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Outlet Branch Circuit Arc-Fault Circuit Interrupter
AFCI receptacle

Outlet Branch Circuit Arc-Fault Circuit Interrupters

Introduction

Now that Outlet Branch Circuit Arc-Fault Circuit Interrupters (OBC AFCIs) are available on the market, let's review the National Electrical Code® (NEC®) requirements governing their use in dwelling unit branch circuits. This review will cover the requirements in the 2005, 2008 and 2011 editions of the NEC. (See the Electrical Shortz titled *What's New in the 2014 NEC: Arc-Fault Circuit Interrupters*, 0760DB1401, for the requirements in the 2014 edition of the NEC.) The requirements in the 2011 NEC can be summarized as follows:

New construction: The home run feeding an OBC AFCI located at the first outlet must be in a steel wiring method with steel junction and outlet boxes used, or run in conduit or tubing encased in at least 2 in. of concrete, regardless of the type of home construction (stick built, mobile or manufactured).

Extensions or modifications: An OBC AFCI may be used without restriction.

Receptacle replacements: An OBC AFCI may be used without restriction.

An OBC AFCI is a wiring device, somewhat similar in appearance to that of a receptacle type GFCI, which is listed to the UL 1699A Outline of Investigation for Outlet Branch Circuit Arc-Fault Circuit-Interrupters.

Fundamental NEC Requirements

Arc-Fault Circuit Interrupters (AFCIs) are required in many different dwelling unit branch circuits. Article 100 defines a dwelling unit as:

Dwelling Unit - A single unit, providing complete and independent living facilities for one or more persons, including permanent provisions for living, sleeping, cooking, and sanitation.

The fundamental location requirements for AFCIs are found in Section 210.12(A). The requirements in the 2011 edition are as follows:

(A) Dwelling Units - All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets installed in dwelling unit family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas shall be protected by a listed arc-fault circuit interrupter, combination-type installed to provide protection of the branch circuit.

Since the 1999 edition first required the use of AFCIs, effective January 1, 2002, they have been provided in the form of UL 489 listed circuit breakers also listed to UL 1699, the Underwriters Laboratories Standard for Arc-Fault Circuit Interrupters.

NEC OBC AFCI Requirements

The requirements in the 2005 edition were stated in the form of an exception to Section 210.12(B):

Exception: The location of the arc-fault circuit interrupter shall be permitted to be at other than the origination of the branch circuit in compliance with (a) and (b):

- a. The arc-fault circuit interrupter installed within 6 ft. (1.8 m) of the branch circuit overcurrent device as measured along the branch circuit conductors.
- b. The circuit conductors between the branch circuit overcurrent device and the arc-fault circuit interrupter shall be installed in a metal raceway or a cable with a metallic sheath.

The exception to Section 210.12(B) in the 2008 edition was rewritten and expanded to provide more flexibility for installers:

Exception No. 1: Where RMC, IMC, EMT or steel armored cable, Type AC, meeting the requirements of 250.118 using metal outlet and junction boxes is installed for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a combination AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

The exception, now to Section 210.12(A), was rewritten and expanded once again in the 2011 edition:

Exception No. 1: If RMC, IMC, EMT, Type MC, or steel armored Type AC cables meeting the requirements of 250.118 and metal outlet and junction boxes are installed for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install an outlet branch-circuit type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

Exception No. 2: Where a listed metal or nonmetallic conduit or tubing is encased in not less than 2 in. (50 mm) of concrete for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install an outlet branch-circuit type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

The code panel recognizes that placing the home run in steel conduit serves three key functions:

1. The conduit protects the wire from physical damage such as a nail or screw damaging the insulation of the conductors.
2. Any arcing fault due to a damaged conductor is contained with the raceway, not exposing it as an ignition source
3. The metal raceway serves as a ground path to facilitate opening the circuit breaker faster, protecting against any further fault hazard.

Use of OBC AFCIs in New Construction

2011 NEC 210.12(A) Exception No. 1 permits the use of an OBC AFCI in the branch circuits serving the specified areas if the wiring between the overcurrent device (circuit breaker) and the first outlet is RMC, IMC, EMT, Type MC, or steel armored Type AC cable meeting the requirements of Section 250.118. This portion of a branch circuit is typically referred to as the "home run". It also requires that metal outlet and junction boxes be installed in the home run. Type NM cable and plastic outlet and junction boxes may be used downstream from the OBC AFCI.

Section 210.12(A) Exception No. 2 permits the use of an OBC AFCI if the home run is installed in listed metal or nonmetallic conduit or tubing if the conduit or tubing is encased in not less than 2 inches of concrete.

In order to fully understand these new exceptions, we need to understand how the NEC defines an outlet. According to Article 100 an outlet is defined as: "A point on the wiring system at which current is taken to supply utilization equipment". In other words, an outlet may be a receptacle, or it may also be a luminary (lighting fixture) or some other type of utilization equipment. This means that the home run must terminate in an OBC AFCI before it feeds any type of utilization equipment.

Use of AFCIs in Branch Circuit Extensions or Modifications

A new requirement regarding the extension or modification of branch circuits serving specific areas was added to Section 210.12 in the 2011 edition:

(B) Branch Circuit Extensions or Modifications — Dwelling Units. In any of the areas specified in 210.12(A), where branch-circuit wiring is modified, replaced, or extended, the branch circuit shall be protected by one of the following:

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

Note that steel or concrete encased wiring methods are not required for the use of OBC AFCIs in extensions or modifications.

The code panel recognizes that in the case of a branch circuit extension, it could be an extra hardship to require the protection of the entire already installed branch circuit; therefore, protecting the addition of the branch circuit was the focus.

Receptacle Replacements

A new requirement was also added in the 2011 edition regarding the replacement of receptacles, effective January 1, 2014.

406.4 General Installation Requirements

(D) Replacements.

(4) Arc-Fault Circuit-Interrupter Protection. Where a receptacle outlet is supplied by a branch circuit that requires arc-fault circuit interrupter protection as specified elsewhere in this Code, a replacement receptacle at this outlet shall be one of the following:

1. A listed outlet branch circuit type arc-fault circuit interrupter receptacle.
2. A receptacle protected by a listed outlet branch circuit type arc-fault circuit interrupter type receptacle.
3. A receptacle protected by a listed combination type arc-fault circuit interrupter type circuit breaker.

This requirement becomes effective January 1, 2014.

Mobile and Manufactured Homes

AFCI protection of bedroom branch circuits in mobile and manufactured homes has been required by since the 2002 edition. Section 550.25 was revised in the 2011 edition to require compliance with Section 210.12.

550.25 Arc-Fault Circuit-Interrupter Protection

(A) Definition- Arc-fault circuit interrupters are defined in Article 100.

(B) Mobile homes and manufactured homes - All 120-volt branch circuits that supply 15- and 20-ampere outlets installed in family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas of mobile homes and manufactured homes shall comply with 210.12.

Summary

The requirements for use of OBC AFCIs in the 2011 NEC can be summarized as follows:

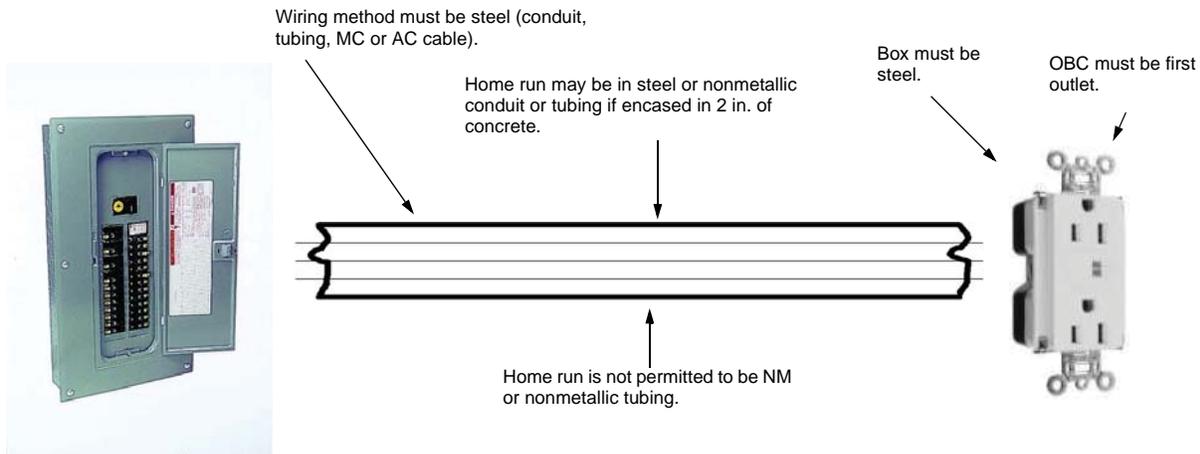
New construction: The home run feeding an OBC AFCI located at the first outlet must be in a steel wiring method, with steel junction and outlet boxes used, or run in conduit or tubing encased in at least 2 inches of concrete, regardless of the type of home construction (stick built, mobile or manufactured). See Figure 1.

Extensions or modifications: An OBC AFCI may be used without restriction.

Receptacle replacements: An OBC AFCI may be used without restriction.

See the Electrical Shortz titled *What's New in the 2014 NEC: Arc-Fault Circuit Interrupters*, 0760DB1401, for the requirements in the 2014 edition of the NEC.

Figure 1: 2011 NEC Requirements for Using an OBC AFCI in New Construction



For More Information

NFPA 70 National Electrical Code; 2005, 2008 and 2011 editions.

What's New in the 2014 NEC: Arc-Fault Circuit Interrupters, 0760DB1401

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