ICC 2019 LAS VEGAS NEVADA

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2019 Annual Conference Educational Sessions

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Session: IAEI Residential Installations Conforming with Part 8 of the 2018 IRC

One- and Two Family Dwelling Electrical Systems – 2018 IRC

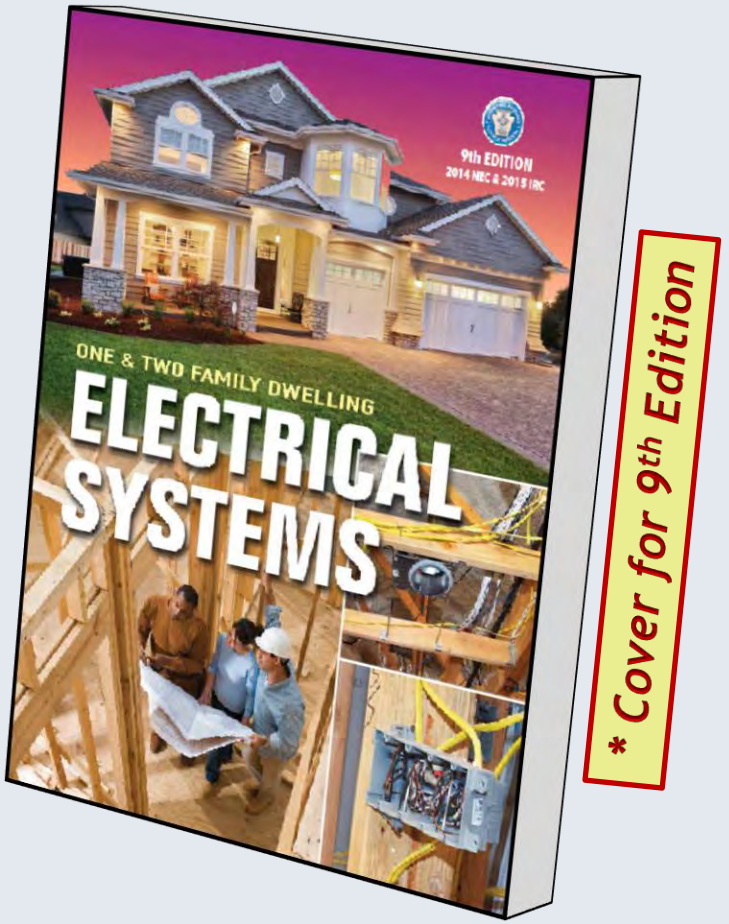
2019 ICC Annual Conference – Las Vegas, NV

Training Presentation by:

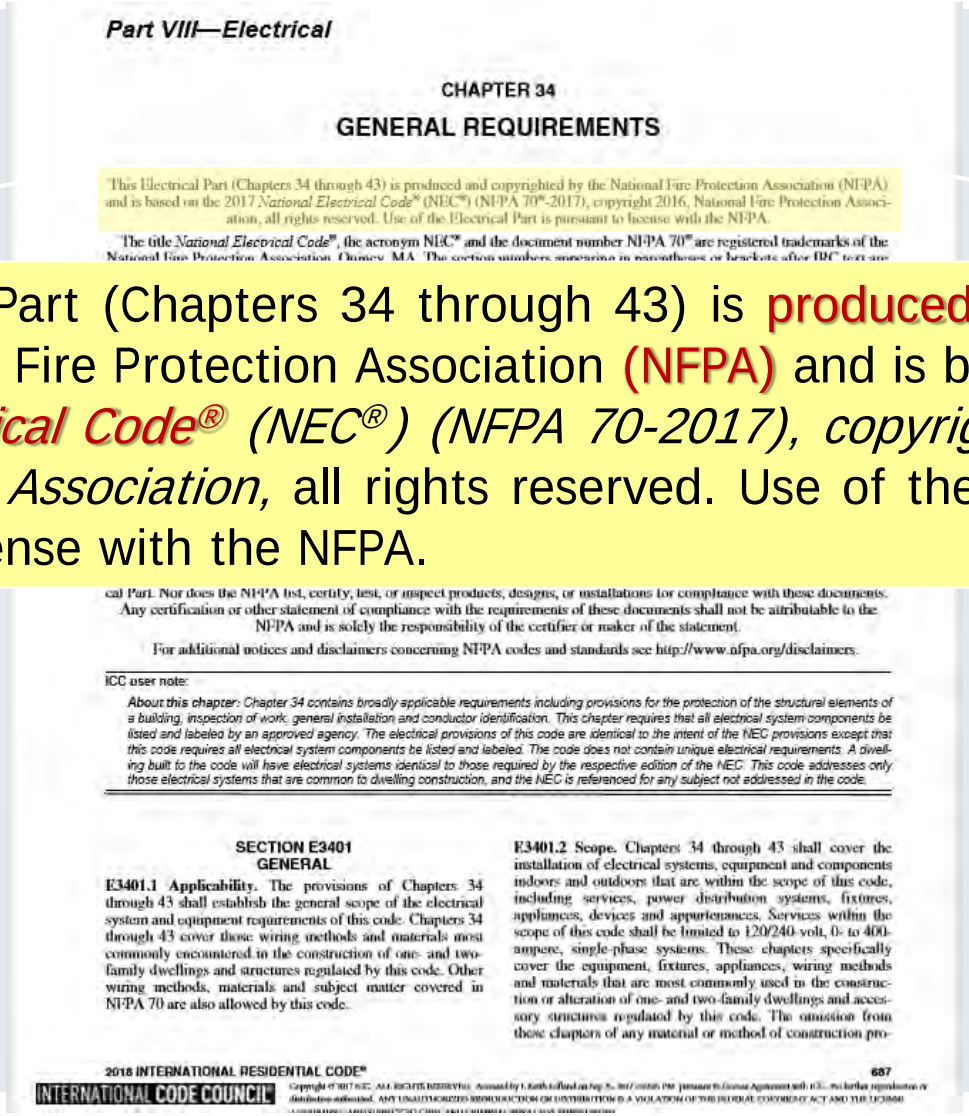
International Association of Electrical Inspectors

One- and Two Family Dwelling Electrical Systems – 2017 *NEC*

- Presentation based on IAEI's *One- and Two-Family Dwelling Electrical Systems* , 9th edition textbook
- This textbook is based on the requirements contained the **2017 *NEC*** and the **2018 *IRC***



2018 IRC Part VIII - Electrical



Part VIII—Electrical

CHAPTER 34

GENERAL REQUIREMENTS

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ICC user note:

About this chapter: Chapter 34 contains broadly applicable requirements including provisions for the protection of the structural elements of a building, inspection of work, general installation and conductor identification. This chapter requires that all electrical system components be listed and labeled by an approved agency. The electrical provisions of this code are identical to the intent of the NEC provisions except that this code requires all electrical system components be listed and labeled. The code does not contain unique electrical requirements. A dwelling built to the code will have electrical systems identical to those required by the respective edition of the NEC. This code addresses only those electrical systems that are common to dwelling construction, and the NEC is referenced for any subject not addressed in the code.

SECTION E3401
GENERAL

E3401.1 Applicability. The provisions of Chapters 34 through 43 shall establish the general scope of the electrical system and equipment requirements of this code. Chapters 34 through 43 cover those wiring methods and materials most commonly encountered in the construction of one- and two-family dwellings and structures regulated by this code. Other wiring methods, materials and subject matter covered in NFPA 70 are also allowed by this code.

E3401.2 Scope. Chapters 34 through 43 shall cover the installation of electrical systems, equipment and components indoors and outdoors that are within the scope of this code, including services, power distribution systems, fixtures, appliances, devices and appurtenances. Services within the scope of this code shall be limited to 120/240-volt, 0- to 400-ampere, single-phase systems. These chapters specifically cover the equipment, fixtures, appliances, wiring methods and materials that are most commonly used in the construction or alteration of one- and two-family dwellings and accessory structures regulated by this code. The omission from these chapters of any material or method of construction pro-

2018 INTERNATIONAL RESIDENTIAL CODE® 687

INTERNATIONAL CODE COUNCIL

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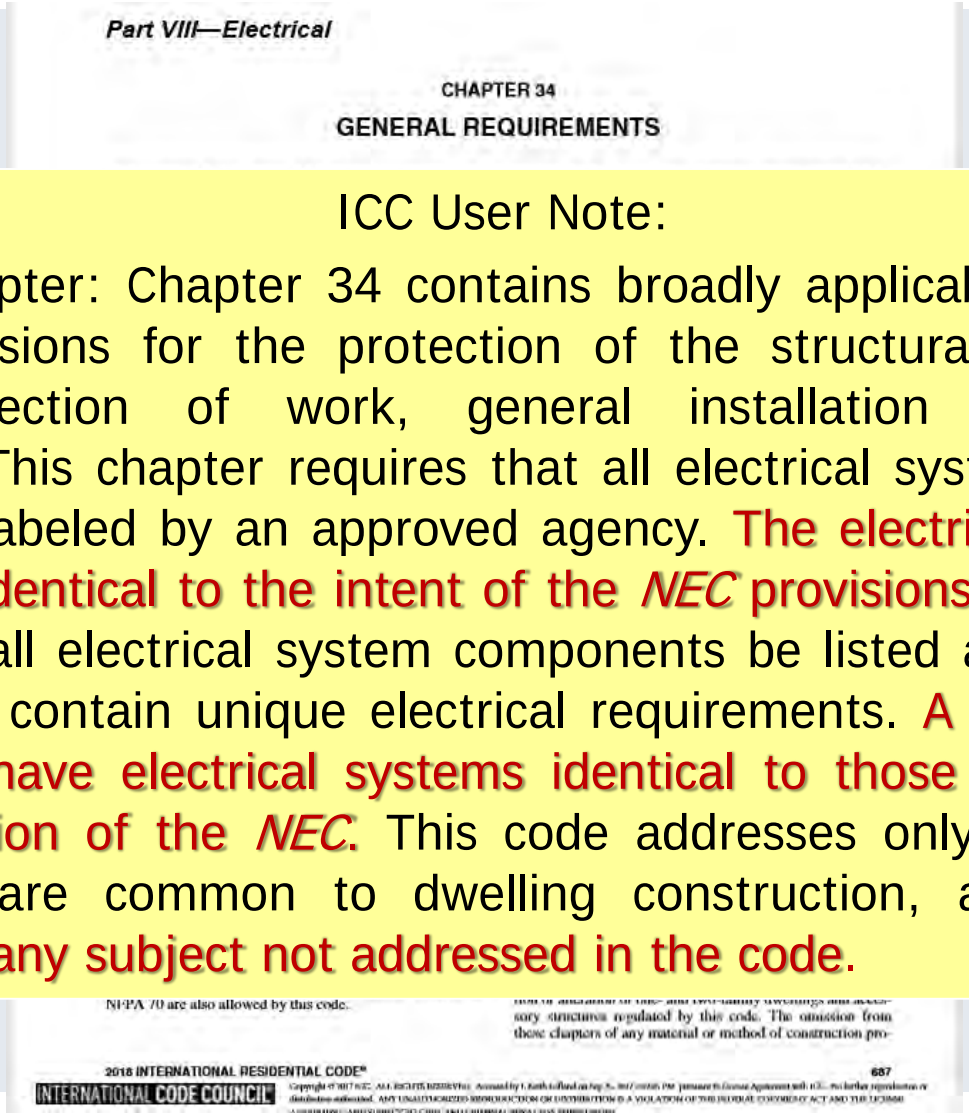
2018 IRC Part VIII - Electrical


Part VIII—Electrical

CHAPTER 34

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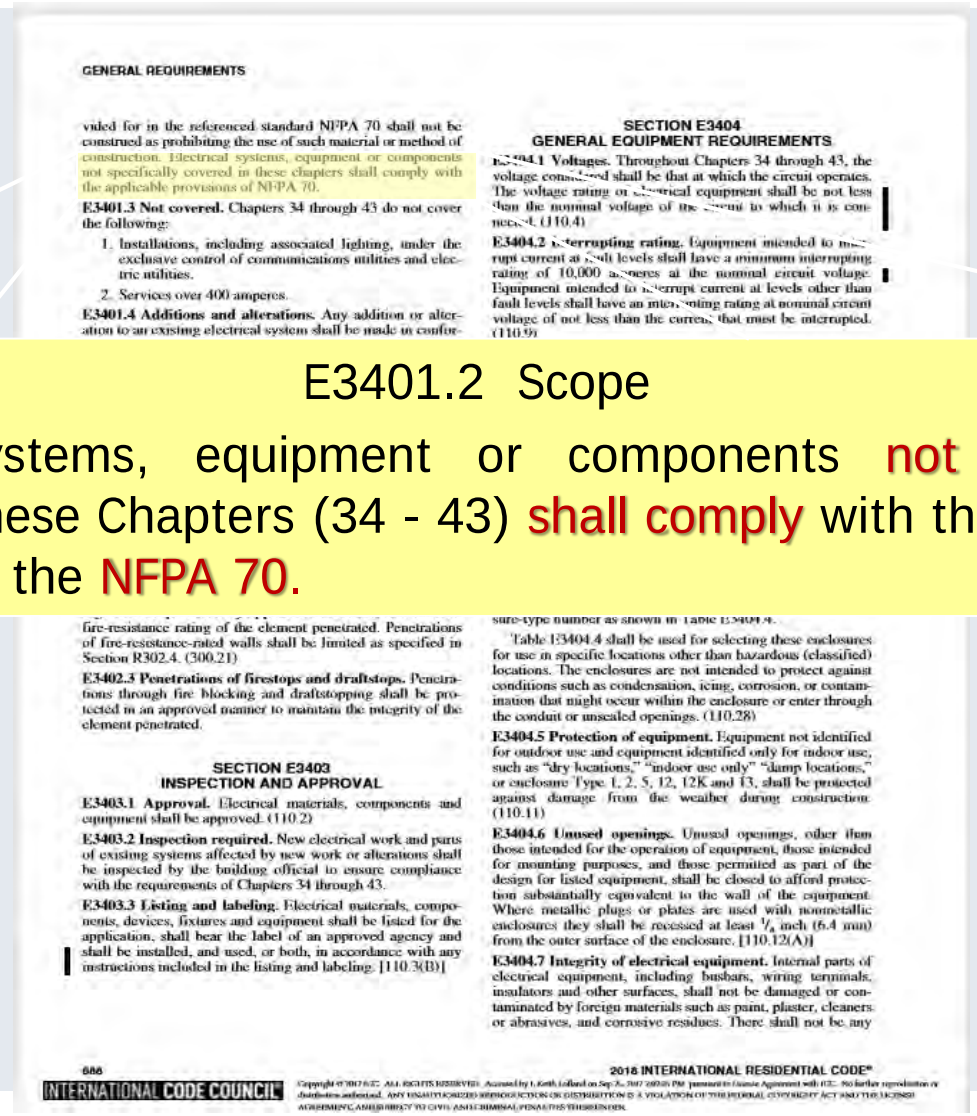
2018 INTERNATIONAL RESIDENTIAL CODE®

687

INTERNATIONAL CODE COUNCIL

2018 IRC Part VIII - Electrical



GENERAL REQUIREMENTS

vided for in the referenced standard NFPA 70 shall not be construed as prohibiting the use of such material or method of construction. Electrical systems, equipment or components not specifically covered in these chapters shall comply with the applicable provisions of NFPA 70.

E3401.3 Not covered. Chapters 34 through 43 do not cover the following:

1. Installations, including associated lighting, under the exclusive control of communications utilities and electric utilities.
2. Services over 400 amperes.

E3401.4 Additions and alterations. Any addition or alteration to an existing electrical system shall be made in confor-

SECTION E3404
GENERAL EQUIPMENT REQUIREMENTS

E3404.1 Voltages. Throughout Chapters 34 through 43, the voltage considered shall be that at which the circuit operates. The voltage rating of electrical equipment shall be not less than the nominal voltage of the circuit to which it is connected. (110.4)

E3404.2 Interrupting rating. Equipment intended to interrupt current at fault levels shall have a minimum interrupting rating of 10,000 amperes at the nominal circuit voltage. Equipment intended to interrupt current at levels other than fault levels shall have an interrupting rating at nominal circuit voltage of not less than the current that must be interrupted. (110.9)

fire-resistance rating of the element penetrated. Penetrations of fire-resistance-rated walls shall be limited as specified in Section R302.4. (300.21)

E3402.3 Penetrations of firestops and draftstops. Penetrations through fire blocking and draftstopping shall be protected in an approved manner to maintain the integrity of the element penetrated.

SECTION E3403
INSPECTION AND APPROVAL

E3403.1 Approval. Electrical materials, components and equipment shall be approved. (110.2)

E3403.2 Inspection required. New electrical work and parts of existing systems affected by new work or alterations shall be inspected by the building official to ensure compliance with the requirements of Chapters 34 through 43.

E3403.3 Listing and labeling. Electrical materials, components, devices, fixtures and equipment shall be listed for the application, shall bear the label of an approved agency and shall be installed, and used, or both, in accordance with any instructions included in the listing and labeling. [110.3(B)]

sure-type number as shown in Table E3404.4.

Table E3404.4 shall be used for selecting these enclosures for use in specific locations other than hazardous (classified) locations. The enclosures are not intended to protect against conditions such as condensation, icing, corrosion, or contamination that might occur within the enclosure or enter through the conduit or unsealed openings. (110.28)

E3404.5 Protection of equipment. Equipment not identified for outdoor use and equipment identified only for indoor use, such as "dry locations," "indoor use only" "damp locations," or enclosure Type 1, 2, 5, 12, 12K and 13, shall be protected against damage from the weather during construction. (110.11)

E3404.6 Unused openings. Unused openings, other than those intended for the operation of equipment, those intended for mounting purposes, and those permitted as part of the design for listed equipment, shall be closed to afford protection substantially equivalent to the wall of the equipment. Where metallic plugs or plates are used with nonmetallic enclosures they shall be recessed at least $\frac{1}{4}$ inch (6.4 mm) from the outer surface of the enclosure. [110.12(A)]

E3404.7 Integrity of electrical equipment. Internal parts of electrical equipment, including busbars, wiring terminals, insulators and other surfaces, shall not be damaged or contaminated by foreign materials such as paint, plaster, cleaners or abrasives, and corrosive residues. There shall not be any

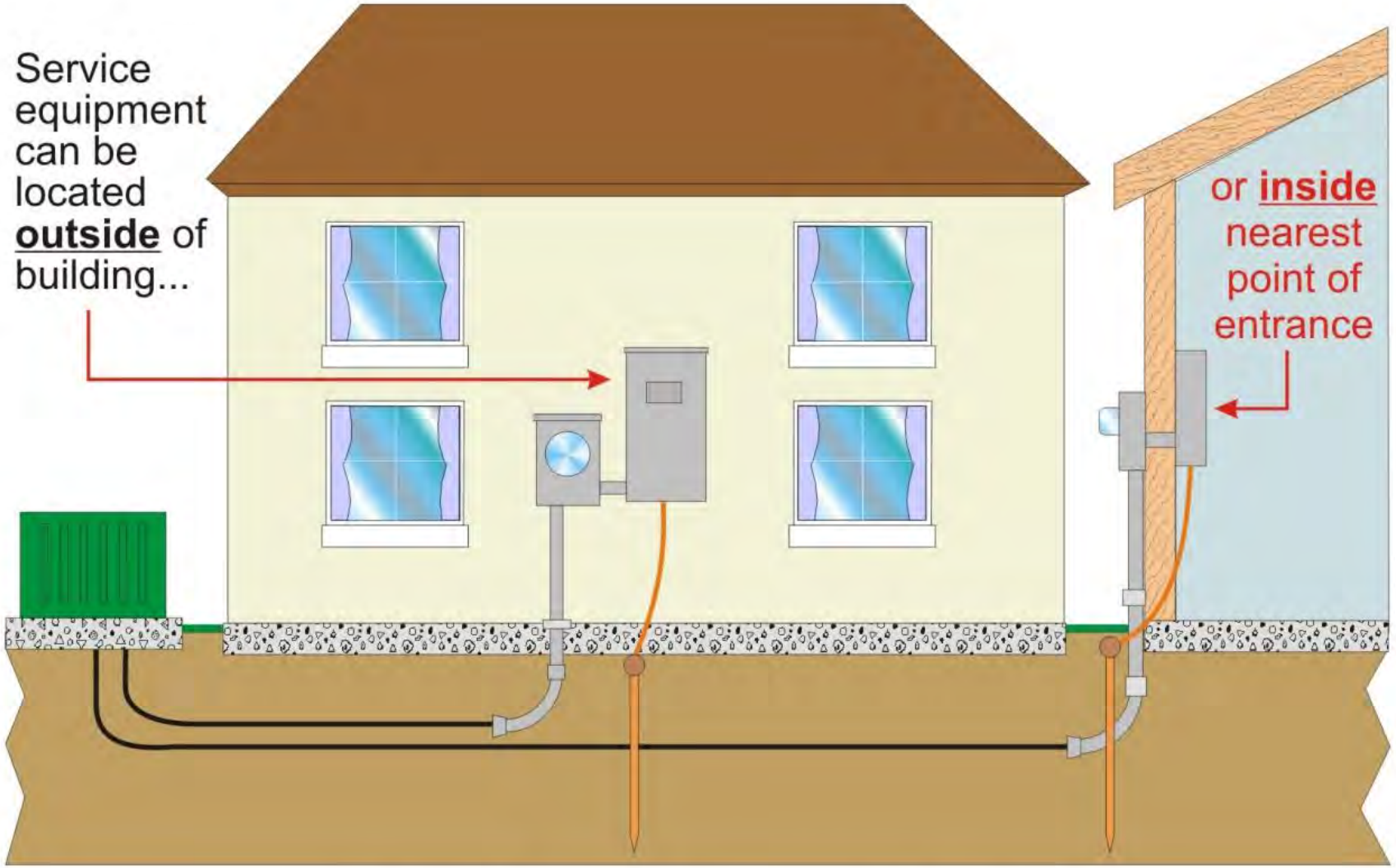
E3401.2 Scope

Electrical systems, equipment or components not specifically covered in these Chapters (34 - 43) shall comply with the applicable provisions of the NFPA 70.


6713

Gray Areas ?

E3601.6.2 Service Disconnect Locations



Location of service disconnecting means

NEC 230.70(A)(1)

Officer Johnson runs into one of those "gray areas" of the law.

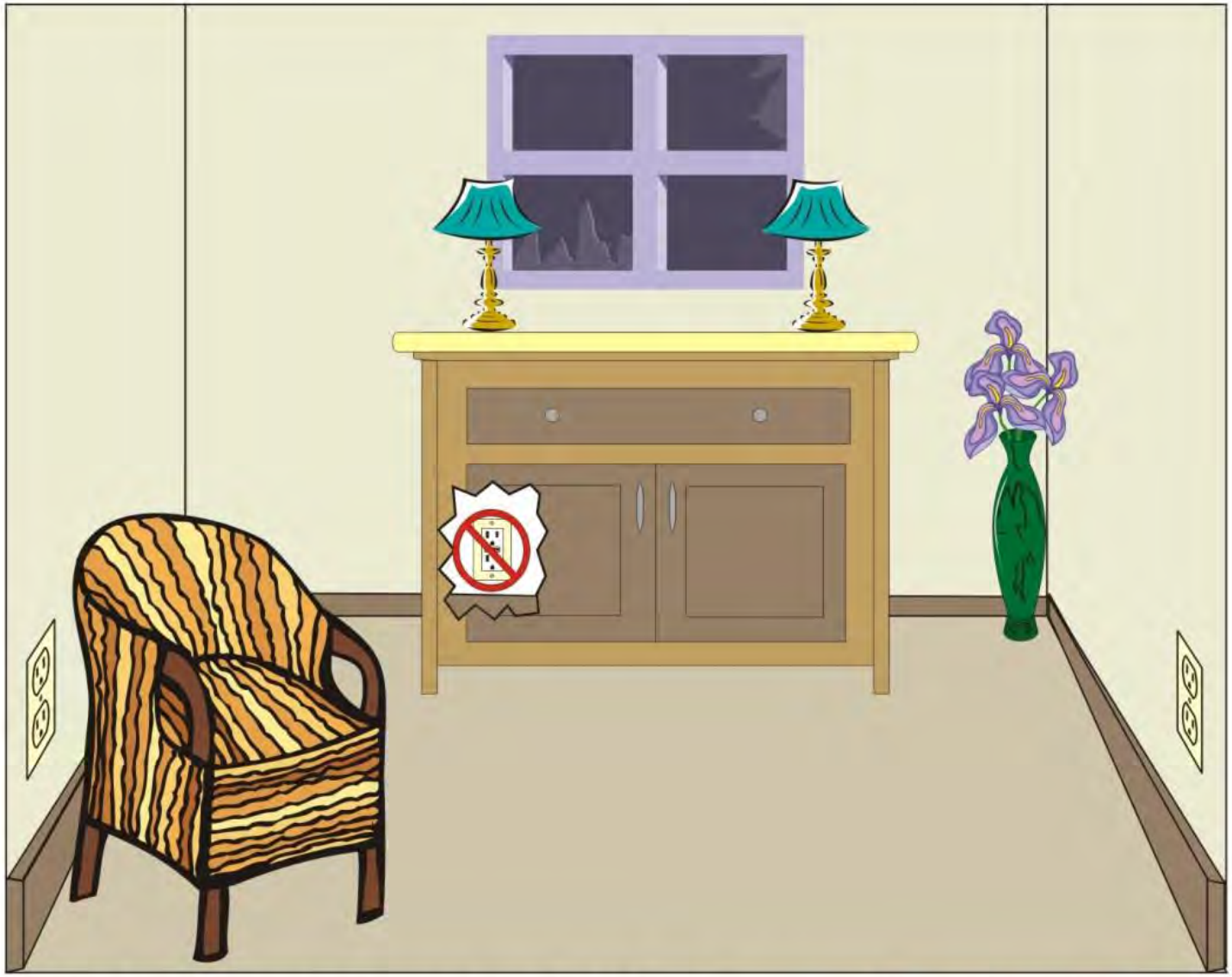
GFCI Requirements for Dwelling Units


GFCI
PROTECTED
OUTLET
TEST
RESET

Chapter 35: Definitions

- **Ground-Fault Circuit Interrupter (GFCI).** "A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device."
- *NEC* Informational Note: Class A ground-fault circuit interrupters trip when the current to ground is 6 mA or higher and do not trip when the current to ground is less than 4 mA
- For further information, see UL 943, *Standard for Ground-Fault Circuit Interrupters*

E3902.14 GFCIs in Readily Accessible Locations



All GFCIs for personnel must be installed in a readily accessible location

NEC 210.8

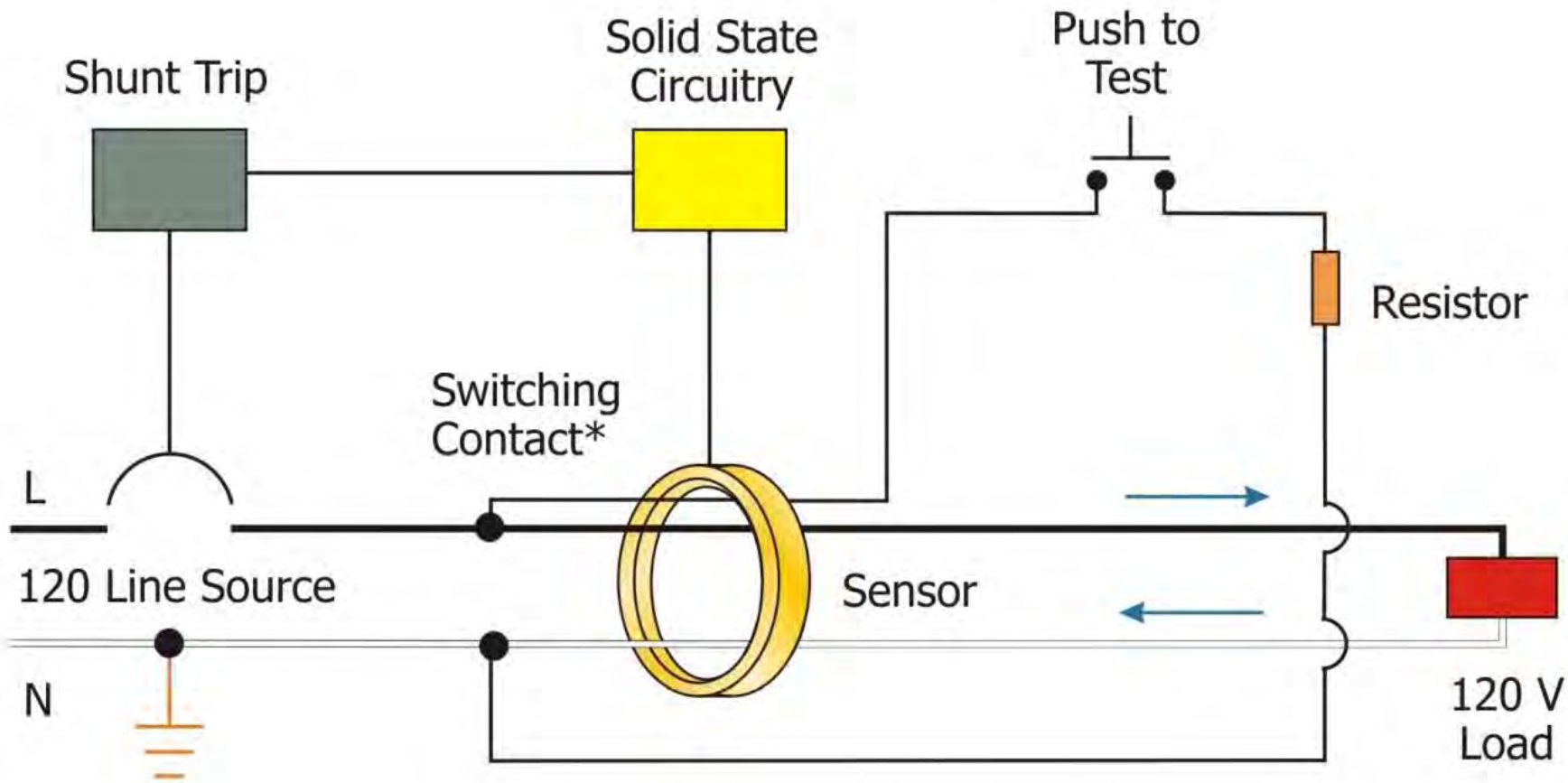
GFCI Protection Required in Dwellings

Bathrooms	E3902.1
Garages and Accessory Buildings	E3902.2
Outdoors	E3902.3
Crawl Spaces	E3902.4
Unfinished Basements	E3902.5
Kitchens	E3902.6
Sinks	E3902.7
Bathtub and Shower Stalls	E3902.8
Laundry Areas	E3902.9
Dishwashers	E3902.10
Boathouses	E3902.11
Boat Hoists	E3902.12
Electrically Heated Floors	E3902.13
Swimming Pools and Similar Installations	Chapter 42

(Note: See Chapter 14 for additional information)

PUSH
TO
TEST
ON
TRIP
OFF
20
15A
ON
OFF
MADE IN USA

GFCI Principles of Operation



*Receptacle-type GFCI devices switch both the phase and neutral

E3902: GFCI for Dwelling Units

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the following locations shall have GFCI protection for personnel:

1. **Bathrooms**
2. **Garages** (accessory buildings)
3. **Outdoors**

   Ex. to (3): Receptacles that are not readily accessible and are supplied by a dedicated branch circuit for electric snow-melting or deicing equipment [E4101.7]

4. **Crawl spaces** — at or below grade level

Note: These GFCI devices shall be installed in a readily accessible location

NEC 210.8(A)

E3902: GFCI for Dwelling Units *(cont.)*

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the following locations shall have GFCI protection for personnel:

5. **Unfinished basements**

   Ex. to (5): A receptacle supplying only a permanently installed fire alarm or burglar alarm system

6. **Kitchens** — where the receptacles are installed to serve the countertop surfaces
7. **Sinks** — [installed within 1.8 m (6 ft) of the outside edge of the sink]
8. **Bathtub and Shower Stalls** – [installed within 1.8 m (6 ft) of the outside edge of the bathtub or shower stall]

Note: These GFCI devices shall be installed in a readily accessible location

NEC 210.8(A)

E3902: GFCI for Dwelling Units *(cont.)*

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the following locations shall have GFCI protection for personnel:

9. **Laundry Areas**
10. **Kitchen Dishwasher Branch Circuit** — outlets that supply dishwashers
11. **Boathouses**
12. **Boat Hoists** — for 240 volt or less outlets that supply boat hoist *(readily accessible location)*
13. **Electrically Heated Floors** — bathrooms, kitchens, hydromassage bathtub, spa and hot tub locations

Note: These GFCI devices shall be installed in a readily accessible location

NEC 210.8(A)

E3902.14 Ground-Fault Circuit-Interrupter Protection for Personnel

New 2017 NEC

- A new provision was added at the parent text of E3902.14 to indicate the measurement from receptacles to objects *(such as a sink)* that would qualify for GFCI protection
- This distance should be measured as the "shortest path" a cord of an appliance connected to a receptacle would take without piercing a:
  - Floor
  - Wall
  - Ceiling
  - Fixed Barrier
  - or passing through a door, doorway, or window

NEC 210.8

E3902.14 Measurement for GFCI Protection

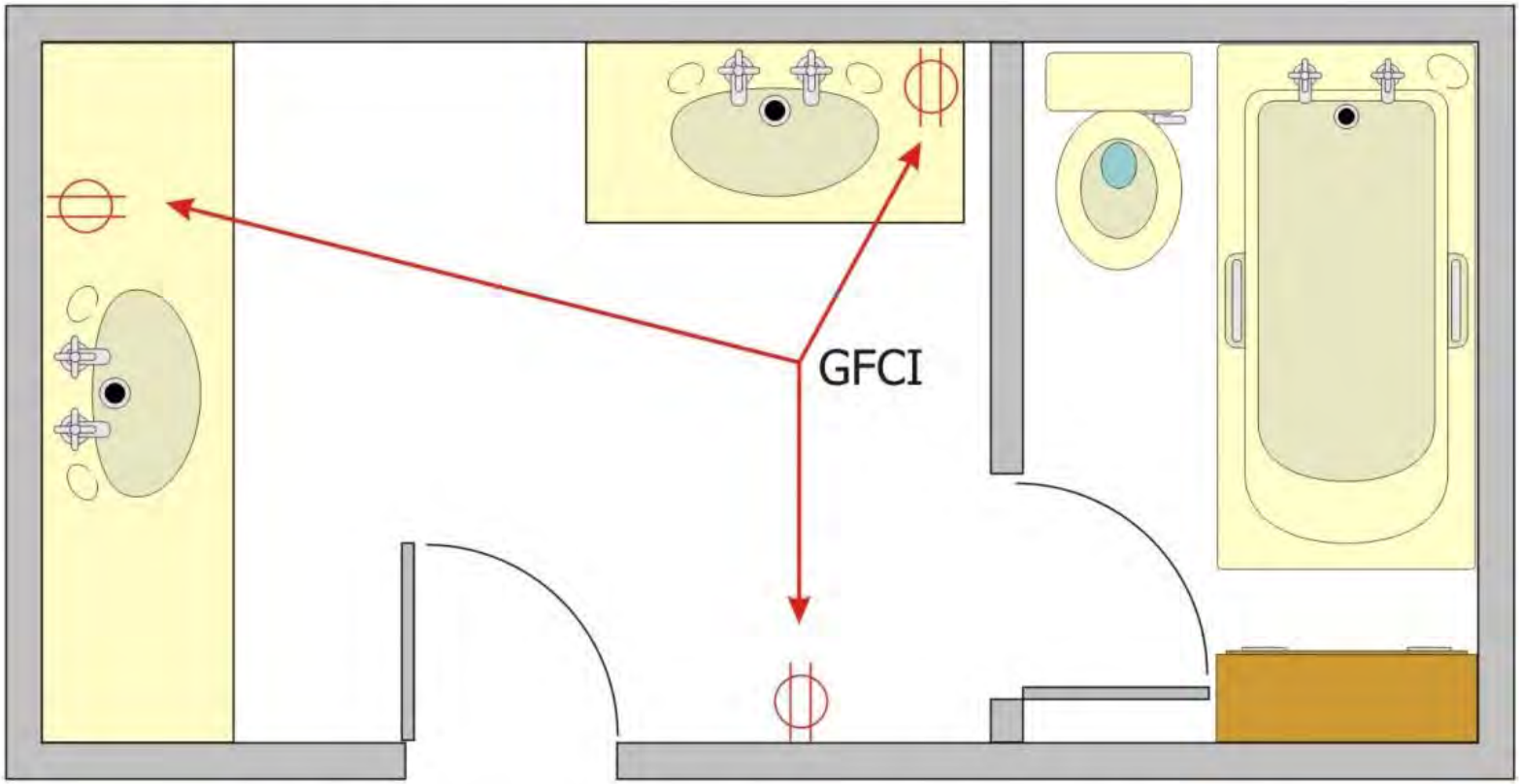
GFCI protection shall be provided as required in 210.8(A) through (E) and installed in a readily accessible location

When determining distance from receptacles, distance shall be measured as the “shortest path” the cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, or fixed barrier, or passing through a door, doorway, or window

NEC 210.8

E3902.1 GFCI Protection for Bathrooms

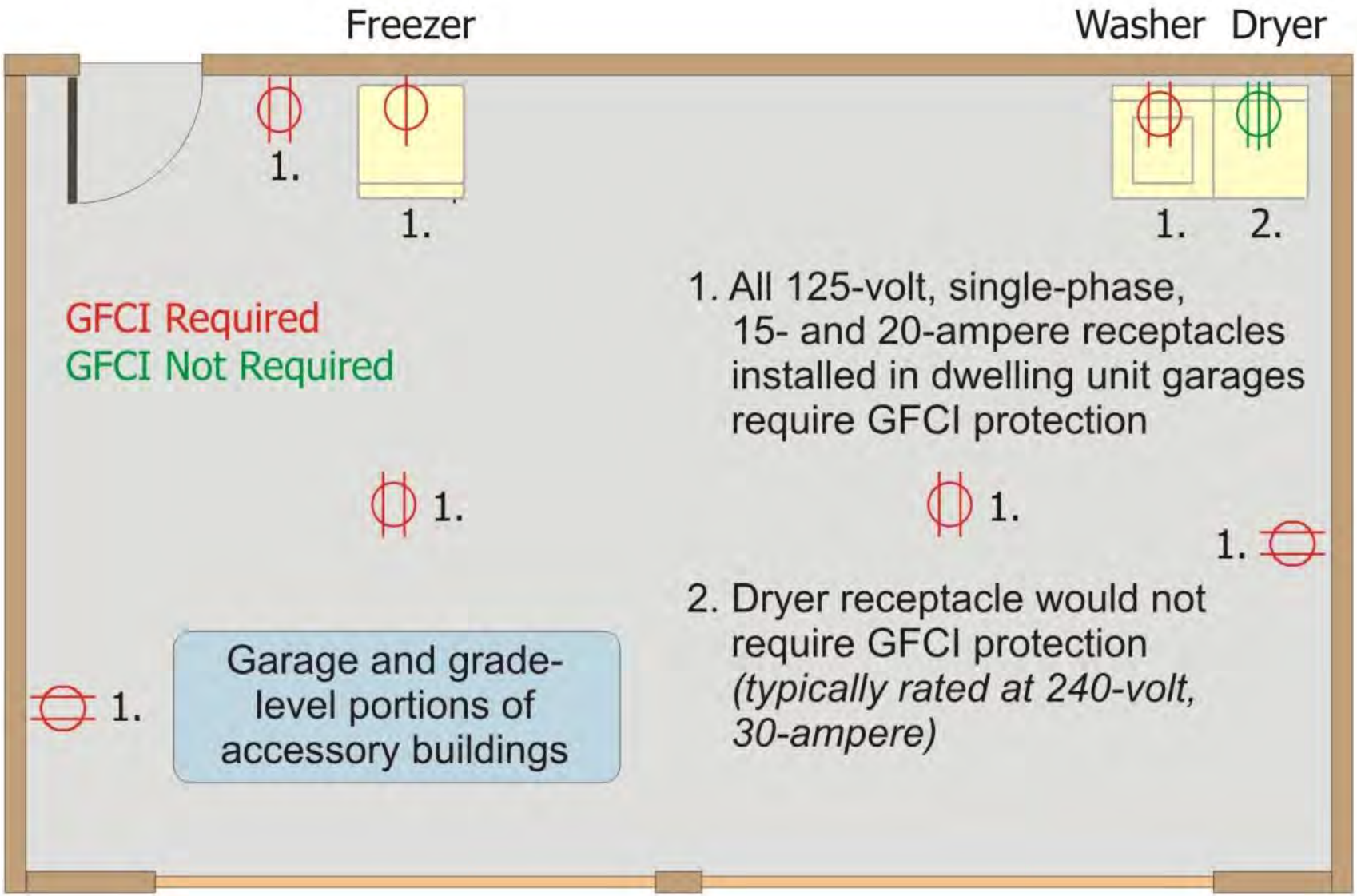
A bathroom is defined as "an area including a basin with one or more of the following: a toilet, a urinal, a tub, a shower, a bidet, or a similar plumbing fixtures"



A bathroom with (2) basins, a toilet, and a tub

NEC 210.8(A)(1)

E3902.2 GFCI Protection in Garages



NEC 210.8(A)(2)

E3902.3 GFCI Protection Outdoor Receptacles

All 125-volt, single-phase, 15- and 20-ampere receptacles installed outdoors shall have GFCI protection for personnel

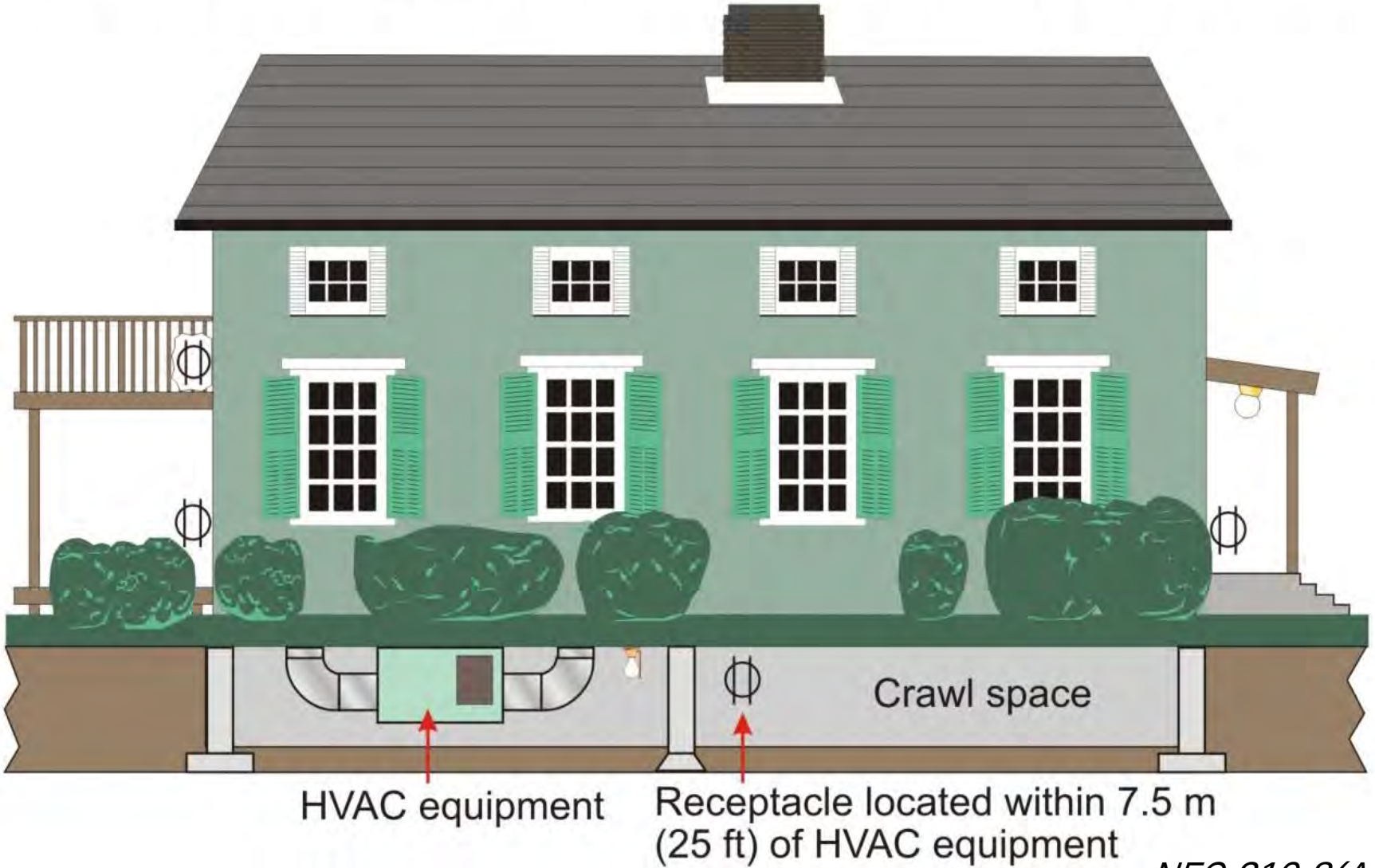
GFCI not required for 15- and 20-ampere receptacle dedicated for deicing or snow melting equipment *(that is not readily accessible)*

NEC 210.8(A)(3)


MultiMac
Weatherproof Cover
WR
TEST MONTHLY
RESET
RESET
TEST
TEST
SEE INSTRUCTIONS
WR
MultiMac
Weatherproof Cover
5,763,831
6,420,653
6,420,654
4,874,906
6,770,814
5,243,135
6,642,453
6,441,307
6,563,051
U.S. Patents, and Other Foreign Patents Pending

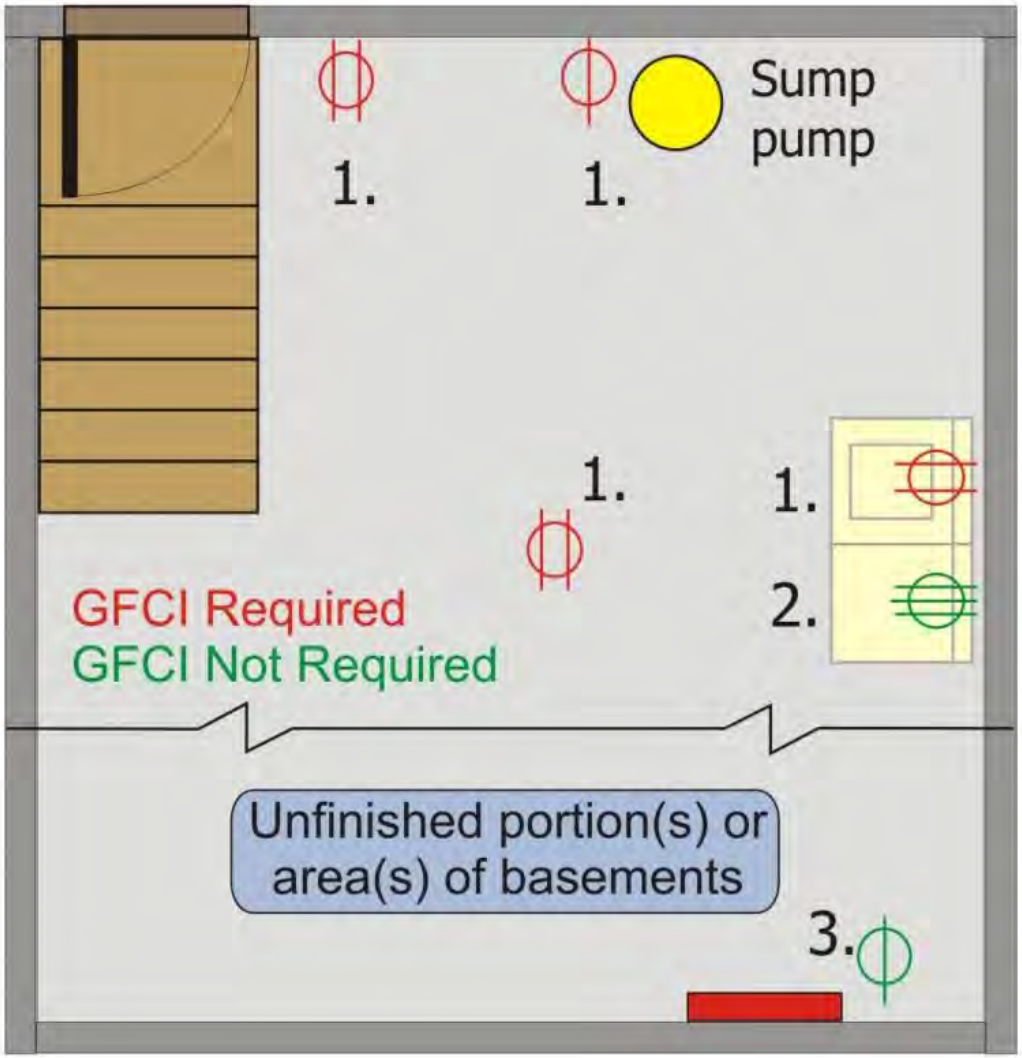
E3902.4 Crawl Spaces

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in crawl spaces *(at or below grade level)* shall have GFCI protection for personnel



NEC 210.8(A)(4)

E3902.5 GFCI Protection Unfinished Basements



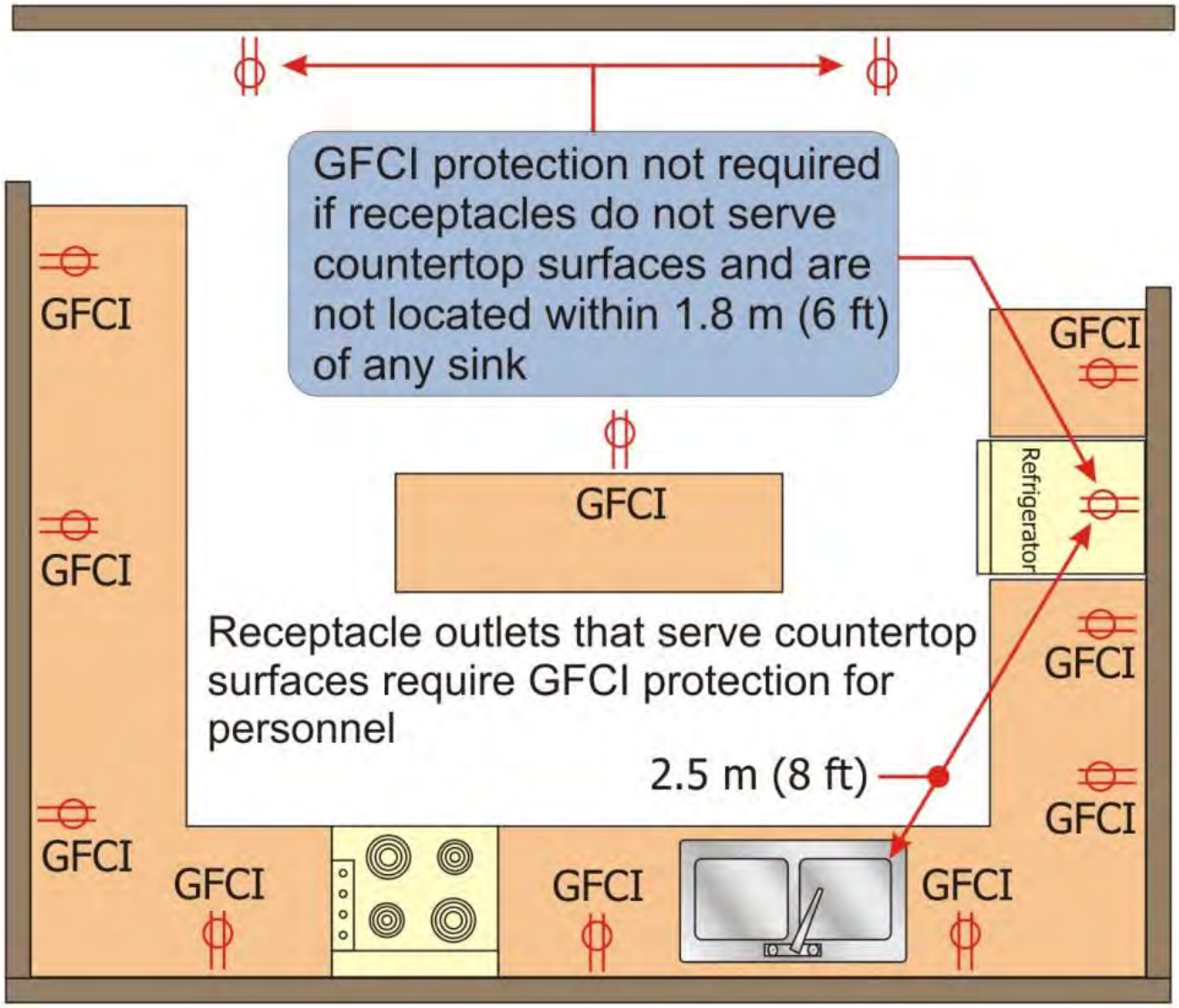
1. All 125-volt, single-phase, 15- and 20-ampere receptacles installed in unfinished basements require GFCI protection (one exception-see below)

2. Dryer receptacle would not require GFCI protection as this is typically rated at 240 -volt, 30-ampere

3. A single receptacle supplying a permanently installed burglar/fire alarm system is not required to have GFCI protection

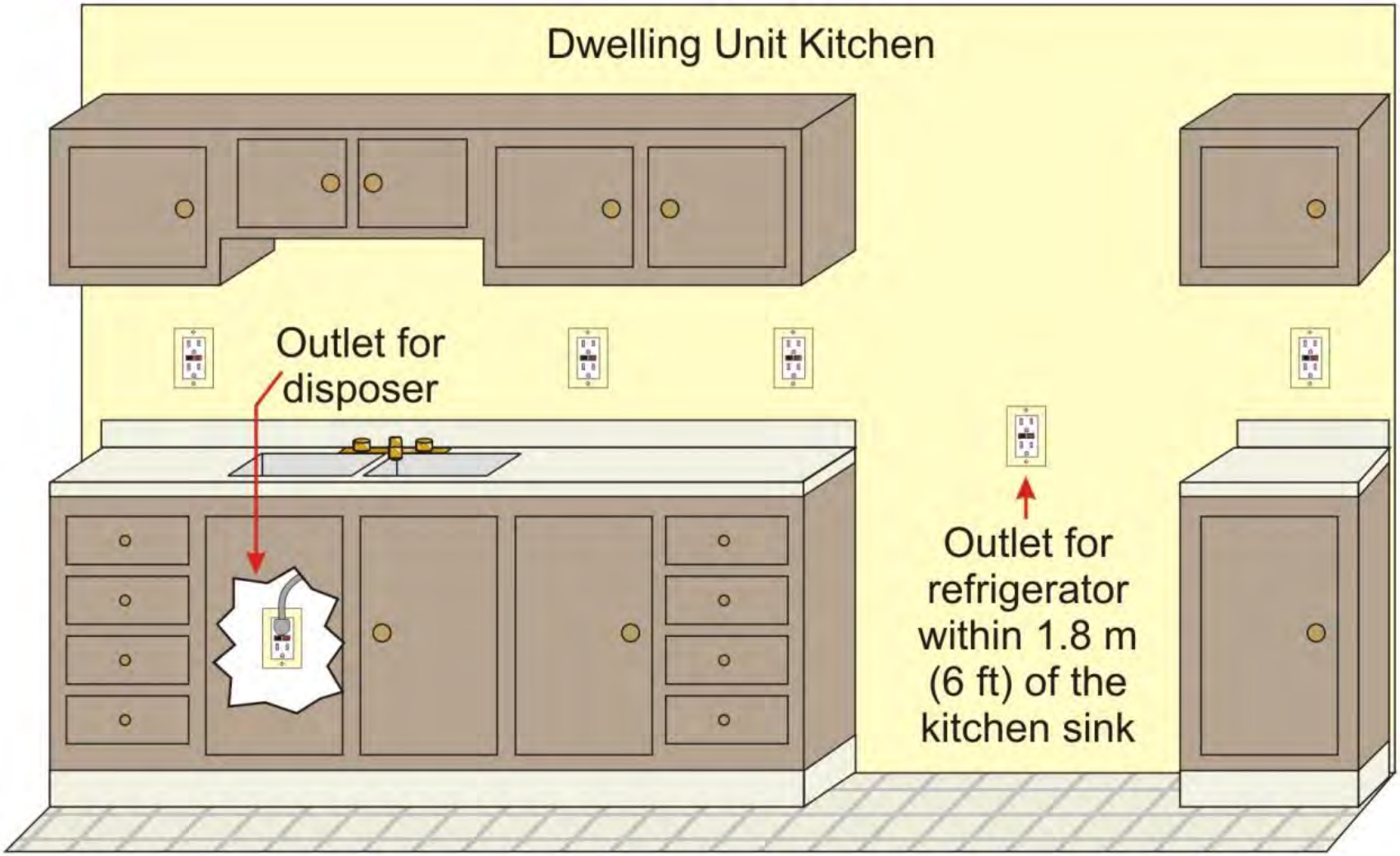
NEC 210.8(A)(5)

E3902.6 GFCI Kitchen Countertop Receptacles



NEC 210.8(A)(6) and (A)(7)

E3902.7 GFCI Required at Dwelling Unit Sinks

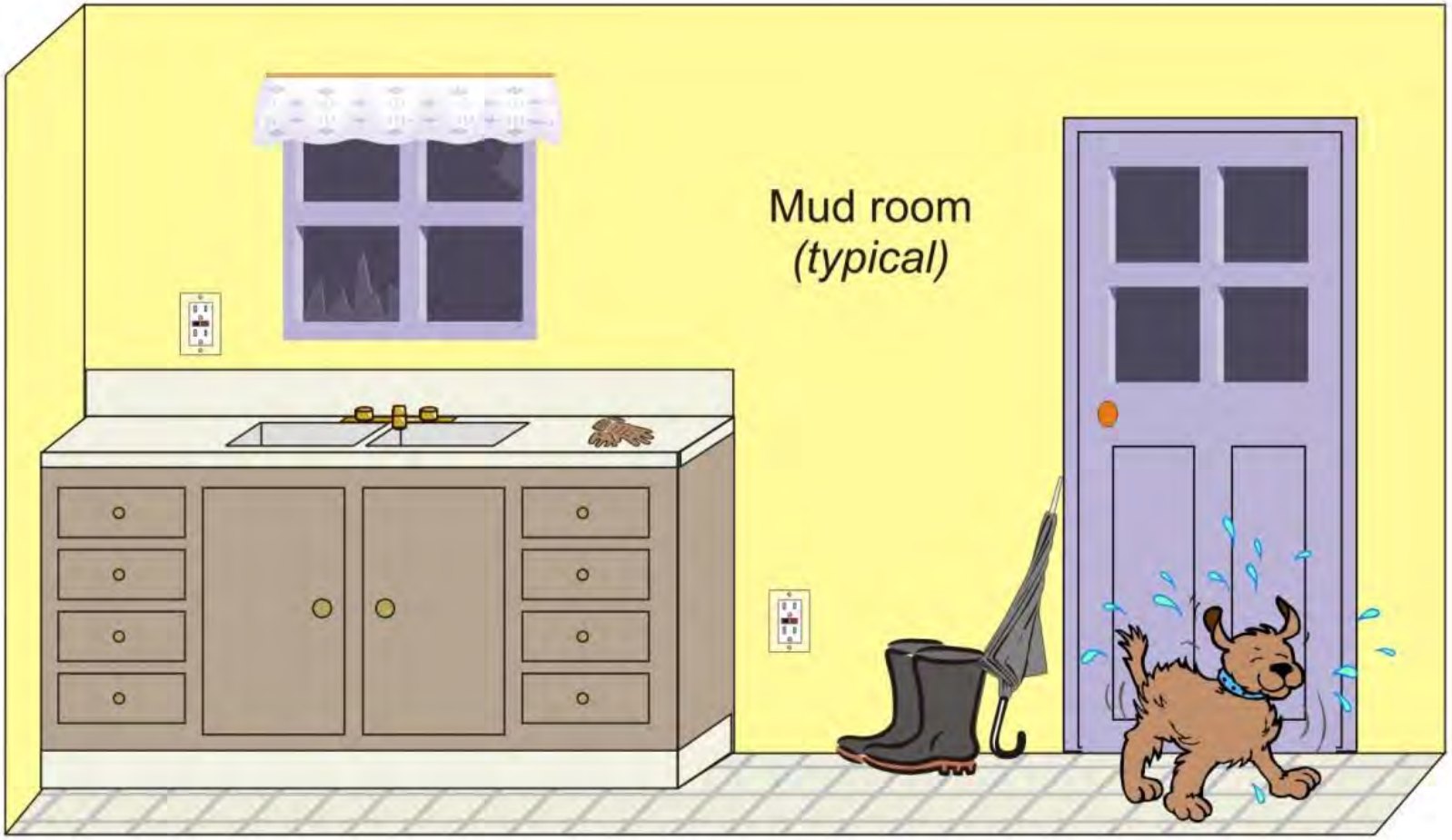


All 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) of the outside edge of any dwelling unit sink now require GFCI protection

NEC 210.8(A)(7)


KGUARD
1/3 HP

E3902.7 GFCI Dwelling Unit Sinks



GFCI required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) of the outside edge of a dwelling unit sink *(laundry, utility, mud room, kitchen, wet bar, etc.)*

NEC 210.8(A)(7)

E3902 GFCI Protection at Sinks

GFCI required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) from the top inside edge of a dwelling unit sink *(laundry, utility, mud room, kitchen, wet bar, etc.)* without the measurement piercing a floor, wall, ceiling, or fixed barrier, or passing through a door, doorway, or window

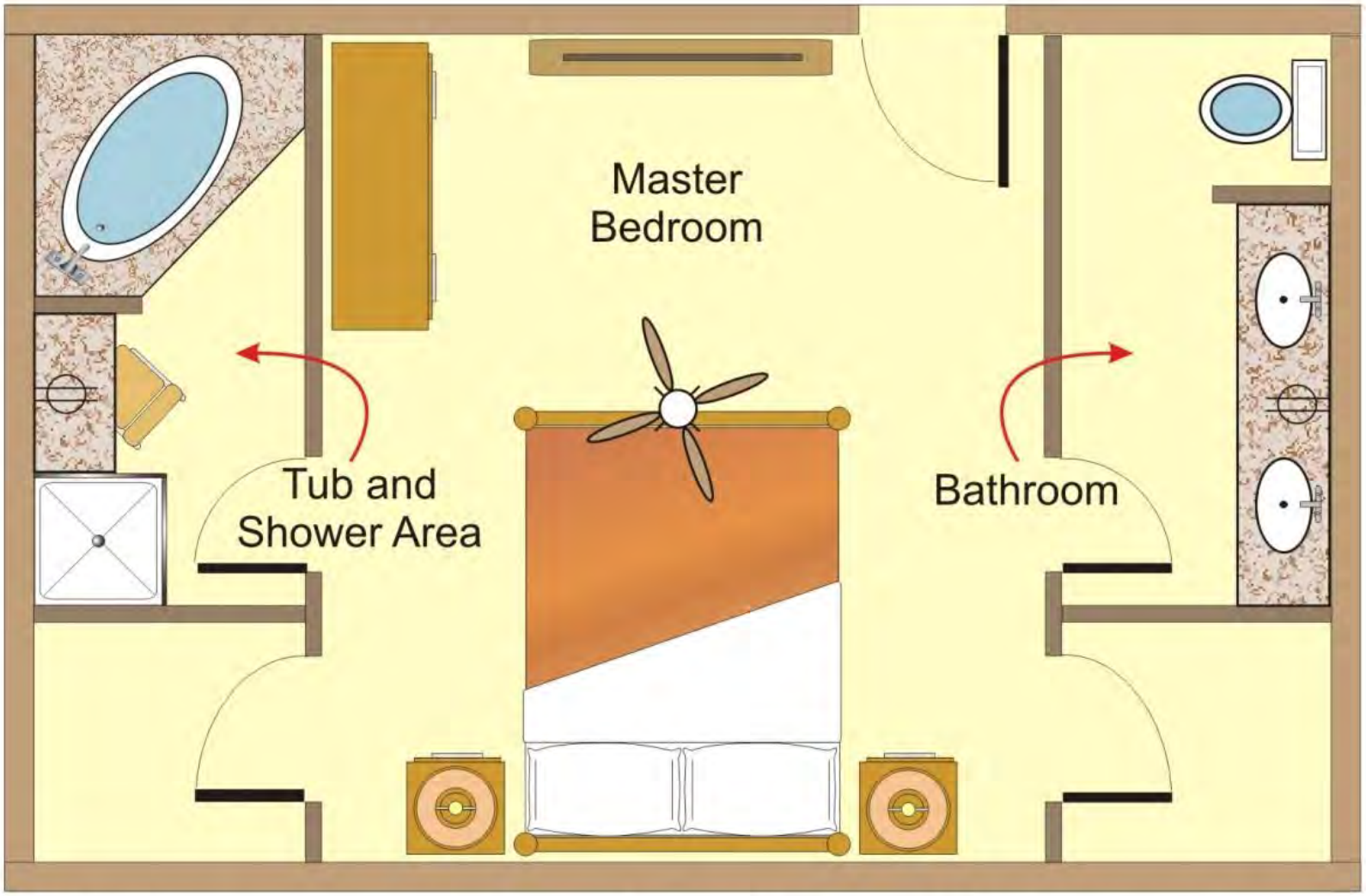
NEC 210.8(A)(7)

Note: Same requirement at 210.8(B)(5) for non-dwelling unit sinks


2017 NEC


Cheers
Hard Rock

E3902.8 GFCI Bathtub or Shower Stalls



All 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m (6 ft) of the outside edge of a dwelling unit bathtub or shower stall requires GFCI protection

NEC 210.8(A)(9)

E3902.9 GFCI Dwelling Laundry Areas

GFCI protection required for all 125-volt, single-phase, 15- and 20-ampere receptacles located in a laundry room areas *(with or without a sink present)*

NEC 210.8(A)(10)

E3902.12 GFCI for Boat Hoists

- Ground-fault circuit-interrupter protection for personnel required to be provided for outlets that supply boat hoists installed in dwelling unit locations
- Required for all outlets rated up to and including 240 volt branch circuits supplying dwelling unit boat hoists
- Applies to both cord and plug connected and direct-wired
- GFCI protection also required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed at dwelling unit boathouses [E3902.11] [*NEC* 210.8(A)(8)]

NEC 210.8(C)

E3902.10 Dwelling Unit Kitchen Dishwasher Branch Circuit

- GFCI protection now required for all outlets that supply dishwashers installed in dwelling units
  - Includes both receptacle and hard-wired outlet for dishwasher
- Modern-day electronically controlled dishwashers can experience “end of life” failures that can result in increased risk of electrical shock
- GFCI protection for outlets supplying dishwashers can mitigate these increased risk of electrical shock

NEC 210.8(D)


GE Profile

E3902.4 GFCI Protection- Crawl Space Lighting Outlets

New 2017 NEC

- GFCI protection is now required for lighting outlets not exceeding 120 volts in crawl spaces where the space is at or below grade level
  - Applies to all crawl space, dwelling unit and non-dwelling unit alike
- The new GFCI requirements for lighting outlers was predicated on a fatality of a worker in a crawl space (broken incandescent light bulb of a keyless lampholder)
- Numerous open-bulb keyless or pull chain lampholders installed in crawl spaces are constantly being damaged

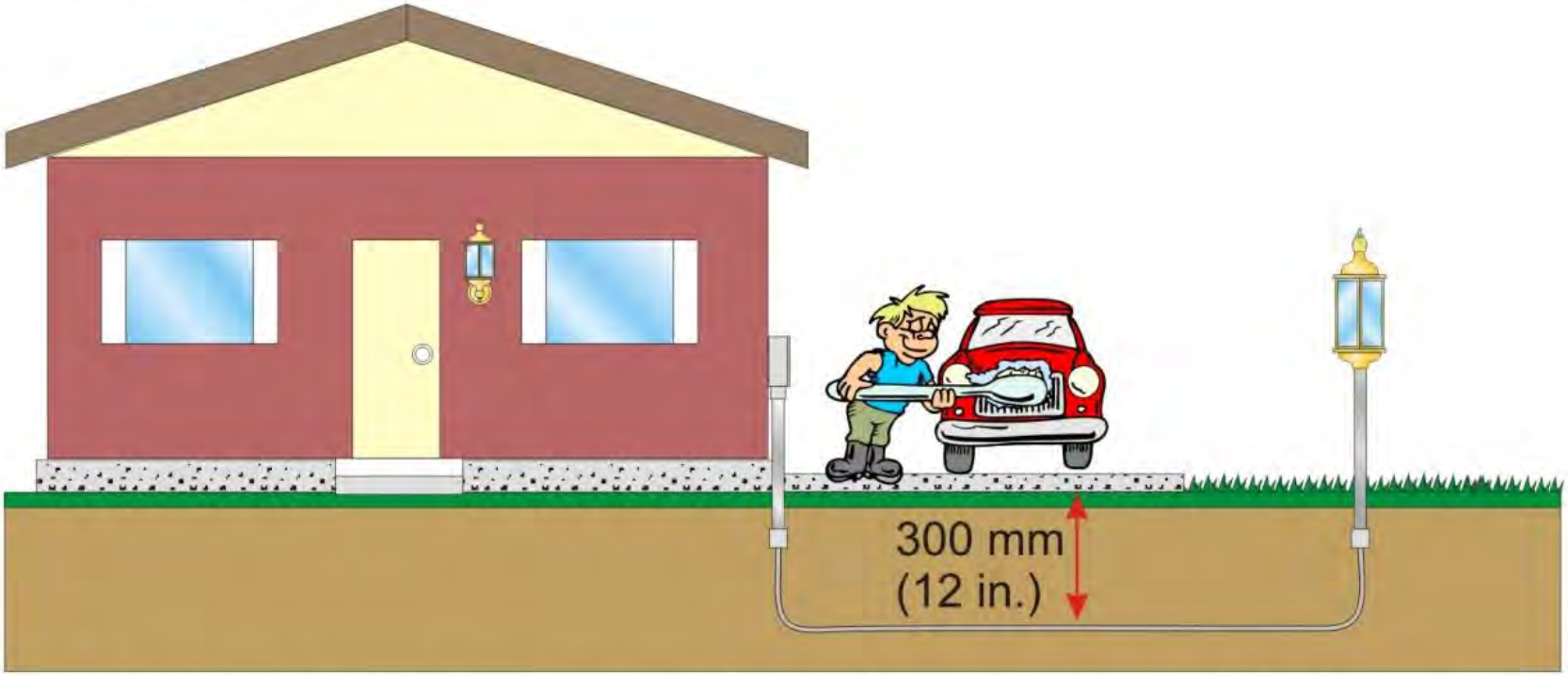
NEC 210.8(E)

2017 NEC

Lighting outlets in crawl spaces require GFCI protection

Table E3803.1 GFCI Residential Burial Depth

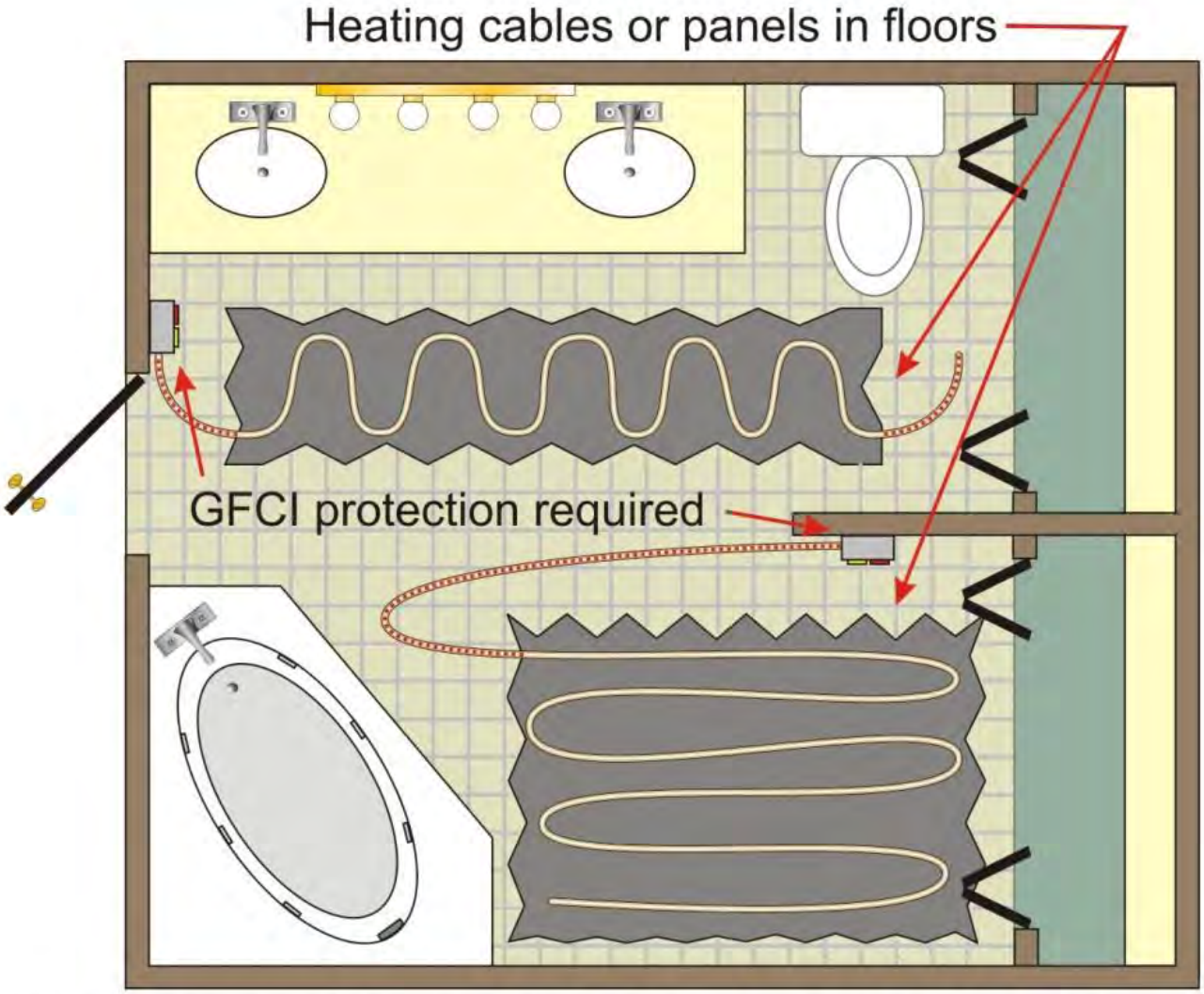
120 volt branch circuits installed under residential driveways and lawn areas generally must be installed at least 450 mm (18 in.) to 600 mm (24 in.) below grade



If underground conductors are protected by an overcurrent device rated at not more than 20 amperes and provided with GFCI protection, the burial depth may be reduced to 300 mm (12 in.)

NEC Table 300.5

E3902.10 GFCI for Heated Floor Cables



Electric heating cables installed in floors in bathrooms, kitchens, and in hydromassage bathtubs locations required to be GFCI protected

NEC 424.44(G)

GFCI - Swimming Pools, Spas, Hot Tubs

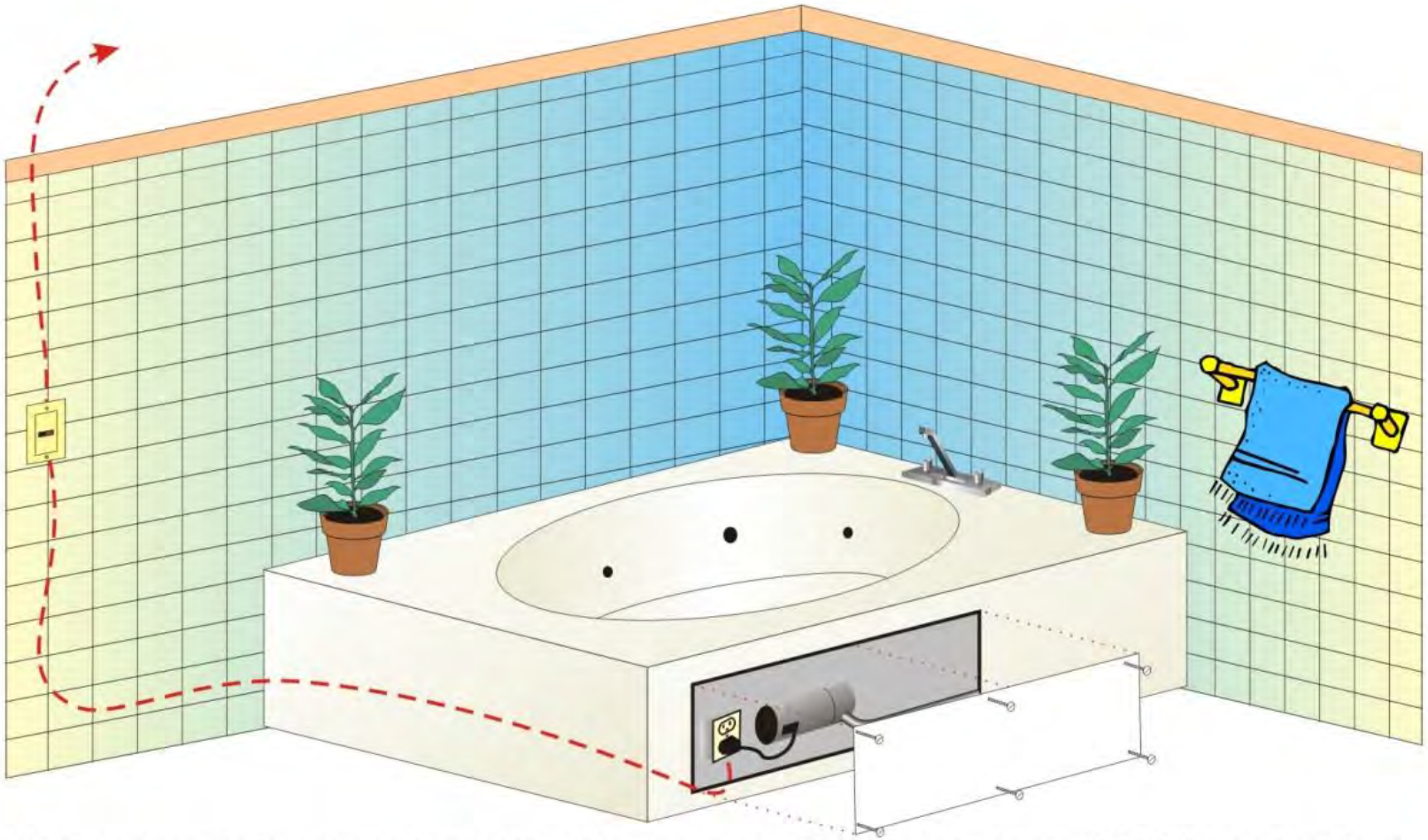
- There are several ground-fault circuit-interrupter (GFCI) requirements in IRC Chapter 42 *[NEC Article 680]* pertaining to swimming pools, spas, hot tubs, etc.
- These GFCI requirements are discussed in great detail in Chapter 14 of this presentation

E4209.1 GFCI for Hydromassage Bathtubs

- Hydromassage bathtubs and their associated electrical components are required to have ground-fault circuit interrupter (GFCI) protection
- This GFCI protection shall comply with the following:
  - Be on an individual branch circuit(s)
  - GFCI device shall be readily accessible
- All 125-volt, single-phase 15-, 20-, and 30-ampere receptacles located within 1.83 m (6 ft) of the inside walls of a hydromassage tub require GFCI protection

NEC 680.71

E4209.1 GFCI for Hydromassage Bathtub



Hydromassage bathtub electrical equipment requires GFCI protection from individual branch circuit

GFCI device required to be readily accessible

All 125-volt, single phase receptacles (up to 30 ampere) located within 1.83 m (6 ft) of hydromassage tub require GFCI protection

NEC 680.71

AFCI Requirements for Dwelling Units

E3902.12 Arc-Fault Circuit-Interrupters

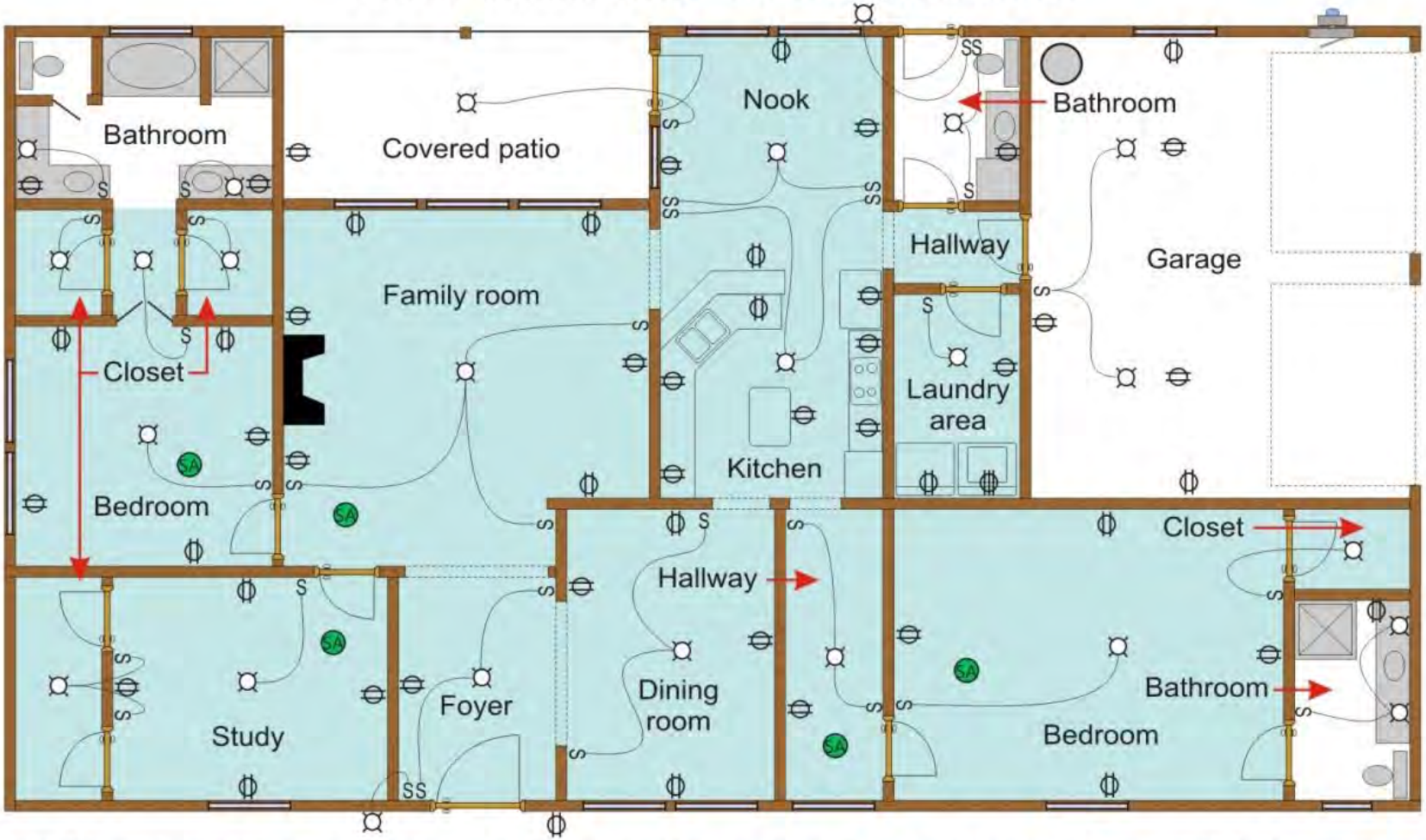
- AFCI is a device intended to provide protection from the effects of arcing type faults
- AFCI recognizes the characteristics that are unique to arcing
- The entire branch circuit is required to be protected
- Required for all 125-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets and devices installed in dwelling unit in the following locations:

kitchens	family rooms	dining rooms
living rooms	parlors	libraries
dens	bedrooms	sun rooms
recreation rooms	closets	hallways
laundry areas	similar rooms or areas	

NEC 210.12(A)

E3902.16 AFCI Protection Required

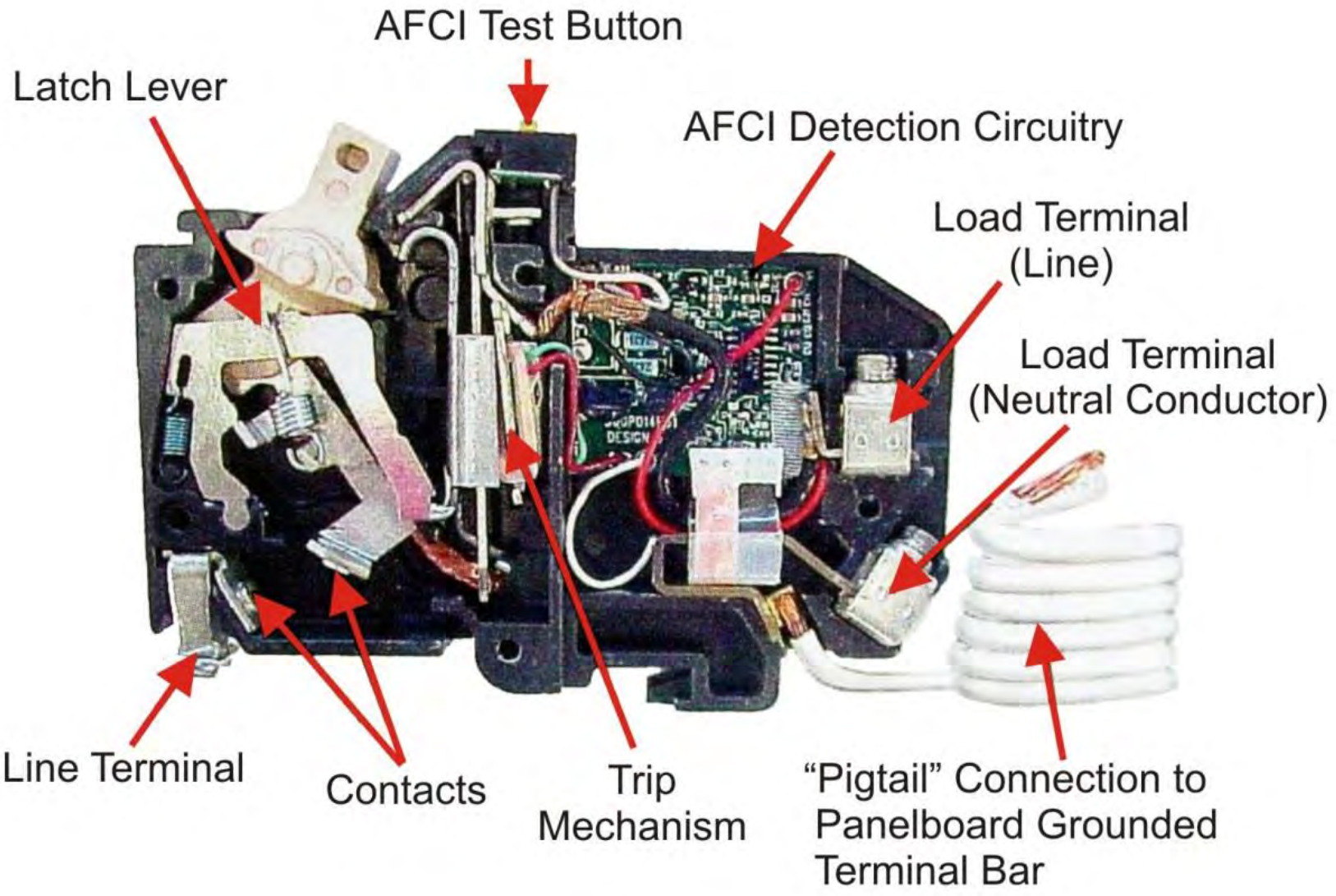
Green shaded area = AFCI required area



AFCI protection is required for all 125 volt, single-phase,15- and 20-ampere branch circuits supplying outlets and devices in several areas of a dwelling unit *(including 125 volt, single-station smoke alarms)*

NEC 210.12(A)

AFCI Circuit Breaker – Cut-A-Way View



E3902.16 Arc-Fault Circuit-Interrupter Protection

Listed Outlet Branch-Circuit Type AFCI Devices

Courtesy of Pass & Seymour/Legrand

Listed Combination Overcurrent Protection Type AFCI Device

Courtesy of Eaton Corporation

NEC 210.12

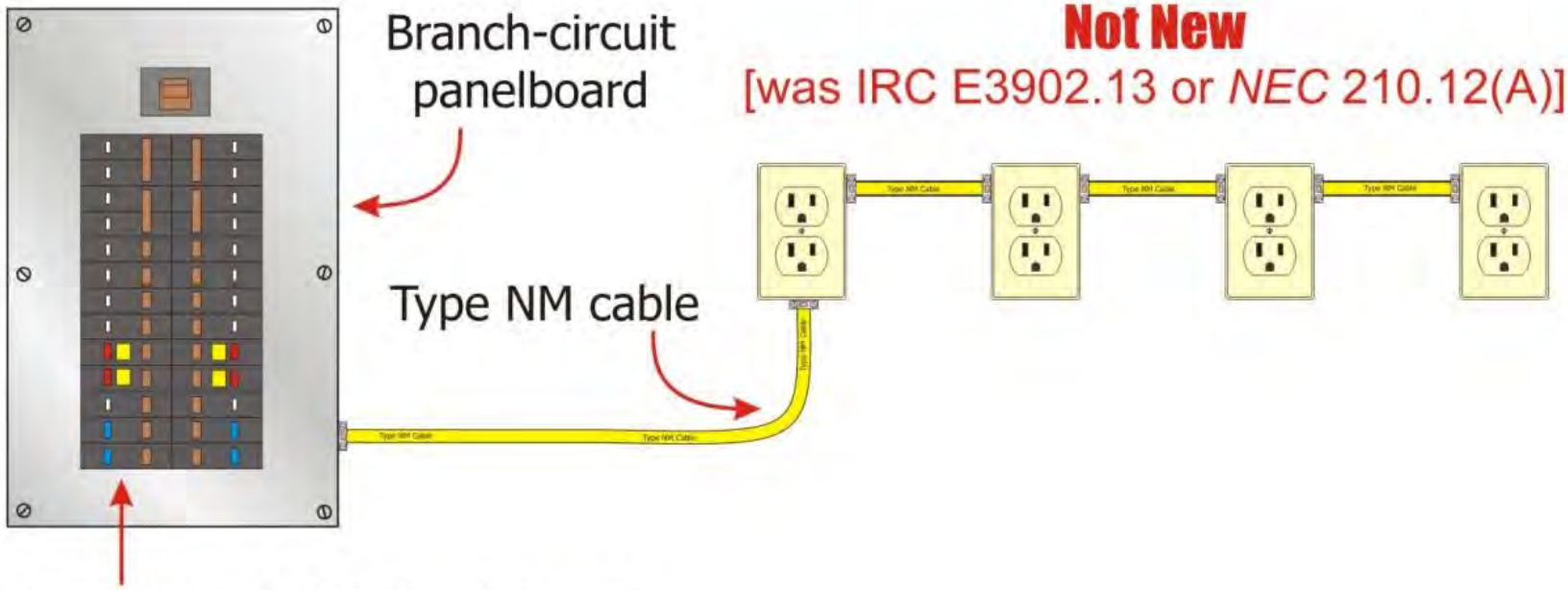
Dual Function AFCI/GFCI Protection

Courtesy of Schneider Electric

- Square D QO™ and HomeLine™ Dual Function Circuit Breaker
- Dual-Function Arc Fault and Ground Fault protection, in a single, easy-to-install device

E3902.16 AFCI Protection

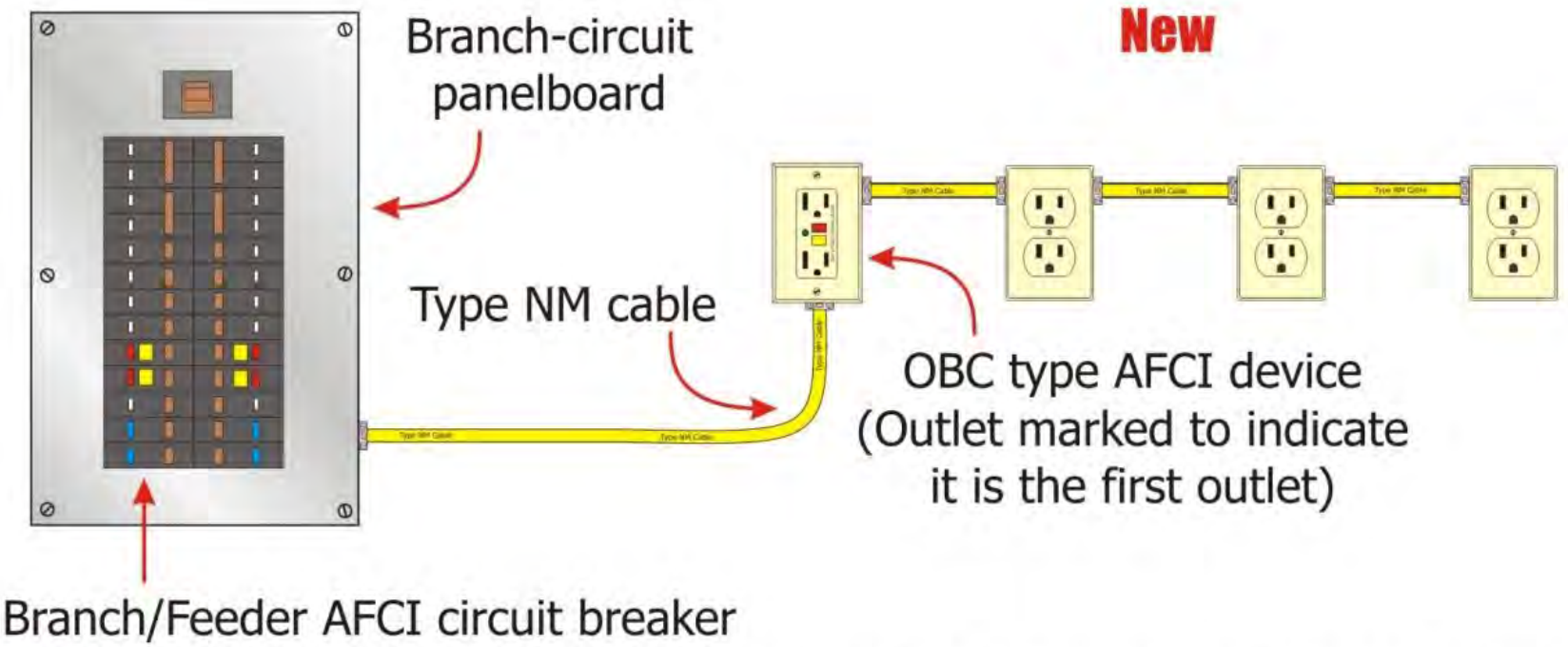
All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):



(1) A listed combination type arc-fault circuit interrupter, installed to provide protection of the entire branch circuit

E3902.16 AFCI Protection

All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):

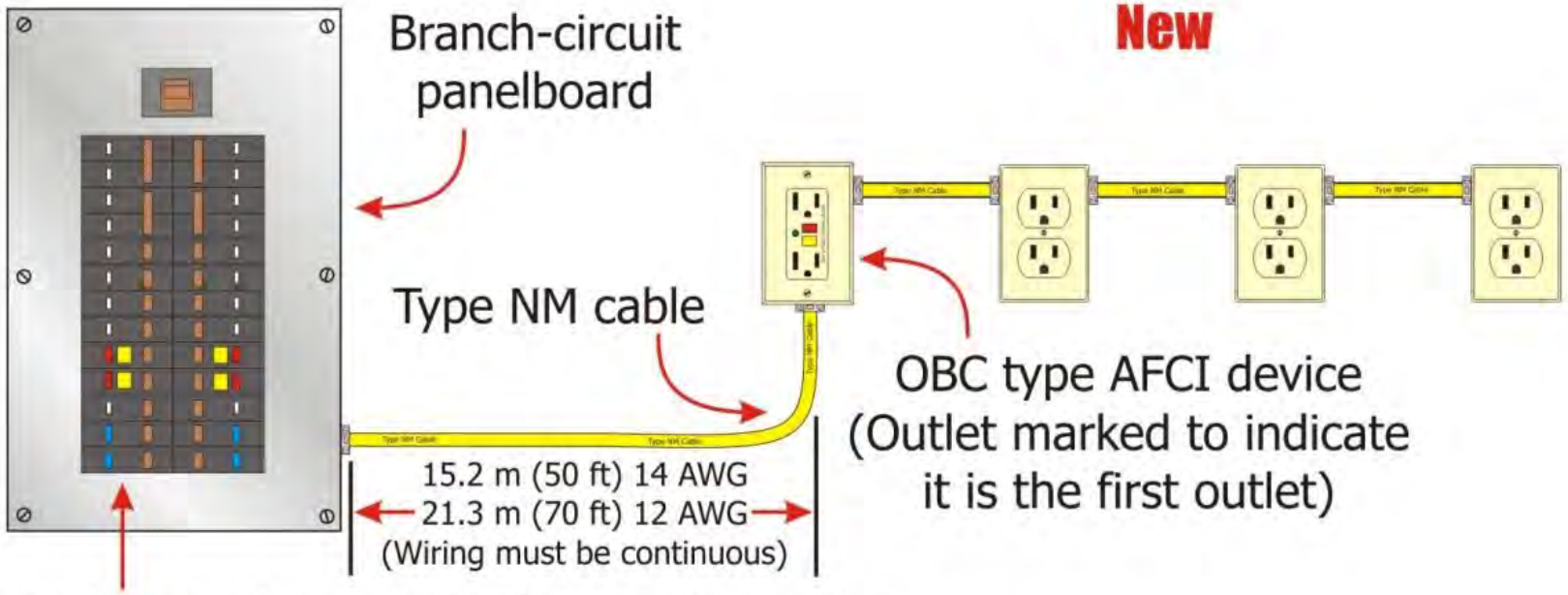


(2) A listed branch/feeder type AFCI installed at the origin of the branch circuit in combination with a listed outlet branch circuit type AFCI installed at the first outlet box on the branch circuit (first outlet marked to indicate that it is the first outlet)

NEC 210.12(A)

E3902.16 AFCI Protection

All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):

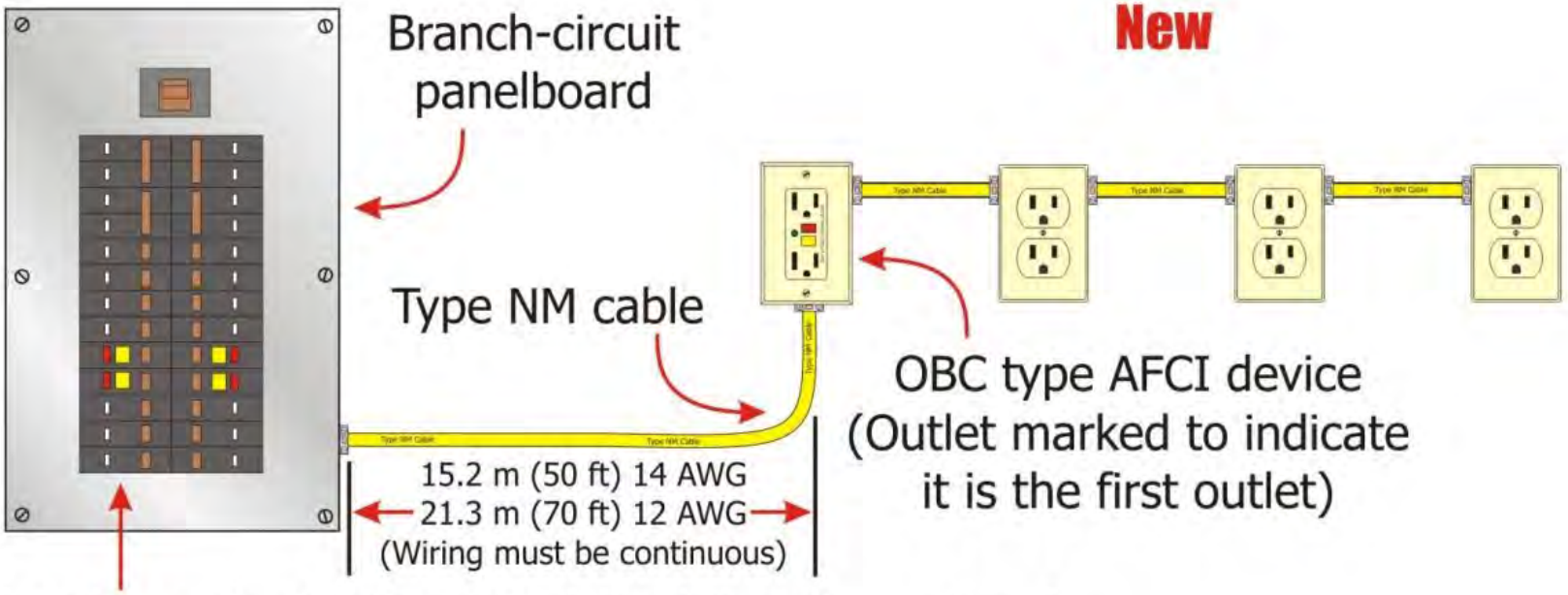


(3) A listed supplemental arc protection circuit breaker installed at the origin of the branch circuit in combination with a listed outlet branch circuit type AFCI installed at the first outlet box on the branch circuit (with three limiting conditions)

NEC 210.12(A)

E3902.16 AFCI Protection

All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):

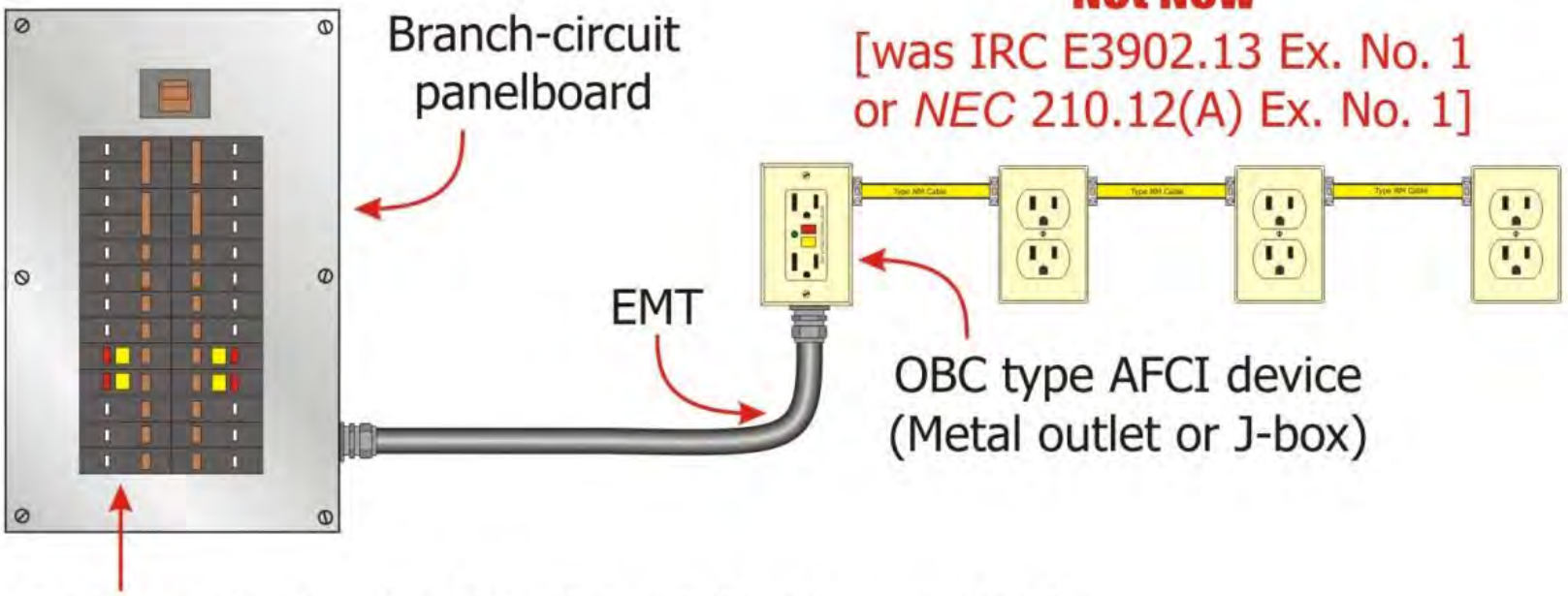


(4) System Combination Type AFCI. A listed outlet branch circuit type AFCI installed at the first outlet in combination with a listed branch circuit over-current protective device (with four limiting conditions) (OCPD & OBC AFCI device must be identified and listed as "System Combination" type AFCI)

NEC 210.12(A)

E3902.16 AFCI Protection

All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):



(5) A listed outlet branch-circuit type AFCI device (first outlet) is permitted with RMC, IMC, EMT, Type MC, steel armored Type AC cables, metal wireways, or metal auxiliary gutters and metal outlet and junction boxes installed for the portion of the branch circuit between the OCPD and the first outlet

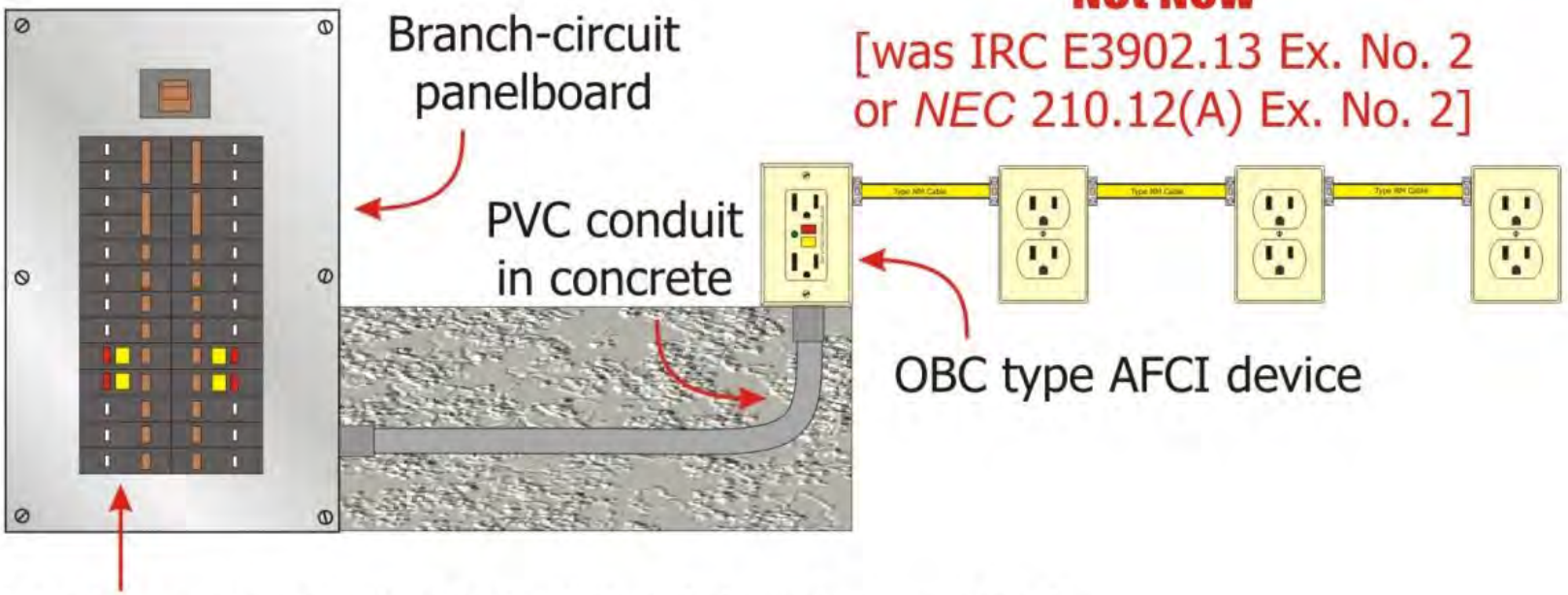
NEC 210.12(A)

E3902.16 AFCI Protection

All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in specified areas of dwelling unit shall be protected by any of the means described in (1) through (6):

Not New

[was IRC E3902.13 Ex. No. 2
or *NEC* 210.12(A) Ex. No. 2]

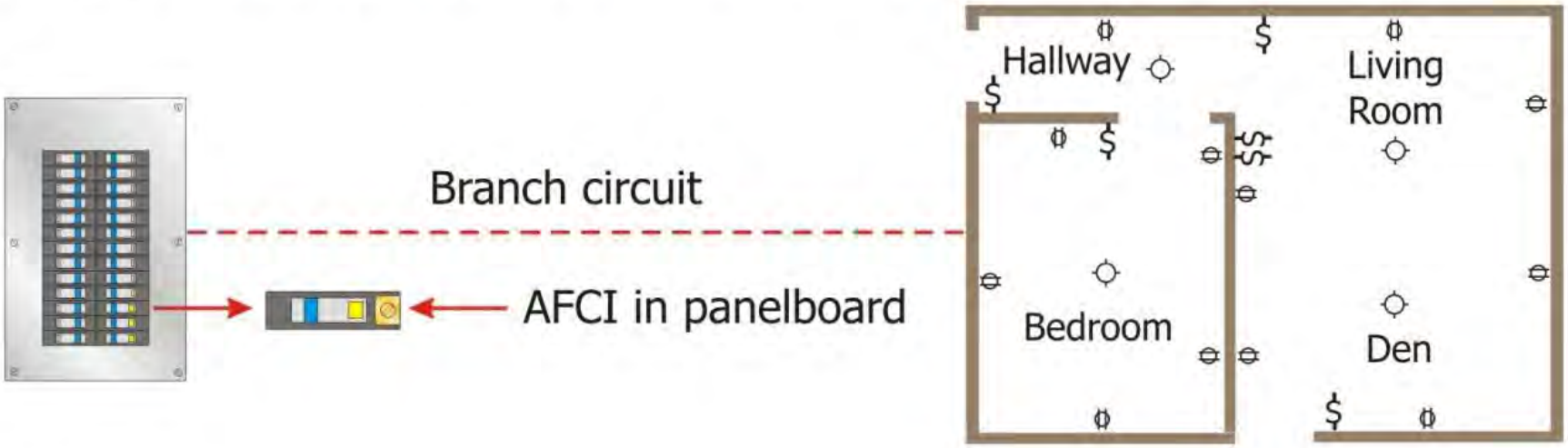


(6) Where a listed metal or nonmetallic conduit or tubing or Type MC cable is encased in not less than 50mm (2 in.) of concrete for the portion of the branch circuit between the OCPD and the first outlet, it shall be permitted to install an a listed outlet branch circuit type AFCI at the first outlet

NEC 210.12(A)

E3902.12 AFCI Protection

All 120 volt, single phase, 15- and 20-ampere branch circuits supplying outlets installed in dwelling unit bedrooms and other areas of the dwelling are required to be protected by a listed combination arc-fault circuit interrupter device



AFCI protection required to be of the combination type

Combination type AFCI detects both parallel and series arc faults

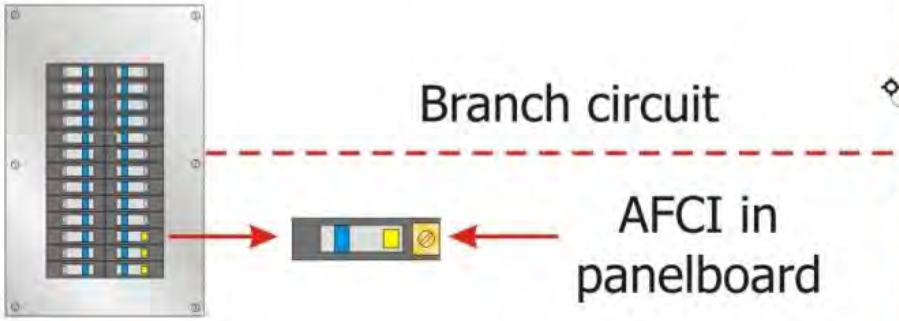
Parallel Arc Fault = Direct contact of two opposite polarities

Series Arc Fault = An arc across a break in a conductor

NEC 210.12(A)

E3902.16 (1.) Combination AFCI Protection

All 120 volt, single phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in dwelling unit bedrooms and other areas of the dwelling are required to be protected by a listed combination arc-fault circuit interrupter device when E3902.16 (1.) is employed



AFCI protection required to be of the combination type

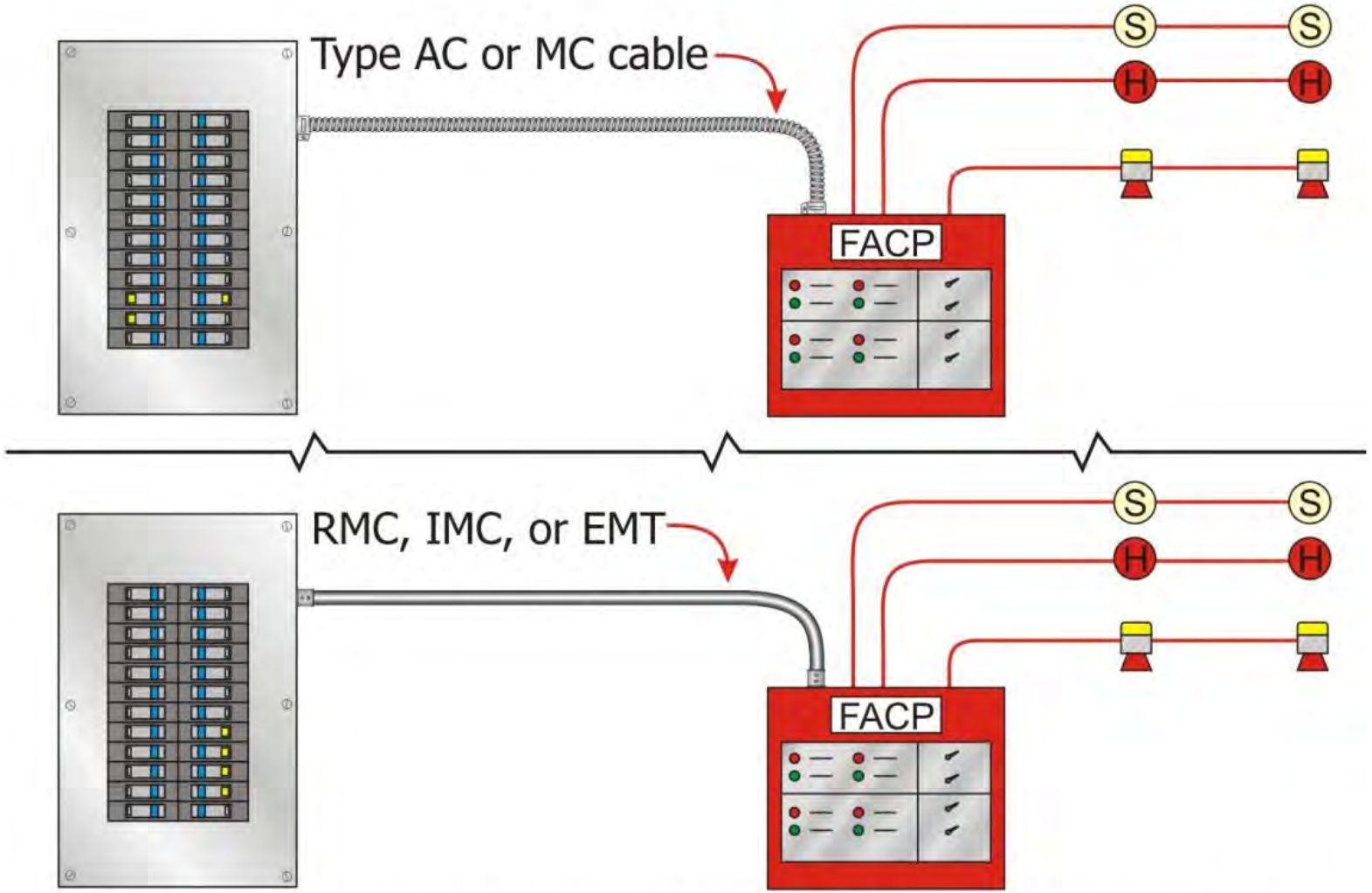
Combination type AFCI detects both parallel and series arc faults

Parallel Arc Fault = Direct contact of two opposite polarities

Series Arc Fault = An arc across a break in a conductor

NEC 210.12(A)(1)

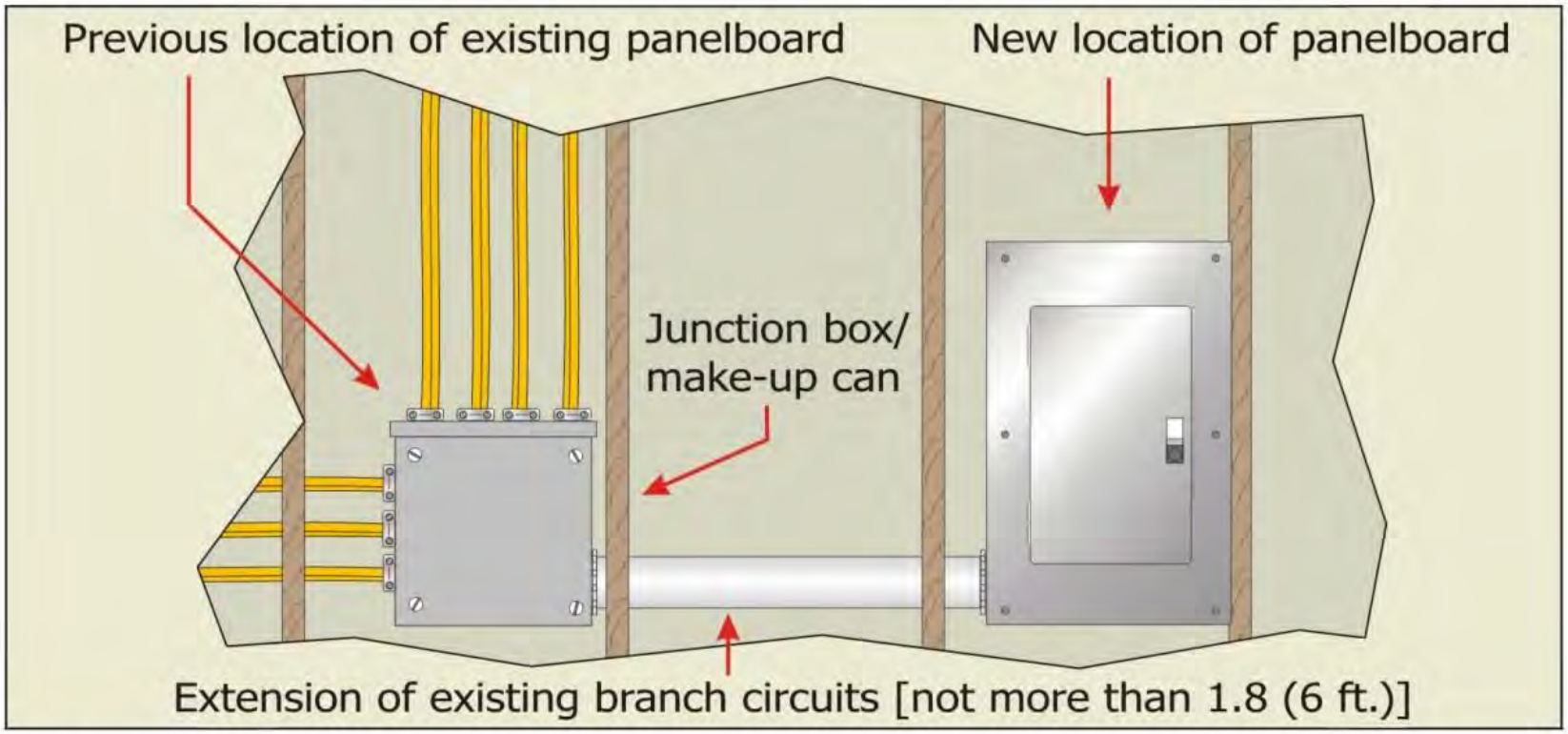
E3902.16 Exception Fire Alarm System



Individual branch circuit is permitted without AFCI protection where it is installed using metal outlet boxes and RMC, IMC, EMT, Type MC or steel armored Type AC cable for permanently installed fire alarm systems

NEC 210.12(A), Ex.

E3902.17 AFCI for Extensions or Modifications



In any of the areas specified in E3902.16, where branch-circuit wiring is modified, replaced or extended, the branch circuit shall be protected by:

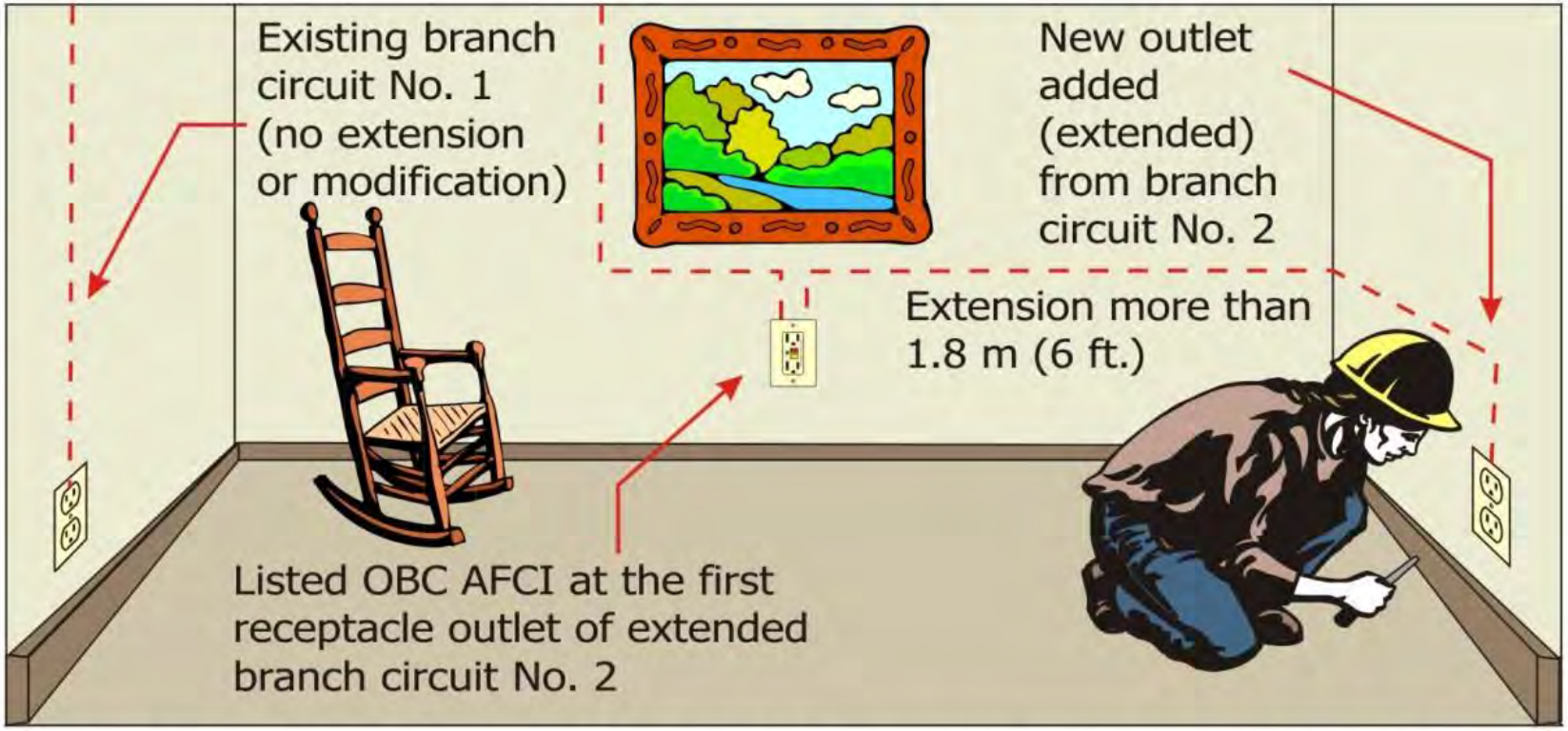
(1) A listed combination AFCI located at the origin of the branch circuit, or

(2) A listed outlet branch-circuit AFCI located at the first receptacle outlet of the existing branch circuit

Exception: *AFCI protection is not required where the extension is not more than 1.8 m (6 ft.) and does not include any additional outlets or devices*

NEC 210.12(B)

E3902.17 AFCI for Extensions or Modifications



In any of the areas specified in E3902.16, where branch-circuit wiring is modified, replaced or extended, the branch circuit shall be protected by:

(1) A listed combination AFCI located at the origin of the branch circuit, or

(2) A listed outlet branch-circuit AFCI located at the first receptacle outlet of the existing branch circuit

Exception: *AFCI protection is not required where the extension is not more than 1.8 m (6 ft.) and does not include any additional outlets or devices*

NEC 210.12(B)

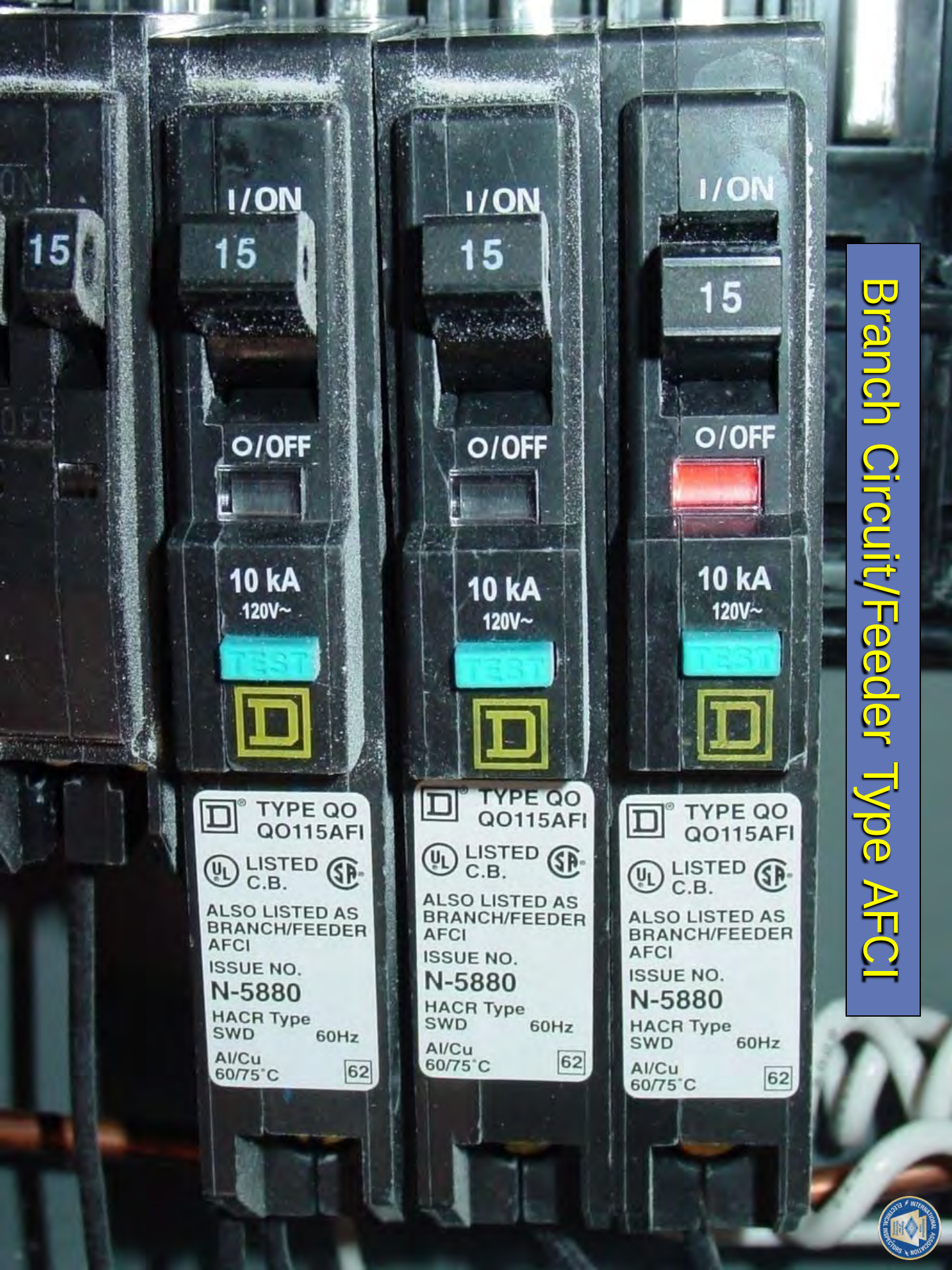
120-Volt Single-Station Smoke Alarm

AFCI Protection Required? – YES (E3902.11)

Power-Limited Fire Alarm (PLFA) Circuits

AFCI Protection Required? - NO (*NEC* 760.41)

Combination Type AFCI


I/ON
15
O/OFF
10 kA
120V~
TEST
TYPE QO
QO115AFI
LISTED
C.B.
ALSO LISTED AS
BRANCH/FEEDER
AFCI
ISSUE NO.
N-5880
HACR Type
SWD
60Hz
Al/Cu
60/75°C
62
Branch Circuit/Feeder Type AFCI

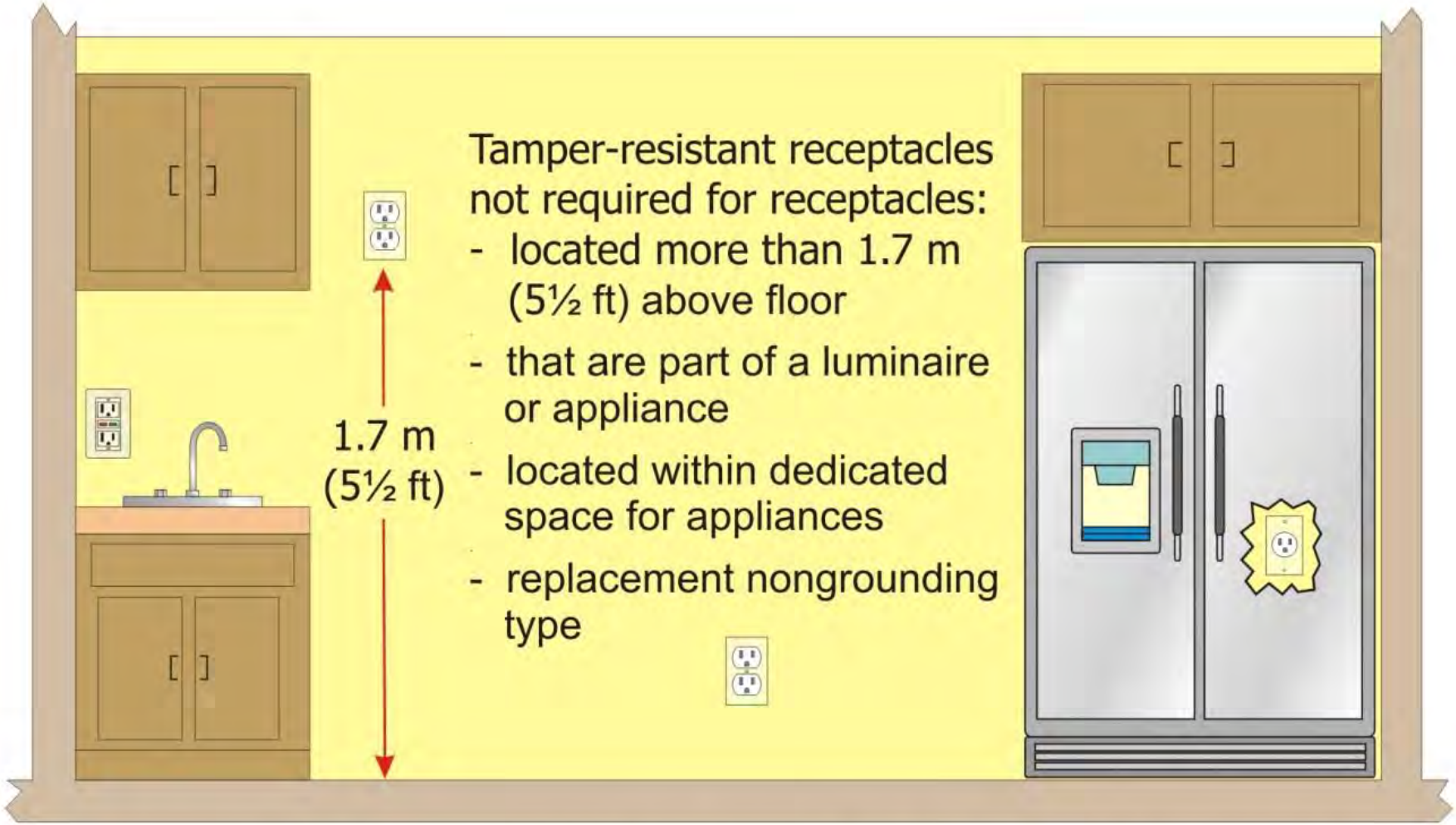
Tamper-Resistant Receptacle Requirements for Dwelling Units

E4002.14 Tamper-Resistant Receptacles

- All nonlocking 125-volt, 15- and 20-ampere receptacles in areas of a dwelling unit referred to in 210.52 are required to be listed tamper-resistant receptacles
- Receptacles in the following locations ***shall not*** be required to be tamper-resistant:
  - Receptacles located more than 1.7 m (5½ ft) above the floor
  - Receptacles part of a luminaire or appliance
  - Single or duplex receptacle for appliances located within dedicated appliance space *(not easily moved)*
  - Nongrounding receptacles used for replacement of nongrounding-type receptacles

NEC 406.12(A)

E4002.14 Tamper-Resistant Receptacles



In all areas specified in E3901.1, all nonlocking type 125-volt, 15- and 20-ampere receptacles required to be listed tamper-resistant receptacles

NEC 406.12(A)

E4002.14 Tamper-Resistant Receptacles

- The following areas of the dwelling are specifically referenced in 210.52 and require tamper-resistant receptacles:

Kitchens	Recreation rooms
Family rooms	Bathrooms
Dining rooms	Outdoors
Living rooms	Laundry areas
Parlors	Basements
Libraries	Garages
Dens	Accessory buildings
Sunrooms	Hallways
Bedrooms	Foyer

*Similar rooms or areas of dwelling unit

NEC 406.12(A)

E4002.14 Tamper-Resistant Receptacles

Courtesy of Pass & Seymour/Legrand

Tamper-resistant receptacles are available in a wide variety of models for various applications

NEC 406.12(A)

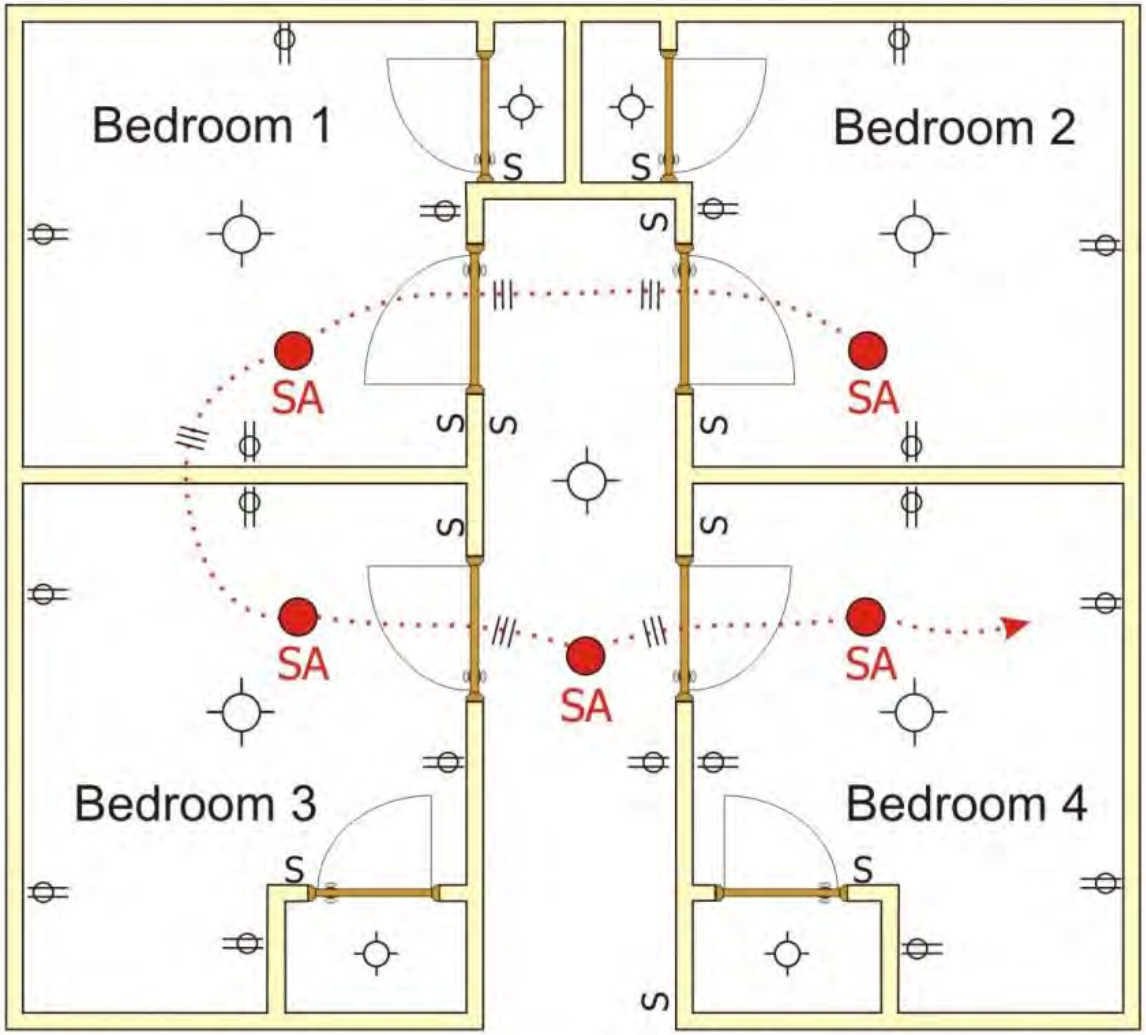

15A
125V

Smoke Alarm Requirements for Dwelling Units

IRC R314 Smoke Alarms for Dwelling Units

- Smoke alarm requirements are generally governed by local building codes
- Smoke alarms are generally required in the following locations:
  - Sleeping quarters
  - Hallways/corridors in the immediate vicinity of bedrooms
  - Each level of the dwelling (*excluding crawl spaces/attics)*
- Interconnected to all smoke alarms
- Primary power source: premise wiring system *(with battery backup)*

R314.3 Smoke Alarm Locations



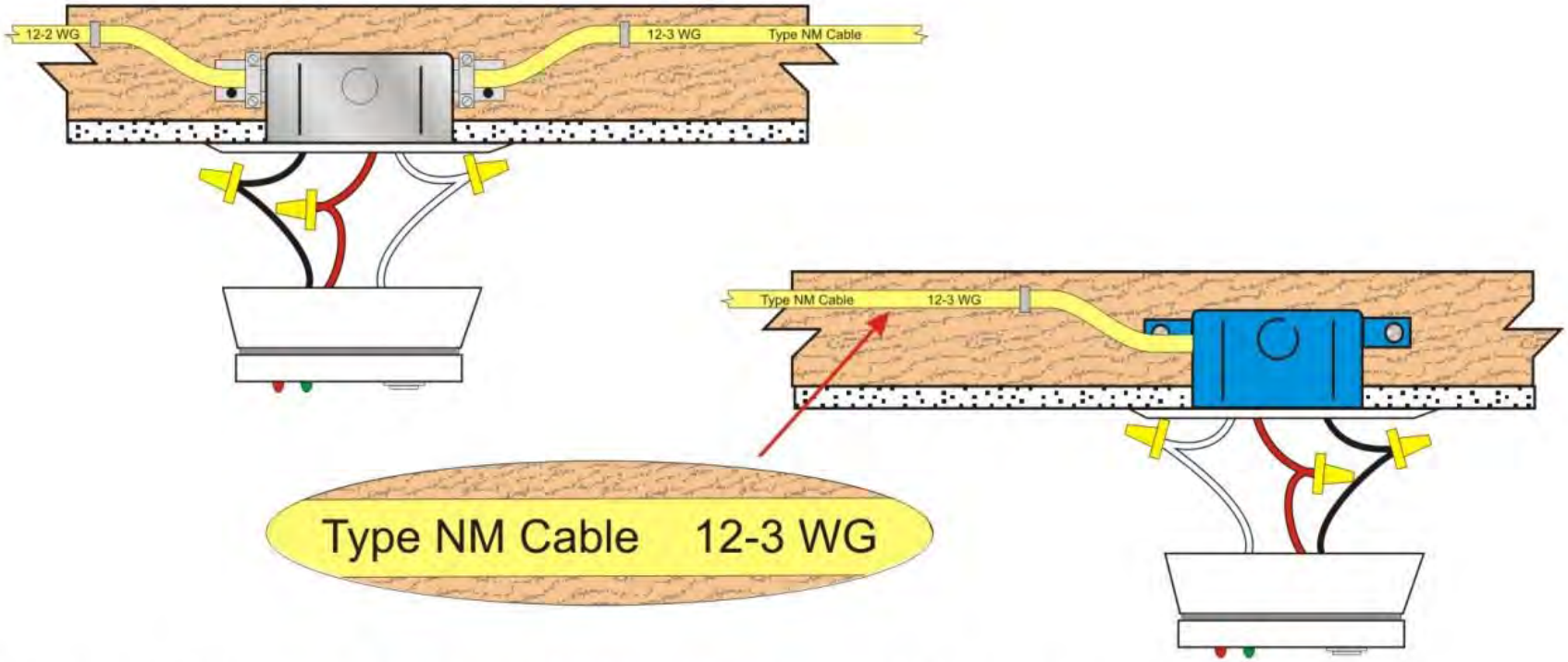
Smoke alarms are required in each sleeping room and in hallways leading to sleeping rooms

IRC R314.3 Smoke Alarm Locations

Smoke alarms required at each level and must be interlocked so activation of one sounds all

Building Codes will typically not require smoke alarms in crawl spaces or uninhabitable attics

IRC R314.4 Smoke Alarm Interconnections



Smoke alarms are required in dwellings and no disconnecting means is permitted other than an overcurrent device

Where multiple smoke alarms are installed, they must be wired so they are interconnected to sound all upon activation of a single device *(physical interconnection not required where listed wireless alarms are installed and all alarms sound upon activation of one alarm)*

Carefully follow the manufacturer's installation and maintenance instructions

09-2005
ROTATE TO REMOVE
DO NOT PAINT

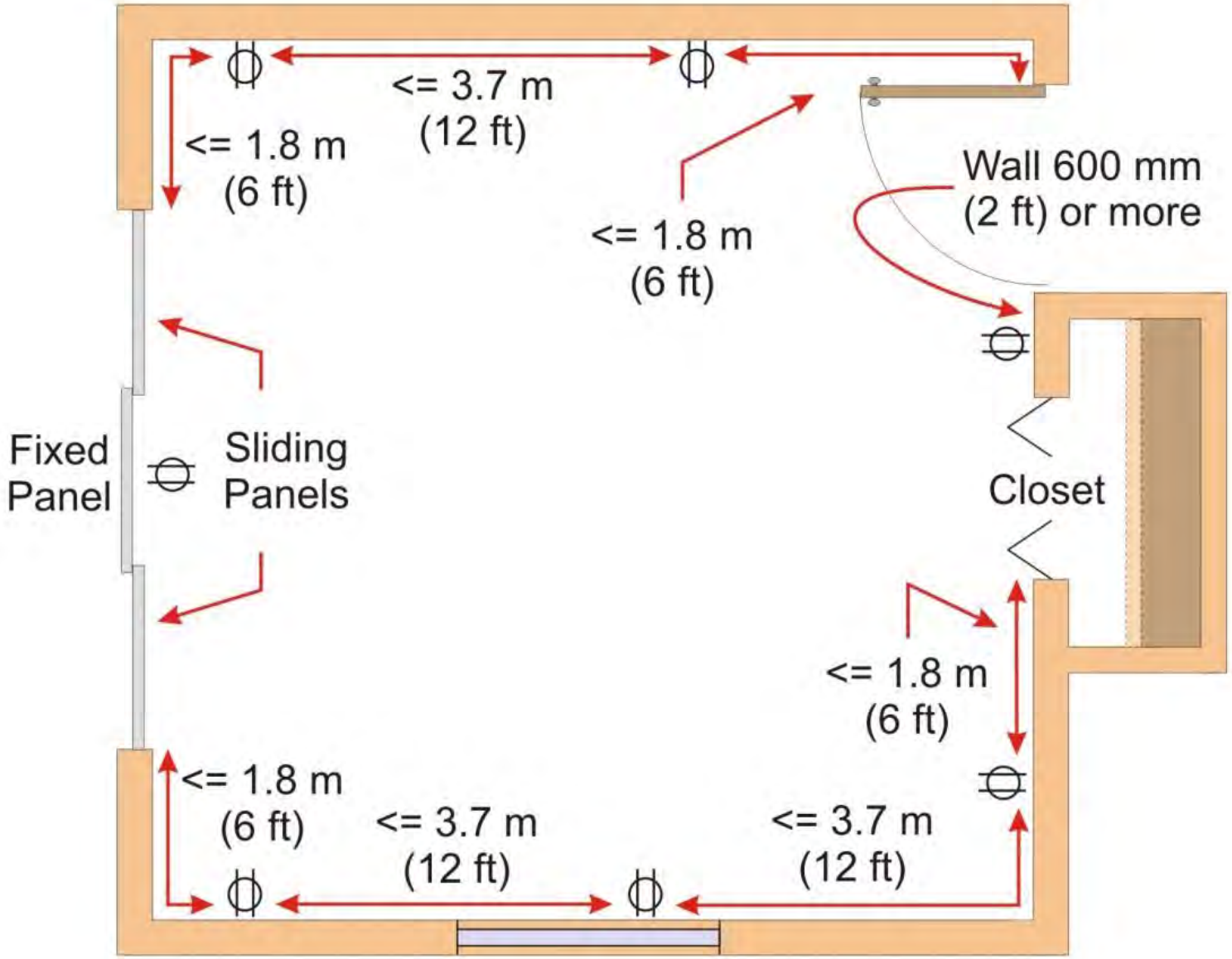
Receptacle Wall Spacing Requirements for Dwelling Units

E3901.2 Dwelling Unit Receptacle Outlets

- Spacing rules call for installation of receptacle outlets so that no point along the floor line in any wall space is more than 1.8 m (6 ft) measured horizontally from an outlet in that space [E3901.2.1]
- Includes 600 mm (2 ft) wall space and wall space occupied by fixed panels in exterior or interior walls [E3901.2.2]
- Does not include sliding panels in exterior or interior walls [E3901.2.2]
- Fixed room dividers are included in the 1.8 m (6 ft) measurement [E3901.2.2]

NEC 210.52(A)

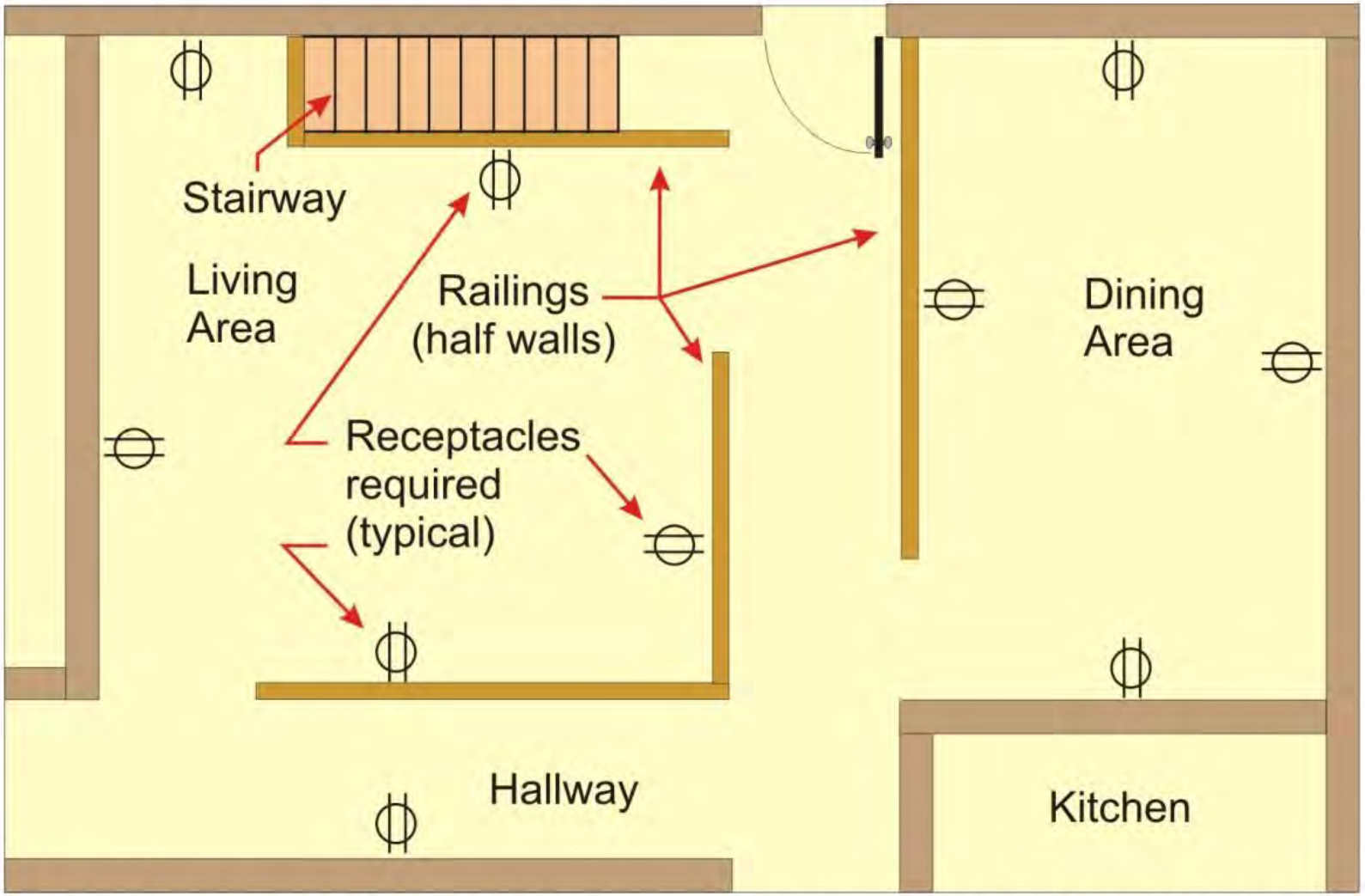
E3901.2 Receptacle Location and Spacing



NEC 210.52(A)


12 ft
6 ft

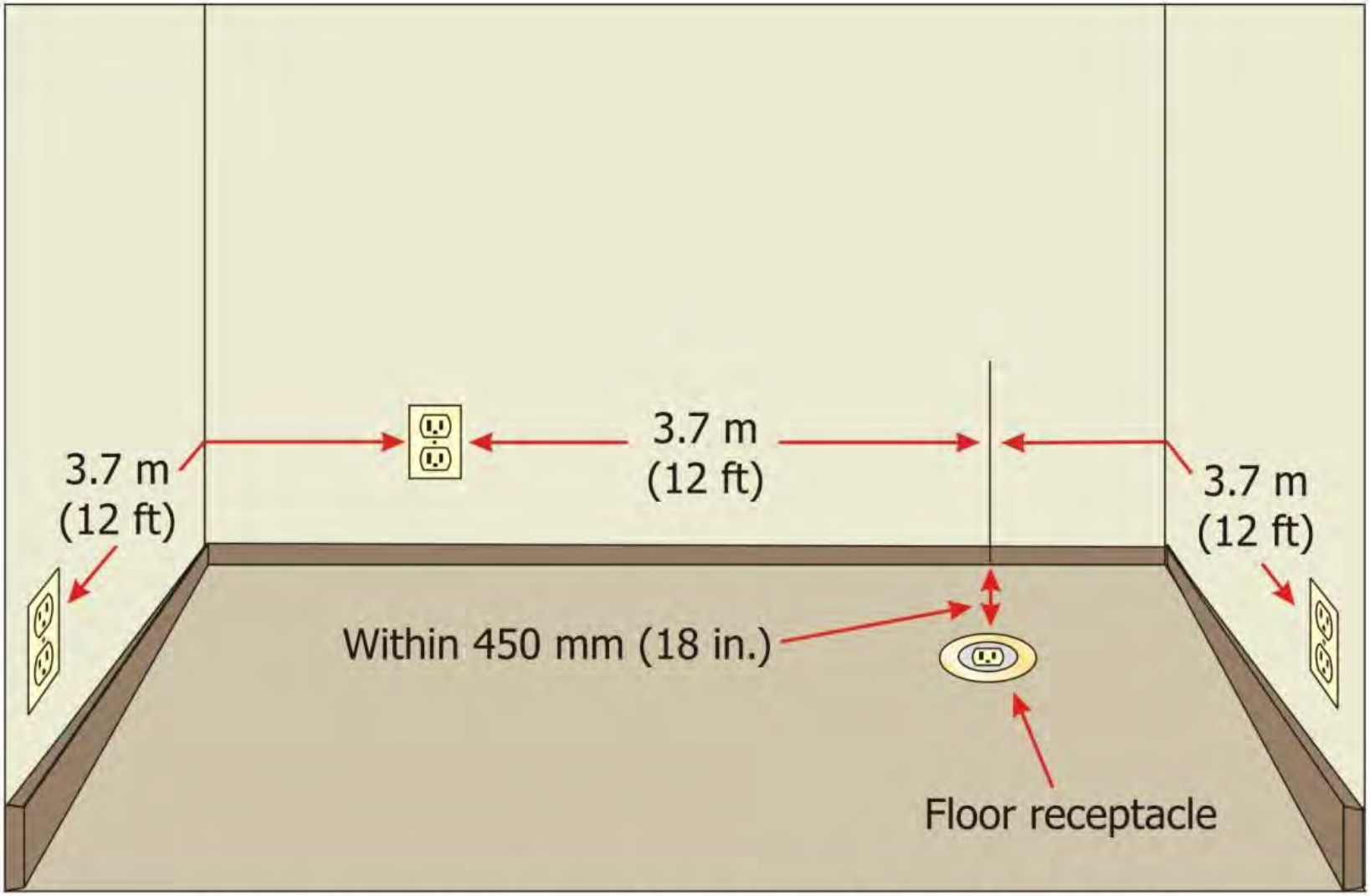
E3901.2 Receptacle Location and Spacing



Wall space shall include fixed room dividers, such as freestanding bar-type counters or railings

NEC 210.52(A)(2)

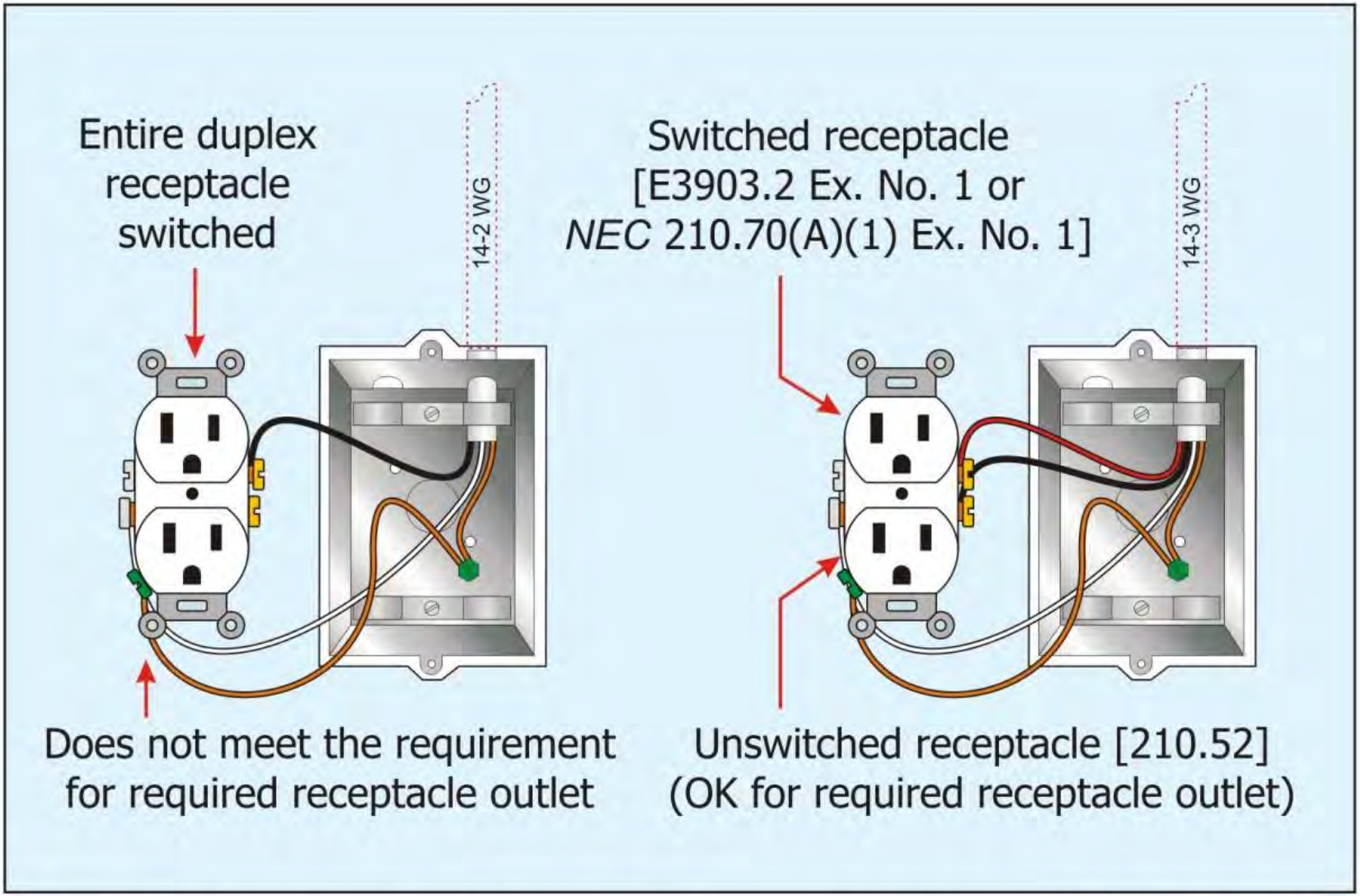
E3901.2.3 Floor Receptacles



Floor receptacles must be within 450 mm (18 in.) of the wall to be counted as required receptacle

NEC 210.52(A)(3)

E3901.1 Dwelling Unit Receptacle Outlets



Switched receptacles do not count as receptacle outlets required by E3901.1

NEC 210.52

E3901.2.2 Receptacle Wall Space

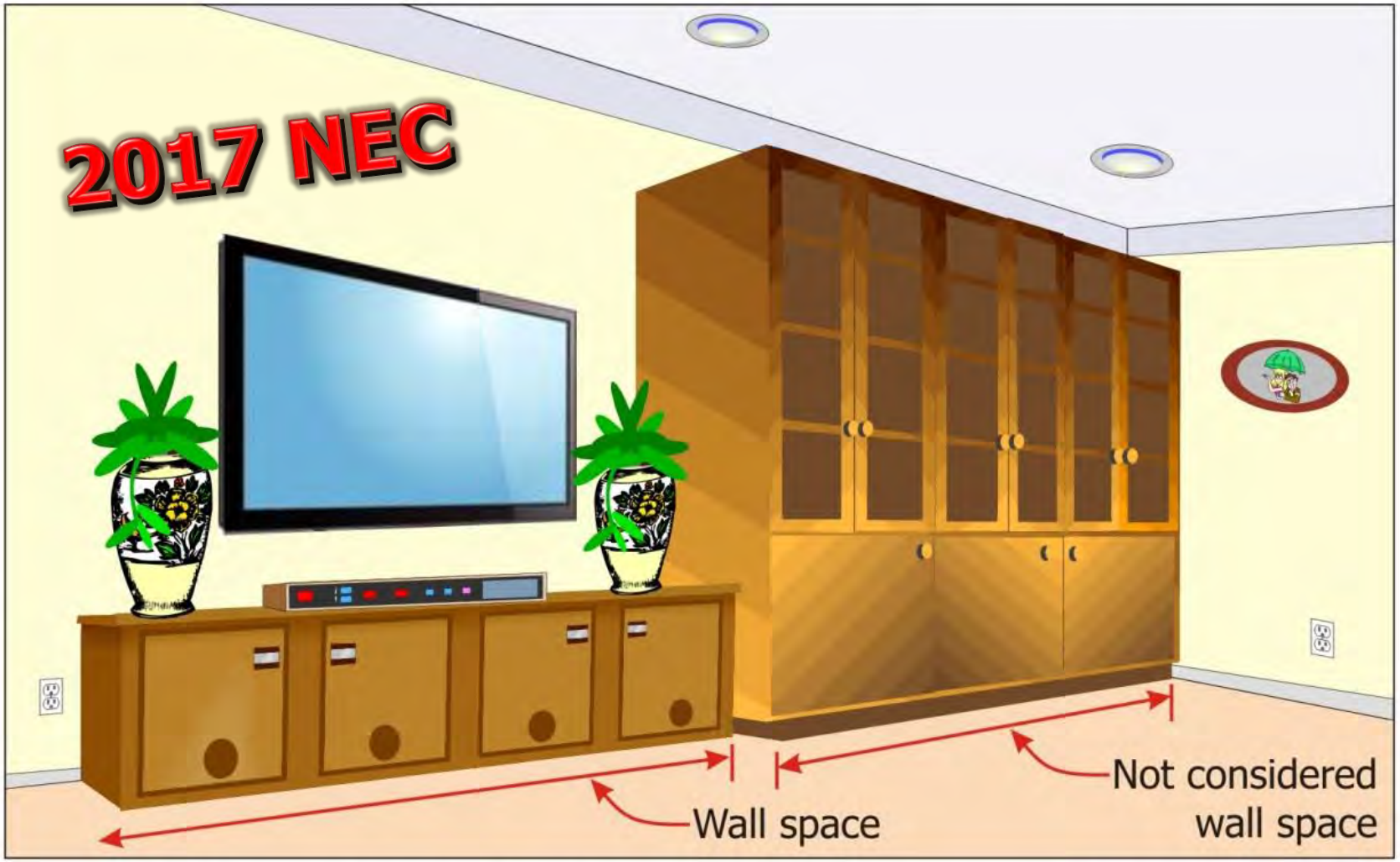
New 2017 NEC

- Fixed cabinets “that do not have countertops or similar work surfaces” was added as an item that will constitute a break in a wall space for receptacle spacing reasons in dwelling units
- This distinquishes “fixed cabinets” such as kitchen pantry-type cabinets *(but not limited to kitchen cabinets)* that do not have countertops or similar work surfaces from short desk-type cabinets with countertops that are clearly intended as work surfaces
- This change will ensure that receptacle outlets are required and installed for such things as lap top computers, printers, televisions, etc.

NEC 210.52(A)(2)


2017 NEC

E3901.2.2 Receptacle Wall Spacing



Any space 600 mm (2 ft) or more in width and unbroken along the floor line by doorways and similar openings, fireplaces, and fixed cabinets that do not have countertops or similar work surfaces

NEC 210.52(A)(2)


2017 NEC


2017 NEC

Small Appliance Branch Circuit Requirements for Dwelling Units

E3901.3 Small Appliance Receptacles

- Two or more 20-ampere small appliance branch circuits required to serve all receptacle outlets only in the kitchen, pantry, breakfast room, dining room or similar area of a dwelling unit
- The 20-ampere small appliance branch circuits are required to supply refrigeration equipment located in these areas as well
  - Exception permits an individual 15- or 20-ampere branch circuit for refrigeration equipment only
- Generally, the two or more small appliance branch circuits cannot have other outlets *(outdoor, bedroom, etc.)*

(cont. on next slide)

E3901.3 Small Appliance Receptacles *(cont.)*

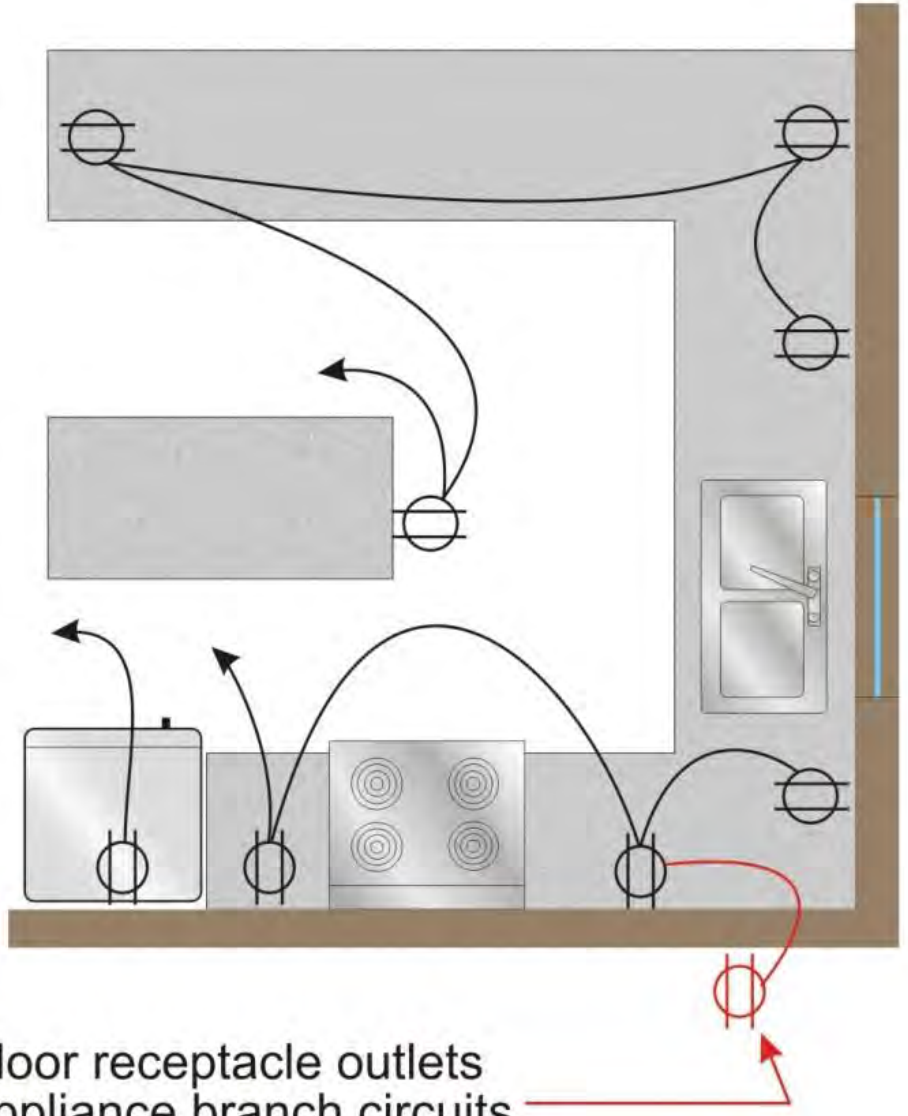
- At least two of the 20-ampere small appliance branch circuits are required to serve the countertop surfaces in the kitchen
- Either or both of these two small appliance branch circuits can also supply other receptacle outlets in the same room or adjacent permitted areas such as a dining room or pantry receptacle outlets
- No small appliance branch circuit can serve more than one kitchen

E3901.3 Small Appliance Receptacles

Minimum of two small appliance branch circuits limited to receptacle outlets only in kitchens, dining rooms, and similar areas

(See exceptions for clock outlet and gas appliances)

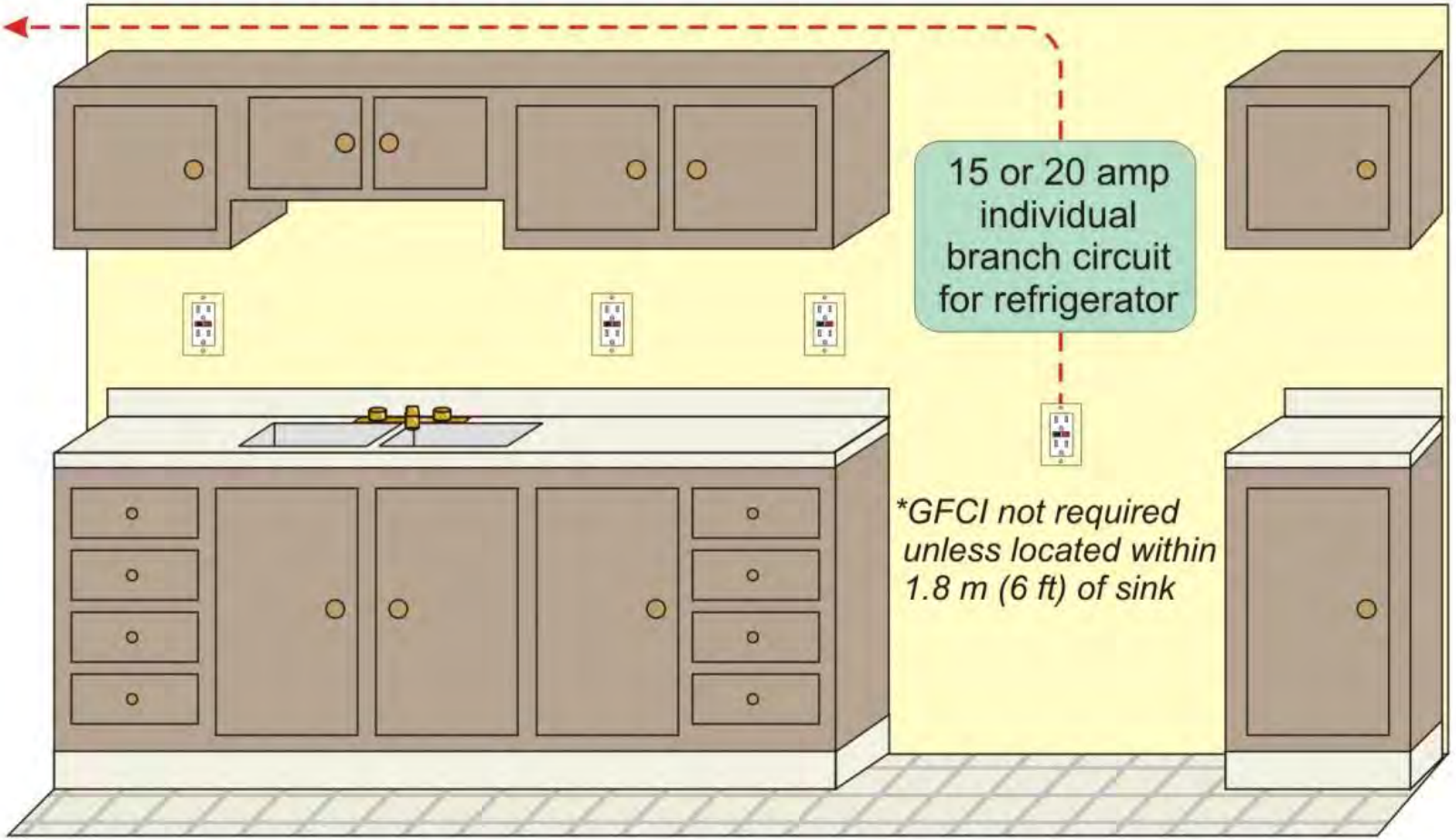
An additional dedicated 15-ampere or greater branch circuit permitted for refrigeration equipment



Other outlets such as outdoor receptacle outlets NOT permitted on small appliance branch circuits

NEC 210.52(B)

E3901.3 Ex. No. 2 Refrigerator Branch Circuit



Refrigeration equipment generally required to be served by the two or more 20-ampere small-appliance branch circuits

The receptacle outlet for refrigeration equipment is permitted to be supplied from an individual branch circuit rated 15 amperes or greater

NEC 210.52(B)(1) Ex. No 2

New 2017 NEC

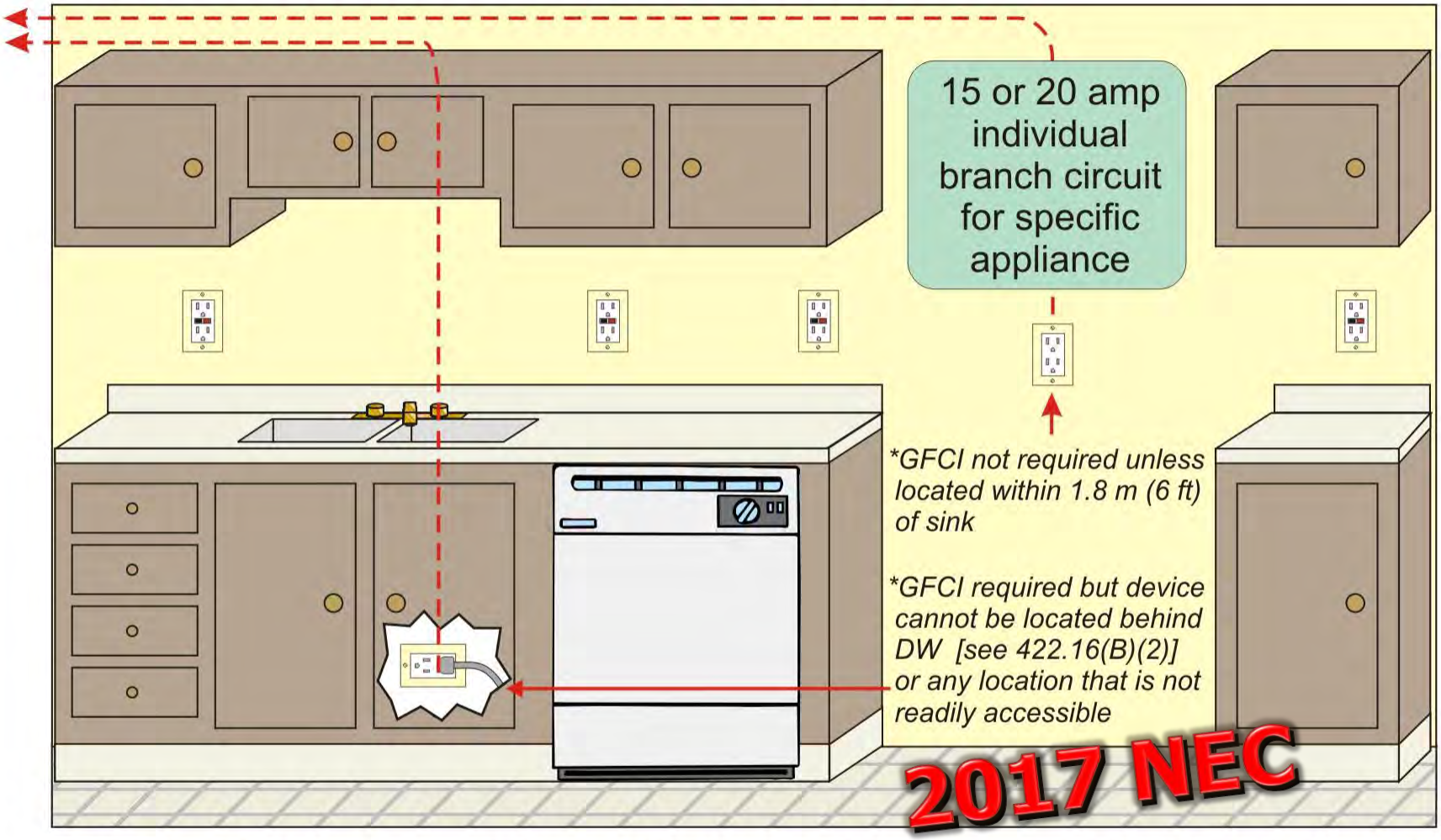
E3901.3 Ex. No. 2

~~Refrigerator~~ Appliance Branch Circuit

- Any dwelling unit kitchen appliance is now permitted *(by the exception)* to be supplied by an individual branch circuit rated 15 amperes or greater
- E3901.3 requires receptacle outlet serving the refrigeration equipment be supplied from one of the 20-ampere rated small-appliance branch circuits
- Previous exception allowed refrigerator to be supplied by an individual branch circuit rated 15 amperes or greater *(why just refrigerator?)*
- Revised exception will now allow an individual branch circuit 15 amperes or greater for kitchen appliances such as garbage disposal, dishwasher, or permanently installed microwave

NEC 210.52(B)(1) Exception No. 2

E3901.3 Ex. No. 2 Small Appliance Branch Circuit

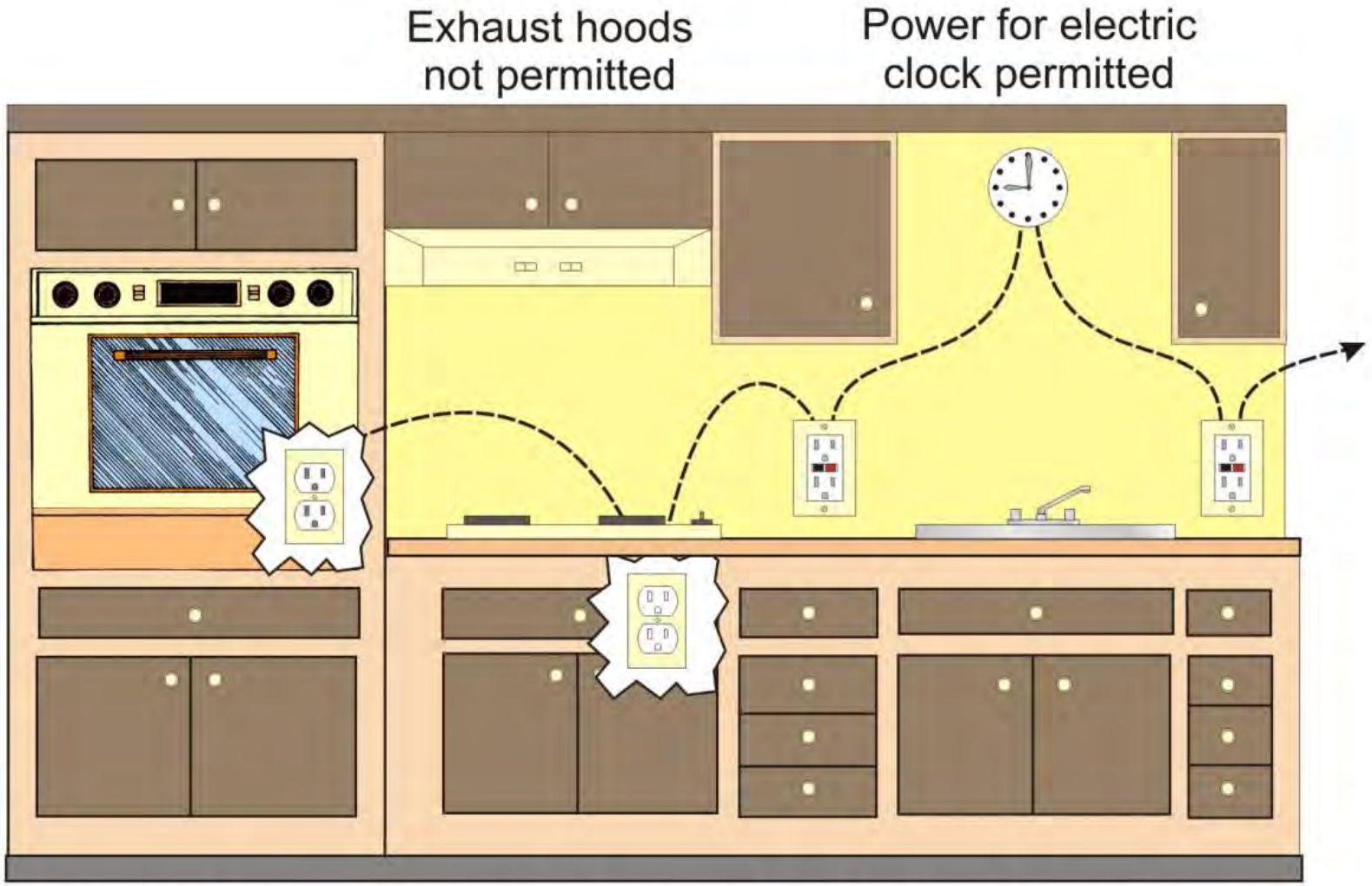


Refrigeration equipment generally required to be served by one of the two or more 20-ampere small-appliance branch circuits

The receptacle outlet for any specific appliance is permitted to be supplied from an individual branch circuit rated 15 amperes or greater

NEC 210.52(B)(1) Ex. No. 2

E3901.3.1 Ex. No. 1 & 2 No Other Outlets



Receptacle(s) for supplemental equipment and lighting for gas-fired ranges, ovens or counter-mounted units permitted on small appliance branch circuits

NEC 210.52(B)(2) Ex. No. 1 & 2

E3901.4 Kitchen Countertop Receptacles

- Base or Wall Mounted Countertops (E3901.4.1)
  - Receptacle outlets shall be installed so that no point along the wall line is more than 600 mm **(24 in.)** measured horizontally from a receptacle outlet in that space
  - A receptacle outlet must be installed at each wall countertop space that is 300 mm **(12 in.)** or wider
  - *(See E3901.4.1 Exception)*
  - Countertop spaces separated by rangetops, refrigerators, or sinks shall be considered as separate countertop spaces *(E3901.4.4)*

NEC 210.52(C)

E3901.4 Kitchen Countertop Receptacles

- Island and Peninsular Countertops
  - At least one receptacle shall be installed at each island or peninsular countertop space with a long dimension of 600 mm (24 in.) or greater and a short dimension of 300 mm (12 in.) or greater *[E3901.4.2, E3901.4.3]*
  - A peninsular countertop is measured from the connecting edge *(of the base countertops)*
  - Where a range or sink is installed in an island or peninsular countertop and the width of the countertop behind the range or sink is less than 300 mm (12 in.), the range or sink is considered to divide the countertop space into two separate countertop spaces

NEC 210.52(C)(2) and (C)(3)

E3901.4.5 Kitchen Countertop Receptacles

- All Kitchen Countertops
  - Receptacle outlets shall be located above, but not more than 500 mm (20 in.) above, the countertop
  - Receptacle outlet assemblies listed for the application shall be permitted to be installed in countertops
  - Receptacle outlets rendered not readily accessible by appliances fastened in place, appliance garages, sinks, rangetops, or appliances occupying dedicated space are not considered as these required outlets

(cont. on next slide)

NEC 210.52(C)(5)

E3901.4.5 Kitchen Countertop Receptacles

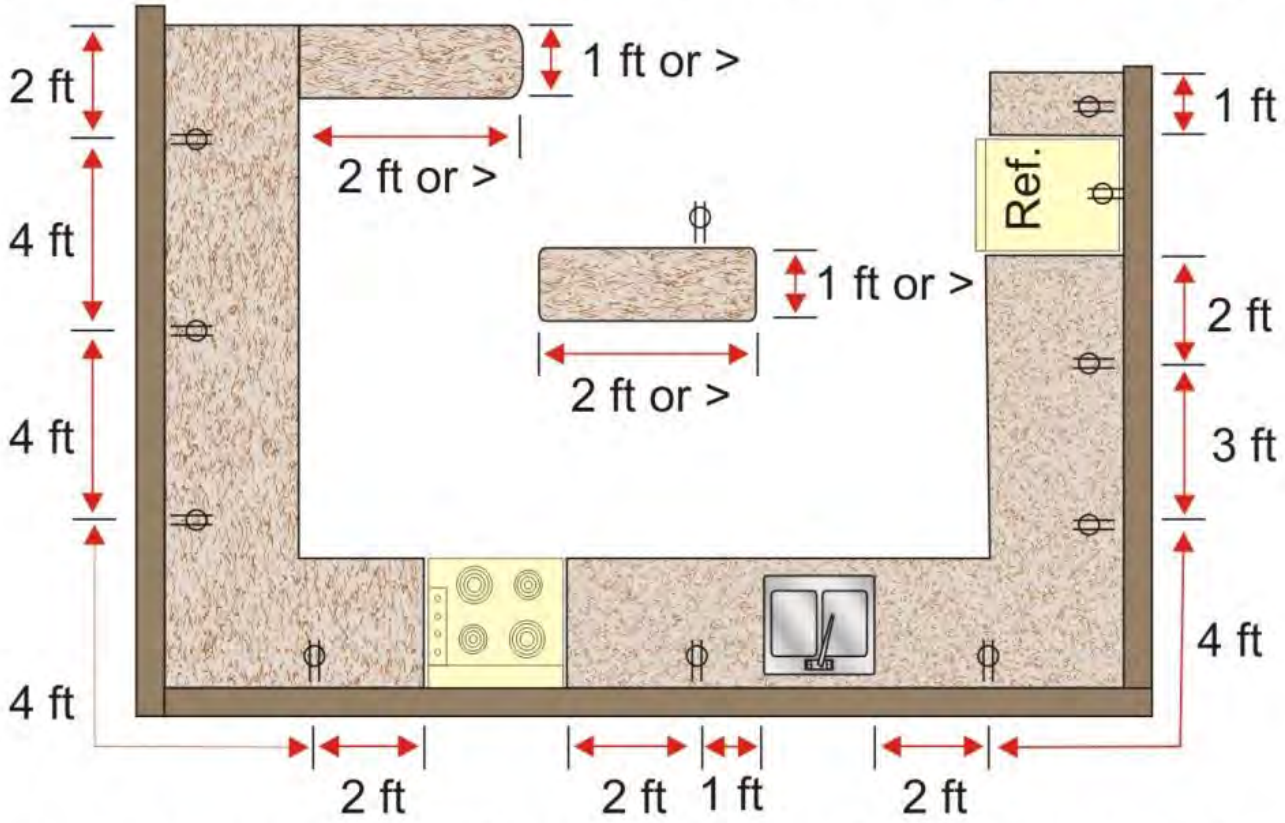
- All Kitchen Countertops
  - Receptacle outlets permitted to be mounted not more than 300 mm (12 in.) below the countertop under one of two conditions:
    - Construction for the physically impaired
    - On island and peninsular countertops where the countertop is flat across its entire surface *(no backsplashes, dividers, etc.)* with no means to mount a receptacle within 500 mm (20 in.) above the countertop

NEC 210.52(C)(5)

E3901.4 Kitchen Receptacles at Counter Spaces

No point on wall countertop spaces more than 600 mm (24 in.) from a receptacle outlet (measured along the backsplash)

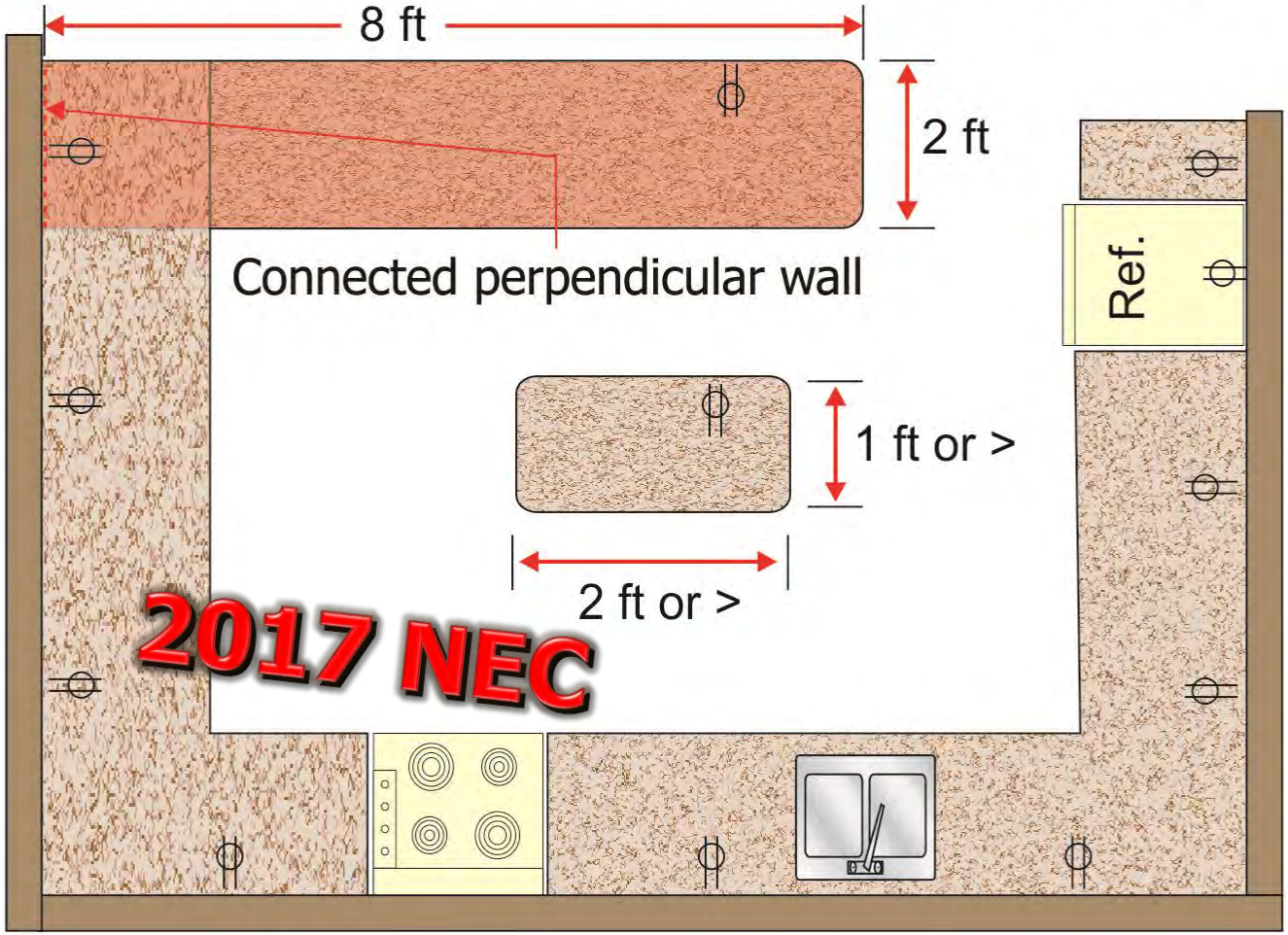
Receptacle outlet required for wall space 300 mm (12 in.) or greater



Counter spaces separated by range tops, refrigerators or sinks are considered as a separate counter space *(receptacle outlet(s) required for each space)*

NEC 210.52(C)

E3901.4.3 Peninsular Countertop Spaces

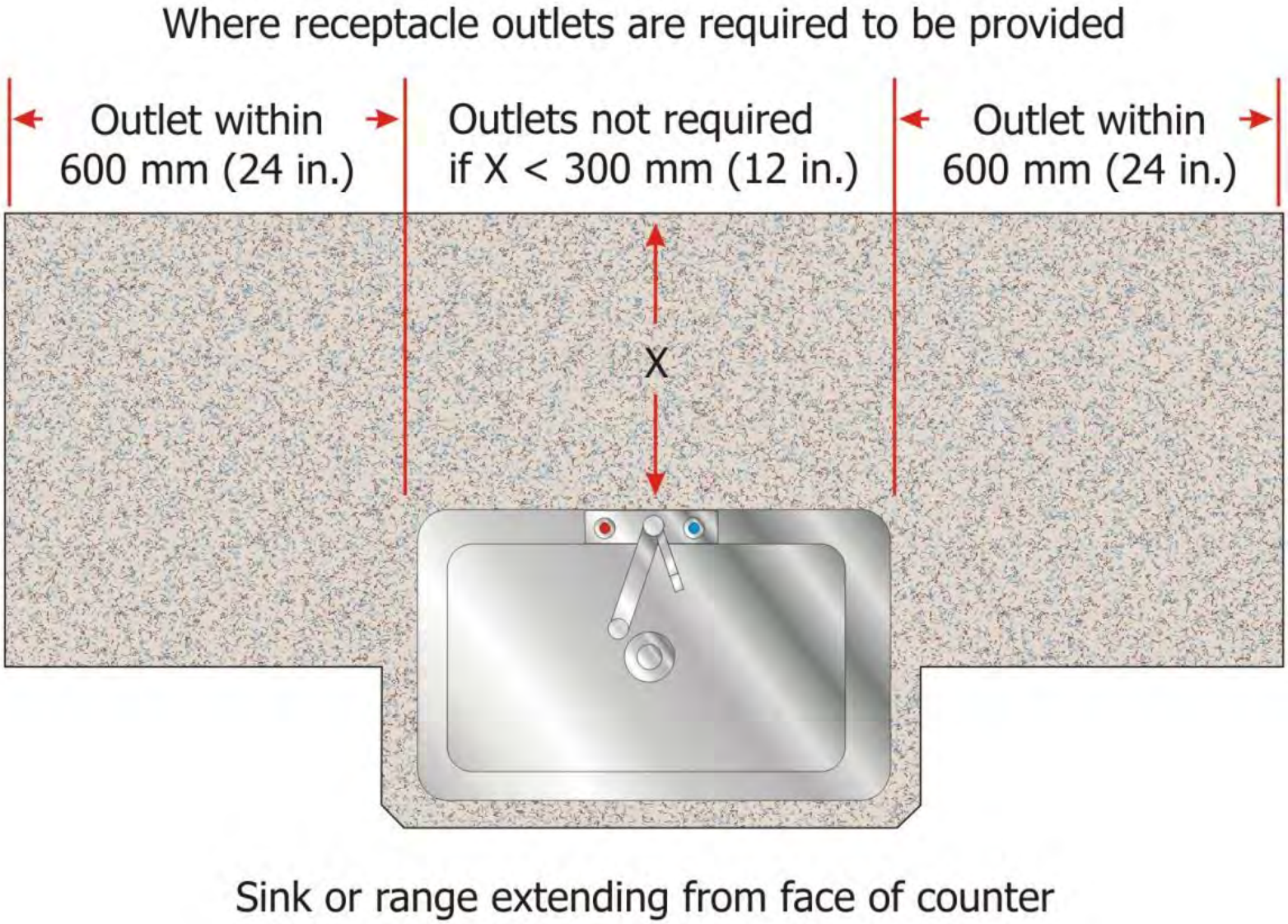


At least one receptacle outlet to be installed at each peninsular countertop long dimension space with a long dimension of 600 mm (24 in.) or greater and a short dimension of 300 mm (12 in.) or greater

Measurements to be measured from the "connected perpendicular wall"

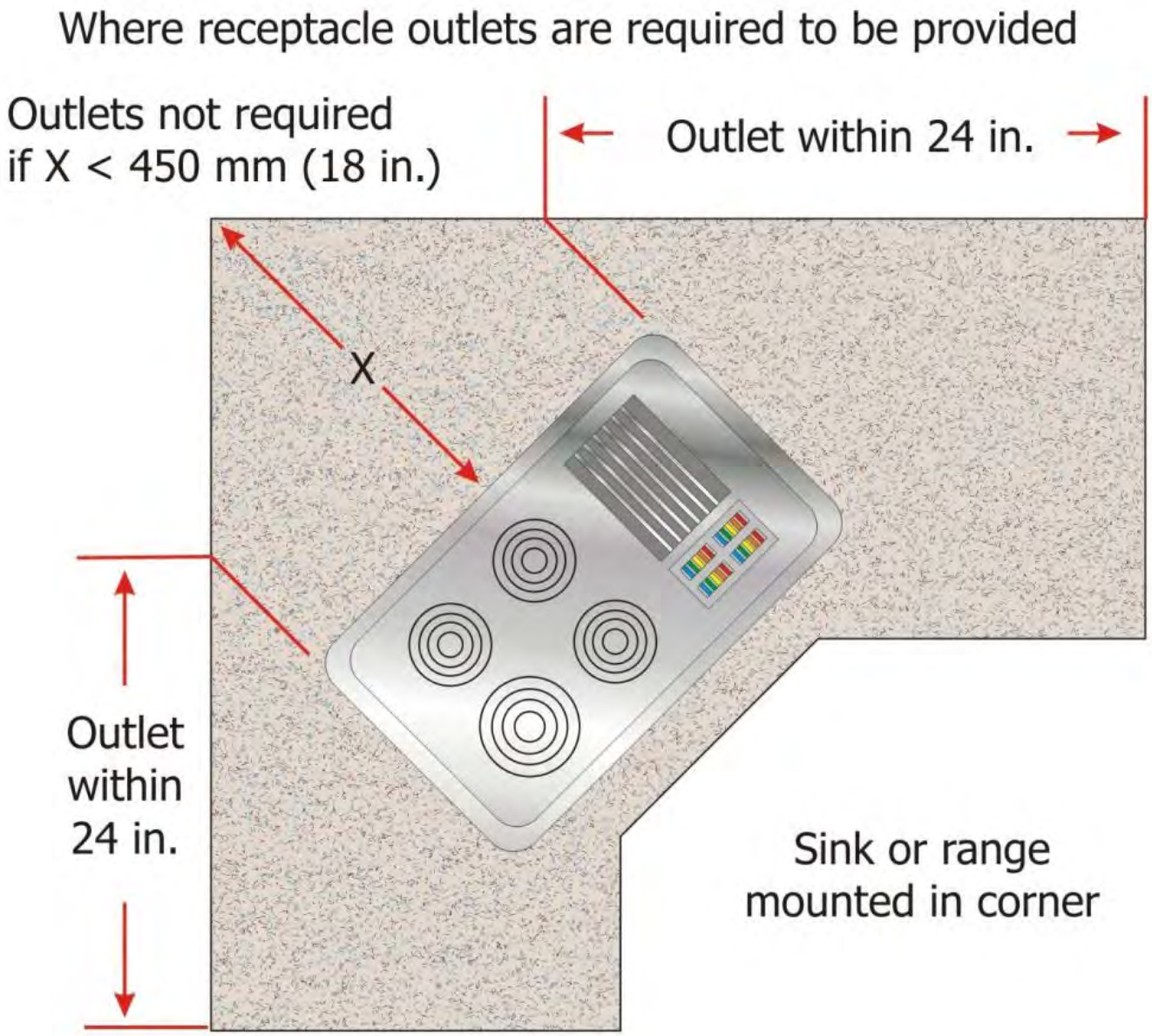
NEC 210.52(C)(3)

Figure E3901.4.1 Kitchen Countertop Receptacles



NEC Figure 210.52(C)(1)

Figure E3901.4.1 Kitchen Countertop Receptacles

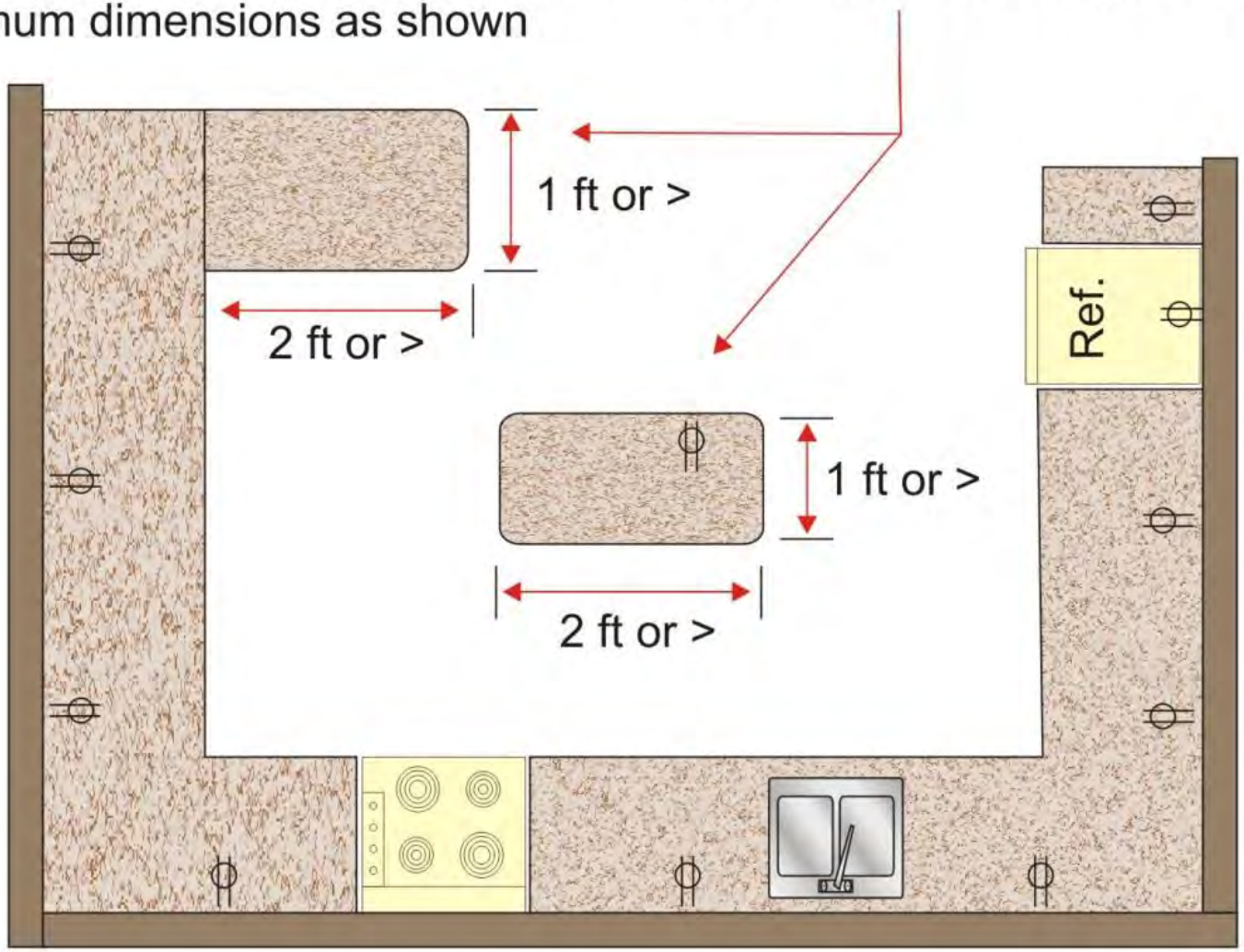


NEC Figure 210.52(C)(1)

E3901.4.4 Separate Spaces

Range, counter-mounted cooking units, or sinks create separate spaces

One receptacle required for peninsular and island counter spaces with minimum dimensions as shown



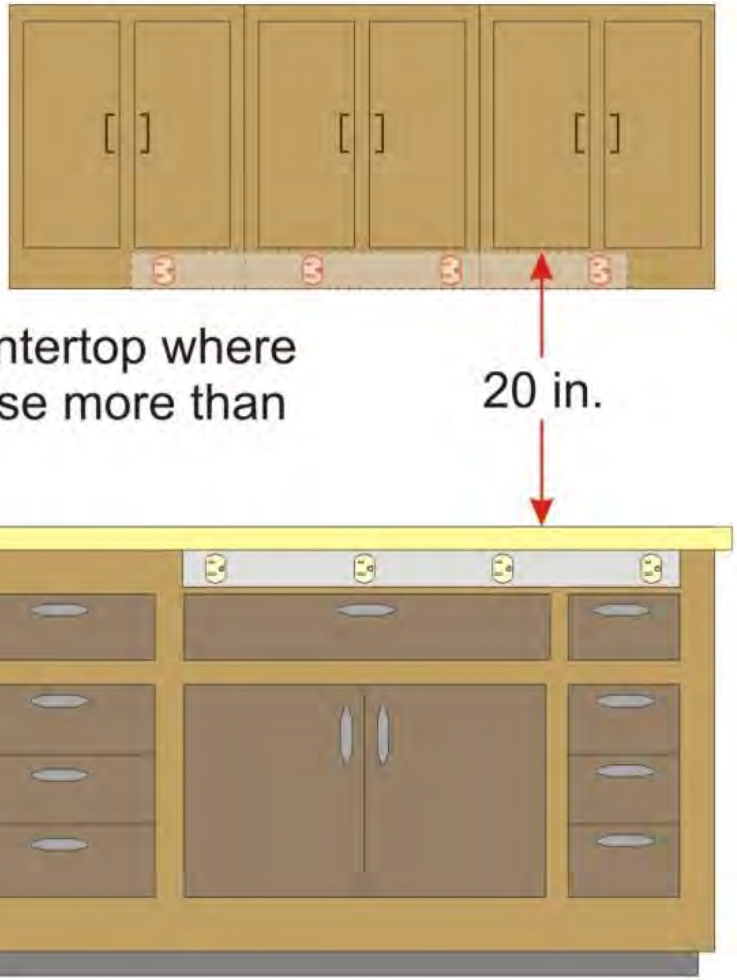
NEC 210.52(C)(4)

E3901.4.5 Receptacle Outlet Locations

Maximum 500 mm (20 in.) above counter-top surface in order to serve countertop

Not permitted face-up in work surface or countertop

Receptacles NOT to be located below countertop where countertop extends beyond the support base more than 150 mm (6 in.)



Maximum 300 mm (12 in.) below countertop only for:

(1) Construction for the physically impaired

(2) Where island or peninsular countertop is flat across entire surface (no backsplash) and no means for mounting receptacle above countertop within 500 mm (20 in.)

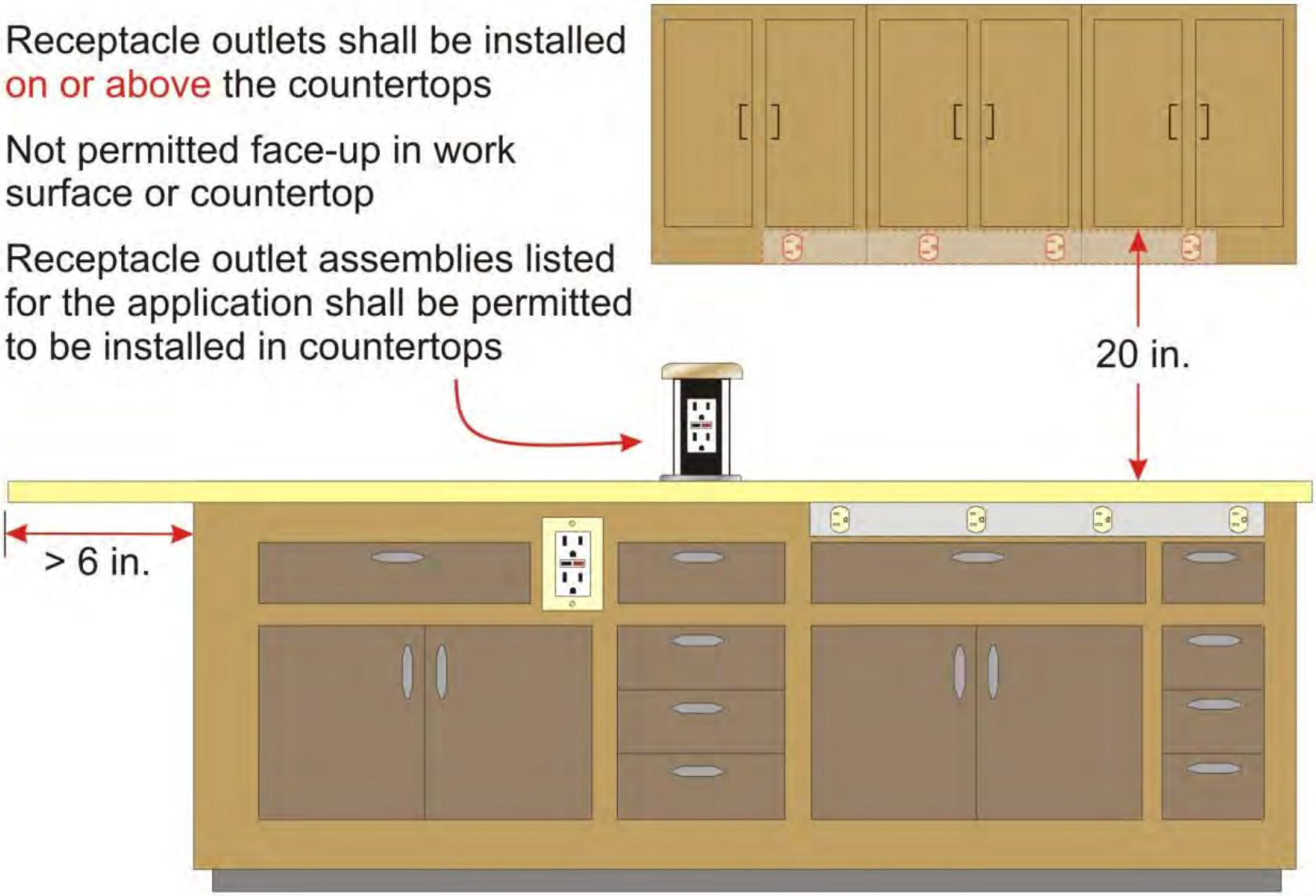
NEC 210.52(C)(5)

E3901.4.5 Receptacle Outlet Locations

Receptacle outlets shall be installed on or above the countertops

Not permitted face-up in work surface or countertop

Receptacle outlet assemblies listed for the application shall be permitted to be installed in countertops



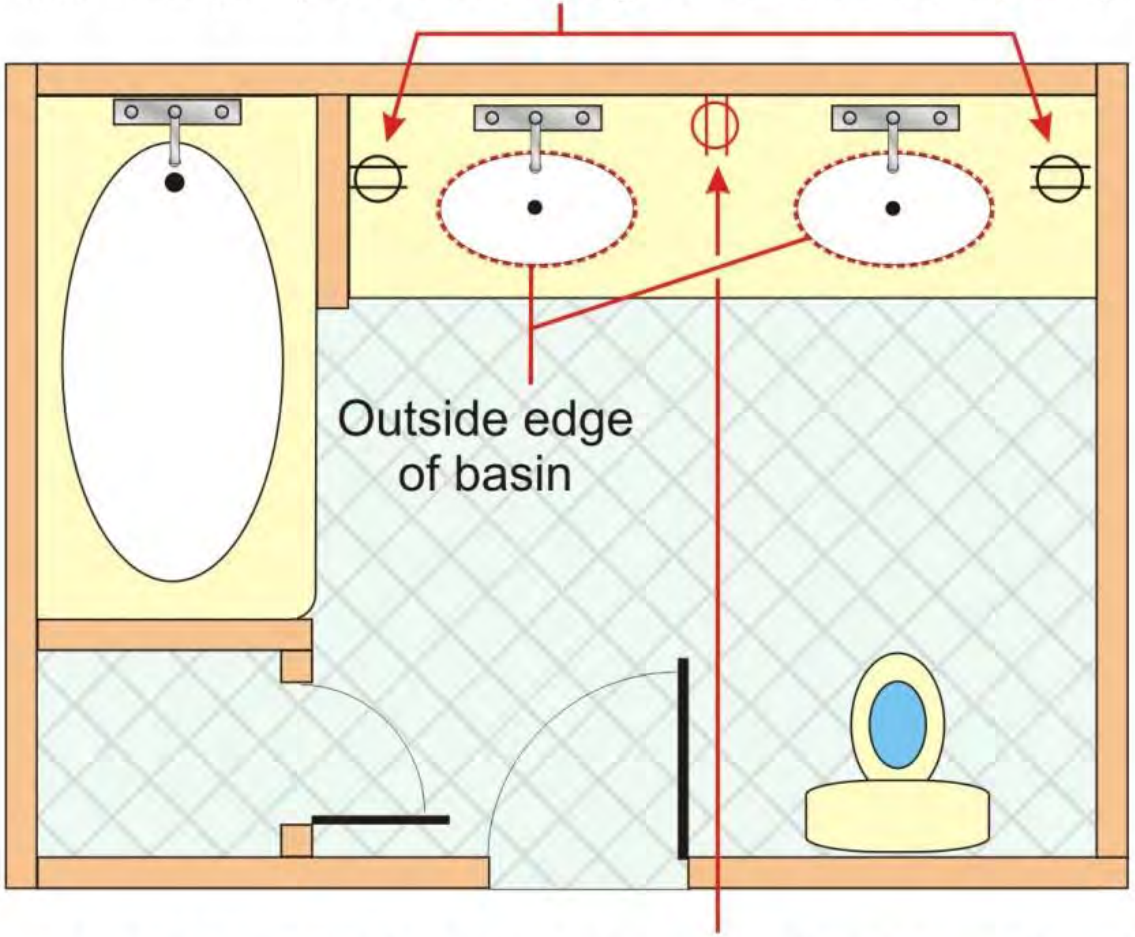
NEC 210.52(C)(5)

Photos courtesy of Thomas & Betts Corporation

Other Receptacle Outlet (Areas) Requirements for Dwelling Units

E3901.6 Bathroom Receptacle Outlet

At least one receptacle outlet to be installed within 900 mm (3 ft) of outside edge of each basin (sink)



One receptacle centered between the basins and within 900 mm (3 ft) of each basin (sink) is permitted as well

NEC 210.52(D)

E3901.6 Bathroom Receptacle Outlet

Receptacle outlet must be located within 900 mm (3 ft) of the outside edge of the basin (sink)

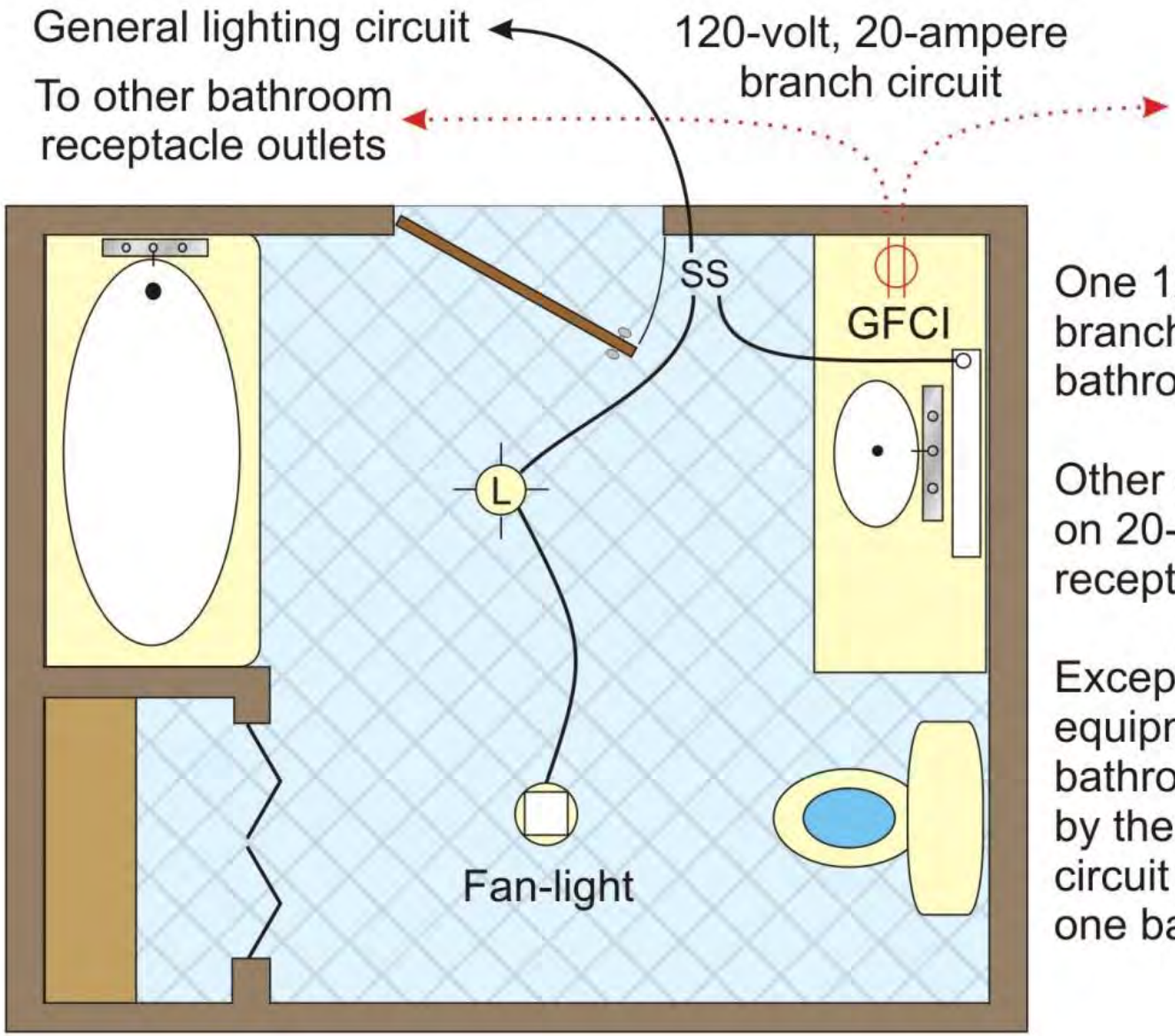
Receptacle outlet permitted on wall or partition adjacent to basin

Receptacle outlet mounted on front or side of vanity can serve as required receptacle outlet if not more than 300 mm (12 in.) below the top of basin

Receptacle outlet assemblies permitted to be installed in the countertop

NEC 210.52(D)

E3703.4 Bathroom Branch Circuit



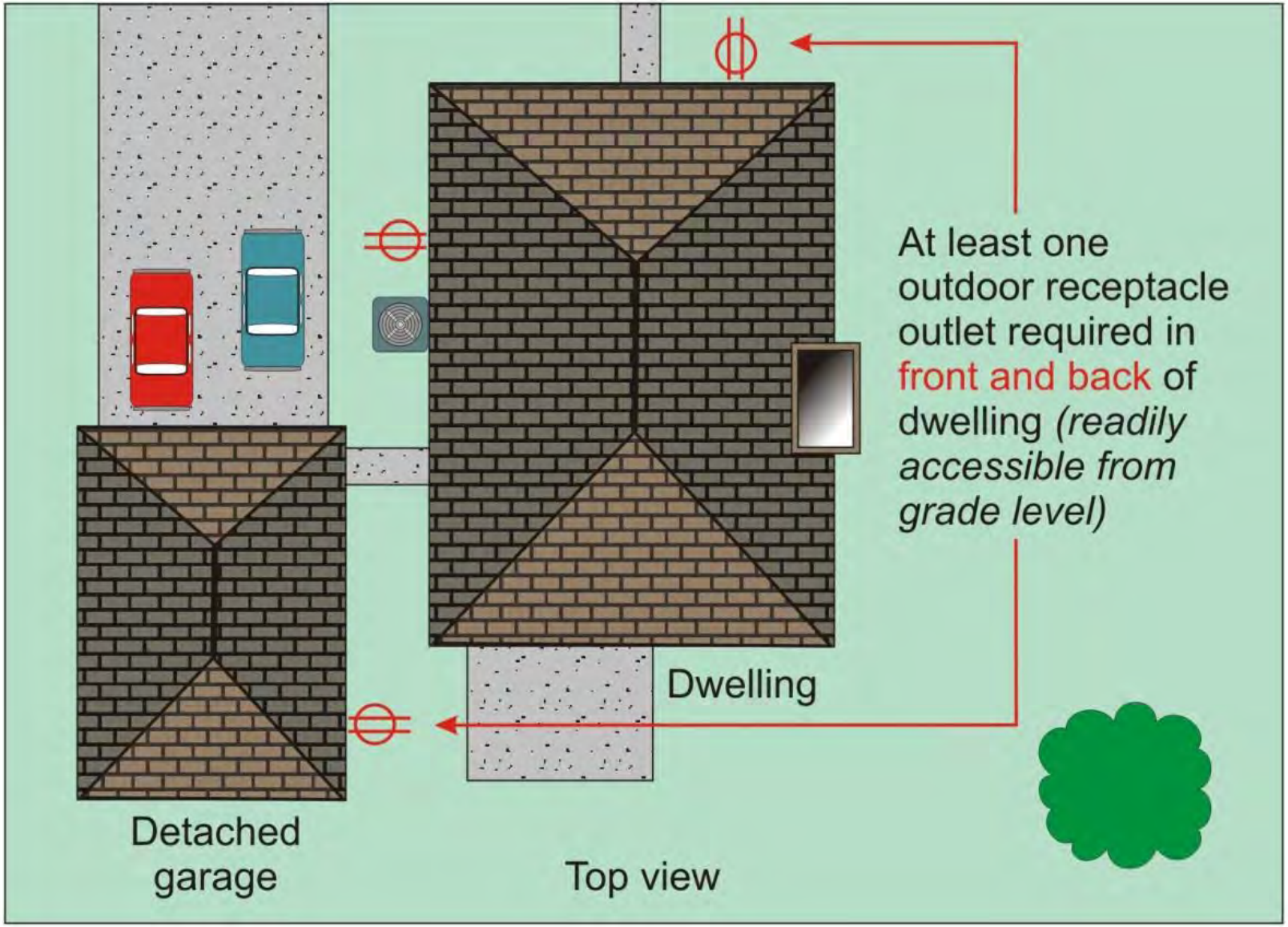
One 120-volt, 20-ampere branch circuit to supply bathroom receptacles

Other outlets not permitted on 20-ampere bathroom receptacle circuit

Exception permits other equipment within the same bathroom to be supplied by the 20-ampere branch circuit where it supplies one bathroom only

NEC 210.11(C)(3)

E3901.7 Outdoor Receptacle Outlet(s)

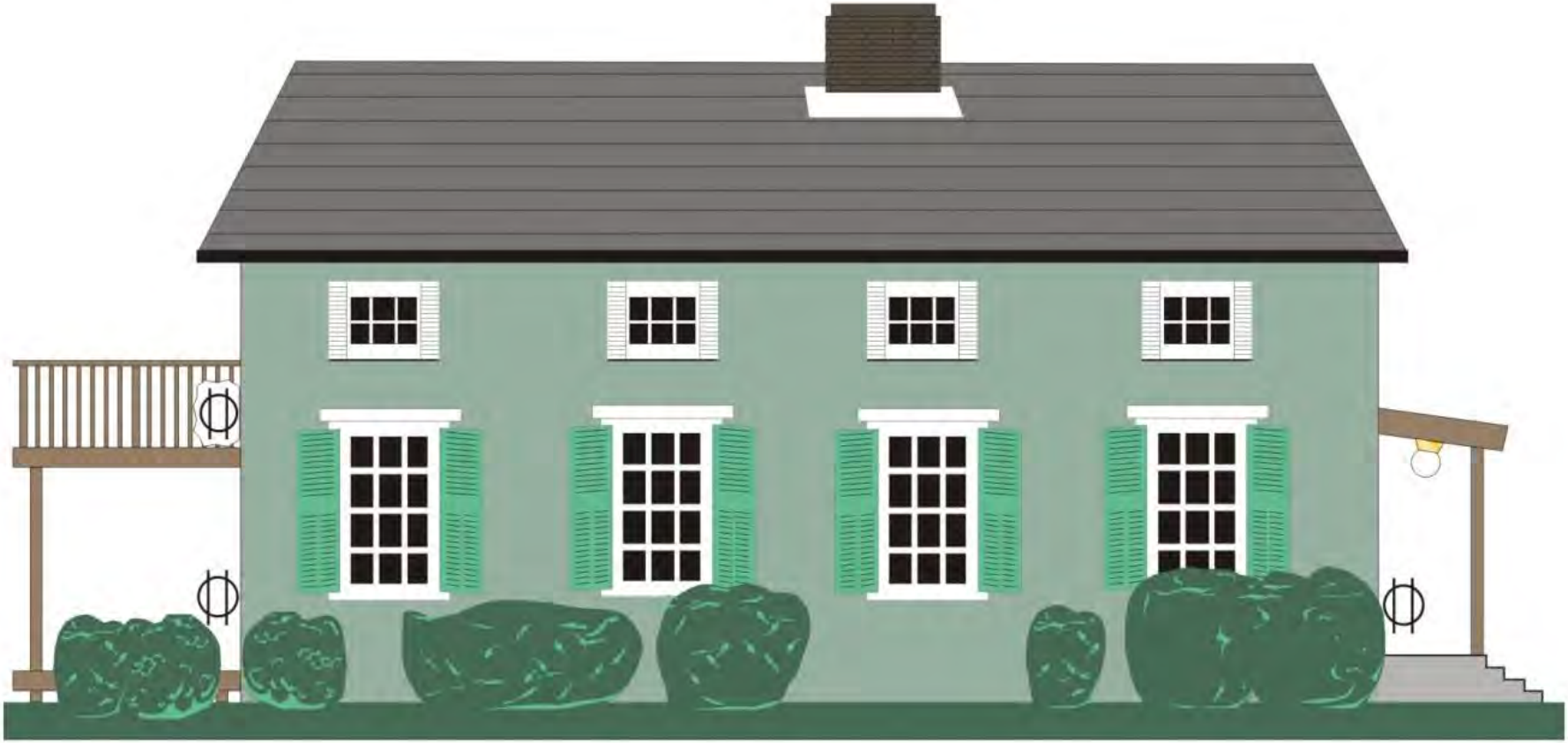


NEC 210.52(E)(1)

Photos Courtesy of Thomas & Betts

Product Courtesy of
Arlington Industries

E3901.7 Balconies, Decks, and Porches



At least one 125-volt, 15- or 20-ampere receptacle outlet must be installed at every attached balcony, deck, or porch that is accessible from inside the dwelling unit

The receptacle outlet(s) must be accessible from the balcony, deck, or porch and shall not be located more than 2.0 m (6½ ft) above the walking surface

NEC 210.52(E)(3)

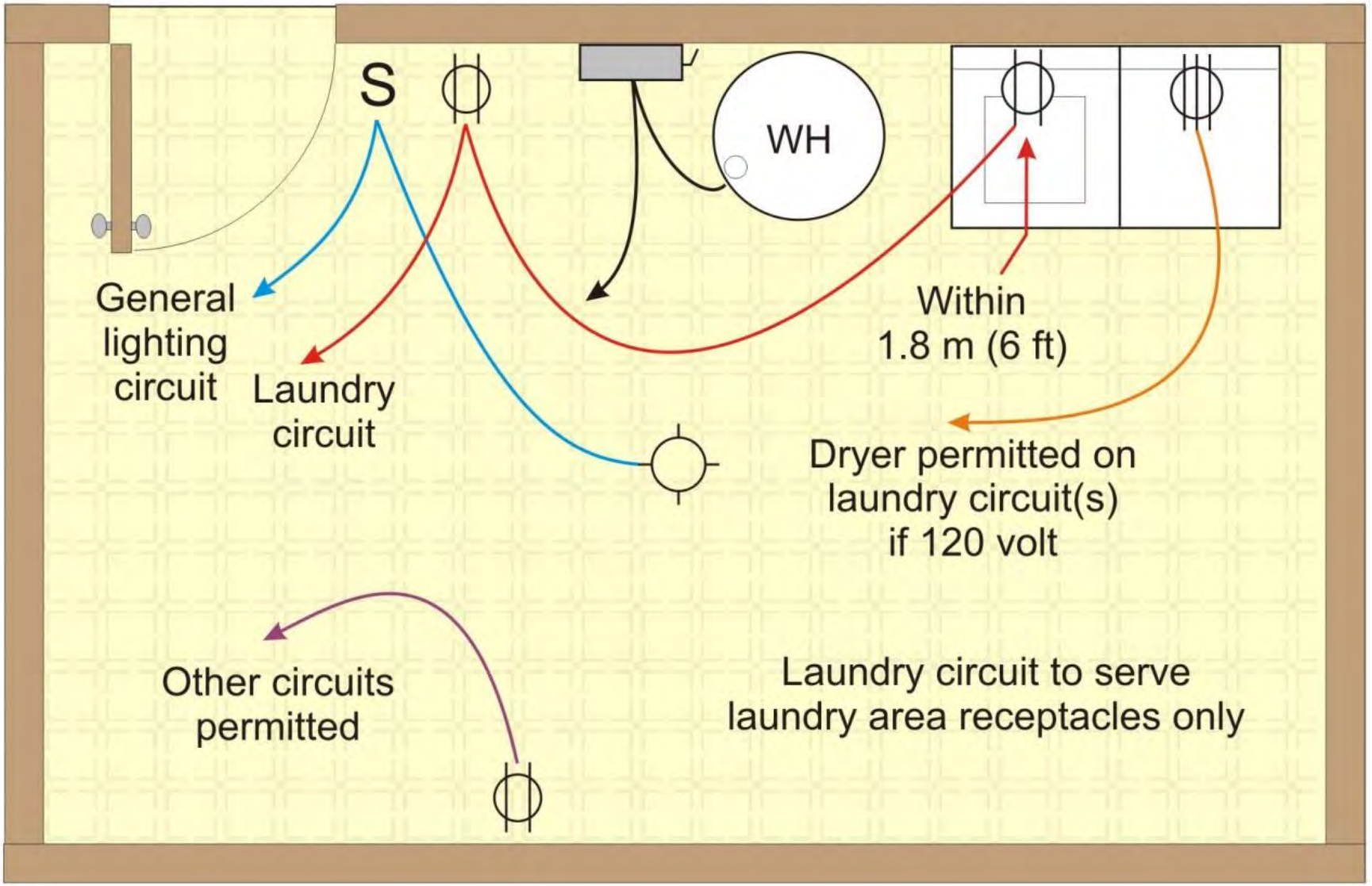
Outlet no longer required to be installed “within the perimeter of the balcony, deck or porch”

Laundry Circuit and Outlet(s)

- At least one receptacle outlet shall be installed in areas designated for the installation of laundry equipment *(exception for multifamily dwellings with laundry facilities)* [E3901.8]
- A 20-ampere branch circuit shall be provided to supply the laundry receptacle outlet(s) [E3703.3]
- This circuit shall have no other outlets
- Appliance receptacle outlet(s) installed for specific appliances *(such as laundry equipment)* must be installed within 1.8 m (6 ft) of the intended location of the appliance [E3901.5]

NEC 210.52(F), 210.11(C)(2), and 210.50(C)

E3901.8, E3901.5 Laundry Receptacle Outlet(s)



NEC 210.52(F), 210.50(C)

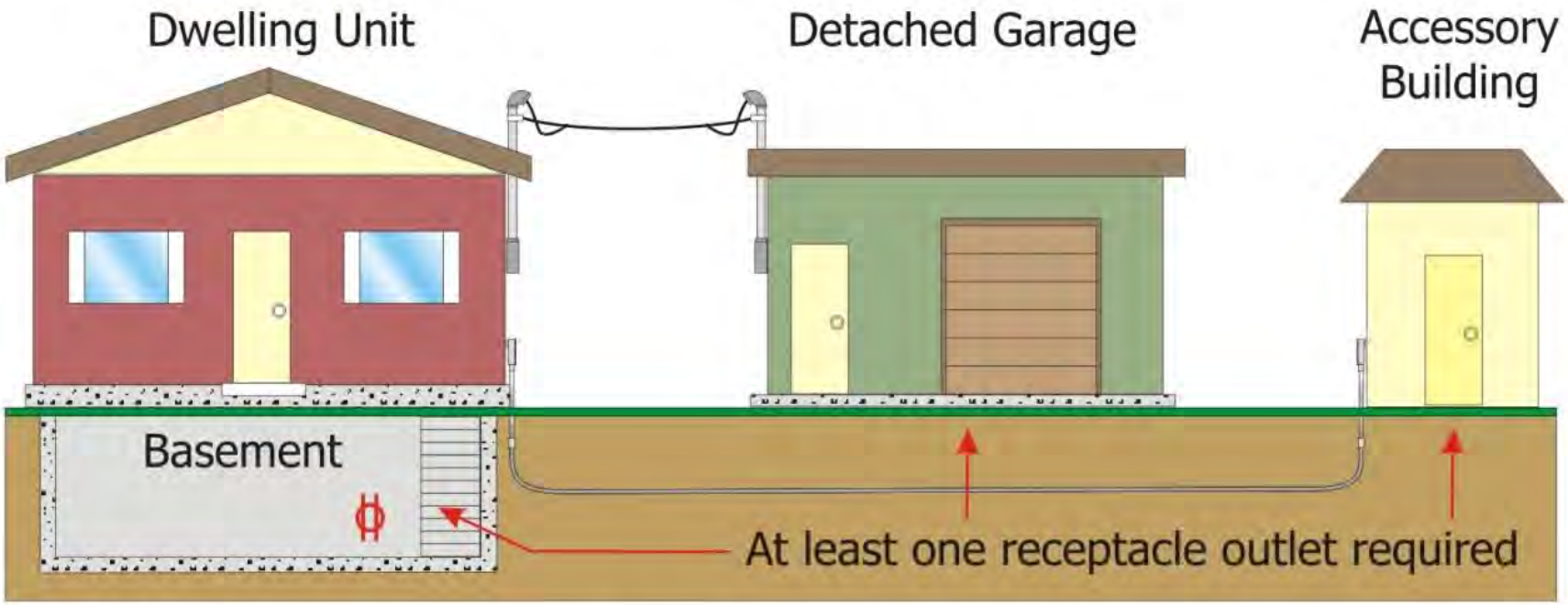

HN-12-2
10-3
CHARLOTTE PIPE S/A
NOT FOR PRESSURE

E3901.9 Basements, Garages, and Accessory Buildings

- At least one receptacle outlet shall be installed in the areas specified in 210.52(G)(1) through (3)
  - 210.52(G)(1) Garages
  - 210.52(G)(2) Accessory Buildings
  - 201.52(G)(3) Basements
- These receptacles shall be in addition to receptacles required for specific equipment
- Branch circuit supplying garage receptacle(s) **shall not supply outlets outside the garage**
- Receptacle required for **each car space** in a garage
- This is an effort to recognize the possibility of electric vehicle (EV) and plug-in hybrid electric vehicle (PHEV) charging in these garages

NEC 210.52(G)

E3901.9 Basements, Garages, and Accessory Buildings (with Power)



At least one 125-volt, 15- or 20-ampere receptacle outlet, in addition to those for specific equipment, shall be installed in areas specified below:

- Attached garages and in each detached garage with electric power *(see specifics for garages on next slide)*
- Accessory buildings with electric power
- Unfinished basements - each seperate portion of the basement

NEC 210.52(G)

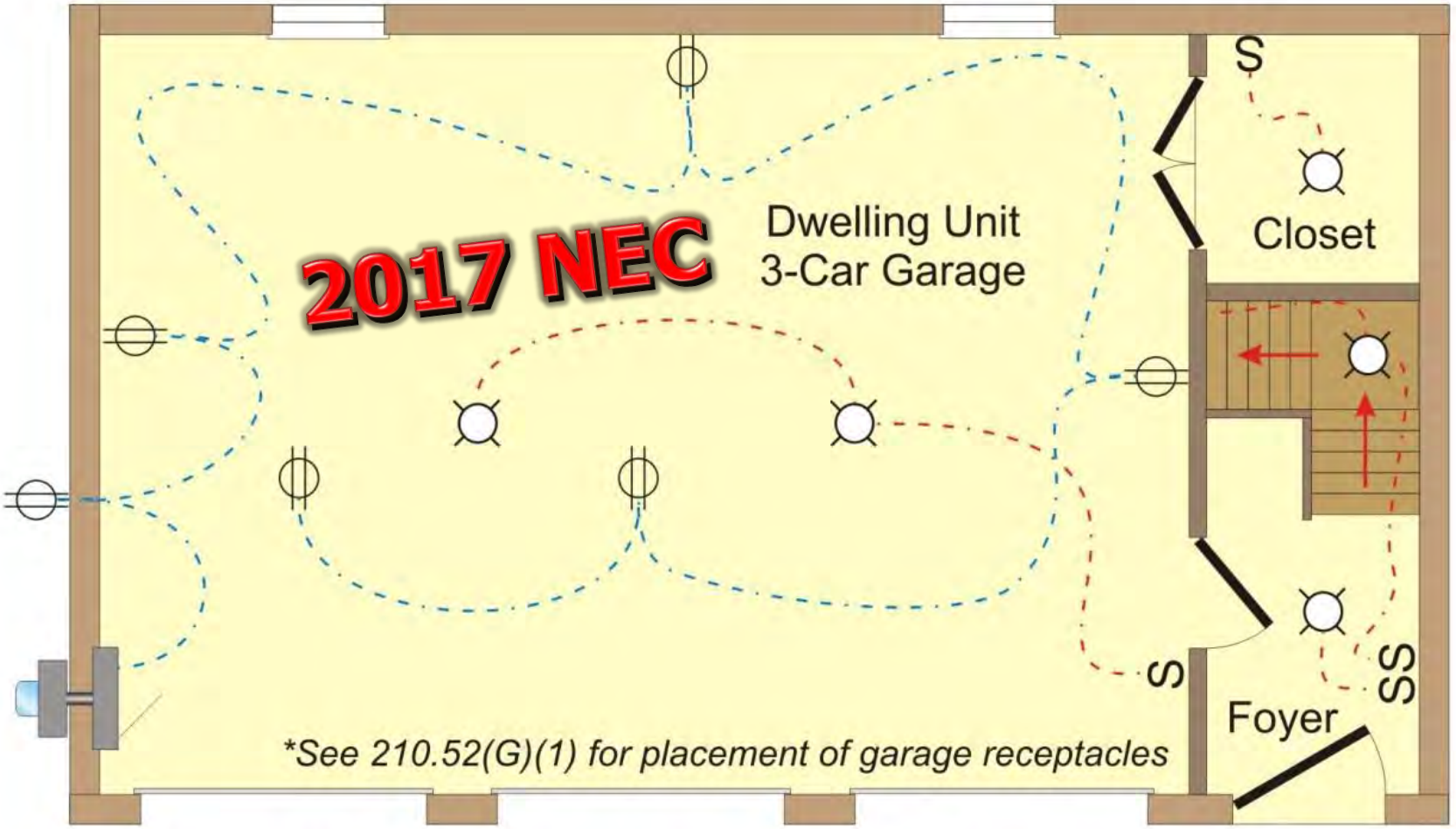
E3703.5 Garage Branch Circuits

New 2017 NEC

- New requirement added for minimum rated 120 volt, 20 ampere branch circuit for dwelling unit garage receptacles
- Garage receptacle outlet branch circuit prohibited from serving other outlets *(see exception)*
- Exception for readily accessible receptacles located outdoors
- 15 ampere rated branch circuit in the modern dwelling unit garage is typically not sufficient for appliance and tools rated at 12 to 16 amperes
- Lighting outlets in the dwelling unit garage required to be supplied by general lighting circuits

NEC 210.11(C)(4)

E3703.5 Garage Branch Circuits

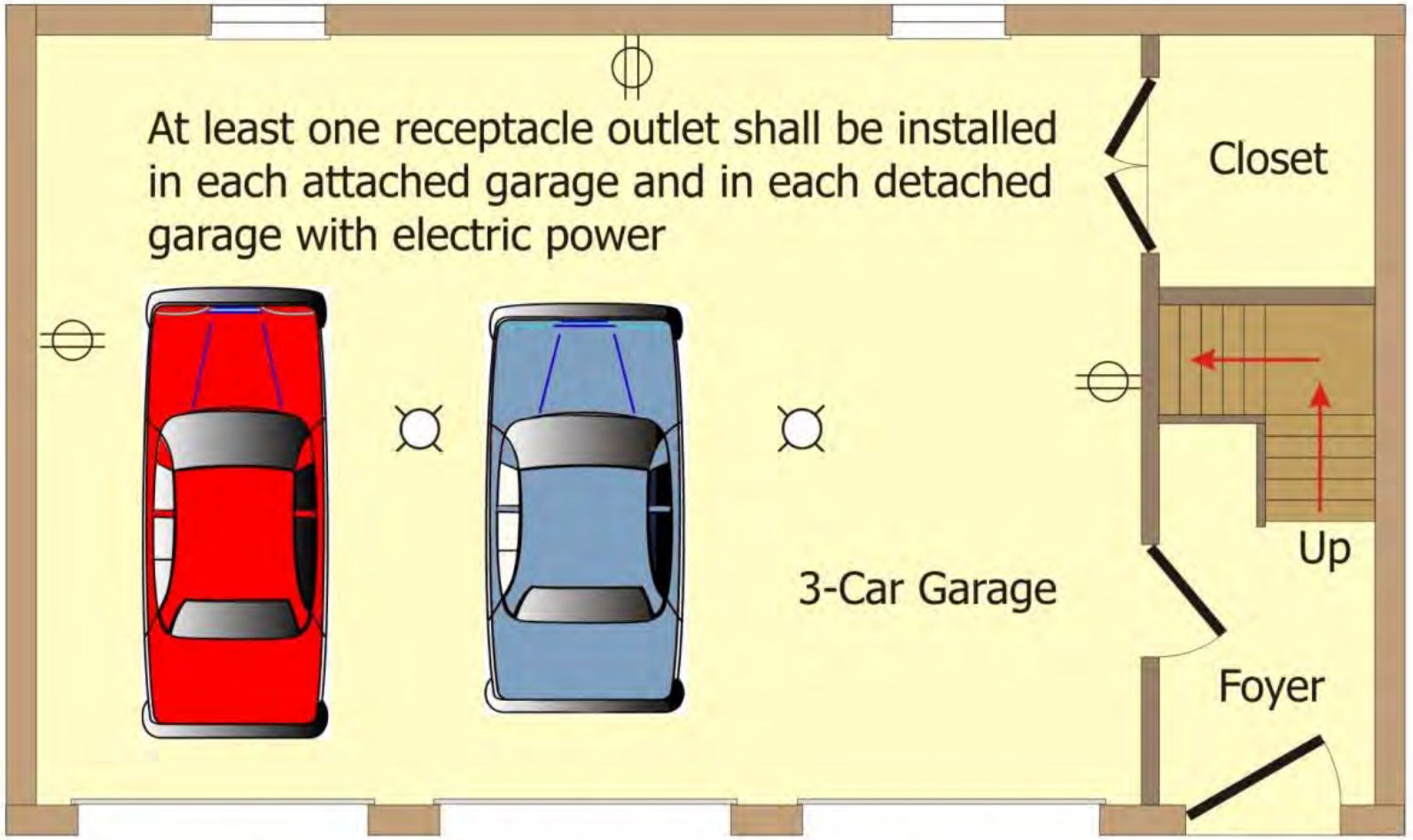


At least one 120-volt, 20-ampere branch circuit shall be installed to supply receptacle outlets in dwelling unit garages (no other outlets)

Exception permits supply of readily accessible outdoor receptacle outlets

NEC 210.11(C)(4)

E3901.9 Dwelling Unit Garages



The branch circuit supplying this receptacle(s) shall not supply outlets outside of the garage

At least one receptacle outlet shall be installed for each car space

NEC 210.52(G)(1)

E3901.9 Dwelling Unit Garages

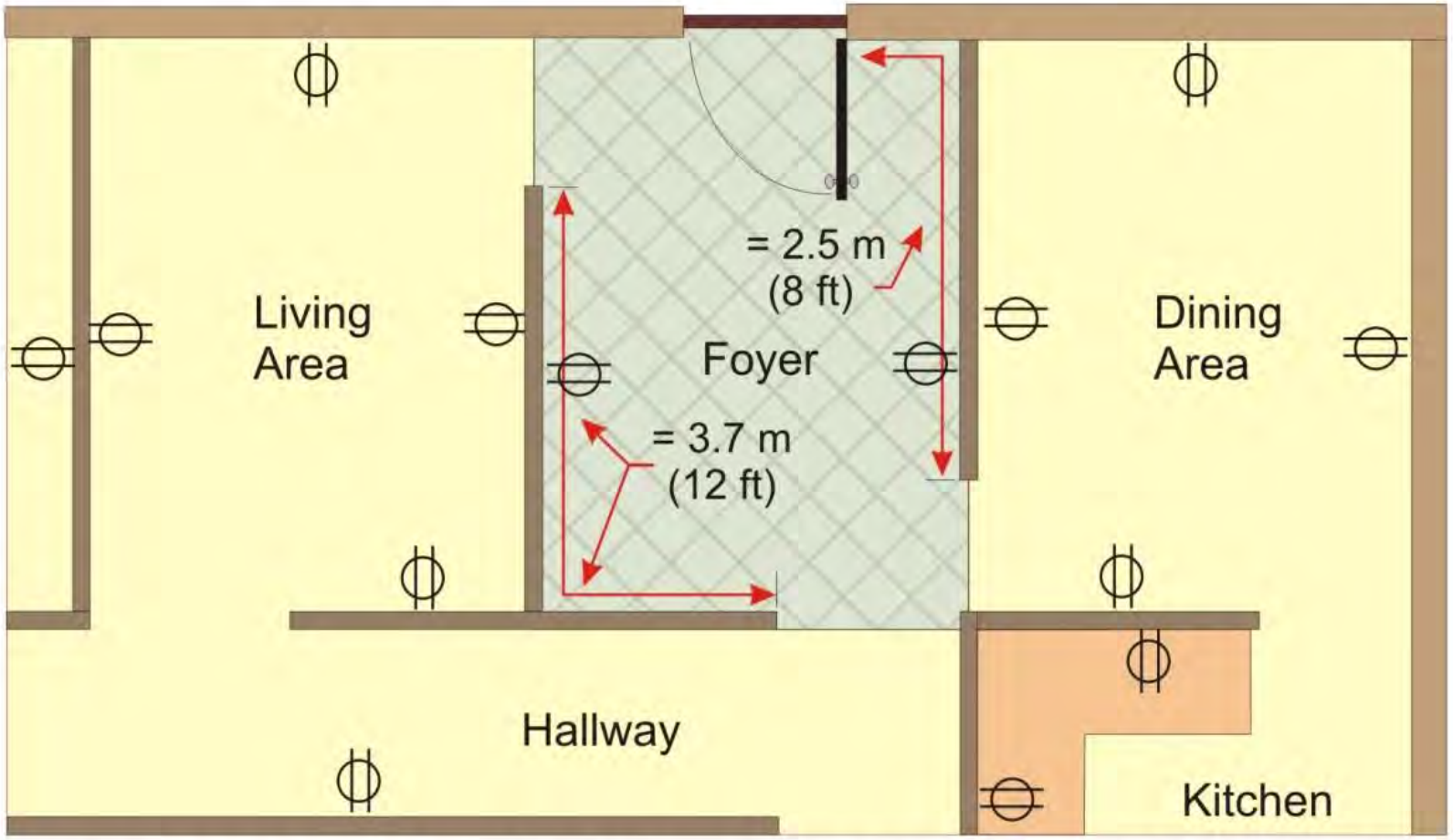
In each attached garage and in each detached garage with electric power, at least one receptacle outlet is required to be installed "in each vehicle bay and not more than 1.7 m (5½ ft) above the floor"

Note: *See 210.11(C)(4) for garage branch circuit requirements*

NEC 210.52(G)(1)


Hallway
Receptacle Outlet(s)

E3901.11 Foyers



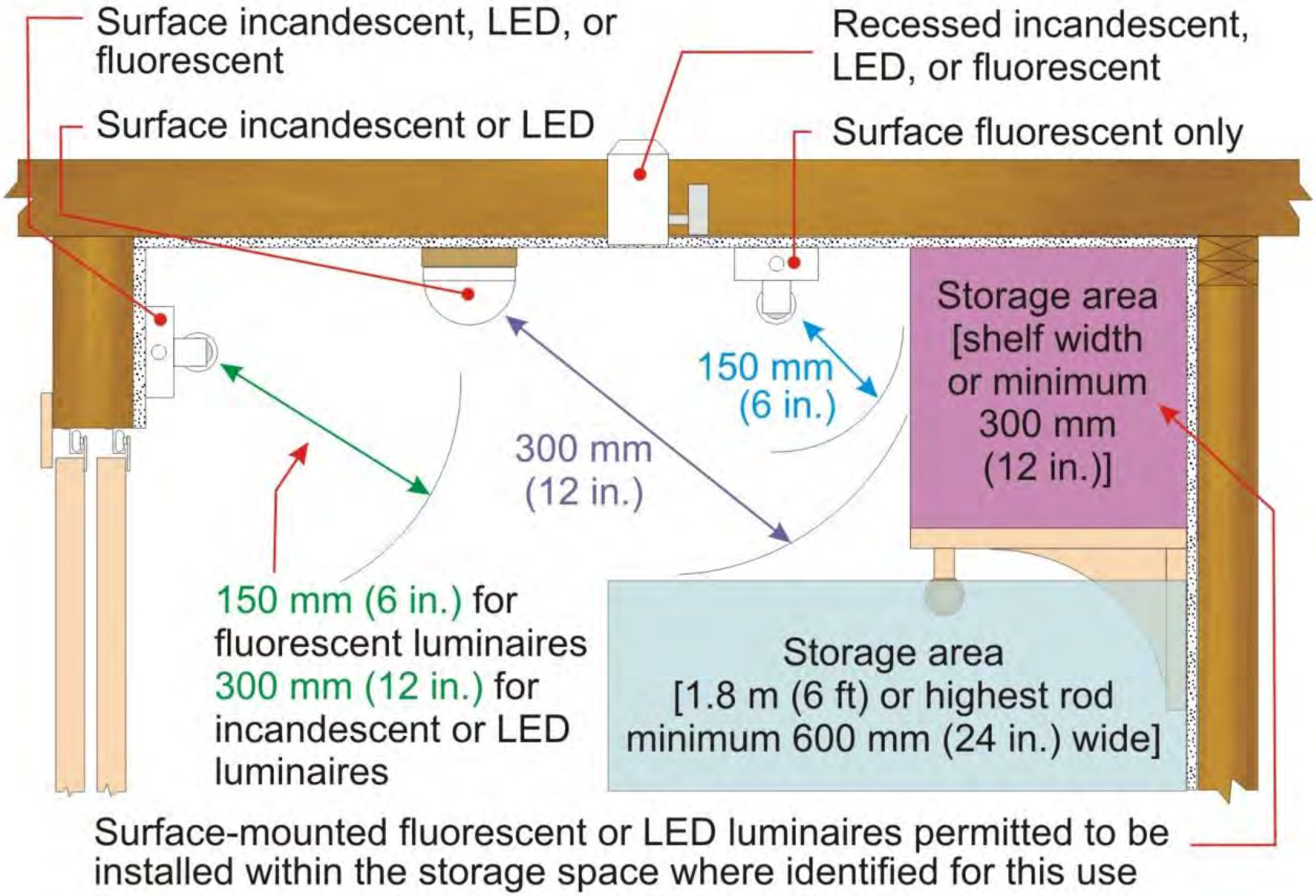
Foyers that are not part of a hallway having an area that is greater than 5.6 m^2 (60 ft^2) are required to have a receptacle(s) located in each wall space 900 mm (3 ft) or more in width

Doorways, door-side windows that extend to the floor, and similar openings shall not be considered wall space

NEC 210.52(I)

Lighting in Clothes Closets for Dwelling Units

E4003.12 Luminaire Clearances in Clothes Closets

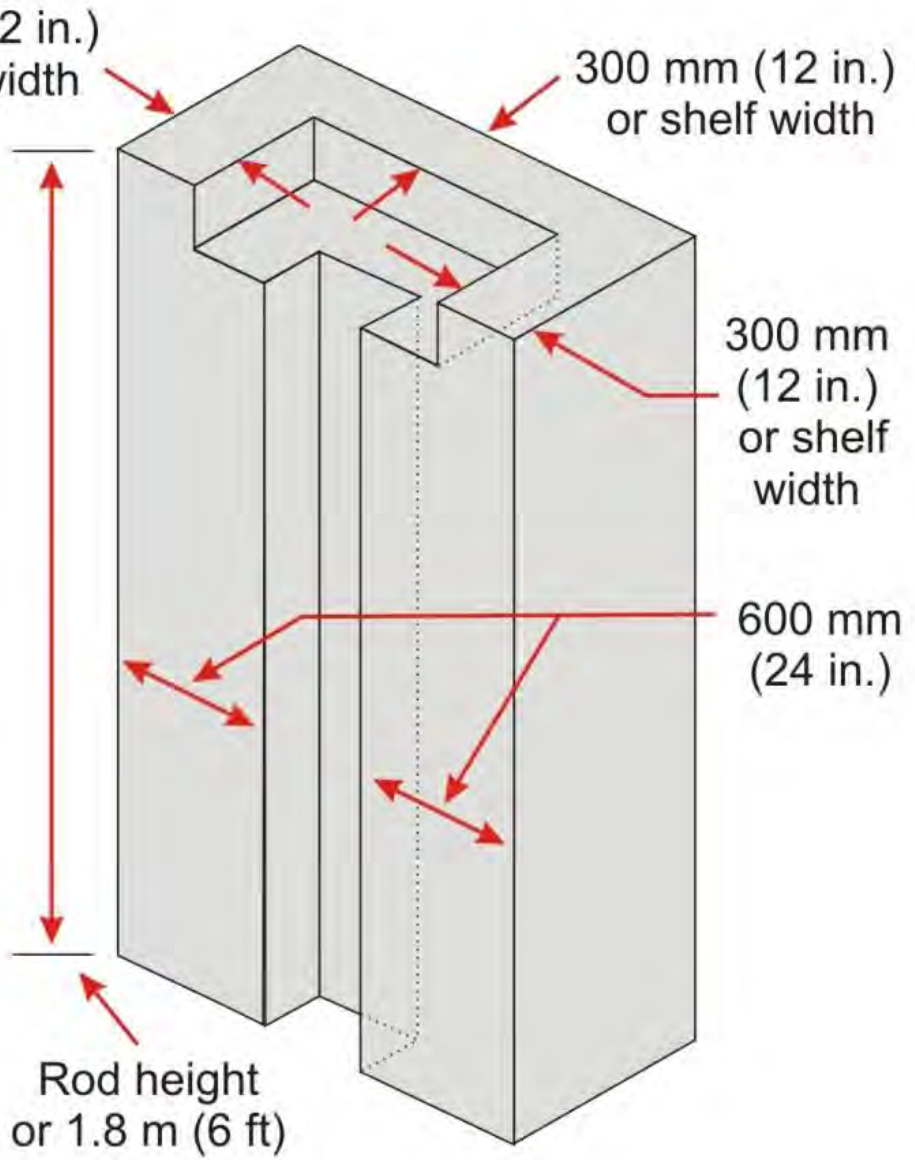


NEC 410.16

E4003.12 Definition: Closet Storage Space

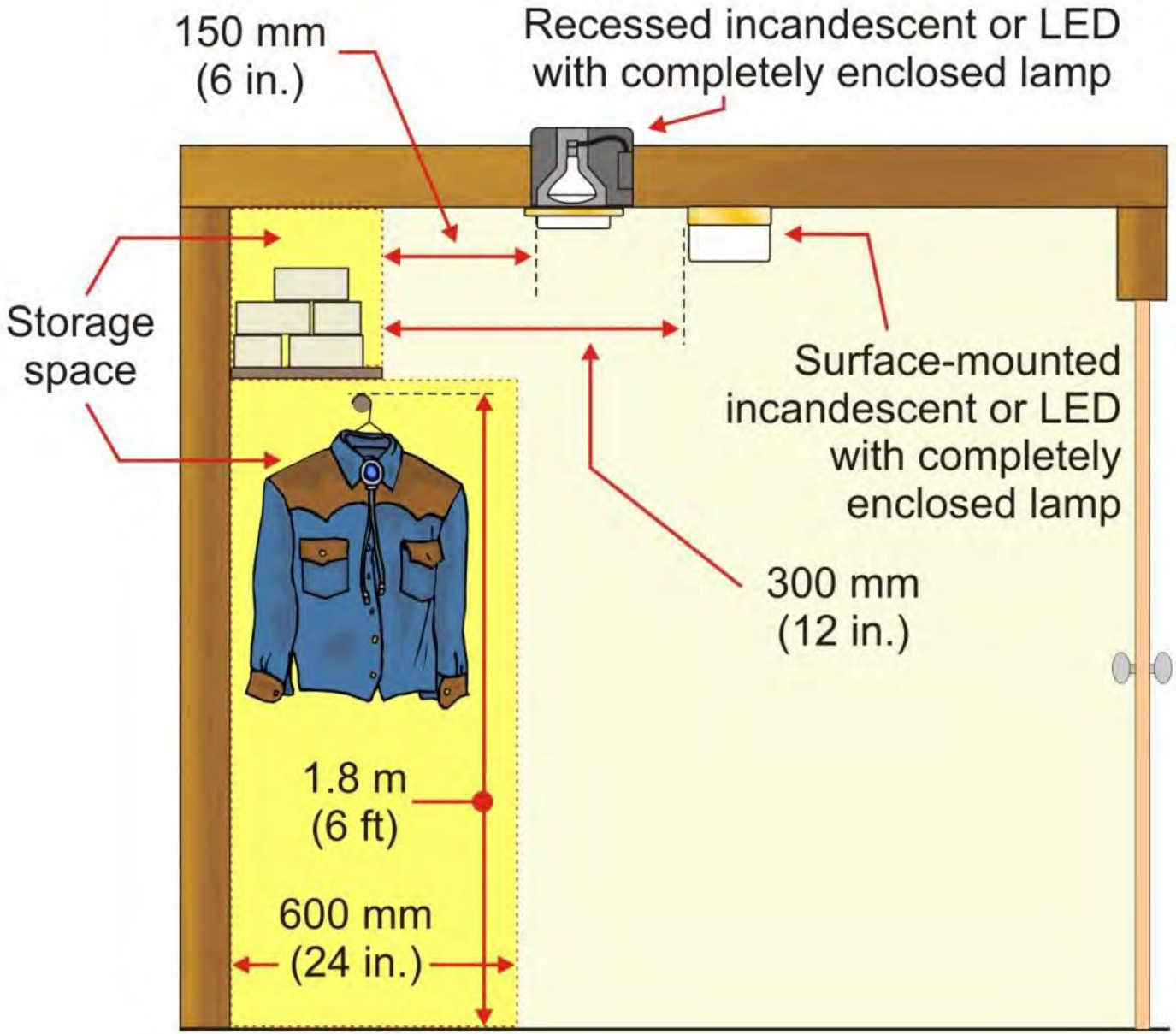
Closet Storage Space. The volume bounded by the sides and back closet walls and planes extending from the closet floor vertically to a height of 1.8 m (6 ft) or to the highest clothes-hanging rod and parallel to the walls at a horizontal distance of 600 mm (24 in.) from the sides and back of the closet walls, respectively, and continuing vertically to the closet ceiling parallel to the walls at a horizontal distance of 300 mm (12 in.) or the width of the shelf, whichever is greater; for a closet that permits access to both sides of a hanging rod, this space includes the volume below the highest rod extending 300 mm (12 in.) on either side of the rod on a plane horizontal to the floor extending the entire length of the rod.

Reproduction of NEC Figure 410.2



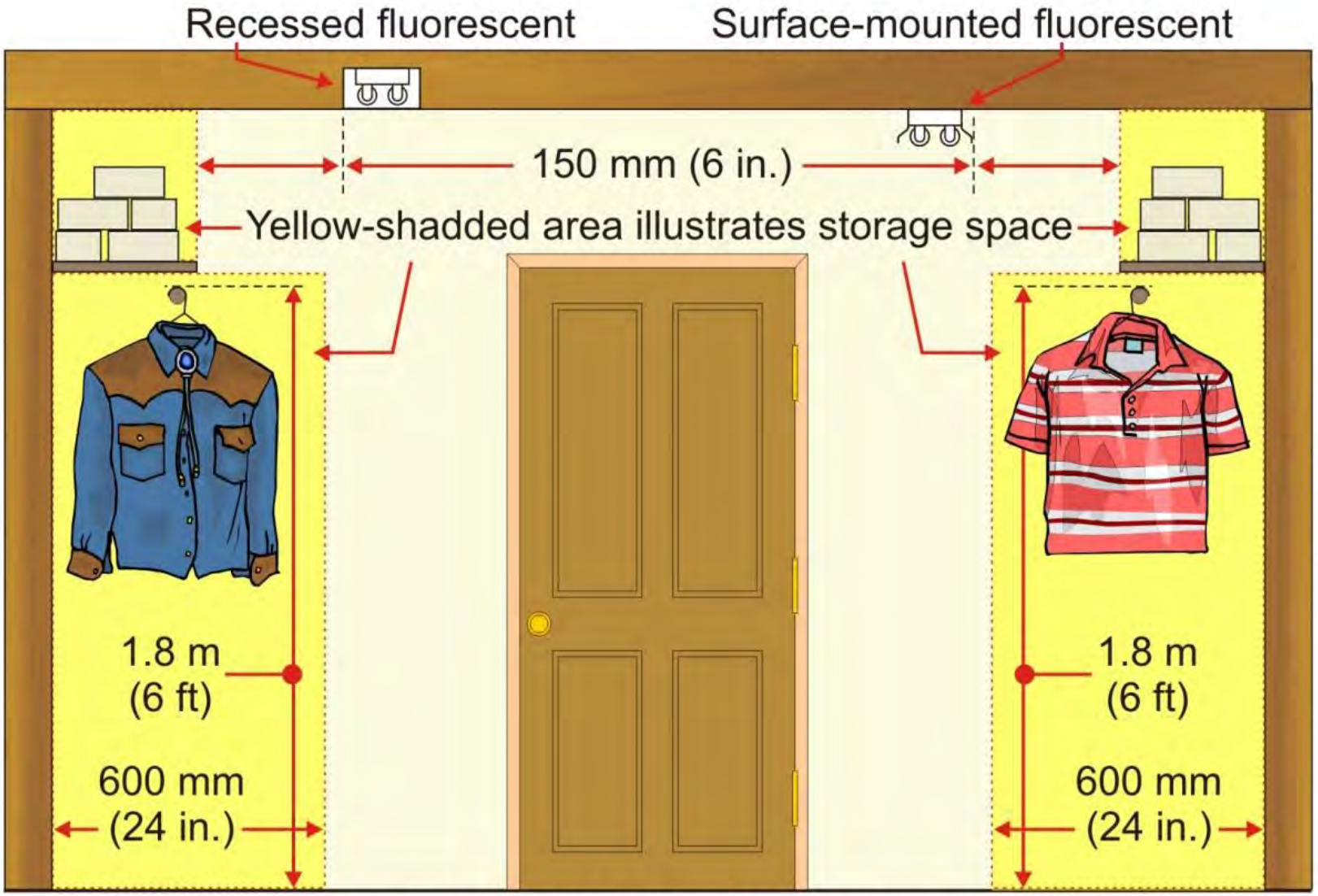
NEC 410.2 & Figure 410.2

E4003.12 Incandescent or LED Luminaires



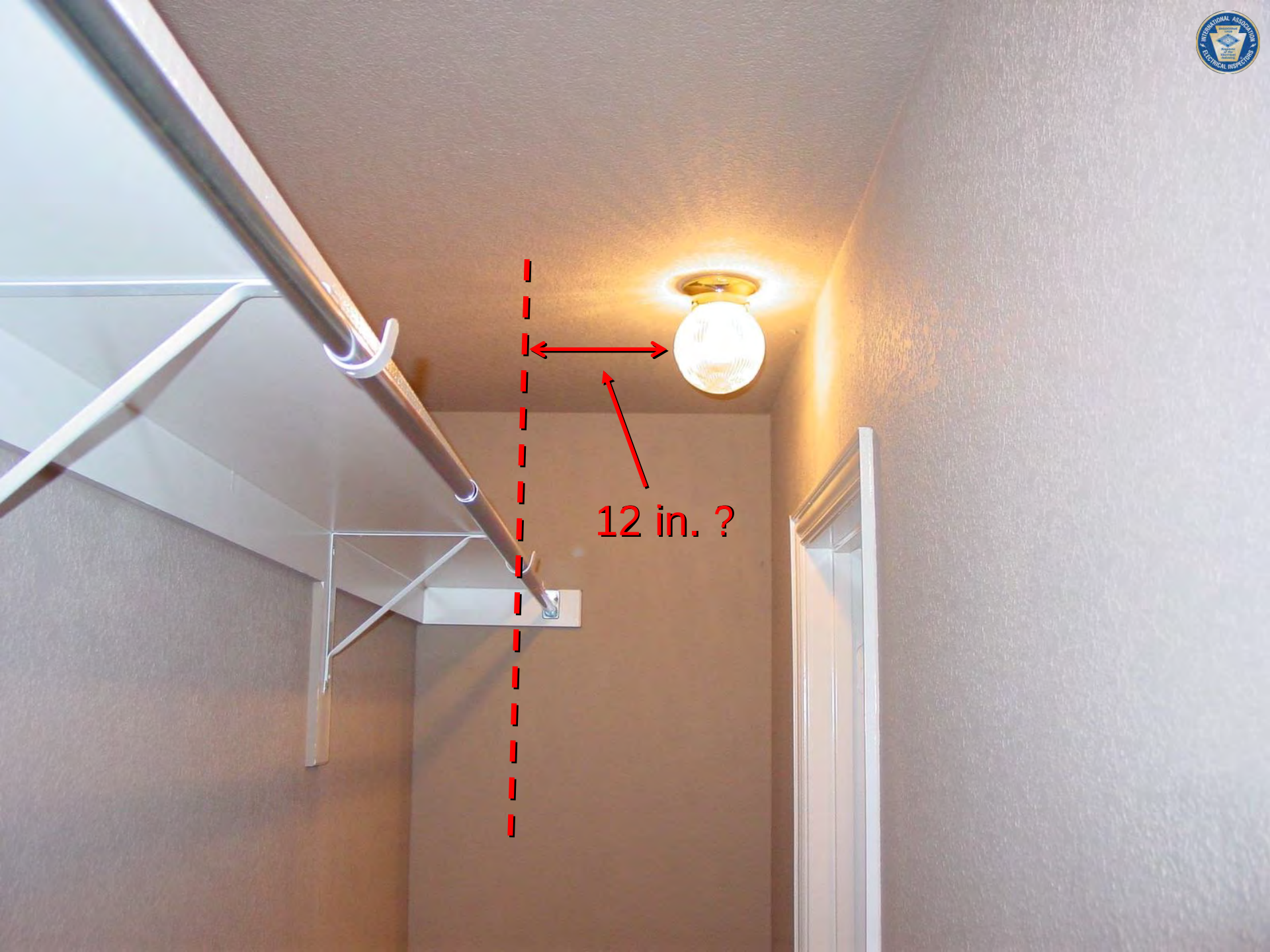
NEC 410.16(C)

E4003.12 Fluorescent Luminaires

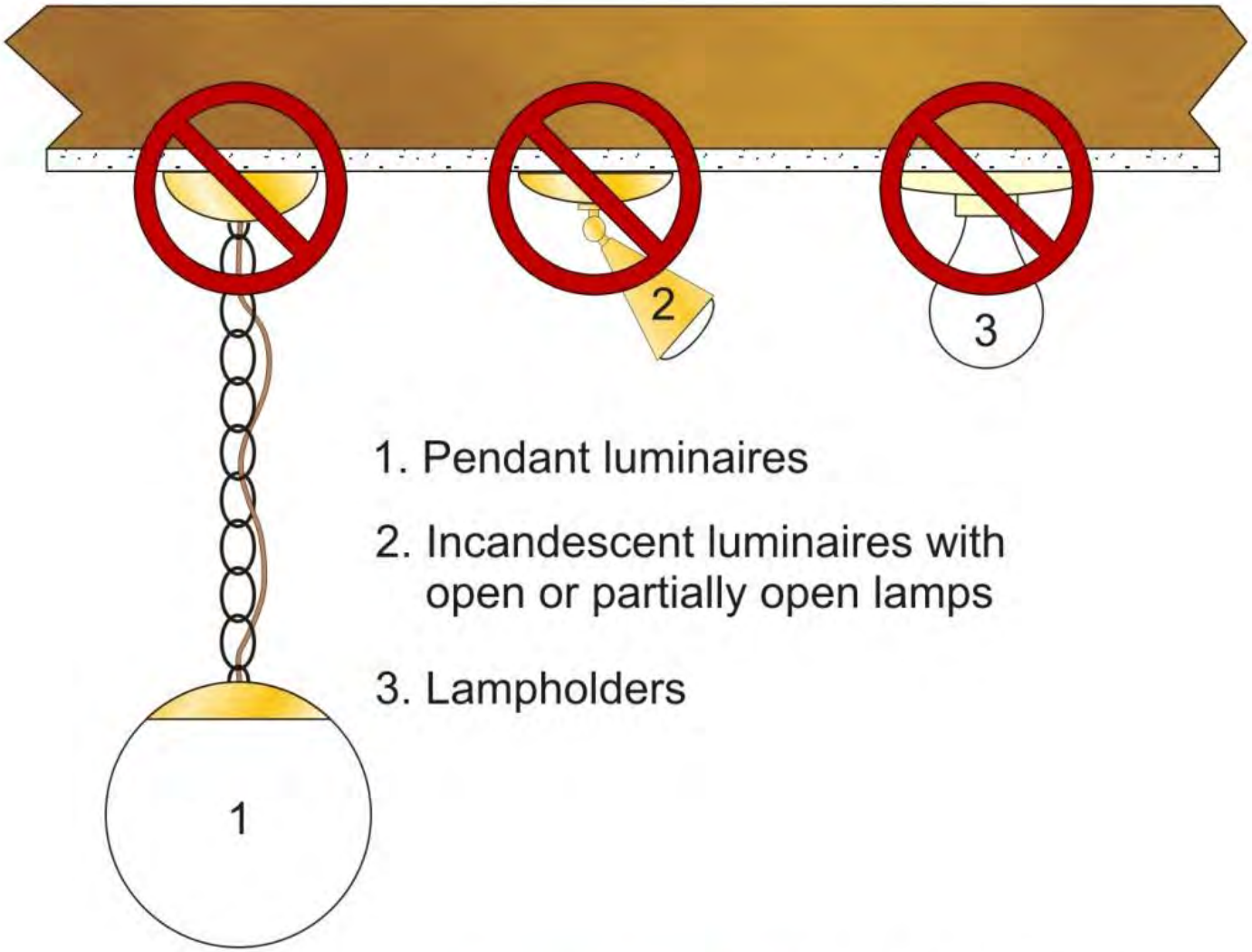


Surface-mounted fluorescent or LED luminaires permitted to be installed within the storage space where identified for such use

NEC 410.16(C)


12 in. ?

E4003.12 Luminaires Not Permitted in Closets



1. Pendant luminaires
2. Incandescent luminaires with open or partially open lamps
3. Lampholders

Luminaire types not permitted in clothes closets

NEC 410.16(B)

One- and Two Family Dwelling Electrical Systems – 2018 IRC

Training Presentation by:

International Association of Electrical Inspectors

ICC 2019
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Thank You For Attending

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