

Arc-Fault Circuit Interrupters: National Electrical Code Inclusion Was Based on Faulty Reasoning

What Are AFCIs?

Arc-fault circuit interrupters (AFCIs) are devices “intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and by functioning to de-energize

The main issue: the

blems AFCIs are designed to prevent occur overwhelmingly in older dwellings.

(Linda &

dential Electrical Distribution System Fires, 1987) This means that the bulk of these
wired in accordance with the 1965 or earlier editions of the NEC. Further, they
with products manufactured to product safety standards of a similar vintage. In the
numerous changes have been made in both the NEC and product safety standards
te against similar fires in newer homes—even as they age.

The strongest association with electrical distribution fires was observed in dwellings over 40 years old, and with more than half of the housing stock older than 35 years, electrical issues have become an increasingly larger player in residential fires. (U.S. Fire Administration, 2016)

Differences between Older and Newer Homes

The 1987 CPSC study confirmed the logical assumption that older homes with smaller services, few GFCIs, overloaded circuits and many extension cords have a greater risk of electrical fires than a new home built to a recent edition of the NEC. Homes built before 1965 may still have fuses instead of circuit breakers, and those built before 1945 may still have knob and tube wiring. As of 2011, roughly 41% of the nation's occupied detached single-family homes had been built before 1965, which suggests fuses are still present in about 20% of all homes. (John R. Hall, 2013)

Many older homes were wired with a very limited number of receptacle outlets, necessitating extensive use of extension cords or improper alterations and additions to the original electrical system, both recognized fire hazards. However, in the intervening years, the NEC has required significant increases in the number of required receptacle and lighting outlets, significantly reducing the need for extension cords in newer homes.

Grounding provisions in the NEC have expanded to require electrical enclosures and boxes to be grounded and an equipment grounding conductor in the wiring. In technical language, these grounding methods increase the likelihood of low-level arcing faults progressing rapidly to arcing ground faults of a magnitude sufficient to activate conventional circuit breakers. As non-metallic sheathed cable (Romex) with its bare ground wire has become the norm, the likelihood of an arcing fault being the hot-to-ground type, which is detectable by a conventional circuit breaker, has increased significantly. (National Fire Protection Association, 1998) And conversely, there has been an equally significant decrease in the probability of arc faults occurring that an AFCI device can detect, namely line-to-line and line-to-neutral faults.

Ever since the 1978 edition of the NEC, electrical wires must be run not less than 1 ¼ inches from the front edge of the framing members or be protected with a steel plate or other means. This almost eliminates the chance of wires getting hit by nails or screws because it offers a margin of safety against such damage. Standard nails and screws for ½-inch drywall are 1 ¼ inches long, leaving ½ inch of space between the fastener and where a wire might run.

Further code provisions that protect wiring from damage include requiring a maximum support spacing of 4 ½ feet, a maximum support distance from an electrical box of 12 inches to reduce vibrations that might cause the wire to rub where it enters the box, and requiring bushings where wiring runs through openings in metal framing members and where entering an electrical

constructed with proper wiring methods and equipment by present standards should not be prone to fire.” But they then argue that “all new dwellings eventually get old” and so AFCIs are necessary.

The Data Used to Support AFCIs

In 1998, when AFCI requirements were added to the NEC, data from the CPSC report “Revised Residential Fire Loss Estimates 1980-1998” was integral to that decision. The report stated that approximately 41,000 fires per year could be attributed to electrical distribution equipment (e.g. installed wiring, lighting). (Linda & Jean, Revised Residential Fire Loss Estimates 1980-1998, 1998) This was equal to about 10% of all residential fires. The report claimed that these fires also accounted for about 350 deaths and 1,400 injuries each year. The CPSC’s later report, “Residential Fire Loss Estimates 2010-2012,” showed a much different picture. There were an estimated 9,600 fires annually which could be attributed to electrical distribution equipment, or 2.7% of all residential fires. (David, 2012) For this time period, these fires accounted for an estimated 130 deaths and 470 injuries annually.

There is a reason for the discrepancy: These fire loss estimates are based on the National Fire Protection Association’s national fire loss estimates and the U.S. Fire Administration’s

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