PDHonline Course E355 (3 PDH)

Revisions for the 2011 National Electrical Code® - Part 1

Instructor: Patrick Ouillette

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5272 Meadow Estates Drive
Fairfax, VA 22030-6658
Phone: 703-988-0088
www.PDHonline.com

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PDH Course E355

Revisions for the 2011 *National Electrical Code*®

Part 1

Patrick S. Ouillette, P.E.

Introduction

Part 1 of this 4-part series covers Code-wide changes through Article 240. The course covers only major Code changes, but provides depth of coverage.

The layout and the method of presentation will enable new Code users to navigate through the changes. Those well experienced in the Code will find depth in the coverage. Through the heading(s) at the beginning of each Code change addressed in the document, the reader will readily identify the section affected by the change and the specific subject being discussed. The Significance section serves as an introduction to the Code change under discussion. An Analysis of the Code change follows, with explanation as necessary to help the student understand the revision, its background, and the logic of the change. Graphics, photographs, examples, or calculations are used to illustrate the change and to enhance learning. The Summary is a brief re-statement of the highlights of the Code change. An Application Question, with Answer and key to the correct answer, is included at the end of each Code section studied for exercise in applying the change and to broaden learning. Many of the sections analyzed contain a Code Refresher that addresses existing Code requirements related to the change. The author attempts to tie the entire *NEC*® together through the study of the changes.

Although there are many references to the 2011 *NEC*® throughout this document, the course and quiz can be completed without the need to refer to the *NEC*® itself. For further study on any Code section within this course, the 2011 *NEC*® should be consulted.

Acknowledgements

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The term *grounding conductor* has been deleted from the *NEC*.
The definition of *grounding conductor* was not materially different from the definition of *grounding electrode conductor*. A grounding conductor was used in Article 770 and in the Chapter 8 articles to perform the same function as a grounding electrode conductor. In every instance where grounding conductor was used, it is replaced with *bonding conductor*, *bonding jumper*, or *grounding electrode conductor* in the 2011 *NEC*. For example, Part IV, Grounding Methods, in Article 800 of the 2008 *NEC* uses the term *grounding conductor* to refer to the conductor that connects communications equipment to earth, or to another conductor that is connected to earth. In the 2011 *NEC*, *grounding conductor* has been replaced with “bonding conductor or grounding electrode conductor.” A *bonding conductor* may be used to connect the communications equipment to the intersystem bonding termination. A grounding electrode conductor is used to connect communications equipment directly to earth.

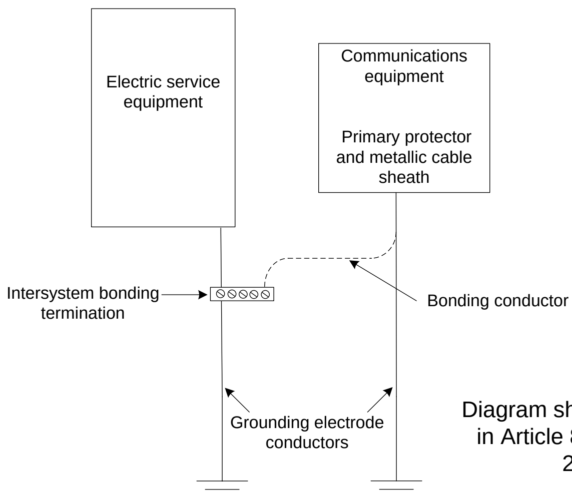


Diagram showing use of terms in Article 800, Part IV of the 2011 NEC

The 2011 *National Electrical Code* contains three new articles:

Article 399 – Outdoor Overhead Conductors over 600 Volts
Article 694 – Small Wind Electric Systems
Article 840 – Premises-Powered Broadband Communications Systems

Fine Print Notes have been renamed **Informational Notes** to more accurately describe their purpose. Informational Notes contain explanatory material and are not enforceable as requirements of the *NEC*. [90.5(C)]

Annexes have been renamed **Informative Annexes.** Informative Annexes are not part of the enforceable requirements of the *NEC*, but are included for information purposes. [90.5(D)]

Automatic (revised definition)
"Performing a function without the necessity of human intervention."

The definition of *automatic* has been simplified.

Bathroom (revised definition)
"An area including a basin with one or more of the following: a toilet, a urinal, a tub, a shower, a bidet, or similar plumbing fixtures."

As with the previous definition, a *bathroom* does not exist if there is no basin.

Bonding Jumper, System (revised definition relocated from 250.2)
"The connection between the grounded circuit conductor and the supply-side bonding jumper, or the equipment grounding conductor, or both, at a separately derived system."

A *system bonding jumper* performs the same function as a main bonding jumper at a service, except a "system" bonding jumper is used in a separately derived "system." A *supply-side bonding jumper* is a bonding conductor installed on the supply side of a service or within a service equipment enclosure, or for a separately derived system, that ensures electrical conductivity between metal parts required to be electrically connected. The definition for the new term *bonding jumper, supply-side* is in 250.2, since its use is exclusive to Article 250. A supply-side bonding jumper shall not be smaller than the sizes shown in Table 250.66 for grounding electrode conductors.

Intersystem Bonding Termination (revised definition)
"A device that provides a means for connecting bonding conductors for communications systems to the grounding electrode system."

The definition of *intersystem bonding termination* has been simplified.

Separately Derived System (revised definition)
"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 connection from circuit conductors of one system to circuit conductors of another system, other than connections through the earth, metal enclosures, metallic raceways, or equipment grounding conductors."

The revised definition of *separately derived system* clarifies that metal raceways and metal covered cables connecting metal enclosures of a separately derived system to metal enclosures of another system, which ultimately connects the systems together at a common grounding electrode system, does not violate the definition of *separately derived system*.

Service Conductors, Overhead (new definition)
"The overhead conductors between the service point and the first point of connection to the service-entrance conductors at the building or other structure."

Since *overhead service conductors* are on the customer side of the service point, these conductors fall under the jurisdiction of the *NEC*. These conductors are not the same as *service drop* conductors.

<u>Service Conductors, Underground</u> (new definition)
"<u>The underground conductors between the service point and the first point of connection to the service-entrance conductors in a terminal box, meter, or other enclosure, inside or outside the building wall</u>."

Underground service conductors are under the jurisdiction of the *NEC*.

Service Drop (revised definition)
"The overhead conductors <u>between the utility electric supply system and the service point</u>."

Service drop conductors are under the exclusive control of an electric utility and must be installed according to the provisions of the National Electrical Safety Code (NESC). Typically, *service drop* conductors are the conductors between the utility pole-mounted transformer and the point of attachment to a building.

Service Lateral (revised definition)
"The underground conductors between the <u>utility electric supply system and the service point</u>."

Service lateral conductors are on the utility side of the service point and are therefore under the exclusive control of the electric utility.

Uninterruptible Power Supply (new definition)
"<u>A power supply used to provide alternating current power to a load for some period of time in the event of a power failure</u>."

In addition, an *uninterruptible power supply* may provide power conditioning for the load, reducing the effects of voltage and frequency variations.

Electrical Connections

Significance
Fine-stranded cables are distinguished from Class B and C stranding in new Table 10 in Chapter 9.

Analysis
Requirements for terminating cables more finely stranded than Class B or C stranding are relocated in Article 110 from Article 690, since these conductors and cables are not exclusive to solar applications. Fine-stranded cables are used for battery connections, dock wiring, cranes, elevators, welders, and UPS systems. Table 10 in Chapter 9 shows the characteristics of Class B and C stranding. Fine-stranded conductors are other than Class B and C and include Classes D, G, H, I, K, and M. Class AA and A stranding is not as fine as Class B and C stranding.

Connectors and terminals for conductors more finely stranded than Class B and C stranding shall be identified for the specific conductor class or classes. The rule applies to both terminals and splices. UL 486A-486B requires that connectors for other than Class B or C stranding be marked with the conductor class and the number of strands.

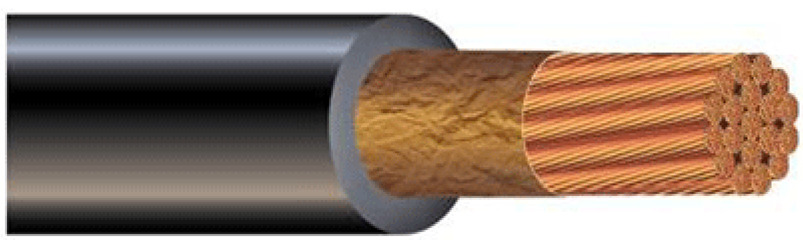
New Informative Annex I contains Recommended Tightening Torque Tables from UL Standard 486A-486B. In the absence of connector or equipment manufacturer's recommended torque values, Tables I.1, I.2, and I.3 may be used to correctly tighten screw-type connections for power and lighting circuits.

Chapter 9, Table 8, Conductor Properties, and other *NEC* tables are based on conductors with Class B stranding.

Summary
Connectors and terminals for conductors more finely stranded than Class B and C stranding shall be identified for the specific conductor class or classes.

Application Question
A 6 AWG copper Type G-GC portable power cable has 259 strands of copper per 6 AWG conductor. Can the cable be terminated with standard terminations?

Answer
No. According to Chapter 9, Table 10 this cable uses neither Class B nor Class C stranding.



Courtesy of Southwire Company A finely stranded cable

Available Fault Current

Significance

This new section requires that the available fault current be field marked on service equipment for other than dwelling unit installations. The requirement will reinforce the rules in 110.9 and 110.10.

Analysis

This is a new Code section but only the requirement for field marking the value of the available fault current is new. In order to comply with existing Sections 110.9 and 110.10, the available fault current must be known, only now its value must be marked on the service equipment. Also, the available fault current must be known in order to perform a Flash Hazard Analysis for the marking required by 110.16 of the existing Code. Section 110.9 requires that protective equipment intended to interrupt current at fault levels have an interrupting rating not less than the available fault current at the line terminals of the equipment, e.g., a service circuit breaker. This requirement is applicable over the life of the equipment, so if the size of a service increases or other modifications are made that could increase the available fault current, updated fault-current calculations must be made and posted.

The required field marking must include the date the fault-current calculation was performed and be sufficiently durable for the environment involved. The marking is not required in industrial installations where only qualified persons will service the installation. Generally, the fault-current calculation will be the responsibility of the project engineer rather than the electrician. However, it is necessary for the installing electrician to know when equipment may not be of sufficient rating for the available fault current. Short-circuit currents can be calculated by using the classical approach, the ANSI/IEEE method, the kVA method, or the simple point-to-point method used in the following examples. There is a relatively simple way to determine the worst case fault current. The impedance and kVA rating of the supply transformer must be known. If the supply transformer is a padmount, this information can be easily read from the nameplate.

Example 1

Determine the worst case available fault current at the secondary terminals of a 3-phase, 112.5 kVA transformer with 4% impedance. The secondary voltage (voltage of the service) is 277/480 volts.

The symbols/values used in the fault-current calculations have the following meanings:

$E_{L\text{-}L}$ = line-to-line voltage at the transformer secondary terminals
FLA = transformer full-load current
$I_{S.C.}$ = available fault current (short-circuit current assuming infinite utility supply)
kVA = transformer power rating
Z = transformer impedance expressed as a decimal. To express a percentage in decimal form, divide by 100 (move the decimal point 2 places to the left). For example, 3.9% becomes 0.039 and 4% becomes 0.04. Even though not shown, there is an implied decimal point after

the number 4 and other whole numbers.
1.732 =3-phase multiplier

First find the transformer full-load current:

$$FLA = \frac{kVA \times 1000}{E_{L-L} \times 1.732} = \frac{112,500}{480 \times 1.732} = \mathbf{135.32\ amps}$$

Now calculate the worst case fault current at the transformer secondary terminals:

$$I_{S.C.} = \frac{FLA}{Z} = \frac{135.32}{.04} = \mathbf{3383\ amps}$$

The fault current available at the secondary terminals of the transformer is 3383 amperes. This value is less than 10,000 amps, so equipment rated at 10,000 A.I.C. RMS symmetrical can be used. This calculation method assumes there is unlimited primary short-circuit current available (infinite bus) from the utility and yields the worst case fault current. The calculations are the same for a single-phase system, except that the 1.732 multiplier is not used.

The above procedure determines the available fault current at the secondary terminals of the supply transformer. The new Code section requires the marking of the value of fault current that is available at the terminals of the service equipment. The fault current at the service equipment will be less than the fault current at the secondary of the supply transformer depending on the size, type (copper or aluminum), and length of the service-entrance conductors, and the type of enclosure for the conductors. The point-to-point method of calculating the available short-circuit current at the service equipment is demonstrated in Example 2.

Example 2
Determine the available fault current at the service disconnect of a 3-phase, 277/480-V service supplied from a 500 kVA transformer with 1.3% impedance. Service-entrance conductors between the supply transformer and the service disconnect are parallel 400 kcmil copper, single conductors, 85 ft long in PVC conduit.

The first two steps of the calculation are the same as in the previous example.

Find the transformer full-load current:

$$FLA = \frac{kVA \times 1000}{E_{L-L} \times 1.732} = \frac{500,000}{480 \times 1.732} = \mathbf{601.42\ amps}$$

Calculate the worst case fault current at the transformer secondary terminals:

$$I_{S.C.} = \frac{FLA}{Z} = \frac{601.42}{0.013} = \mathbf{46,263.08\ amps}$$

Next, find the "f" factor:

$$f = \frac{1.732 \times L \times I_{S.C.}}{C \times n \times E_{L-L}}$$

where:
L = conductor length (feet) from transformer secondary terminals to service equipment terminals
$I_{S.C.}$ = available fault current at transformer secondary terminals
C = constant from Table of "C" Values (see Appendix)
n = number of conductors per phase
E_{L-L} = line-to-line voltage of system

$$f = \frac{1.732 \times 85 \times 46{,}263.08}{24297 \times 2 \times 480}$$

f = 0.2920

Find the "M" multiplier:

$$M = \frac{1}{1 + f}$$

M = 0.7740

$I_{S.C.\ (\text{at the service})} = I_{S.C.\ (\text{at the transformer})} \times M$

$I_{S.C.\ (\text{at the service})} = 46{,}263.08 \times 0.7740 \approx$ **35,808 A**

If there is a significant motor load, the contribution of the motor load to the available short-circuit current must be considered. For a reasonable estimate, multiply the total motor current by 4 and add this to the short-circuit current as determined above. More detailed information on use of the point-to-point method and other methods for determining short-circuit current are available from a variety of sources.

Summary
For other than dwelling units and industrial installations where only qualified persons will perform service, service equipment must be field marked with the maximum available fault current at the time of installation and when the service is modified.

Application Question
Is the marking of the available fault current the same as the warning required by 110.16?

Answer
No. The requirement in 110.16 is for an arc-flash hazard warning label. If results of a Flash Hazard Analysis are also posted, they could include information on the incident energy, Flash Protection Boundary, and Hazard/Risk Category.

Table of “C” Value Constants

“C” Values for Conductors												
AWG or kcmil	Copper Conductors											
	Three Single Conductors						Three-Conductor Cable					
	Steel Conduit			Nonmagnetic Conduit			Steel Conduit			Nonmagnetic Conduit		
	600V	5KV	15KV	600V	5KV	15KV	600V	5KV	15KV	600V	5KV	15KV
14	389	389	389	389	389	389	389	389	389	389	389	389
12	617	617	617	617	617	617	617	617	617	617	617	617
10	981	981	981	982	982	982	982	982	982	982	982	982
8	1557	1551	1551	1559	1555	1555	1559	1557	1557	1560	1558	1558
6	2425	2406	2389	2430	2418	2407	2431	2425	2415	2433	2428	2421
4	3806	3751	3696	3826	3789	3753	3830	3812	3779	3838	3823	3798
3	4774	4674	4577	4811	4745	4679	4820	4785	4726	4833	4803	4762
2	5907	5736	5574	6044	5926	5809	5989	5930	5828	6087	6023	5958
1	7293	7029	6759	7493	7307	7109	7454	7365	7189	7579	7507	7364
1/0	8925	8544	7973	9317	9034	8590	9210	9086	8708	9473	9373	9053
2/0	10755	10062	9390	11424	10878	10319	11245	11045	10500	11703	11529	11053
3/0	12844	11804	11022	13923	13048	12360	13656	13333	12613	14410	14119	13462
4/0	15082	13606	12543	16673	15351	14347	16392	15890	14813	17483	17020	16013
250	16483	14925	13644	18594	17121	15866	18311	17851	16466	19779	19352	18001
300	18177	16293	14769	20868	18975	17409	20617	20052	18319	22525	21938	20163
350	19704	17385	15678	22737	20526	18672	22646	21914	19821	24904	24126	21982
400	20566	18235	16366	24297	21786	19731	24253	23372	21042	26916	26044	23518
500	22185	19172	17492	26706	23277	21330	26980	25449	23126	30096	28712	25916
600	22965	20567	17962	28033	25204	22097	28752	27975	24897	32154	31258	27766
750	24137	21387	18889	29735	26453	23408	31051	30024	26933	34605	33315	29735
1000	25278	22539	19923	31491	28083	24887	33864	32689	29320	37197	35749	31959
	Aluminum Conductors											
14	237	237	237	237	237	237	237	237	237	237	237	237
12	376	376	376	376	376	376	376	376	376	376	376	376
10	599	599	599	599	599	599	599	599	599	599	599	599
8	951	950	950	952	951	951	952	951	951	952	952	952
6	1481	1476	1472	1482	1479	1476	1482	1480	1478	1482	1481	1479
4	2346	2333	2319	2350	2342	2333	2351	2347	2339	2353	2350	2344
3	2952	2928	2904	2961	2945	2929	2963	2955	2941	2966	2959	2949
2	3713	3670	3626	3730	3702	3673	3734	3719	3693	3740	3725	3709
1	4645	4575	4498	4678	4632	4580	4686	4664	4618	4699	4682	4646
1/0	5777	5670	5493	5838	5766	5646	5852	5820	5717	5876	5852	5771
2/0	7187	6968	6733	7301	7153	6986	7327	7271	7109	7373	7329	7202
3/0	8826	8467	8163	9110	8851	8627	9077	8981	8751	9243	9164	8977
4/0	10741	10167	9700	11174	10749	10387	11185	11022	10642	11409	11277	10969
250	12122	11460	10849	12862	12343	11847	12797	12636	12115	13236	13106	12661
300	13910	13009	12193	14923	14183	13492	14917	14698	13973	15495	15300	14659
350	15484	14280	13288	16813	15858	14955	16795	16490	15541	17635	17352	16501
400	16671	15355	14188	18506	17321	16234	18462	18064	16921	19588	19244	18154
500	18756	16828	15657	21391	19503	18315	21395	20607	19314	23018	22381	20978
600	20093	18428	16484	23451	21718	19635	23633	23196	21349	25708	25244	23295
750	21766	19685	17686	25976	23702	21437	26432	25790	23750	29036	28262	25976
1000	23478	21235	19006	28779	26109	23482	29865	29049	26608	32938	31920	29135

600 Volts, Nominal, or Less – Spaces About Electrical Equipment – Working Space – Height of Working Space

Significance

A new Code rule distinguishes between meters and meter sockets for the purpose of determining compliance with working space requirements and permitted intrusions into the working space.

Analysis

The depth of the working space required in front of electrical equipment is determined from Table 110.26(A)(1) and varies from 3 ft to 4 ft depending on the nominal voltage to ground and the exposure to live parts and grounded parts. The width of the working space in front of equipment must be the width of the equipment or 30 in., whichever is greater. The working space shall extend from the floor or platform to a height of 6 ½ ft or the height of the equipment, whichever is greater. Equipment associated with an installation is permitted to be mounted above or below the equipment and to extend not more than 6 in. beyond the front of the equipment. For example, a wireway mounted below a panelboard is permitted to be up to 6 in. deeper than the panelboard, without violating the clear working space required in front of the panelboard from the floor to the required height of the working space.

New Exception No. 2 to 110.26(A)(3) permits a *meter* to extend into the working space to a depth of more than 6 in. Meter *sockets* must not extend into the working space more than 6 in. beyond the other equipment.

Section 110.26(E) in the 2008 *NEC* has been deleted and its requirements have been included in 110.26(A)(3) and Exception No.1 in the 2011 Code, since the requirements were redundant.

Summary

Meter *sockets* shall not extend into the working space more than 6 in. beyond other equipment. Meters installed in meter sockets are permitted to extend beyond the other equipment.

Application Question

A meter socket is installed above a panelboard. The meter *socket* is 6 in. deeper than the panelboard. Does the installation comply with 110.26(A)(3), Exception No. 2?

Answer

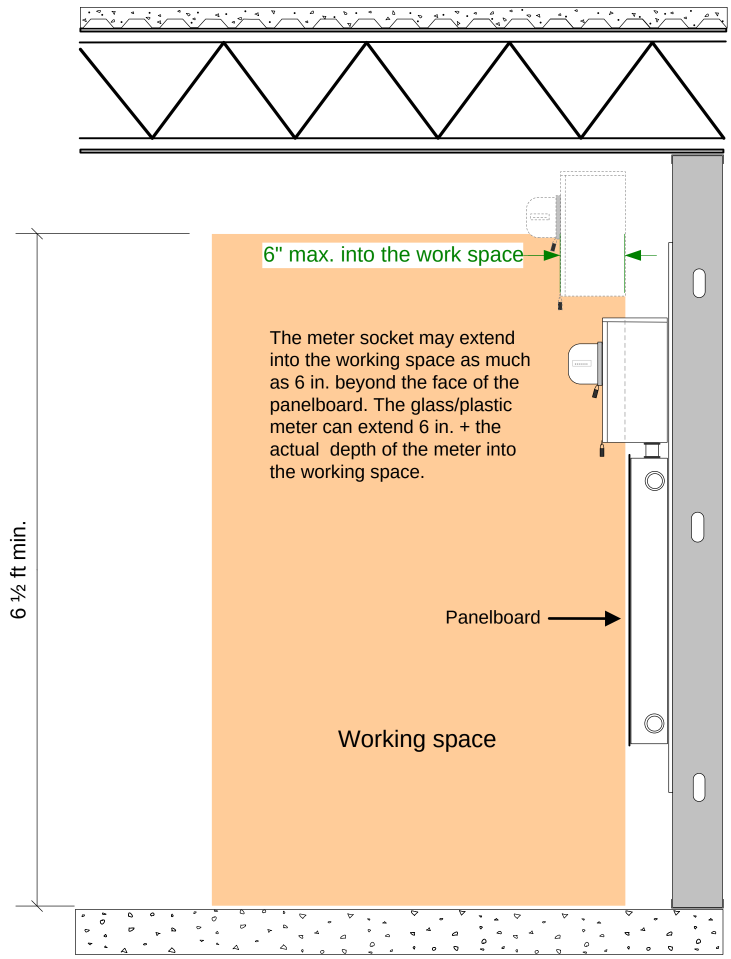
Yes. The installation is Code compliant.

Application Question

A transformer is installed indoors on a concrete floor directly below the wall-mounted panelboard it supplies. The transformer is more than 6 in. deeper than the panelboard. Does the installation comply with 110.26(A)(3)?

Answer

No. This is a common violation cited by inspectors.


6" max. into the work space
The meter socket may extend into the working space as much as 6 in. beyond the face of the panelboard. The glass/plastic meter can extend 6 in. + the actual depth of the meter into the working space.
6 ½ ft min.
Panelboard
Working space

600 Volts, Nominal, or Less – Spaces About Electrical Equipment – Illumination

Significance

Safety for those working on service equipment, switchboards, panelboards, and motor control centers is the motivation behind this requirement. Working space for electrical equipment must have working lighting that can be controlled by service personnel.

Analysis

Lighting must be provided for the working space around electrical equipment. Further, this lighting must be able to be controlled by service personnel. For instance, if the lighting is controlled by a timer or occupancy sensor, it must also have a switch or other means to allow service personnel to override the automatic control and thus provide continuous lighting in the working space.

The danger presented to service personnel who may lose lighting while performing examination, adjustment, upgrades, or maintenance on energized equipment is obvious and therefore manual control of the lighting is mandatory. Taking voltage or current measurements is an example of a task requiring good lighting, particularly since equipment must be energized.

A combination of automatic and manual controls for the lighting is acceptable so long as a manual control can override the automatic control.

The required working space lighting may not be controlled by automatic means only.

Summary

Keep the working space about electrical equipment safe by illumination that is not controlled by automatic means only, but has manual override controls.

Application Question

Can working space lighting for electrical equipment have automatic controls?

Answer

Yes, so long as manual override controls are installed.

600 Volts, Nominal, or Less – Enclosure Types

Significance
Enclosure types suitable for use in certain operating environments are required by the *NEC* for certain electrical equipment. The list of equipment for which marked enclosure types is required has expanded.

Analysis
Revised Section 110.28, formerly 110.20, expands the list of electrical equipment for which enclosure types suitable for use in certain operating environments are required. The following equipment shall be marked with an enclosure-type number as shown in Table 110.28, formerly Table 110.20:

- Switchboards and panelboards
- Industrial control panels
- Motor control centers and motor controllers
- Meter sockets

Added in the 2011 NEC

- Enclosed switches, pullout switches, and circuit breakers
- Transfer switches
- Power outlets and portable power distribution equipment
- Adjustable-speed drive systems
- Termination boxes
- General-purpose transformers
- Fire pump controllers and fire pump motors

The addition of this equipment is consistent with the *UL Guide Information for Electrical Equipment* (UL White Book), and will clarify the products and equipment that are required to have enclosures marked with an enclosure-type number. The enclosure types in Table 110.28 are for use in ordinary locations, and are not suitable for use in hazardous (classified) locations. Complete information about the suitability of an enclosure-type number is located in the UL White Book, Category (AALZ), *Electrical Equipment for Use in Ordinary Locations*. UL 50, *Enclosures for Electrical Equipment*, is the standard for electrical equipment enclosures intended to be installed in non-hazardous locations.

Summary
The *NEC* has clarified what products and equipment are required to have enclosures marked with an enclosure-type number by expanding the list of equipment requiring enclosures with the enclosure-type designation.

Ground-Fault Circuit-Interrupter Protection for Personnel

Significance

The GFCI protective devices specified in 210.8(A), (B), and (C) are now required to be “readily accessible.” This rule will change the way installers typically locate GFCI receptacles. In some cases, installers may elect to use GFCI circuit breakers in lieu of receptacles.

Analysis

There is little doubt that monthly testing of GFCI receptacles, typically recommended by the device manufacturer, is not performed on a regular basis, or perhaps not at all. Part of the reason for not testing the devices is that the GFCI receptacles may not be readily accessible. The receptacle adjacent to the bathroom sink is easily accessed and probably gets tested from time to time. GFCIs behind appliances, furnishings, or other equipment are probably seldom tested, if at all. This Code change requires all GFCI receptacles required by 210.8 to be installed in a “readily accessible” location. GFCI devices located behind furniture or appliances are accessible but not readily accessible. The provision applies only to GFCI devices that are required to be installed by 210.8(A), (B), and (C). GFCI receptacles required by other sections of the *NEC* are not subject to the readily accessible provision. This rule also applies to GFCI circuit breakers. Existing Section 240.24(A) already requires overcurrent devices to be readily accessible.

Summary

All GFCI devices required by 210.8 shall be installed in a readily accessible location.

Application Question

An electrician installs a GFCI receptacle required by 210.8 in a readily accessible location. Later, the receptacle is rendered not readily accessible due to cord-and-plug-connected equipment being placed in front of the receptacle by an occupant of the building. Is there a violation of the 2011 *NEC*?

Answer

Yes. However, the installer may not be responsible for the violation. It is reasonable to expect the electrician to have communicated with the owner or operator of the building concerning placement of receptacles. The AHJ may have some difficulty enforcing this new *NEC* rule.

Ground-Fault Circuit-Interrupter Protection for Personnel – Dwelling Units – Other Than Dwelling Units – Sinks

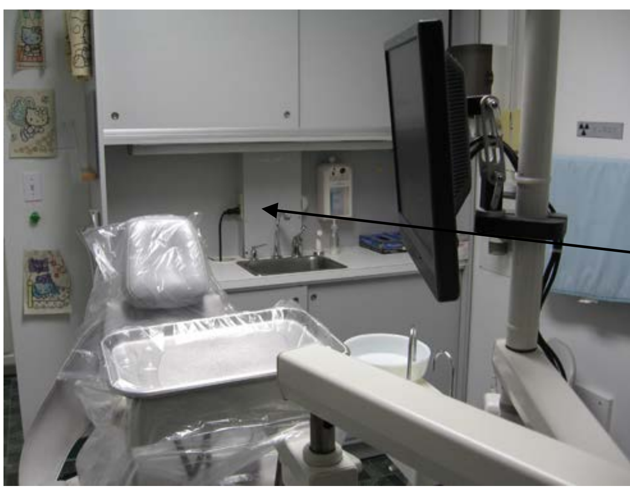
Significance

An exception in the 2008 *NEC* allows 125-volt receptacles within 6 ft of sinks in patient care areas of health care facilities to be installed without GFCI protection. In some cases, this exception has been misapplied. This change provides clarification of the rule.

Analysis

The exception was written too broadly and has been interpreted to exempt receptacles near sinks in health care facilities such as dentists' and doctors' examining rooms from the GFCI requirement. The intent of Exception No. 2 to 210.8(B)(5) is to exempt receptacles within 6 ft of sinks in patient bed locations. These receptacles might need to supply critical patient care like life support or monitoring equipment. Receptacles within 6 ft of sinks in doctors' and dentists' exam rooms are not exempted from the GFCI requirement. Normally, these exam rooms are not used to administer any type of critical care. Receptacles in patient bathrooms are required to be GFCI protected.

The GFCI requirement for receptacles near sinks in dwelling units has also been revised. Section 210.8(A)(7) now requires GFCI protection for receptacles within 6 ft of all sinks in areas other than kitchens. The previous language specified GFCI protection for receptacles within 6 ft of laundry, utility, and wet bar sinks. GFCI protection for receptacles near kitchen sinks is addressed in subsection (6).



125-volt, GFCI-protected receptacle within 6 ft of sink in dental examination room

Summary

Receptacles within 6 ft of sinks in patient bed locations of general care or critical care areas of health care facilities shall not require GFCI protection. Receptacles within 6 ft of sinks in doctors' and dentists' examination rooms shall be GFCI protected.

Application Question: T F A 125-volt, 20-A receptacle located within 6′ of a sink in a patient bed location of a health care facility is exempt from the requirement for GFCI protection.
Answer: True. See 210.8(B)(5), Exception No.2 to (5).

Ground-Fault Circuit-Interrupter Protection for Personnel – Other Than Dwelling Units – Indoor wet locations

Significance

The ability of ground-fault circuit interrupters to save lives is well established. GFCI requirements have been expanded to cover indoor wet locations.

Analysis

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in indoor wet locations shall have GFCI protection for personnel. Indoor car washes and food processing areas of facilities that manufacture food products are examples of applications of the new requirement. The existing Code only covers *outdoor* wet locations. Generally, the same hazards exist in indoor wet locations as for outdoor locations. This rule will help to protect persons using portable tools and equipment in indoor wet locations.

Indoor car wash

GFCI receptacle in weatherproof enclosure

Summary

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in indoor wet locations shall have GFCI protection for personnel.

Application Question

T F All 125-volt, single-phase, 15- and 20-ampere receptacles installed in indoor wet locations of food processing plants shall have GFCI protection for personnel.

Answer: True. This is an application of the new requirement for GFCI protection in 210.8(B)(6).

Code Refresher

- ✓ All 15- and 20-A, 125- and 250-V receptacles in wet locations shall have an enclosure that is weatherproof whether or not the attachment plug is inserted. [406.9(B)(1)]
- ✓ All 15- and 20-A, 125- and 250-V nonlocking-type receptacles in damp or wet locations shall be a listed weather-resistant type. [406.9(A) and (B)(1)]

Ground-Fault Circuit-Interrupter Protection for Personnel – Other Than Dwelling Units – Locker rooms with associated showering facilities

Significance
Any area where persons may operate electrical devices while standing on conductive floors is a good application for GFCI protection. Requirements for GFCI protection for personnel have been expanded to include convenience receptacles in locker rooms with associated showering facilities.

Analysis
The existing *NEC* does not require GFCI protection for receptacles in locker rooms. GFCI protection for receptacles in bathrooms is required by existing Code, but locker rooms may not be located in the immediate bathroom area. The 2011 *NEC* requires GFCI protection for all 125-volt, single-phase, 15- and 20-ampere receptacles located in locker rooms with associated showering facilities. The shower area does not have to be adjacent to the locker room for the rule to apply. The distance between the locker room and shower area is unimportant. If there are showering facilities associated with the locker room, then the requirement for GFCI-protected receptacles applies. The protection is for persons that may be using electric shavers or hair dryers in bare feet on wet conductive floors. Ceramic or stone tile flooring is often used in these areas.

Locker room with associated showering facilities

Summary
All 125-volt receptacles installed in locker rooms with associated showering facilities shall have GFCI protection for personnel.

Application Question
Does the Code require a receptacle to be installed in a locker room?

Answer
No, but if a receptacle is installed in a locker room with associated showering facilities, the receptacle shall have GFCI protection for personnel.

Ground-Fault Circuit-Interrupter Protection for Personnel – Other Than Dwelling Units – Garages, service bays, and similar areas where electrical equipment is to be used

Significance
The 2008 *NEC* requires GFCI protection for specific 125-volt receptacles in commercial garages that are within the scope of Article 511. This Code change expands the requirement for GFCI-protected receptacles to other types of commercial garages.

Analysis
The garages covered by this rule are nondwelling garages not within the scope of Article 511, Commercial Garages, for which GFCI protection for certain receptacles is already a requirement. Article 511 covers areas used for service and repair operations in connection with self-propelled vehicles in which volatile flammable liquids or flammable gases are used for fuel or power. A "flammable liquid" is any liquid that has a closed-cup flashpoint below 100°F (37.8°C). Garages for the service and repair of diesel-fueled vehicles are not within the scope of Article 511, since diesel fuel has a flash point above 100°F.

Auto detail garage

GFCI-protected receptacles

This Code change applies to nondwelling unit garages (including diesel garages), service bays, and similar areas where electrical diagnostic equipment, electrical hand tools, or portable lighting equipment are to be used.

Summary
All 125-volt, single-phase, 15- and 20-ampere receptacles installed in nondwelling garages, service bays, and similar areas where electrical diagnostic equipment, electrical hand tools, or portable lighting equipment are to be used shall have GFCI protection for personnel.

Application Question
T F A commercial garage for the service and repair of electric vehicles shall meet the GFCI requirement in 210.8(B)(8) for all 125-volt, 15- and 20-A receptacles.

Answer
True. This is an application of the new requirement for GFCI-protected receptacles.

Arc-Fault Circuit-Interrupter Protection – Dwelling Units

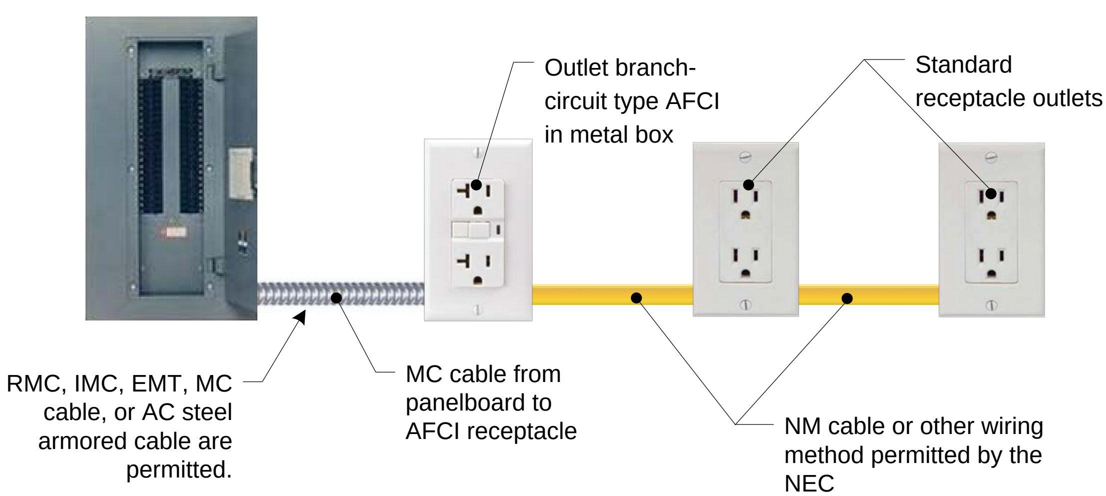
Significance

Type MC cable has been added to the list of approved wiring methods for wiring from the panelboard to the first outlet, when an arc-fault circuit-interrupter (AFCI) receptacle is used to protect the circuit rather than an AFCI circuit breaker.

Analysis

Since arc-fault protection in the *NEC* is for protection of the entire branch circuit, the AFCI device is normally a circuit breaker installed as the overcurrent device. To allow for the use of AFCI receptacles, the Code permits an outlet branch-circuit type AFCI to be installed at the first outlet from the overcurrent device, provided the circuit home run (the portion of the circuit between the panelboard and the first outlet) is protected against physical damage. Type MC cable has been added to the list of protected wiring systems for wiring of the home run. Since MC cable is a common wiring method, wiremen installing MC cable in an entire structure will not be required to use a conduit system (or Type AC cable) to accommodate the use of AFCI receptacles. The outlet branch-circuit type AFCI affords protection against the effects of series and parallel arcs downstream, including extension cords plugged into receptacles, and detects series arcs upstream of the receptacle location. Physical protection is required for the portion of the circuit that does not have parallel arc detection. The permitted wiring methods for the circuit home run are rigid metal conduit (RMC), intermediate metal conduit (IMC), electrical metallic tubing (EMT), Type MC, or steel armored AC cables meeting the requirements of 250.118 for equipment grounding. Additionally, metal outlet and junction boxes are required between the overcurrent device and the first outlet.

AFCI receptacles could find wide use in older homes where a fuse panel or an older circuit breaker panel might exist, for which AFCI breakers are not available. Aged wiring could be protected without the cost of upgrading the service panel.



Listed outlet branch-circuit type AFCI receptacles are expected to be available before the 2014 Code cycle.

Summary
If RMC, IMC, EMT, Type MC, or steel armored Type AC cables meeting the equipment grounding requirements of 250.118 and metal outlet and junction boxes are used between the overcurrent device and the first outlet, it is permissible to install an outlet branch-circuit type AFCI receptacle at the first outlet for protection of the circuit.

Application Question
When using a receptacle-type AFCI in lieu of an AFCI circuit breaker, is aluminum AC cable a permitted wiring method for the home run wiring?

Answer
No. The *NEC* requires the use of steel armored Type AC cable. Testing for crush-resistance has not been performed on Type AC cables.

Code Refresher
- ✓ To comply with the AFCI requirements in 210.12(A), the only type of AFCI circuit breaker permitted is a listed combination-type AFCI circuit breaker. Branch/feeder AFCIs were permitted to be used until January 1, 2008. The combination-type AFCI provides both series and parallel arc detection for the entire branch circuit, including extension cords. “Combination” refers to the fact that the device will detect *both* series and parallel arcing. The use of outlet branch-circuit AFCIs is by an exception to 210.12(A).

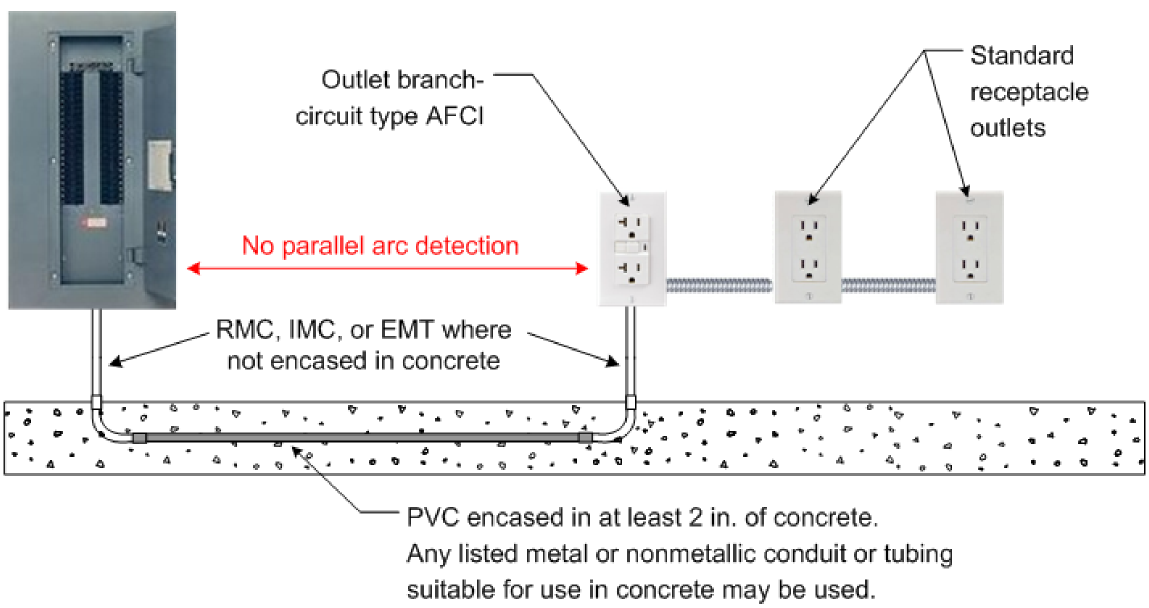
Arc-Fault Circuit-Interrupter Protection – Dwelling Units

Significance

A new exception has been added to 210.12(A) that permits use of a receptacle-type AFCI when the branch circuit home run is installed in metal or nonmetallic raceway encased in concrete.

Analysis

Where a listed metal or nonmetallic conduit or tubing is encased in not less than 2 in. of concrete for the portion of the circuit between the overcurrent device and the first outlet, it is permissible to install an outlet branch-circuit type AFCI at the first outlet to provide arc-fault protection for the circuit. This method provides only series arc detection upstream from the AFCI receptacle. This may not be much of a concern, since the concrete provides physical protection for the circuit conductors for most of the home run. For the portion of the home run that is not encased in concrete, the conductors shall be enclosed in RMC, IMC, or EMT. This exception could see wide application in concrete floors poured over metal decking in multistory buildings.



Summary

Where a listed metal or nonmetallic conduit or tubing is encased in not less than 2 in. of concrete for the portion of the circuit between the overcurrent device and the first outlet, it is permissible to install an outlet branch-circuit type AFCI at the first outlet to provide arc-fault protection for the circuit.

Application Question

T F For application of 210.12(A), Exception No. 2, PVC can be used for the home run wiring only when encased in concrete.

Answer: True. Even though PVC is acceptable for providing physical protection for wiring that is within 1¼ in. from the face of framing members (see 300.4), for the purpose of 210.12(A), Exception No. 2, no portion of PVC is permitted without concrete encasement.

Arc-Fault Circuit-Interrupter Protection – Branch Circuit Extensions or Modifications – Dwelling Units

Significance

Arc-fault circuit-interrupter protection for existing branch circuits in dwelling units is now required when branch circuits are modified, replaced, or extended.

Analysis

In any of the areas specified in 210.12(A), where branch circuits are modified, replaced, or extended, arc-fault circuit-interrupter protection shall be provided by either of the following:

- A listed combination-type AFCI located at the origin of the branch circuit
- A listed outlet branch-circuit type AFCI located at the first receptacle outlet of the existing branch circuit

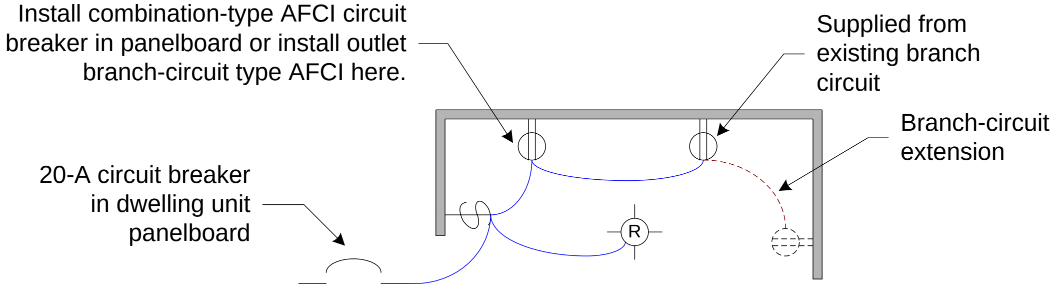
The option to install receptacle-type AFCIs will accommodate installations where AFCI circuit breakers are not available for an existing panelboard. However, receptacle-type AFCIs do not provide parallel arc detection (short circuit or ground fault) upstream from the AFCI location. Only series arc detection (loose or broken connection) is provided upstream. Also, the existing wiring method for the home run might not provide physical protection for the circuit conductors. Physical protection for home run wiring is required for new wiring, according to the exceptions to 210.12(A), when receptacle-type AFCIs are used.

Note that the requirement is for the AFCI receptacle to be located at the first *receptacle* outlet, recognizing that the first outlet on a circuit may be an outlet for a luminaire or other utilization equipment. If there are no receptacle outlets on the existing circuit, then an AFCI receptacle shall be installed at the first receptacle outlet of the extension to the existing branch circuit.

Section 210.12(A) lists the areas in dwelling units where AFCI protection for branch circuits is required: family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas. AFCI protection is not required for branch circuits that supply outlets in kitchens, bathrooms, garages, basements, crawl spaces, or outdoors. The new subsection applies to existing 120-volt, single-phase, 15- and 20-ampere branch circuits that serve outlets in any of the areas specified in 210.12(A).

Summary

For modifications or extensions of existing branch circuits that supply any of the areas of dwelling units specified in 210.12(A), the branch circuit shall be protected by a combination-type AFCI circuit breaker, or an outlet branch-circuit type AFCI located at the first receptacle outlet of the circuit.



Application Question

A 20-amp, 120-volt circuit supplies living room outlets in a dwelling unit. The circuit was installed before the *NEC* requirement for AFCIs became effective. The overcurrent device is a circuit breaker, for which an AFCI replacement is readily available. The circuit is extended to add a receptacle outlet.

T F The *NEC* permits the use of an outlet branch-circuit type AFCI for circuit arc-fault protection.

Answer

True. Even when a combination-type AFCI circuit breaker is available for an existing panelboard, a circuit breaker type or receptacle-type AFCI is permitted.

Eaton Corporation

Required Outlets – Dwelling Unit Receptacle Outlets – Countertops

Significance
A new receptacle outlet assembly has been recognized by the *NEC* for countertop spaces. This assembly offers another alternative to receptacle mounting below countertop surfaces in cabinet faces. Receptacles in cabinet faces can be a safety hazard, especially to children.

Analysis
The options for installing required receptacles to serve island and peninsular countertop surfaces has been limited to "tombstone" outlets and receptacles installed below the countertop surface. Many homeowners do not like the appearance of the tombstone receptacles, and cords plugged into receptacles below the countertop are accessible to children. The 2011 *NEC* permits outlet assemblies listed for the application to be installed *in* countertops. The listed receptacle assembly shown in the photo below stores beneath the countertop surface, leaving only the flush round plate visible on the countertop when stored. Use of this type of receptacle will result in some loss of usable space in the base cabinet below. This Code change applies also to bathroom countertops of dwellings in Section 210.52(D). The receptacle outlet assembly pictured below complies with Section 406.5(E), which prohibits receptacles in countertops and similar work surfaces in dwellings to be mounted in a face-up position.

Courtesy of Thomas & Betts Corp.

Summary
Receptacle outlet assemblies listed for the application are permitted to be installed *in* countertops located in dwelling unit kitchens, pantries, breakfast rooms, dining rooms, and bathrooms.

Application Question
The assembly pictured above is installed in an island countertop in a residential kitchen. The island does not contain a sink. Does the receptacle require GFCI protection?

Answer

Yes. Section 210.8(A)(6) requires GFCI protection for receptacles installed to serve countertop surfaces in kitchens of dwelling units.

Required Outlets – Dwelling Unit Receptacle Outlets – Outdoor Outlets – Balconies, Decks, and Porches

Significance

A convenience receptacle outlet is required on balconies, decks, and porches of any size that are accessible from inside a dwelling unit.

Analysis

In the previous Code, a receptacle was not required for balconies, decks, or porches with a usable area of less than 20 ft^2. This revision requires that at least one receptacle outlet be installed within the perimeter of balconies, decks, or porches of any size that are accessible from inside a dwelling unit. The receptacle(s) shall not be located more than 6½ ft above the surface of the balcony, deck, or porch.

Many small “balconies” are architectural projections that might consist of a safety guardrail at a second floor door(s) for natural ventilation or aesthetics. Even though there might be very little usable space on the balcony, these areas are frequently used for holiday decorations. The intent of this Code section is to prevent passage of extension cords through doorways and windows.

The small balconies in the photos above are examples of the type of balconies now included in the Code requirement for placement of a convenience receptacle. In the photo on the right, the balcony is accessed only through windows, so the receptacle requirement may not apply. However, the photo does show the decorative use of these balconies.

Summary

At least one receptacle outlet shall be installed within the perimeter of balconies, decks, or porches of any size that are accessible from inside a dwelling unit.

Application Question

T F The receptacle required by 210.52(E)(3) for balconies, decks, and porches is not required to be tamper-resistant.

Answer

False. Tamper-resistant receptacles are required outdoors at dwelling units and in all areas specified in 210.52, Dwelling Unit Receptacle Outlets. The only areas not specified in 210.52 are closets and crawl spaces. The tamper-resistant requirement applies to 125-volt, 15- and 20-ampere, nonlocking-type receptacles. There is a new exception to the general requirement for tamper-resistant receptacles in 406.12 that specifies four instances where tamper-resistant receptacles in dwelling units are not required.

Code Refresher

- ✓ All outdoor 125-volt, 15- and 20-ampere receptacles at dwelling units shall have GFCI protection for personnel. [210.8(A)(3)]
- ✓ All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles installed in damp and wet locations shall be a listed weather-resistant type. [406.9(A) and (B)(1)]
- ✓ All 15- and 20-ampere, 125- and 250-volt receptacles installed in wet locations shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. [406.9(B)(1)]
- ✓ A receptacle installed outdoors in a location protected from the weather (under roofed open porches, etc.) or in other damp locations shall have a receptacle enclosure that is weatherproof when the receptacle is covered, i.e., when the attachment plug cap is not inserted and the receptacle cover is closed. [406.9(A)]
- ✓ A "dwelling unit" is a single unit that provides complete and independent living facilities for one or more persons, including permanent provisions for living, sleeping, cooking, and sanitation. A "multifamily dwelling" is a building that contains three or more dwelling units. [Article 100, Definitions]

Required Outlets – Dwelling Unit Receptacle Outlets – Basements, Garages, and Accessory Buildings

Significance

The 2011 *NEC* contains specific requirements for outlets in one-family dwelling accessory buildings that are supplied with electric power. The same safety concerns should be addressed in residential outbuildings as in detached garages.

Analysis

A one-family dwelling accessory building supplied with electric power shall have at least one receptacle outlet installed, in addition to outlets for specific equipment. The intent of the requirement is that a receptacle outlet be available that is not dedicated to other equipment. Existing Code requires GFCI protection for convenience receptacles in accessory buildings, not intended for habitation, that have a floor at or below grade level. Also, current Code requires tamper-resistant receptacles in dwelling unit accessory buildings, since accessory buildings are among the areas specified in Section 210.52 (see Section 406.12). The *NEC* does not require AFCI-protected branch circuits for the supply of electric equipment in accessory buildings. Note that an accessory building does not have to be supplied with electric power.

Required receptacle outlet in an accessory building of a single-family dwelling

Summary

For a one-family dwelling, an accessory building supplied with electric power shall have at least one receptacle outlet installed, in addition to outlets for specific equipment.

Application Question

T F The requirement for a receptacle outlet in accessory buildings applies to multifamily dwellings, since multifamily dwellings contain individual dwelling units.

Answer

False. The requirement applies to an accessory building with electric power on the property of a one-family dwelling. A *one-family dwelling* is a building that consists solely of one dwelling unit. However, many Code rules do pertain to each dwelling unit of a multifamily dwelling, e.g., GFCI, AFCI, and tamper-resistant requirements.

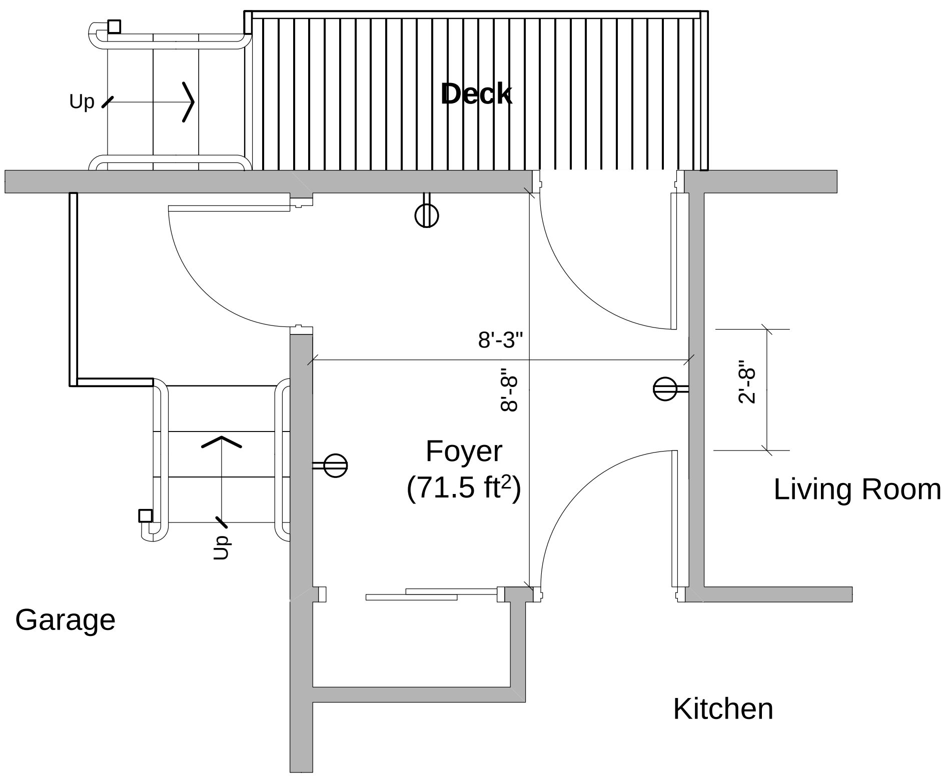
Required Outlets – Dwelling Unit Receptacle Outlets – Foyers

Significance

The list of areas within dwelling units where receptacle outlets are required now includes foyers.

Analysis

The 2011 Code requires that convenience receptacle outlets be installed in dwelling unit foyers. The *NEC* already has requirements for receptacles in hallways, and now introduces requirements for receptacles in foyers, distinguishing this area from hallways. Generally, hallways are relatively narrow corridors or passageways, whereas foyers are lobbies or vestibules just inside the entrance to a building. Foyers that have an area of more than 60 ft^2 shall have a receptacle outlet(s) in each wall space 3 ft or more in width that is unbroken by doorways, floor-to-ceiling windows, and similar openings. The new requirement applies to one-family dwellings and dwelling units within two-family and multifamily dwellings.



Receptacle placement in a dwelling unit foyer

Summary

Foyers that have an area of more than 60 ft^2 shall have a receptacle outlet(s) in each wall space 3 ft or more in width that is unbroken by doorways, floor-to-ceiling windows, and similar openings.

Application Question
For the foyer diagram above, is the receptacle located within the 2′-8″ wall space a required outlet?

Answer
Yes. For the purpose of receptacle spacing, the wall space behind the swing of a door is included in the wall-line measurement, even though this space may not be usable. A receptacle does not have to be located behind a door, but the space must be counted.

Code Refresher
- ✓ At least one receptacle outlet is required in dwelling unit hallways of 10 ft or more in length. The length of the hallway is the length along the centerline of the hallway without passing through a doorway.

Raceway Seal

Significance

All underground raceways entering buildings or structures from underground distribution systems must be sealed to prevent moisture from contacting live parts.

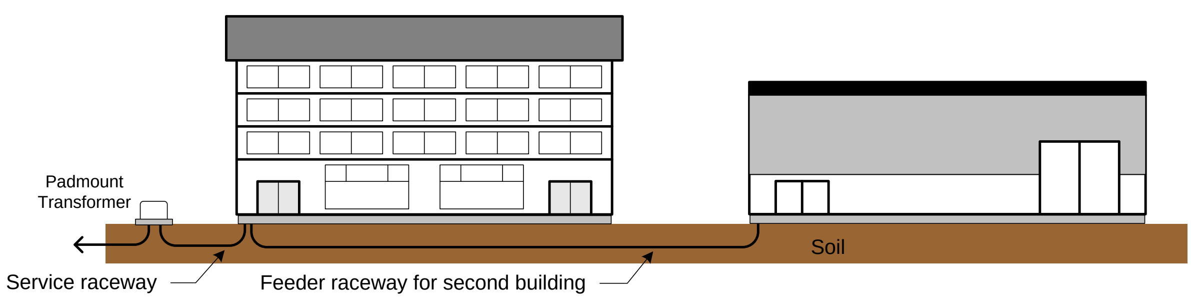
Analysis

Article 225 deals with requirements for Outside Branch Circuits and Feeders run on or between buildings, structures, or poles. New Section 225.27 requires that all underground raceways entering buildings be sealed in accordance with 300.5(G) to prevent moisture from contacting live parts. Section 230.8 of the existing Code requires service raceways to be sealed. Beginning with the 2011 *NEC*, branch-circuit raceways and feeder raceways must also be sealed. The requirement includes spare or unused raceways. Sealants shall be identified for use with the cable insulation, shield, or other components. Raceways must be sealed or plugged at either or both ends. Sealing or plugging of underground raceways entering buildings may also be necessary when hazardous gases or vapors are present.

In addition to addressing raceways entering buildings, the intent of the rule is to include raceways emerging from ground and entering enclosures mounted *on* buildings or structures. An outdoor pedestal with electrical equipment mounted on it is considered a structure.

The sealing is required for underground raceways that are continuous and for direct-buried cable transitioning to conduit for physical protection as the wiring system emerges from the ground. The sealing required by this section is not the same as the sealing required for hazardous locations. The seal may be applied underground where direct-burial wiring transitions to conduit, or aboveground at the end of a conduit where the conduit enters an enclosure. Flexible putty-type sealant like Gardner Bender (GB) electrical sealing compound can be used underground and conduit sealing bushings such as O-Z/Gedney Type CSBI can be used aboveground at conduit ends.

The applicability of this new rule for outside branch circuits and feeders is a matter for the AHJ, since 300.5(G) requires sealing only when there is a certain likelihood that moisture could contact live parts.



Sealing is required for the service and feeder raceways.

Summary

Where a raceway, including an unused or spare raceway, through which moisture may contact live parts, enters a building or structure from an underground distribution system, the raceway shall be sealed or plugged at either or both ends. Sealants shall be identified for use with the cable insulation, shield, or other components.

Application Question

T F The raceway sealing required by this section must be done at both ends of a raceway.

Answer

False. The Code states that only one end of a raceway is required to be plugged or sealed. However, the feeder raceway in the diagram above must be sealed at both ends, since the raceway enters two buildings.

Buildings or Other Structures Supplied by a Feeder(s) or Branch Circuit(s) – Number of Supplies

Significance

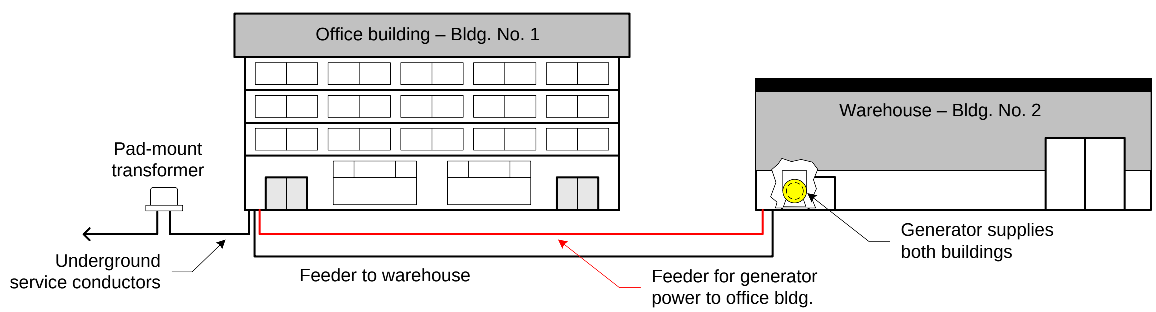
Only one feeder or branch circuit is permitted to be run from a building to supply a second building. The 2011 *NEC* applies this same general rule for a feeder or branch circuit originating in the second building that supplies power back to the first building.

Analysis

The general rule in Section 225.30 that limits the number of supplies to a building to one is similar to the general rule in 230.2 that limits the number of services to a building to one. Where more than one building is on the same property and under single management, each building supplied from a feeder or branch circuit on the load side of a service disconnecting means shall be supplied with only one feeder or branch circuit. The Code change in this section addresses a branch circuit or feeder that originates in these additional buildings and prohibits more than one branch circuit or feeder to supply power back to the original building. A generator located in a second building supplying power back to the first building is permitted by the existing Code and the 2011 Code. The Code change is for the purpose of limiting the number of supplies in both directions between buildings. Section 225.30(A) through (E) permits more than one supply from one building to another for fire pumps, emergency systems, legally required and optional standby systems, parallel power production systems, multiple sources for enhanced reliability, special occupancies, capacity requirements, different characteristics, and when documented switching procedures are followed.

Summary

Generally, only one feeder or branch circuit is permitted to be run from a building to supply a second building. Only one feeder or branch circuit originating in the second building is permitted to supply power back to the first building.



Application Question

T F For the service and feeder wiring in the diagram above, there must be a plaque at the service equipment in Building No. 1 identifying the generator supply and its location.

Answer: True. See 225.37, 230.2(E), and either 700.7, 701.7, or 702.7 depending on whether the generator is connected as emergency, legally required standby, or optional standby.

Service-Entrance Conductors – Minimum Size and Rating – General

Significance

For sizing grounded service-entrance conductors that supply continuous loads, the additional 25% upsizing is no longer required where the grounded conductor is not connected to an overcurrent device.

Analysis

For sizing service-entrance conductors the general rule is that the ampacity of the service-entrance conductors, before the application of any adjustment or correction factors, be not less than the sum of the noncontinuous loads plus 125% of the continuous loads. If the conductors terminate at an overcurrent device where both the overcurrent device and its assembly are listed for operation at 100% of their rating, the additional 25% of conductor ampacity is not required. A new exception permits grounded conductors that are not connected to an overcurrent device to be sized at 100 percent of the sum of the continuous and noncontinuous loads. Conductors that are not connected to an overcurrent device are not subject to the heat dissipated by the overcurrent device assembly.

The revised rules for sizing grounded service-entrance conductors are now the same as existing Code rules for sizing grounded feeder circuit conductors in 215.2(A)(1), Exception No. 2.

Example: Lighting load for retail store

The store has an area of 3750 ft^2 and has 40 linear ft of show window. The store is supplied by a 120/240-V, single-phase, 3-wire service.

The neutral load for the service-entrance conductors is calculated according to Section 220.61, Feeder or Service Neutral Load, and applicable sections of Parts II and III of Article 220.

Continuous loads: (All of the lighting is considered a continuous load.)

General lighting [220.12]	3750 ft^2 x 3 VA/ ft^2	11,250 VA
Show window lighting [220.43(A)]	40 ft x 200 VA/ft	8000 VA
Outside sign [220.14(F)]		1200 VA
		20,450 VA

Lighting component of service load for ungrounded conductors:

20,450 VA x 125% = 25,563 VA

25,563 VA ÷ 240 V = 107 A

Lighting component of service load for grounded (neutral) conductor:

20,450 VA ÷ 240 V = 85 A

Summary

Grounded service-entrance conductors that are not connected to an overcurrent device shall be permitted to be sized at 100% of the sum of the continuous and noncontinuous load.

Application Question

T F The new exception to 230.42(A)(1) for determining the ampacity of a grounded service-entrance conductor, where the conductor in not connected to an overcurrent device, applies also to the grounded service-entrance conductor of an underground system.

Answer

True. Generally, service-entrance conductors of an underground system will originate at the load terminals of a meter. It is important to know where the service point is located and to understand the definitions related to underground service conductors in Article 100. A *service lateral* is on the line side of the service point and is not subject to the *NEC*. *Underground service conductors* are within the jurisdiction of the *NEC*.

Service-Entrance Conductors – Cable Trays

Significance

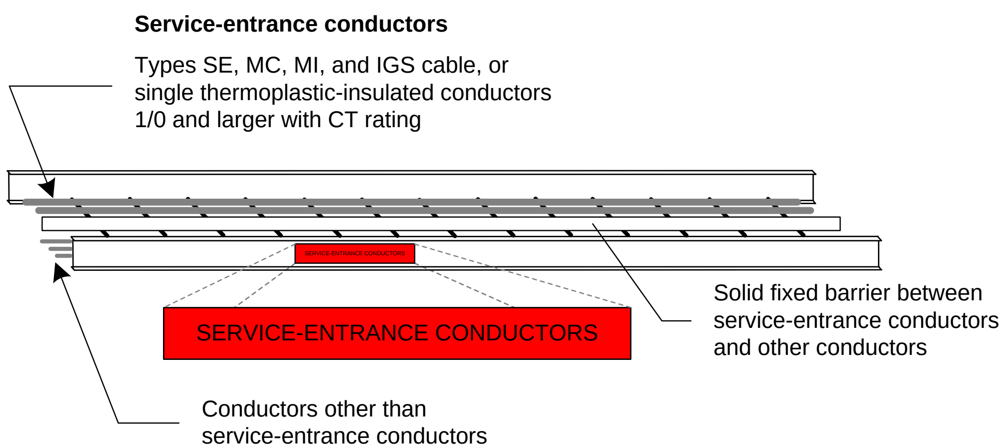
Cable tray systems used for the support of service-entrance conductors are limited to certain cable types and wiring methods.

Analysis

Cable trays used to support service-entrance conductors shall contain only the following cable types or wiring method:

1) Type SE (service-entrance) cable
2) Type MC (metal-clad) cable
3) Type MI (mineral-insulated, metal-sheathed) cable
4) Type IGS (integrated gas spacer) cable
5) Single thermoplastic-insulated conductors 1/0 and larger with CT (cable tray) rating

Conductors other than service-entrance conductors may be installed in the tray with service-entrance conductors provided there is a solid fixed barrier separating the service-entrance conductors from the other conductors.



Summary

Cable tray systems used for the support of service-entrance conductors may contain only Types SE, MC, MI, and IGS cable, or single thermoplastic-insulated conductors 1/0 and larger with CT rating.

Application Question

T F Type XHHW single conductor 1/0 and larger conductors can be used as service-entrance conductors supported by cable tray systems.

Answer

False. Type XHHW is a *thermoset* insulation. See *NEC* Table 310.104(A).

Circuit Breakers – Non-instantaneous Trip

Significance

Circuit breakers without an instantaneous trip function can now only be installed if an approved means is employed to reduce arc-flash exposure time.

Analysis

Non-instantaneous trip circuit breakers are sometimes used to facilitate selective coordination with other overcurrent devices. Where selective coordination is required, delayed tripping must not jeopardize the safe operation of electrical equipment or the safety of persons who might be exposed to the incident energy at a fault. A longer clearing time can expose persons to higher levels of incident energy at a fault, thereby increasing the hazard. New Section 240.87 requires that one of the methods identified in this section be used to limit a circuit's energy level when a non-instantaneous trip circuit breaker is used:

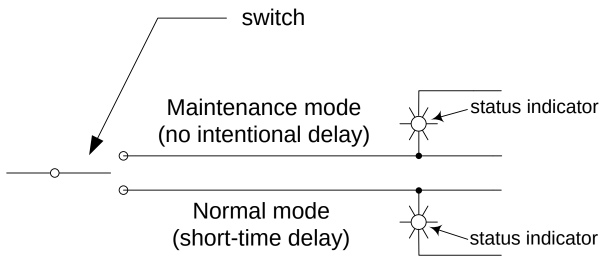
1. Zone-selective interlocking – Upstream and downstream circuit breakers communicate with each other and determine whether the upstream breaker should trip without intentional delay or after a pre-set time delay, depending on the location of the fault.
2. Differential relaying – The current flowing into the upstream breaker is compared with the current flowing out of the downstream breaker. Under normal conditions, the difference is zero. A fault between the upstream and downstream breakers will result in a difference current that will reach the level of a pre-set setting and cause the upstream breaker to trip without delay.
3. Energy-reducing maintenance switching with local status indicator – A worker can set the trip unit to "no intentional delay" whenever working within the flash protection boundary, and then back to the normal (short-time delay) mode when finished.
4. Approved equivalent means – This allows for new technology and innovation.

Working on energized equipment should only be done when de-energization is not feasible and after following the requirements for working on energized equipment in NFPA 70E, *Standard for Electrical Safety in the Workplace.*

Where a circuit breaker without instantaneous trip is used, documentation of the location of the breaker(s) shall be available to those authorized to design, install, operate, or inspect the installation.

New Section 240.87 does not apply to circuit breakers that have their instantaneous trip setting set to "off." This section only applies to circuit breakers that do not have an instantaneous trip function. Modern circuit breakers are available with instantaneous trip settings and an energy-reducing maintenance switch that will achieve both selective coordination and reduced energy levels during fault conditions.

Summary
Circuit breakers without an instantaneous trip function can now only be installed if an approved means is employed to reduce arc-flash exposure time. Where a circuit breaker without instantaneous trip is used, documentation of the location of the breaker(s) shall be available to those authorized to design, install, operate, or inspect the installation.



Energy-reducing maintenance switch

Application Question

T F Where a circuit breaker with an instantaneous trip function is used, the *NEC* does not permit use of the methods identified in 240.87 to limit a circuit's energy level.

Answer

False. The Code is silent on this. The *NEC* is not a design manual.