West Virginia Fire Commission Response to Comments of the Building Code, 87-04

BACKGROUND

The Fire Commission is proposing a revision to the Building Code to remove conflicts with State Law, update the ICC/ANSI Standard for American National Standards for Accessibility & Usable Building Facilities from the 2009 edition to the 2017 edition, update the NFPA Standard for the National Electric Code from the 2014 edition to the 2017 edition, and remove outdated and unnecessary language.

Prior to the Commission's initial filing of the Rule, a stakeholder meeting was held at the Office of the State Fire Marshal on May 17, 2019, and, along with members of the Fire Commission, and the Office of the State Fire Marshal, the list of attendees is attached as addendum 1 to this document. The proposed rule was reviewed, and revisions made, prior to the Commission's consideration and approval for initial filing with the Secretary of State for comment.

During the public comment period, the Commission received written comments from two entities, each was discussed by the Commission at its meeting on July 25, 2019, at 10:00 a.m. and are outlined as follows:

1) The American Chemistry Counsel Plastics Division requests that the Commission adopt either the 2015 or the 2018 IECC code for residential construction.
   Answer: The Building Code provides a minimum standard for building in the State of West Virginia. A builder or consumer may adopt any level of construction that has a standard greater than that of the 2009 standard, currently in place. As long as the 2015 or 2018 IECC codes are above the minimum standard, there is no prohibition on a builder using those standards, as such, the Commission will not be adopting this change.
2) The National Association of Home Builders requests that the rule be revised to remove language requiring AFCI devices for residential dwelling units, including one- and two-family homes, while leaving it in place for hotels, motels, and dormitories.
   Answer: The standard as proposed in this rule by the Commission is necessary to protect life and property.
3) The National Association of Home Builders requests that the rule be revised to remove the requirement that AFCI devices be installed in residential dwelling units, including one- and two-family homes, when a receptacle is replaced, but do not remove it for dormitories.
   Answer: The standard as proposed in this rule by the Commission is necessary to protect life and property.
4) The National Association of Home Builders requests that the rule be revised to remove the requirement for tamper resistant receptacles in one- and two-family homes.
   Answer: The standard as proposed in this rule by the Commission is necessary to protect life and property.

Technical clean-up was made to the Rule.

This summarizes the topics upon which comments were made to the West Virginia State Fire Commission of the Fire Code, 87 CSR 4.

ADDENDUM 1

May 17th 2019 Stakeholders Meeting 2020 87CSR 4

Sign In Sheet

1. Drew D. Cantis - City of Morgantown Code Enf.
2. Kelly A. Bragg - WV Office of Energy
3. John Brumley - Home Builder W.V.
4. KAREN LAYNE - WV OFFICE OF ENERGY
5. Reeves Sloan - HBAWV
6. Tony Harmon city of Chas.
7. Billy Smith city of Chas.
8. TED SHRIVER STATE FIRE COMMISSION / AIA-WV
9. Jack Jamison WVIBEI
10. Danny Brickles City of Hurricane - WV IAEI
11. DALE A OXLEY Home Builders Assoc. MHCoWV
12. Susan Economou - WV Municipal League
13. Tim Conaghan CES
14. Laura Wynn - RECA
15. David Mann - ACC
16.
17.
18.
19.
20.

American Chemistry Council Plastics Division

WVMA

July 11, 2019

State Fire Marshall Tyree
1207 Quarrier St.
Charleston, WV 25301

RE: State Building Code Rule

Dear Fire Marshall Tyree,

Thank you for the opportunity to provide comments on the "State Building Code" rule. The proposed rule fails to update the residential energy code. This is a tremendous loss for the citizens and businesses of West Virginia. The American Chemistry Council (ACC) and West Virginia Manufacturers Association (WVMA) are important stakeholders in the West Virginia building code. Our members believe West Virginia should go further and update the residential energy code to the 2015 or 2018 International Energy Conservation Code (IECC).

ACC and WVMA are Important Stakeholders
ACC and WVMA represent leading companies engaged in manufacturing and the business of chemistry, covering almost 10% of the State's output and employing 48,500 people.

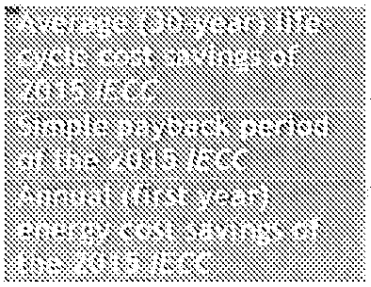
We have extensive knowledge regarding building code development. We partner in recent building science research, including projects with the Department of Energy and Home Innovation Research Labs. Our representatives serve on the ICC, ASHRAE, ASTM, AAMA, and other code and standard setting bodies.

We Request West Virginia Update The Residential Energy Code
The energy cost savings for an upgrade from the 2009 IECC for residential construction to the 2015 IECC are over 25%. An upgrade to the 2018 IECC will include additional savings beyond that level. A building constructed to the 2009 IECC will miss those savings, costing more money to heat and cool every year over the entire life of the building.

Summary of U.S. DOE Analysis Comparing 2015 IECC to 2009 IECC (Residential)	
Metric	Compared to 2009 IECC
Annual (first year) energy cost savings of the 2015 IECC	25.5%

American Chemistry Council Plastics Division

WVMA



We urge reconsideration of this proposed rule to include updating the residential energy code. ACC, WVMA, and our member companies and employees thank you in advance for considering our views.

Sincerely,

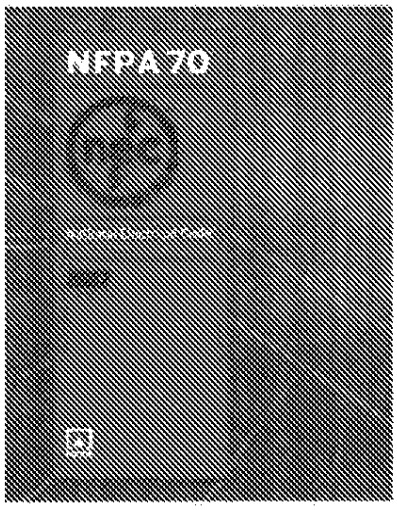
Rebecca R. McPhail
President
West Virginia Manufacturers Association
2001 Quarrier Street
Charleston, WV 25311
304-342-2123

Josh Young
Senior Director, Government Affairs, State Affairs and Political Mobilization
American Chemistry Council
700 2nd St. NE
Washington D.C. 20002

National Association of Home Builders

2017

National Electrical Code Suggested Amendments



5/1/2017

National Association of Home Builders

State and local HBAs should consider these amendments to maintain cost-effective and affordable code provisions when discussing the adoption of the 2017 National Electrical Code. NAHB developed these amendments based on the outcome of the 2017 NFPA Code Development Cycle.

Each amendment is shown in *legislative text* (underline and ~~strikethrough~~) and includes a supporting reason/s explaining why the jurisdiction should consider them. Some of the suggested amendments have additional supporting documents and information on the NAHB website.

From the *"Amendment Lookup"* page read the brief introduction and choose the amendment you are interested in. The underlined portion is a hotlink to the amendment.

If you have technical questions or would like additional information, please contact:

Dan Buuck
Senior Program Manager
202-266-8366
dbuuck@nahb.org

Note: This document is also available in "Word" format upon request.

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2017 National Electrical Code

1. Arc-Fault Circuit Interrupters (AFCI)

This amendment removes the requirement for AFCI devices for residential dwelling units, including one- and two-family homes, while leaving it in place for hotels, motels and dormitories. The requirement for AFCIs applies predominantly to new homes, although the strongest association with electrical distribution fires was observed in dwellings over 40 years old. The data did not show that AFCIs were necessary when they were first introduced into the electrical code, and it has not supported the devices' continued expansion in the code.

Revise as follows:

210.12 Arc-Fault Circuit-Interrupter Protection. Arc-fault circuit-interrupter protection shall be provided as required in 210.12(A), (B), and (C). The arc-fault circuit interrupter shall be installed in a readily accessible location.

(A) Means of Protection ~~Dwelling Units. All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in dwelling unit kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas shall be protected by any of the means described in 210.12(A)(1) through (6).~~

(1) A listed combination-type arc-fault circuit interrupter, installed to provide protection of the entire branch circuit

(2) A listed branch/feeder-type AFCI installed at the origin of the branch-circuit in combination with a listed outlet branch-circuit type arc-fault circuit interrupter installed at the first outlet box on the branch circuit. The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.

(3) A listed supplemental arc protection circuit breaker installed at the origin of the branch circuit in combination with a listed outlet branch-circuit type arc-fault circuit interrupter installed at the first outlet box on the branch circuit where all of the following conditions are met:

   a. The branch-circuit wiring shall be continuous from the branch-circuit overcurrent device to the outlet branch-circuit arc-fault circuit interrupter.

   b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft) for a 14 AWG conductor or 21.3 m (70 ft) for a 12 AWG conductor.

   c. The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.

(4) A listed outlet branch-circuit type arc-fault circuit interrupter installed at the first outlet on the branch circuit in combination with a listed branch-circuit overcurrent protective device where all of the following conditions are met:

   a. The branch-circuit wiring shall be continuous from the branch-circuit overcurrent device to the outlet branch-circuit arc-fault circuit interrupter.

   b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft) for a 14 AWG conductor or 21.3 m (70 ft) for a 12 AWG conductor.

c. The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.

d. The combination of the branch-circuit overcurrent device and outlet branch-circuit AFCI shall be identified as meeting the requirements for a system combination– type AFCI and shall be listed as such.

(5) If RMC, IMC, EMT, Type MC, or steel-armored Type AC cables meeting the requirements of 250.118, metal wire-ways, metal auxiliary gutters, and metal outlet and junction boxes are installed for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a listed outlet branch-circuit type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

(6) Where a listed metal or nonmetallic conduit or tubing or Type MC cable is encased in not less than 50 mm (2 in.) of concrete for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a listed outlet branch-circuit type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

Exception: Where an individual branch circuit to a fire alarm system installed in accordance with 760.41(B) or 760.121(B) is installed in RMC, IMC, EMT, or steel-sheathed cable, Type AC or Type MC, meeting the requirements of 250.118, with metal outlet and junction boxes, AFCI protection shall be permitted to be omitted.

(B) Dormitory Units. All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets and devices installed in dormitory unit bedrooms, living rooms, hallways, closets, bathrooms, and similar rooms shall be protected by any of the means described in 210.12(A)(1) through (6).

(C) Guest Rooms and Guest Suites. All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets and devices installed in guest rooms and guest suites of hotels and motels shall be protected by any of the means described in 210.12(A)(1) through (6).

(D) Branch Circuit Extensions or Modifications — ~~Dwelling Units and~~ **Dormitory Units.** In any of the areas specified in 210.12~~(A)~~ or (B), where branch-circuit wiring is modified, replaced, or extended, the branch circuit shall be protected by one of the following:

(1) A listed combination-type AFCI located at the origin of the branch circuit

(2) A listed outlet branch-circuit-type AFCI located at the first receptacle outlet of the existing branch circuit

Exception: AFCI protection shall not be required where the extension of the existing conductors is not more than 1.8 m (6 ft) and does not include any additional outlets or devices.

Reason:
AFCIs were first introduced in the 1999 edition of the National Electrical Code (NEC) with an effective date of Jan. 1, 2002. Code Making Panel 2, which had responsibility over branch circuits where AFCIs are addressed, largely based its approval of the code change on several U.S. Consumer Product Safety Commission (CPSC) reports. However, the number of incidents cited at the time were several times higher than in later reports, and where the data showed that AFCIs would have a minimal benefit, the results were ignored. The resulting expected benefits led to AFCI requirements being included in the NEC, but were overblown.

The problems with the rationale were so evident that even electrical manufacturers spoke against the proposal. During the 1998 code development cycle comment period, manufacturers' representatives

stated that a large body of information was available to support rejecting an AFCI mandate. The main issue: the electrical problems AFCIs are designed to prevent occur overwhelmingly in older dwellings.

When the Home Was Built Is Important

A CPSC epidemiological study, "Residential Electrical Distribution System Fires," showed that 85% of fires of electrical origin occur in homes that are more than 20 years old. This means that the bulk of these homes were wired in accordance with the 1968 or earlier editions of the NEC. Further, they were wired with products manufactured to product safety standards of a similar vintage. In the years since, numerous changes have been made in both the NEC and product safety standards which mitigate against similar fires in newer homes—even as they age.

The June 2015 issue of the U.S. Fire Administration's Topical Fire Report Series reported "A strong relationship between housing age and the rate of electrical fires has been observed, with housing over 40 years old having the strongest association with electrical distribution fires [emphasis added]." The median age of one- and two-family housing in the U.S. is 40 years. The share of housing units built before 1970 is 39%, and those built before 1950 is 18%. According to a study conducted by the U.S. Consumer Product Safety Commission, dwellings built before 1965 may still have fuses instead of circuit breakers, and those built before 1945 may still have knob and tube wiring.

These older homes were also wired with a very limited number of receptacle outlets, resulting in extensive use of extension cords or improper alterations and additions to the original electrical system, both recognized fire hazards. In addition, they are more likely to have outdated appliances, space heaters or other characteristics that might lead to a greater risk of a fire starting. Newer homes have fire blocking, hardwired smoke alarms and egress windows installed to today's codes, all of which increase the chances of surviving a fire. Even as homes built to today's residential code get older, they will continue to provide protection for families through their improved safety.

While questions regarding construction code requirements intended to increase the safety of homes cannot, and should not, be decided solely on the issue of cost, it is reasonable to ask if there is a demonstrated need for the requirement or if an acceptable level of safety can be achieved through other, less expensive means. The cost of an incremental increase in the margin of safety can be quite high.

Higher regulatory costs have real consequences for working American families. These regulations end up pushing the price of housing beyond the means of many teachers, police officers, firefighters and other middle-class workers. Nationally, for every $1,000 increase in the price of a home, about 150,000 households are priced out of the market for a median-priced new home. The added cost of $300-$400 for AFCIs may not sound like much when compared to the overall cost of a home, but this is only one of many regulations which adds cost for new homebuyers. Every $838 increase in construction costs adds an additional $1,000 to the final price of the home.

Mandating costly incremental increases in safety will only protect those who can afford them and will often decrease safety for those who cannot. Families who cannot qualify to purchase homes due to the increased costs from mandatory code requirements such as AFCIs will have to live in housing that is less safe, because that housing was built to less stringent code requirements.

The total cost to home buyers to install AFCIs is over $430,000,000—per year. ***This is 24 times the cost of damage per year****, and it is clear that requiring AFCIs in new construction will not prevent all damage. This is due to the fact that AFCIs cannot prevent all fires and, more importantly, that electrical fires occur overwhelmingly in older houses.*

From 1980 to 2015 there has been a significant drop in the number of reported fires, injuries and fatalities in the United States. During that time period the number of fires has dropped by 50 percent and fatalities have dropped by about the same margin, even as the population increased. The decline was sharpest during the 1980s before AFCIs were introduced. This further supports the importance of encouraging home owners to move up to newer homes without the added burden of increased regulation.

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2. Arc-Fault Circuit Interrupter (AFCI) Receptacle Replacement

This amendment removes the requirement for AFCI devices to be installed in residential dwelling units, including one- and two-family homes, when a receptacle is replaced, but does not remove it for dormitories.

Revise as follows:

406.4(D)(4) Arc-Fault Circuit-Interrupter Protection. Where a receptacle outlet is located in any areas specified in 210.12(A) or (B), a replacement receptacle at this outlet shall be one of the following:

(1) A listed outlet branch-circuit type arc-fault circuit-interrupter receptacle
(2) A receptacle protected by a listed outlet branch-circuit type arc-fault circuit-interrupter type receptacle
(3) A receptacle protected by a listed combination type arc-fault circuit-interrupter type circuit breaker

Exception No. 1: Arc-fault circuit-interrupter protection shall not be required where all of the following apply:
(1) The replacement complies with 406.4(D)(2)(b).
(2) It is impracticable to provide an equipment grounding conductor as provided by 250.130(C).
(3) A listed combination type arc-fault circuit-interrupter circuit breaker is not commercially available.
(4) GFCI/AFCI dual function receptacles are not commercially available.

Exception No. 2: Section 210.12(B), Exception shall not apply to replacement of receptacles.

Reason:
AFCIs were first introduced in the 1999 edition of the National Electrical Code (NEC) with an effective date of Jan. 1, 2002. Code Making Panel 2, which had responsibility over branch circuits where AFCIs are addressed, largely based its approval of the code change on several U.S. Consumer Product Safety Commission (CPSC) reports. However, the number of incidents cited at the time were several times higher than in later reports, and where the data showed that AFCIs would have a minimal benefit, the results were ignored. The resulting expected benefits led to AFCI requirements being included in the NEC, but were overblown.

The problems with the rationale were so evident that even electrical manufacturers spoke against the proposal. During the 1998 code development cycle comment period, manufacturers' representatives stated that a large body of information was available to support rejecting an AFCI mandate. The main issue: the electrical problems AFCIs are designed to prevent occur overwhelmingly in older dwellings.

When the Home Was Built Is Important

A CPSC epidemiological study, "Residential Electrical Distribution System Fires," showed that 85% of fires of electrical origin occur in homes that are more than 20 years old. This means that the bulk of these homes were wired in accordance with the 1966 or earlier editions of the NEC. Further, they were wired with products manufactured to product safety standards of a similar vintage. In the years since, numerous changes have been made in both the NEC and product safety standards which mitigate against similar fires in newer homes—even as they age.

The June 2015 issue of the U.S. Fire Administration's Topical Fire Report Series reported "A strong relationship between housing age and the rate of electrical fires has been observed, with housing over 40 years old having the strongest association with electrical distribution fires [emphasis

added]." The median age of one- and two-family housing in the U.S. is 40 years. The share of housing units built before 1970 is 39%, and those built before 1950 is 18%. According to a study conducted by the U.S. Consumer Product Safety Commission, dwellings built before 1965 may still have fuses instead of circuit breakers, and those built before 1945 may still have knob and tube wiring.

*These older homes were also wired with a very limited number of receptacle outlets, resulting in extensive use of extension cords or improper alterations and additions to the original electrical system, both recognized fire hazards. In addition, they are more likely to have outdated appliances, space heaters or other characteristics that might lead to a greater risk of a fire starting. Newer homes have fire blocking, hardwired smoke alarms and egress windows installed to today's codes, all of which increase the chances of surviving a fire. **Even as homes built to today's residential code get older, they will continue to provide protection for families through their improved safety.***

While questions regarding construction code requirements intended to increase the safety of homes cannot, and should not, be decided solely on the issue of cost, it is reasonable to ask if there is a demonstrated need for the requirement or if an acceptable level of safety can be achieved through other, less expensive means. The cost of an incremental increase in the margin of safety can be quite high.

Higher regulatory costs have real consequences for working American families. These regulations end up pushing the price of housing beyond the means of many teachers, police officers, firefighters and other middle-class workers. Nationally, for every $1,000 increase in the price of a home, about 150,000 households are priced out of the market for a median-priced new home. The added cost of $300-$400 for AFCIs may not sound like much when compared to the overall cost of a home, but this is only one of many regulations which adds cost for new homebuyers. Every $838 increase in construction costs adds an additional $1,000 to the final price of the home.

Mandating costly incremental increases in safety will only protect those who can afford them and will often decrease safety for those who cannot. Families who cannot qualify to purchase homes due to the increased costs from mandatory code requirements such as AFCIs will have to live in housing that is less safe, because that housing was built to less stringent code requirements.

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From 1980 to 2015 there has been a significant drop in the number of reported fires, injuries and fatalities in the United States. During that time period the number of fires has dropped by 50 percent and fatalities have dropped by about the same margin, even as the population increased. The decline was sharpest during the 1980s before AFCIs were introduced. This further supports the importance of encouraging home owners to move up to newer homes without the added burden of increased regulation.

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3. Tamper-Resistant Receptacles

This amendment removes the requirement for tamper-resistant receptacles in one- and two-family homes.

Revise as follows:

406.12 Tamper-Resistant Receptacles. All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified in 406.12(1) through (7) shall be listed tamper-resistant receptacles.

~~(1) Dwelling units in all areas specified in 210.52 and 550.13~~

~~(2)~~(1) Guest rooms and guest suites of hotels and motels

~~(3)~~(2) Child care facilities

~~(4)~~(3) Preschools and elementary education facilities

~~(5)~~(4) Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices and outpatient facilities

~~(6)~~(5) Subset of assembly occupancies described in 518.2 to include places of waiting transportation, gymnasiums, skating rinks, and auditoriums

~~(7)~~(6) Dormitories

Exception to (1), (2), (3), (4), (5), and (6), ~~and (7)~~: Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5 1/2 ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle or a duplex receptacle for two appliances located within the dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

Reason:

This requirement was added in the 2008 edition of the National Electrical Code (NEC) and is not based on sound technical information which adequately substantiates that it will result in protecting small children from burns or injury. During the revision cycle leading up to the 2008 edition the supporting documentation for the proposal was based on the summarization of several National Electronic Injury Surveillance System reports from 1991-2001. The NEISS system gathers its data by sampling a group of monitored hospitals for the total number of injuries treated. They then take these figures and calculate the estimated national average.

Public comment from electrical contractors criticized the conclusions drawn from the report. They stated that the report did not identify if the incidents were occurring in newer or older homes. Older homes generally have more electrical hazards which can lead to a higher incidence of shocks.

The NEISS reports also did not provide any supporting information of where the child was located at the time the injury occurred, much less that that all incidents occurred in dwelling units or if any child safety devices were present at the time the injury occurred. There is no scientific research available which has proven tamper-resistant (TR) receptacles are more effective than other safety devices that are currently available on the market. The fact sheet, produced by the National Fire Protection Association, states that TR receptacles are preferred over plastic safety caps for the reason that the caps may be lost and may be a choking hazard for some ages. However, the Consumer Product Safety Commission (CPSC) suggests the use of outlet safety covers on their website Childproofing Your Home- 12 Safety Devices to Protect Your Children, and safety covers available in stores today

are large enough not to constitute a choking hazard. It's fair to say CPSC would not advocate their use if there were safety concerns.

Another concern that was shared by many on the technical review committee was the amount of force that must be applied to insert plugs into the tamper-resistant device and how it will affect the elderly community. The devices are designed in a way that the springs will not open unless the prongs are properly aligned with the shutters and are receiving equal amounts of pressure. Many on the panel voiced concern that there was a lack of product testing showing whether there will be an impact to the aging community's ability to use the new devices.

Notes/additional background:

During the 2008 revision Cycle, the National Electrical Manufacturers Association submitted the proposal to require tamper-resistant receptacles in all areas of a dwelling as indicated in Article 210.52 of the NEC. Over 29 negative comments were submitted in response to the proposal and all 29 comments were rejected by the technical committee. The negative comments were submitted by electrical contractors, electrical inspectors, and some manufactures. Below is a list of concerns that were raised:

1. *The required force to insert cords into the device may prove too much for the elderly or disabled.*
2. *There is no scientific data directly comparing current available safety devices to tamper-resistant receptacles to support the claim that TR are more effective and will reduce the number of accidents.*
3. *That the proponent should provide data listing the areas of the dwelling where injuries have occurred, thereby proving the need for tamper receptacle in areas such as attics, crawlspaces, mechanical rooms, countertops and other areas where the receptacles are normally out of reach of children.*
4. *At the time the proposal was approved, it was unknown whether any manufacturers were producing tamper-resistant devices that were compatible or integrated with arc-fault and ground-fault circuit interrupters.*
5. *The supporting documentation submitted by the proponent clearly stated "the results of these incidents are rarely fatal", and that further research should be conducted along with more product development before any such mandate should be implemented.*
6. *That the technical committee should remember, the code is not able to protect each person, in every situations, from every conceivable harm and should not be used as a tool to differ the responsibilities of the parent or caregiver who should be monitoring the children.*
7. *That the substantiation lacked any credible justification for disallowing the use of plastic safety caps other than claiming that they could be lost or become a choking hazard.*
8. *Why limit tamper-resistant receptacles to dwellings? There are several other occupancies that do not require these devices, yet children are present and the receptacles are accessible.*
9. *Tamper-resistant receptacles should be an option for dwellings that children occupy and not mandatory for dwellings where children are not present.*

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December 2017

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 circuit when an arc fault is detected." (National Fire Protection Association, Inc., 2016) Specifically, AFCIs are meant to protect against a sustained arc at a loose connection or between conductors that have damaged insulation. (Lee, Trotta, & King, 2000)

Limitations of AFCIs

These unwanted arcs can sometimes reach conditions that will ignite adjacent combustible material, and while AFCIs can mitigate the arc's potential effects, it cannot prevent them. (Hansen, 2012) Also, while AFCI devices detect some ground faults, they do not protect against as many as a ground-fault circuit interrupter (GFCI). This is by design, since each device is made for a different purpose.

AFCIs and the National Electrical Code

AFCIs were first introduced in the 1999 edition of the National Electrical Code (NEC) with an effective date of Jan. 1, 2002. Code Making Panel 2, which had responsibility over branch circuits where AFCIs are addressed, largely based its approval of the code change on several U.S. Consumer Product Safety Commission (CPSC) reports. **However, the number of incidents cited at the time were several times higher than in later reports, and where the data showed that AFCIs would have a minimal benefit, the results were ignored.** The resulting expected benefits led to AFCI requirements being included in the NEC, but were overblown.

The problems with the rationale were so evident that even electrical manufacturers spoke against the proposal. During the 1998 code development cycle comment period, manufacturers' representatives stated that a large body of information was available to support rejecting an AFCI mandate. (National Fire Protection Association, 1998) The main issue: the electrical problems AFCIs are designed to prevent occur overwhelmingly in older dwellings.

A CPSC epidemiological study, "Residential Electrical Distribution System Fires," showed that 85% of fires of electrical origin occur in homes that are more than 20 years old. (Linda & Dennis, Residential Electrical Distribution System Fires, 1987) This means that the bulk of these homes were wired in accordance with the 1965 or earlier editions of the NEC. Further, they were wired with products manufactured to product safety standards of a similar vintage. In the years since, numerous changes have been made in both the NEC and product safety standards which mitigate 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 ¾ 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 box or fitting. (National Fire Protection Association, Inc., 2016)

Even advocates for AFCI requirements have stated, "The preponderance of fires is clearly in dwellings over 10 years old. With improvements in the NEC over the past decade, a dwelling

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. **These two rationales are contradictory, and the improvements in the NEC as cited above remain as the home ages.**

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 National Fire Incident Reporting System (NFIRS) data. Beginning with 1999 data, a major revision to the NFIRS data coding system considerably affected the estimates of residential fires and related deaths, injuries, and property losses. Because of these changes, the pre-1999 numbers should not be compared with estimates from subsequent years. That being said, if the inclusion of AFCIs in the NEC were being debated after the later report had been published, proponents of the change would have had a much weaker case.

Data in the reports also included fires that occurred in mobile homes and motor homes. Both are outside the scope of the NEC and, therefore, inflated the occurrences of fires. The 1998 report only referred to "residential" fires, but did not define which specific types of residences were included. The 2012 report clarified that the data included not only single-family and multifamily dwellings, but also mobile and motor homes while used as a structure and not in transit.

Conclusions

AFCI requirements in the NEC apply predominantly to new construction, whereas it is in older homes, built to outdated electrical code requirements and using outdated technology, where they would be most effective. An electrical manufacturer representative during the 1998 committee meetings stated it best: "The question of whether this [AFCI] mandate will have a meaningful impact in reducing the number of dwelling fires of electrical origin in new homes as they age (beyond the reduction already resulting from previous code-mandated improvements) is speculative at best."

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