



Expanded Arc-Fault Circuit Interrupter (AFCI) Use Within Homes Will Help To Limit Electrical Fire Ignition in Bathrooms and Other Unfinished Areas

The National Fire Protection Association® (NFPA®) publishes NFPA 70, also known as the National Electrical Code (NEC®) with the purpose being the practical safeguarding of persons and property from hazards arising from the use of electricity. The NEC is revised every three years. Article 210.12, Arc-Fault Circuit-Interrupter (AFCI) protection, has been in the code since the 1999 edition starting with bedroom outlets. The protection of your home's electrical circuits to prevent electrical fires due to arcing of damaged conductors from a parallel or series arc. There has been expansion of AFCI protection to other circuits of the home in subsequent code cycles. The 2017 NEC® now requires AFCI protection in kitchens, laundry areas, and other locations in the household. The American Circuit Breaker Manufacturers Association (ACBMA) and other industry associations support the expanded use of AFCI technology to further protect your home to encompass all dwelling unit 120-volt, single-phase, 15- and 20-ampere branch circuits. Requiring AFCI protection on all 120-volt, single phase, 15- and 20-ampere circuits would complete the NFPA advocacy for the use of AFCIs to reduce residential fires involving electrical failure or malfunction. This enhancement of protection would complete the process that Code Making Panel 2 has been working towards achieving AFCI protection in areas such as bathrooms, unfinished areas of basements, garages, attics, and more.

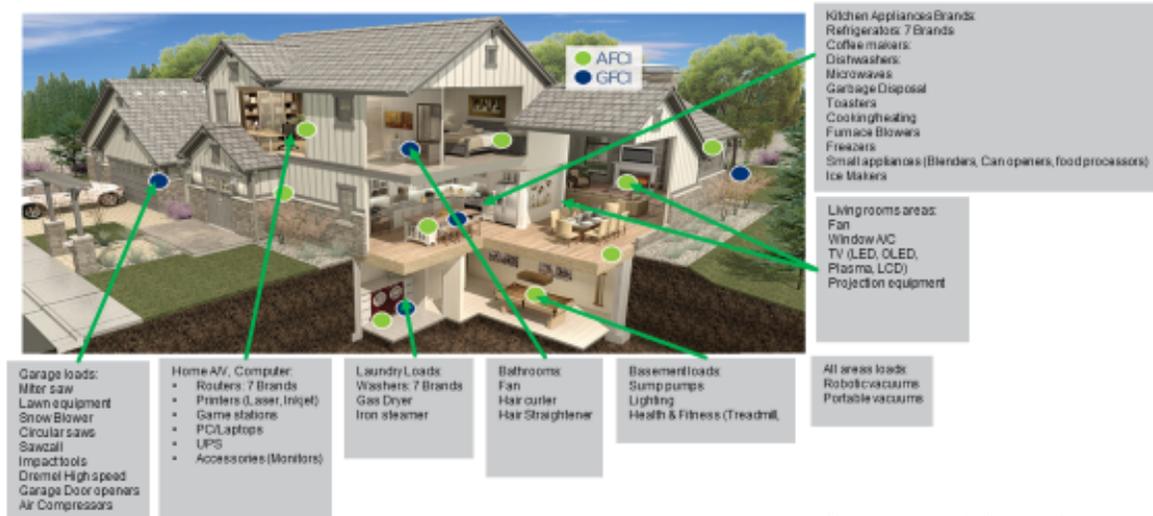
The U.S. Fire Administration shows statistics that the number of residential dwelling fires, deaths, injuries, and dollar loss have significantly decreases between 2006 and 2015. AFCIs play a significant roll in this reduction. Continue this trend by requiring AFCIs on all 15 and 20A, 120V circuits in residential dwellings. The following shows the reduction shown in the report for each category.

- 26% decrease in fires
- 4% decrease in deaths
- 22% decrease in injuries
- 31% decrease in dollar loss

Arc-faults such as these emit a particular electrical signature that are detected by AFCI circuit breakers causing them to trip, thus preventing initial ignition. While the hazard would still exist in a faulty wiring scenario, the event of an AFCI circuit breaker tripping would act as an indicator to inspect the damaged wiring and to point to its replacement.

Compatibility AFCI Validation – Home appliance lab emulation

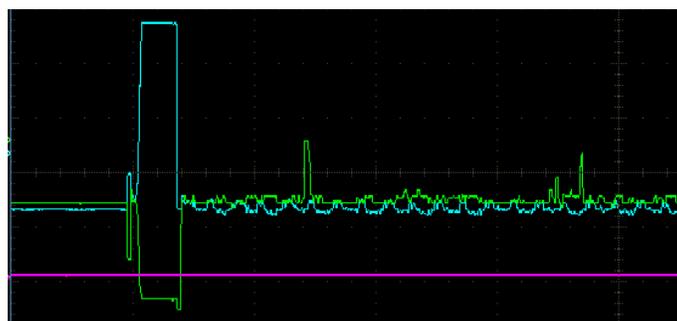
The lab is equipped with +2000 home electrical loads



Courtesy of Schneider

These statistics and other electrical codes, such as the Canadian Electrical Code, support the use and expansion of AFCI protection to these incremental circuits for the 2020 NEC®. The compatibility of AFCI protection on these incremental circuits is verified with various equipment and appliances that are required under UL1699, Standard for Arc-Fault Circuit-Interrupters, and through additional manufacturer testing that goes above and beyond the minimum requirements. The electrical industry continues to work in a proactive manner with appliance manufacturers to ensure compatibility on new designs. Industry groups such as National Electrical Manufacturers Association (NEMA) and American Home Appliance Manufacturers (AHAM) meet and collaborate with the electrical industry on a regular basis. The extensive scope of this collaboration has resulted in ACBMA conducting over 24,000 test cases with 700 use cases to gather data on 250+ appliance brands. In addition to static functional testing, these test cases involved power on/off sequences including idle operation to validate that the load combinations were properly protected by the AFCI circuit breaker.

AFCIs are already being used in bathrooms in the US and Canada. AFCI manufacturers have tested commonly used bathroom exhaust fans to ensure compatibility with AFCIs. The humidity and temperature that bathroom fans are exposed to in the home can reach high levels so fans were tested in both dry and extreme conditions in an environmental chamber of 35°C (95°F) with maximum humidity levels along with water saturation on the outer casings. Below is the electrical reading of a typical start sequence for a dampened commonly used exhaust fan:



In the scope trace above, as the fan begins operation, current (blue) is drawn into the fan and plateaus as the high frequency noise (green) is emitted. After the fan finishes the start sequence and reaches a steady state of operation, the current and noise normalize. During this entire sequence, the AFCI microcontroller (pink) shows no reaction due to no reading of arcing. This is an example of optimal AFCI protection while ensuring AFCI breakers do not react to normal start sequences even in the most strenuous of environmental conditions.

The garage is also an area of significant priority for electrical safety pertaining to AFCI protection. Garage walls are frequently used to hang storage racks and other items. The screws or other fasteners used pose a risk of damaging the branch circuit wiring when installed. Also, high maintenance loads such as drills, saws, sanders, grinders, welders, and air compressors are all susceptible to cord damage that can lead to arc fault events. Considering that flammable materials are commonly stored in these areas, the expansion of AFCI protection to garages is needed to provide the necessary fire protection for all circumstances concerning potentially hazardous, damaged situations.

The garage circuits currently do not require AFCI protection. Since the garage typically does not have fire detection requirements the fires started in these locations tend to get detected later, become larger, and cause more widespread damage than those fires started in other locations of the dwelling. The following are some statistics from a U.S. Fire Administration report on fires originating in garages of residential dwellings.

- An estimated 6,600 residential building garage fires were reported to United States fire departments each year and caused an estimated 30 deaths, 400 injuries and \$457 million in property loss.
- Garage fires result in substantially more injuries per 1,000 fires and greater dollar loss per fire than non-garage fires. The increase in dollar loss per fire may ultimately be due to challenges in the detection and location of garage fires. The fires take longer to detect, become larger in size, and cause more widespread damage.
- The leading cause of residential building garage fires was “electrical malfunction”
- Electrical arcing was the most common heat source in residential building garage fires

Arc-Fault Circuit-Interrupter technology provides optimal protection. There has been a 22% decline in residential building electrical fires in the US from 2007 to 2016 according to the December 2018 report from the US Fire Administration and FEMA and steady decline in the number of electrical-caused fires of 12% over the past ten years in Ontario.^[1] This downward trend is largely attributed to greater fire safety awareness and response, better construction materials, and fire prevention technologies like AFCI. Expansion to provide protection to all residential 120-volt, 15 and 20-ampere branch circuits is supported by ACBMA and other industry associations based on these supporting statistics. Leaders in the electrical industry and advocates for electrical safety are in favor of this movement. AFCI protection for all 120-volt single phase, 15 and 20-ampere branch circuits in dwelling units is recommended for the 2020 NEC®, a move supported by ACBMA. Vote to accept the Certified Amending Motion (Sequence Number 70-10) requiring AFCIs on all 15A and 20A, 120V branch circuit in residential dwellings.

[1] - *Electro Federation of Canada* - <https://www.electrofed.com/products/afci/>

The American Circuit Breaker Manufacturers Association (ACBMA) is a non-profit group whose members include Eaton, ABB, General Electric, Schneider Electric and Siemens.

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