Expanding Home Safety With AFCIs

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Smoke alarms, fire extinguishers, emergency escape ladders — these are all proven methods for making a quick and safe escape from a fire in the home. However, in addition to these measures, proven technology exists to prevent fires from starting in the first place. Arc-fault
circuit interrupters (AFCIs) — the next generation in circuit breaker technology — are one such life-saving tool that should be considered by home owners and home builders alike.

In fact, the *National Electrical Code (NEC),* which contains a requirement for AFCIs since the 1999 edition, has since strengthened its support in the technology. Beginning in January 2008, the next edition of the *NEC* will take effect, expanding the AFCI requirement from only in the bedroom to now being required in occupied areas such as living rooms, dining rooms and other areas where the technology may help improve the safety of the home.

Many prominent experts in the electrical and home building community believe this expanded requirement will have a significant, positive impact on homeowner safety, and decrease the number of lives lost and injuries that occur in home electrical fires.

Advanced AFCI technology was developed in response to an identified problem in the electrical system with causing home fires. According to the latest reports from the United States Fire Administration (USFA), electrical problems spark an estimated 67,800 residential fires every year. These fires are responsible for the deaths of 485 innocent victims, approximately 2,300 injuries and more than $868 million in residential property damage. *(See reference 1.)*

The United States Consumer Products Safety Commission (CPSC) estimates that AFCI technology could prevent more than 50 percent of these types of fires,*(See reference 2)* and the U.S. Department of Housing and Urban Development (HUD) *(See reference 3)* lists AFCI technology as a key device in preventing burns and fire-related
injuries.

Photo 1. The Consumer Product Safety Commission (CPSC) estimates that AFCI circuit breakers could prevent 50-75 percent of electrical fires, and

the U.S. Department of Housing and Urban Development lists the technology as a key device in preventing burns and fire-related injuries.

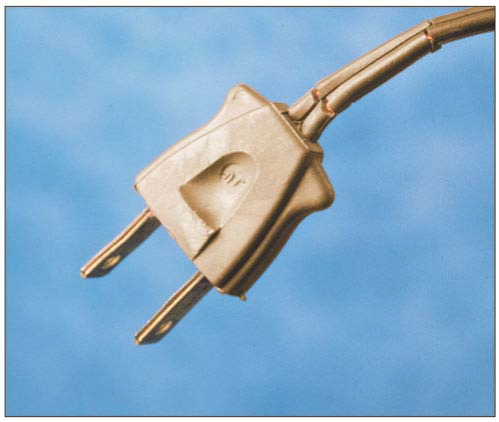
A technological leap forward

Unlike a conventional circuit breaker, which detects overloads and short circuits, an AFCI utilizes advanced electronic technology to "sense" different arcing conditions. Specifically, AFCIs provide increased protection by detecting a condition known as an arc fault, which is defined by Underwriters Laboratories, Inc. (UL), an independent, product-safety certification organization, as an unintentional arcing condition in a circuit.

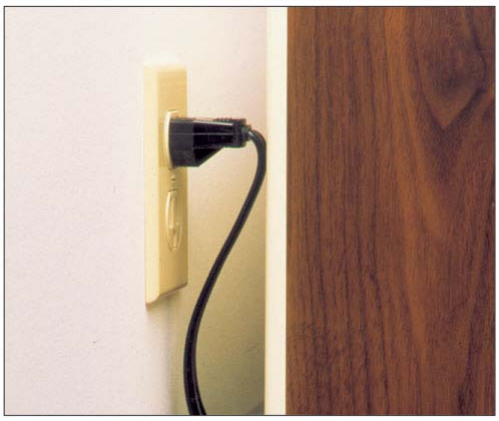
Common household items, such as a motor-driven vacuum cleaner and the motor in a furnace, naturally create arcs when they are operating. These conditions are considered normal arcs, which can also occur when a light switch is turned off.

Arc faults, however, occur from damaged wiring, overheated or stressed electrical cords, worn electrical insulation, wires and/or cords in contact with vibrating metal, damaged electrical appliances and more. This potentially dangerous condition creates high-intensity heat — which may exceed 10,000 degrees Fahrenheit — resulting in burning particles that can easily ignite surrounding material, such as wood framing or insulation.

AFCIs are designed to recognize when arc faults occur and automatically shut the circuit down before it becomes a fire hazard. Manufacturers of AFCIs test for the hundreds of possible operating conditions and design each AFCI to constantly discern between normal and dangerous arcs.



Photos 2-6, at left and below: AFCIs provide increased protection by detecting a condition known as an arc fault, which can occur from damaged wiring, overheated or stressed electrical codes, worn electrical insulation, wires and/or cords in contact with vibrating metal, damaged electrical appliances and more.



Types of Arc-Fault Circuit Interrupters

AFCIs are intended to mitigate the effects of arc faults by de-energizing the circuit when an arc fault is detected. In 1996, Underwriters Laboratories, Inc. published UL 1699 — the recognized national standard for AFCIs.

UL 1699 covers a wide variety of conditions that may affect AFCI performance, including humidity, unwanted tripping, abnormal operation, voltage surges and more. Each type of AFCI is required to comply with UL 1699.

Two types of AFCIs are available — branch/feeder and combination. Both types are intended to be installed at the origin of a branch circuit or feeder, such as a panelboard or load center. The branch/feeder AFCI detects parallel arcing faults, which can occur line-to-line, line-to-neutral and line-to-ground.

The combination AFCI takes the technology one step further and detects not only parallel arcing, but also series arcing, which is useful in identifying lower-level arcing in both branch circuits and power supply cords. A series arc can occur when the conductor in series with the load is unintentionally broken. Effective January 1, 2008, combination AFCI protection will be required in all new homes.

Nationally recognized safety device

As previously mentioned, the *National Electrical Code* specifically defines and mandates the installation of AFCIs.

Research in the arc fault area began in the late 1980s and early 1990s, when the CPSC identified a concern in residential fires that were a result of a problem in the electrical system. It was discovered that a large number of these fires were estimated to be in branch-circuit wiring systems.

The concept of AFCIs gained more momentum when a code proposal was made to NEC-1993 to change the instantaneous trip levels of 15 A and 20 A circuit breakers. The Electronic Industries Association (EIA) studied the issue of electrical fires and determined that additional protection against arcing faults needed to be addressed. This proposal first attempted to call for added protection by requiring that instantaneous trip levels of a circuit breaker be reduced from a range of 120 to 150 amperes down to 85 amperes. However, it became clear that the lowering of those levels below some of the minimums already available on the market would result in significant unwanted tripping due to normal inrush currents.

These early studies and code efforts led to the first proposals to require AFCIs, which were made during the development of NEC-1999. NEC Code-Making Panel 2 (CMP-2) reviewed many proposals, ranging from protecting the entire residence to the protection of the living and sleeping areas. The panel also heard numerous presentations from both sides of the issue. After extensive data analysis and discussion, the code-making panel concluded that AFCI protection should be required in branch circuits that supply receptacle outlets in bedrooms.

The first requirement for AFCIs appeared in NEC-1999 under Section 210.12 and subsequent editions have further upgraded the requirements for its use. The 1999 edition, which became effective in 2002, required that dwelling unit bedrooms have AFCIs installed to protect only those branch circuits that supply 125-volt, single-phase, 15- and 20-ampere receptacle outlets.

After further research and analysis of the technology and its potential safety benefits, the 2002 edition updated Section 210.12 and expanded the requirement for AFCIs to include all bedroom circuits, including those that supply lighting fixtures, smoke alarms, and other equipment. Section 210.12 was again revised in 2005 to provide for a technology upgrade to the combination type of AFCIs.

While previous generations of AFCIs detected parallel arcing, the combination AFCI could also detect series arcing, and at lower levels. NEC-2008, which was published in September, takes safety a step further by requiring that all new home construction install combination AFCIs on circuits not only in bedrooms, but also in additional living areas in the home.

Since the beginning of its evolution in the NEC, several prominent organizations in the United States have come out in support of the technology. In addition to the CPSC and HUD, the expanded requirements have the support of the National Electrical Manufacturers Association (NEMA), National Association of State Fire Marshals, National Electrical Contractors Association (NECA), Electrical Safety Foundation International, as well as many home inspectors and fire personnel, who see firsthand the significant damage electrical fires cause.

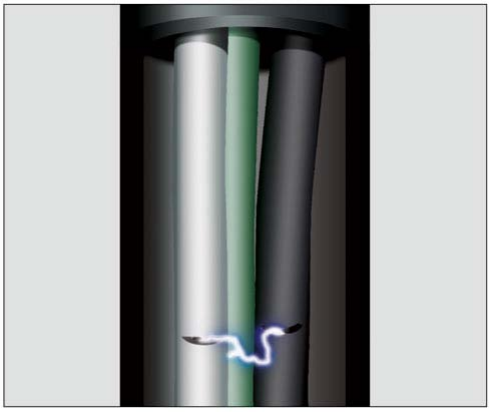


Figure 1, at left: Branch/feeder AFCIs provide protection through the detection of parallel arcing faults that can occur line-to-line, line-to-neutral and line-to-ground.

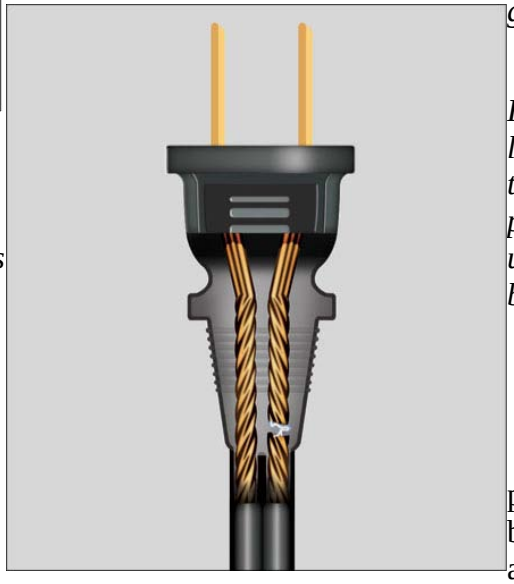


Figure 2, at left: The combination type AFCI takes a step further and detects not only arcing, but also series arcing, which is identifying lower-level arcing in both circuits and power supply cords.

Small cost equals big payoff

As with any change in the required protection for the electrical system, there have been many discussions and deliberations both for and against arc-fault protection being a part of the *NEC*.

Some have argued that the cost of the AFCI is higher than a standard circuit breaker and,

as such, it costs too much to provide the increased protection. Others have argued that since it is a relatively new type of protection, AFCIs do not have the history on which to base a decision as to whether to support it or not.

While there is an additional cost to upgrading new homes from standard circuit breakers to AFCI technology, this cost increase is small. One could argue that AFCIs cost much less than some "non-safety" related upgrades that are typical in a new home, such as expensive kitchen cabinets and countertops. In fact, the cost to homeowners to have builders add additional protection to the home — in the form of AFCIs — is relatively insignificant when compared to the risk of death and injury caused by electrical fires.

A quick survey of hardware stores and do-it-yourself home centers (e.g., Home Depot, Lowe's) found AFCIs priced in the $30–$35 range and standard circuit breakers priced from $2–$4. Using the high-end price of $35, the cost differential between AFCIs and the standard circuit breaker is approximately $31–$33.

According to a September 2006 article in *Electrical Wholesaling* magazine, the average cost of a 2,500 sq. ft. house is $192,846 *(See reference 4);* and with the average number of circuits requiring AFCIs being 12, this equates to an approximate cost increase of $372 – $396 to the homeowner, or one-fifth of one percent of the national average cost of that 2,500-sq. ft. home.

When comparing these figures to the hundreds of millions of dollars lost in electrical fires each year, saving a human life or preventing injury or property loss is well worth the cost of additional protection in the home, and certainly well worth the investment.

The bottom line

Applying technology to improve the electrical safety of the home is a wise investment for both the homeowner and the community at large. Reducing fires of electrical origin and saving lives is an important responsibility of the entire construction and regulatory community.
The irreplaceable value placed on human life taken and heavy toll on property destroyed in electrical fires provides a clear indication of the need for homebuilders and contractors to provide consumers with the safest home possible.

Educating homebuyers on the latest in home-protection devices beyond the smoke alarm, emergency ladders and similar "after-the-fact" safety devices is the first step in preventing electrical fires. In addition, new homeowners should know what options are available in the way of home safety, and are encouraged to ask their builder or electrician about the life-saving capabilities of AFCIs. With the potential to cut the number of electrical fires that occur each year in half, AFCI technology should not be overlooked.

For more information about arc-fault circuit interrupters, visit www.AFCIsafety.org, an educational Web site devoted to educating consumers and industry professionals about the important home safety device.

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Thank you to ASHI Certified Inspector Jim Rooney for recommending this article.

References

1 United States Fire Administration. *On the Safety Circuit: A Fact sheet on Home Electrical Fire Prevention.* 2006.

2 United States Consumer Products Safety Commission. *Economic Considerations – AFCI Replacements. Memorandum,* March 2003.

3 United States Department of Housing and Urban Development, Office of Healthy Homes and Lead Hazard Control. *Healthy Homes Issues: Injury Hazards, Version 3.* March 2006.

4 *Electrical Wholesaling.* Home builders report most recent quarterly sales down from a year ago. September 2006.