



NASFM Science Advisory Committee Recommendations Regarding Arc-Fault Circuit Interrupters to Prevent Fires Originating in Electrical Wiring

The Board of Directors of the National Association of State Fire Marshals (NASFM) has asked the NASFM Science Advisory Committee (SAC) to assist in offering guidance on the use of arc-fault circuit interrupters (AFCIs) in residential housing. This guidance, in part, is derived from the NASFM Consumer Product Safety Task Force Report on AFCIs issued August 1, 2002.

Function and Purpose of AFCIs: While conventional circuit breakers only respond to overloads and short circuits AFCIs continuously monitor the electrical current in a circuit, recognizing unique current and/or voltage signatures associated with arcing faults, and de-energizing the current when unintended arcing conditions occur. Once an unwanted arcing condition is detected, the control circuitry trips the internal contacts, thus de-energizing the circuit and reducing the potential for a fire to occur.

Typical conditions where arc faults may occur include damaged wires by carelessly nailed walled studs, damaged or misapplied equipment, and overheating from excessive current flow. Other common causes for arcing include:

- Cracked insulation on wire or cords from age, heat, chemical erosion or bending stress.
- Loose or improper connections, such as electrical wires to outlets and switches.
- Frayed or ruptured extension or appliance cords.
- Moisture or contaminants between conductors of different voltage.
- Electrical wire insulation chewed by rodents.

The most serious of these conditions (in terms of arc-fault related fire risk) occurs behind walls and under floors. By mitigating the unwanted effects of arcing, AFCIs reduce the risk of electrical fires, thereby safeguarding persons and property.

Installation: As of 2002, the installation of AFCIs is required by the National Electrical Code ® (NEC) in new construction of branch circuits providing power to outlets in dwelling unit bedrooms. AFCIs can also be easily retrofitted into existing structures. The NEC requirement

addresses the new home market, but the biggest potential for home electrical wiring system failures is in existing homes. The quality and safety of electrical wire systems deteriorates over time. As the home building stock increases in age, there is increased likelihood of home electrical wire systems failing, which creates a life safety issue. Whether new home or older home, installation should be performed by a licensed electrician or capable experienced individual.

Impact: Studies by both the National Fire Protection Association (NFPA) and U.S. Consumer Product Safety Commission (CPSC) underscore the significant impact of the use of AFCIs on the frequency of damage, injury, and deaths caused by residential electrical fires. Data from the National Fire Incident Reporting System (NFIRS) and the NFPA indicate that electrical arcing was the cause of approximately 48,800 fires annually in one and two family dwellings between 1994-1998. The use of AFCIs in residences may significantly decrease the frequency of such fires.

Additionally, the US Consumer Product Safety Commission technical staff, after conducting a great deal of independent research on AFCIs, estimates that 50-75% of residential electrical fires can be prevented by employing AFCI technology.¹ That means that of the 73,500 electrical fires annually, AFCIs could potentially prevent 55,125 fires and save more than 440 lives, 1,685 injuries, and \$785,925,000 in property damage, when AFCIs work their way into electrical codes for installation throughout the house.

Standards and Testing: AFCIs have undergone rigorous testing by UL and CPSC and have been in production since 1997, and readily available in stores since 2001. AFCIs are tested to decrease the risk of fire from various types of arcing in accordance with the UL Safety Standard. The UL 1699 Standard addresses several types of AFCIs, each intended for different applications and/or protection of the branch circuit and extension wiring. The performance requirements for these devices include the arc-fault detection tests as described in Section 56 of that standard. All manufacturers' AFCI breaker devices pass all of the tests required for branch/feeder AFCIs.

Some critics refer to a UL study for the CPSC, which involved research on five different technologies designed to detect and monitor conditions that could lead to residential electrical wiring fires. One of those technologies was AFCIs. However, not all of the 14 experimental tests described in the CPSC's report were intended for AFCI technology.²

Cost: Once criticized for their high cost (originally in excess of \$125 per unit), AFCIs have recently become more affordable due to increased production. The added first cost to install AFCI circuit breakers in a new home is approximately \$100. This cost estimate is based on replacing two conventional circuit breakers with an AFCI circuit breaker. While the code requirement is to apply the AFCI to only the bedroom circuits, consideration should be made to include AFCI protection to other circuits as well.

¹ King, William H., Jr., Chief Engineer for Electrical and Fire Safety, Division of Electrical Engineering, US Consumer Product Safety Commission, in discussion with the NASFM Science Advisory Committee, July 14, 2002.

² Dini, David, "Arc Fault Circuit Interrupters," *IAEI News*, September/October 2001.

The SAC agrees that the AFCI technology is sound and should seek continuing and expanded usage in residences, AFCIs can also be applied on a voluntary basis to other high risk applications such as: historic or older buildings, public housing, military installations, assisted living facilities, child care centers, schools, churches, dormitories, etc.

In determining this opinion, the SAC noted that AFCI technology:

- Increases early detection and prevention of arc-faults, reducing property losses, injuries, and loss of life;
- Is simple and affordable to install in new and pre-existing electrical distribution systems;
- Continues to undergo rigorous testing by public and private standards and testing laboratories;
- Is based upon recognized and thoroughly developed scientific methodologies.

Links to Background on NASFM report on AFCI technology, use, and authoritative testing.

http://www.firemarshals.org/issues/home/electrical_fires.html