

Arc Fault Circuit Interrupters

A new electrical safety device, the Arc Fault Circuit Interrupter (AFCI) will be required starting January 1, 2002 for dwelling unit bedroom receptacle branch circuits by the 1999 National Electrical Code (NEC). What possible public safety applications are there for the AFCI? Will the eventual use of the AFCI parallel that of the GFCI since its introduction in the 1968 NEC?

History

The Consumer Product Safety Commission indicates that electrical fires cause more than 40,000 residential fires and a loss of more than 350 lives annually. Arc fault detection has been identified as a promising new technology by the Consumer Product Safety Commission. Substantiation for the 1999 NEC proposal that added the AFCI requirement indicated that 40 percent of residential fires can be attributed to arcing faults. Based on the technology to protect the areas near downed power lines, AFCI's were developed using miniature electronics technology to fit inside a molded case circuit breaker package. AFCI's have been commercially available from several manufacturers for several years. The product is very similar in appearance to a Ground Fault Circuit Interrupter (GFCI) circuit breaker.

How it Works

Using the unique current and or voltage signatures from an arcing fault, an AFCI detects arcing faults, and then trips to deenergize the circuit. Common arcing faults are those from pierced insulation on non-metallic sheathed cable (Romex), damaged extension cords, overheated cords, aged cords or internal appliance wiring. A molded case circuit breaker only protects against overloads and short circuits, not arcing faults. A 20 ampere inverse time circuit breaker will carry 20 amperes indefinitely, and at 40 amperes it will trip in approximately 30 seconds. Instantaneous tripping will occur above approximately 125 amperes. The molded case circuit breaker is not designed to detect arcing faults. There are three types of arcing faults common to household wiring:

Parallel: Direct contact of two wires or opposite polarity

Ground: An arc between on conductor and ground

Series: An arc across a break in a conductor.

The AFCI is designed not to trip due to common arcs from a light switch or similar device.

NEC Implementation

The 1999 NEC in Section 210-12. Arc-Fault Circuit Interrupter Protection has the following requirements:

(a) Definition. An arc-fault circuit interrupter is a device intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and by functioning to de-energize the circuit when an arc fault is detected.

(b) Dwelling Unit Bedrooms. All branch circuits that supply 125-volt, single-phase, 15- and 20-ampere receptacle circuits installed in dwelling unit bedrooms shall be protected by an arc-fault circuit interrupter(s). This requirement shall become effective January 1, 2002.

The requirement for “branch circuit...receptacle circuits” can only be met by an arc fault circuit breaker device supplying the entire branch circuit. The Code Making Panel (CMP) selected January 1, 2002 to allow additional comments during the 2002 code revision cycle. The CMP felt the greatest hazard was in dwelling unit bedrooms and that was a good place to start. If we look at the implementation of the GFCI since its first requirement for use in the 1968 NEC, subsequent code cycles have increased the requirements so that a typical single family dwelling will have 5 to 7 GFCI’s, and the price has dropped from \$30 to \$7 for a receptacle device. It’s possible the AFCI will have the same increased requirement for use in future code cycles. There were many proposals in the 2002 code for receptacle type AFCI’s from receptacle manufacturers but they were all rejected. The current proposal for the 2002 NEC requires AFCI’s for all bedroom branch circuit outlets, not just the receptacle circuits. Note that outlets will include the smoke detector outlet.

AFCI Product Availability

AFCI’s have been available from the major circuit breaker manufacturers for several years. They are available in single and double pole types, in 15 and 20 ampere ratings, at 120/240 Volts. Prices range from \$30 to \$70 for a single pole device. One manufacture has a combination AFCI/GFCI in development.

Applications

There will be numerous applications of the AFCI as the industry becomes more familiar with the product. One on-going application is the protection of aircraft wiring against arcing faults. Eaton Corporation has a two-year contract with the Federal Aviation Administration and the US Navy for \$1 million to adapt the its AFCI technology for aircraft use. Navy studies show 64 in flight electrical fires between July 1995 and December 1997, of which 80 to 90% would have been prevent by AFCI protection, according to Charles Singer, lead project engineer for arc fault circuit-breaker development for the Naval Air Systems Command.¹

Application of AFCI for outdoor decorative lighting is one application that may be required by the 2002 NEC if the proposal is adopted by the CMP. Much of the decorative lighting is imported and not suitable for long term use (see illustration). This application could be best served by a combination AFCI/GFCI. The AFCI would protect against arcing faults, and the GFCI would provide for personnel shock protection.

AFCI’s are available now in manufacturers stock. The application of AFCI’s for other than “dwelling unit bedrooms” remains only for someone to see a public safety application and try one. If you have an application and try an AFCI, contact me at tom@psetraining.com and let me know the results

¹ Design News Online, 09/04/01



Damaged Cord Connector

This damaged female cord connector was used to supply decorative holiday lighting. The cord connector supply circuit was protected by a 120 volt 20 ampere GFCI circuit breaker, clearly demonstrating that a GFCI offers no protection against arcing faults.

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