be an effective ground path

A bonding jumper is now required between trolley and bridge
620.22(A) – Elevators

Car Light Source

A separate branch circuit shall supply:
- Car lights
- Receptacles
- Auxiliary lighting
- Ventilation

Required lighting shall not be connected to a GFCI.

645.17 – Information Technology Equipment

Power Distribution Units
- Used for information technology equipment
- May have multiple panelboards within a single cabinet
- Each panelboard limited to 42 overcurrent devices
- Utilization equipment listed for information technology application
670.3 – Industrial Machinery

Machine Nameplate

- The Nameplate shall include:
  - Supply voltage, phase, frequency, full load current
  - Maximum ampere rating of the short-circuit and ground-fault protective device
  - Ampere rating of largest motor
  - Short circuit current rating of the machine industrial control panel
  - Electrical diagram numbers or the numbers of the index to the electrical drawings

680.23(B)6 – Pools

Servicing Luminaires (Fixtures)

Luminaire shall be removable from the water for relamping or normal maintenance.

Installed to reach from deck or equivalent dry location
**680.26(C) – Pools**

**Equipotential Bonding Grid**

A equipotential common grounding grid shall extend under paved walking surfaces for 3ft horizontally beyond the inside walls of the pool.

Alternate grid Structure:
- 8 AWG bare copper
- Cover contour of pool and deck 3ft from inside wall
- Arranged in 12 inch square grid uniform pattern

3 ft horizontal boundary from inside pool wall

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**680.32 – Storable Pools**

**Ground-Fault Circuit Interrupters Required**

All 125-volt receptacles located within 20 ft of the inside walls of a storable pool shall be protected by a ground-fault circuit interrupter.

680.34 Receptacles shall be located not less than 10 ft from the inside walls of the pool.
680.58 – Fountains

Ground-Fault Circuit Interrupters

All 15- or 20-ampere, single phase 125-volts through 250-volts receptacles located within 20 ft of a fountain edge shall have GFCI protection.

Receptacle installed within 20’

680.62(B)(5) – Therapeutic Pools and Tubs

Bonding

Electrical devices and controls that are not associated with the therapeutic tubs and located within 1.5 m (5 ft.) from such units.

< 5 ft

Electrical device
Article 682 (New)

Natural and Artificially Made Bodies of Water

Applies to electrical installations in and adjacent to natural or artificially made bodies of water not covered by other articles in this Code which includes:

- Aeration Ponds
- Fish Farm Ponds
- Storm Retention Basins
- Treatment ponds
- Irrigation (Channels) Facilities

690.14(C)(1) – Photovoltaic Disconnect

Disconnecting Means Location

- Photovoltaic disconnect shall be readily accessibly either outside or inside nearest the point of entrance
- Shall not be installed in a bathroom
- Exception: Installations that comply with 690.31(E) permits disconnect be located remote from system conductors entry.

Photovoltaic array

Conductors in metallic raceway 690.31(E)

Utility-Interactive Inverter

Service

SQUARE D
690.64(B)(5) – Photovoltaic Power

**Back-fed Circuit Breakers**

- Retention of back-fed circuit breakers not required when utility-interactive inverter is listed to meet NEC 690.60

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695.4(B) – Continuity of Power

**Supervised Connection**

- Disconnecting means shall:
  - Be identified as SUSE
  - Be lockable in the closed position
  - Not be located within equipment that feeds loads other than the fire pump
  - Be located sufficiently remote from other building disconnects

[Diagram of a supervised connection showing the connections between a fire pump controller, building disconnects, and a fire pump disconnect.]
**695.6(H) – Fire Pump Power Wiring**

*Ground Fault Protection of Equipment*

- Ground fault protection of equipment shall not be permitted for fire pumps
- Establishes mandatory requirement to exclude ground fault protection on the fire pump circuit
- Correlates with permission to exclude ground fault in 215.10 and 230.95 on fire pump circuits

**700.12(E) – Emergency Systems**

*Sources of Power*

**Fuel Cell System**

- Rated to supply and maintain total load for 2 hours
- Meet requirements of Article 692
- Where a single fuel cell system serves as the normal source, it shall not serve as the sole source for the emergency system.
700.27 – Emergency Systems

Overcurrent Protection

Selective Coordination

Emergency system(s) overcurrent devices shall be selectively coordinated with all supply side overcurrent protective devices.

701.18 – Legally Required Standby Systems

Overcurrent Protection

Selective Coordination

Legally required standby system(s) overcurrent devices shall be selectively coordinated with all supply side overcurrent protective devices.
702.6 – Optional Standby Systems

Transfer Equipment

● Exception for Temporary Connection
● Transfer equipment not required where
  ■ Conditions of maintenance and supervision exist
  ■ Qualified persons service the installations
  ■ Normal power supply can be isolated by a lockable disconnect

702.11 – Optional Standby Systems

Sources of Power - Outdoor Generator Sets

● Disconnecting Means for Outside Feeders Supplying a Building or Structure
  ■ Disconnect on generator located readily accessible and within sight of the structure permitted to serve as structure disconnect (702.11)
  ■ Disconnect must be provided for all ungrounded conductors (225.31)
  ■ Rated “SUSE” in accordance with (225.36)
  ■ Rating of Disconnect (225.39)
725.56(F) – Class 1, 2 & 3 Remote Control Circuits

Class 2 or 3 Circuits Serving as Audio System Circuits

- Audio circuits installed in accordance with 640.9(C)
- Can not be installed in the same cable or raceway with Class 2 or 3 conductors or cables

725.61 – Application of Listed Class 2, 3, or PLTC Cables

Signaling Raceways

- Listed plenum signaling raceways permitted in 300.22(C) spaces
- Only Type CL2P or CL3P cable permitted in these raceways
- Listed riser signaling raceways permitted in shaft from floor to floor
- Only Type CL2R, CL3R, CL2P or CL3P cable permitted in these raceways
- Listing requirements for nonmetallic signaling raceways in 725.82
725.61 – Class 1, 2 & 3 Remote Control Circuits

Hazardous Location Application of Type PLTC Cables

Type PLTC cable permitted exposed between cable tray and utilization equipment in industrial establishment where:

- Conditions of maintenance and supervision exist
- Cable identified to comply with crush and impact requirements of MC
- Shall be supported and protected against physical damage
- Secured at intervals not to exceed 6ft

760.30(B)(2) – Application of Listed NPLFA Cables

Circuit Integrity Cable (CI)

- Cable used in fire alarm systems to ensure continued operation of critical circuits during a specified time under fire conditions.
- NPLFP-CI permitted in other spaces used for environmental air
760.56(D) – Installation of Different PLFA Circuits

Audio System Circuits and PLFA Circuits

- Audio Circuits in 640.9(C) installed using Class 2 or 3 circuits not permitted in the same raceway with PLFA

800.2 – Definitions

Communications Equipment

The electronic equipment that performs the telecommunications operations for the transmission of audio, video, and data, and including power equipment (e.g., dc converters, inverters and batteries) and technical support equipment (e.g., computers).
800.2 – Definitions

Communications Circuit Integrity (CI) Cable

Cable used in communications systems to ensure continued operation of critical circuits during a specified time under fire conditions.

Example: CMP-CI
Communication Plenum Cable -- CI – 2 hour fire resistance cable
CI Cable already exists for Fire Alarm circuits in NEC 760

800.133 – Installation of Communication Wires

Separation In Raceways, Boxes and Cables

New Exception permits power, Class 1 and communication circuits in the same enclosure, raceway, or outlet box where separated by permanent barrier or listed divider.
The Codes and Standards group can offer on-site custom training on the NEC and related topics. Our staff has extensive involvement in codes and standards development, interpretation and application.

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