Real People
Make Up Life Safety

Changes to the Smoke Alarm + Detector Standards

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Vision matters.

ANSI/UL 217 8th Edition & ANSI/UL 268 7th Edition Smoke Detection Requirements

Revisions to ANSI/UL 217 and ANSI/UL 268

Vision matters.

- October 30, 2015, Underwriters Laboratories announced new requirements for UL 217: Standard for Smoke Alarms, 8th Edition.

  January 11, 2016, Underwriters Laboratories released UL 268: Standard for Smoke Detector Systems, 7th Edition.

  - More than 400 technical changes to the smoke detection standards, to keep pace with technological advancements within the industry.
  - Revisions reflect updates to criteria to reduce nuisance alarms and ensure detection and response to smoldering and flaming polyurethane foam.

The revised requirements will necessitate that the new smoke alarms and smoke detectors will be able to differentiate between smoke from cooking nuisances (such as toast) and other non-lethal sources from actual life-threatening smoke from a fire. These new UL standards and the resulting smarter smoke alarms and smoke detectors are perhaps the most significant technological change suppliers and facility managers have seen in recent times.

Importance of Smoke Detection

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Statistics show that smoke detectors and fire alarm systems save lives:

Residential fire deaths have decreased from 6,015 deaths in 1978 to 3,400 deaths in 2017

Non-residential fire deaths have decreased from 640 deaths in 1977 to 105 deaths in 2017

Hotel and motel fire deaths have increased from 62 in 1980 to 80 in 2017

US population has increased from 222.6 million people in 1978 to 325.7 million people in 2017.

Sources:

- Fire Loss in the U.S. During 2017, NFPA Ben Evarts Oct. 2018
- United States Census Bureau

Challenging Factors

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Factors that limit an occupant's ability to safely exit the dwelling or building during a fire:

- Escape Time
  - Required Safe Egress Time (RSET): Time between ignition and safe evacuation
    - Factors: A + P + M = RSET
      - Alarm time: occupant notification
      - Pre-movement: investigate, belongings, family
      - Movement: walking speed, egress elements
  - Available Safe Egress Time (ASET): Time between ignition and untenable conditions (empirical correlations or fire modeling)
    - Factors: Visibility, heat and carbon monoxide
- Waking effectiveness of the audible fire alarm signal
- Alarm activation time of the rate of detection of the smoke alarm or smoke detector

Decreased Escape Times

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The window of available safe egress time (ASET) in flaming fires has decreased:

- 1975: 17 minutes of ASET
- 2007: 3 minutes of ASET

The average ASET time for smoldering fires in the 1975 and 2007 tests were similar

Source:

- Performance of Home Smoke Alarms Analysis of the Response of Several Available Technologies in Residential Fire Settings (Dunes II) Richard W. Bukowski et al (February 2008)

Decreased Escape Times

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Dwellings and buildings today have increased in size and contain more synthetic materials

Average square footage of new single-family dwellings:

- 1973: 1,660 ft^2
- 2018: 2,565 ft^2

Construction methods are changing from using real wood lumber to engineered lumber and other synthetic materials.

Sources:

- United States Census Bureau: www.census.gov/construction/nrc/pdf/quarterly_starts_completions.pdf

Decreased Escape Times

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Furnishing manufacturers in the last 30 years have replaced natural fibers with lower-cost, man-made synthetic materials

- Natural materials: Legacy furnishings used harvested wood, cotton batting, linen, and silk
- Synthetic materials: Modern furnishings utilize polyurethane foam for padding and synthetic fabrics for covers

Combustion behavior between synthetic and natural materials are very different:

- Synthetic materials ignite and burn faster than natural materials used 40 years ago
- Generate higher heat and smoke release rates than the natural materials

Dangers of Synthetics

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- Rapid burn rate
- Burns hotter
- Reaches flashover at a faster rate
- Oxygen depletion
- Emit dense smoke and toxic gasses
  - Hydrogen cyanide (HCN)
  - Carbon monoxide (CO)
- Reduction in safe egress times (ASET & RSET)

Dangers of Synthetics

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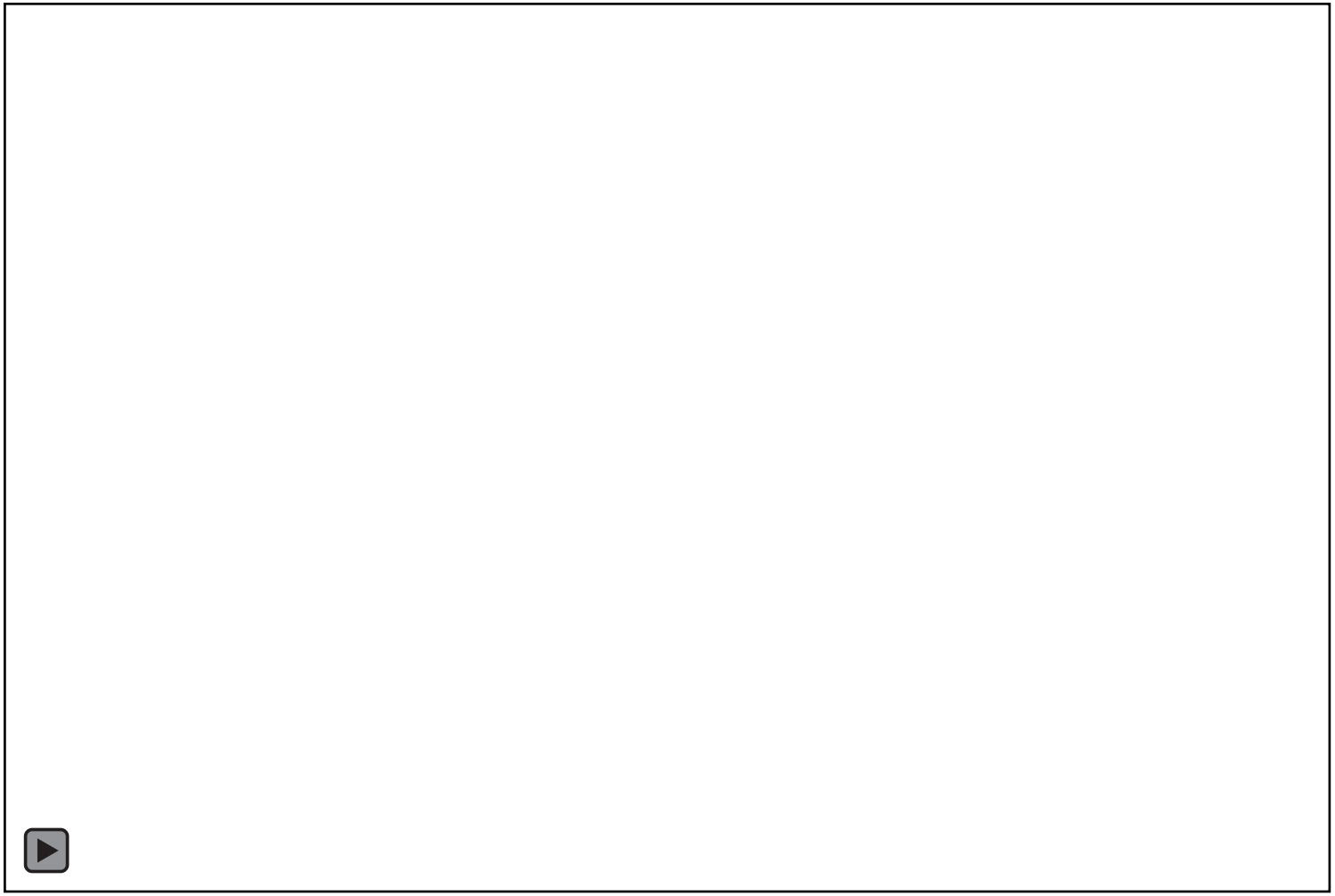
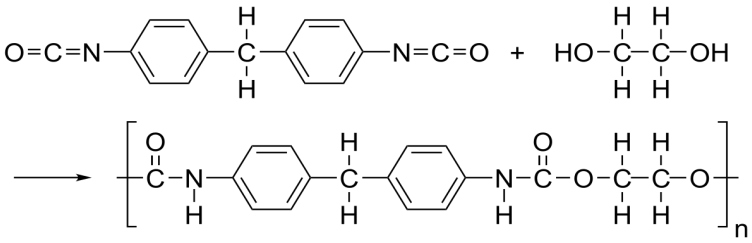


Polyurethane Uses

Vision matters.

- Closed cell flexible foam
  - Furniture
  - Mattresses
  - Carpet padding
- Rigid foam
  - Insulation
  - Noise reduction
- Coatings
  - Sealants for wood & concrete
  - Adhesives
- TPU & RIM
  - Automotive, construction, life safety products
- Thread
  - Garments & Sportswear



Polyurethane Characteristics

Why was Polyurethane Foam Used?

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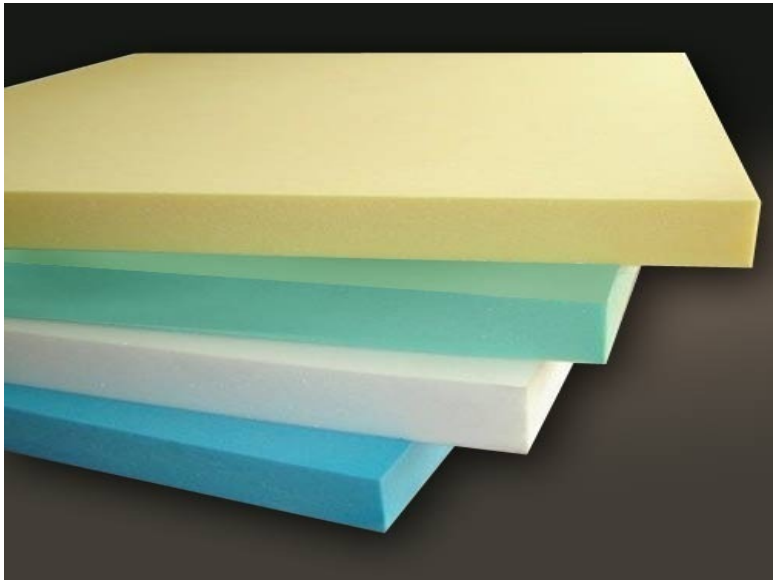
- Increase available egress time
- Expand detection responsiveness
- Expand range of particles, sizes and colors currently represented by ANSI/UL 217 and ANSI/UL 268
  - Unique particle signature
  - Unique burn: solid transitions to liquid
- Used in ANSI/UL 1636: Residential Sprinkler Standard
- Used in EN 54-7 Fire Detection and Fire Alarm Systems



Polyurethane Characteristics

Smoke Characterization Study

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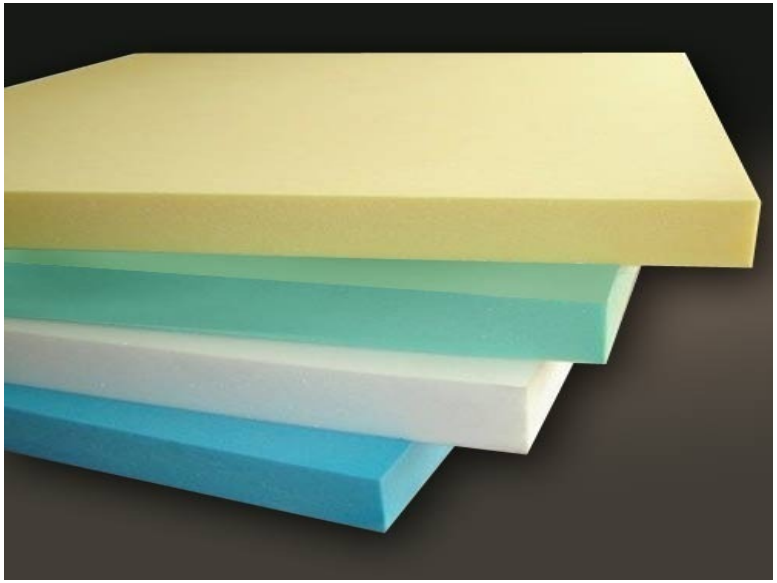
- Unique Particle Signature
  - Flaming polyurethane foam
    - Smallest particle tested approximately 0.05um
    - Black in color
    - Unique burn: solid transitions to liquid
  - Smoldering Polyurethane
    - Particle size is approximately 0.09um
    - Brownish-gold in color



Cooking Nuisance

History

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- Why are new resistance to cooking nuisance requirements needed?
  - Cooking is #1 source of nuisance alarms
  - Up to 73% of all nuisance alarms caused by cooking
  - In fires where smoke alarms were present, but did not operate 46% had missing or disconnected batteries
  - Nuisance alarms cause complacency

Cooking Nuisance

Frozen Hamburger Test

Vision matters.

- Characterization of Smoke Alarm Nuisance Sources from Cooking Scenarios
  - Determine best surrogate of all cooking nuisances
  - Develop requirements for the UL Standards
    - Broiling frozen hamburger best surrogate of all cooking nuisance sources all cooking scenarios: pizza, frying vegetables, bagels, bacon, toast, hamburger
    - Broiling frozen hamburger produces a broad range of particle diameters
      - Small particles initially, followed by larger particles: (0.01um to 1um)
      - Challenged all smoke alarm types: ionization, photoelectric & combination
      - Repeatable results

Flaming Polyurethane Foam Test

Vision matters.

- ANSI/UL 217 8th Edition
  - Section 51.4 Flaming Polyurethane Foam Test
- ANSI/UL 268 7th Edition
  - Annex I2 Flaming Polyurethane Foam Test

Flaming Polyurethane Foam Test

ANSI/UL 217 8th Edition: Section 51.4

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- 51.4.1.1.1: Pure polypropylene oxide polyol, polyether flexible foam using an 80/20 TDI blend: No colorants or fire retardants
- 51.4.2.1.1: *Sample size 14.5 x 17 x 3 inches
- 51.4.2.2.1: Sample conditioning: 73.4°F ± 3°F @ 50% ± 5% humidity for 48 hours prior to testing
- 51.4.2.3.1: *Placement: Aluminum foil lined tray placed on a non-combustible tile
- 51.4.2.4.1: *Point of Ignition
  - Corner of foam closest to alarm
  - 5mL of clean burning material (methylated spirit or denatured alcohol)
- 51.4.3.1: The smoke build rate must be in accordance with the beam and MIC smoke profiles

- 51.4.4.1: All five devices must activate on or before the 5 %/ft obscuration limit

* Exact arrangement may be varied to obtain valid test

Flaming Polyurethane Foam Test

ANSI/UL 217 8th Edition: Section 51.4

Vision matters.

Smoldering Polyurethane Foam Test

Vision matters.

- ANSI/UL217 8th Edition
  - Section 53 Smoldering Polyurethane Foam Test
- ANSI/UL 268 7th Edition
  - Annex I3 Smoldering Polyurethane Foam Test

Smoldering Polyurethane Foam Test

ANSI/UL 217 8th Edition: Section 53

Vision matters.

- 53.1.1.1: Pure polypropylene oxide polyol, polyether flexible foam using an 80/20 TDI blend: No colorants or fire retardants
- 53.2.1.1: *Sample size 14.5 x 17 x 4 inches
- 53.2.2.1: Sample conditioning: 73.4°F ± 3°F @ 50% ± 5% humidity for 48 hours prior to testing
- 53.2.3.1: *Method: Smoldering without transition to open flame. Smoldering may be induced by several means including: radiant heaters, hot plate, cartridge heaters
- 53.3.3: The smoke build rate must be in accordance with the beam and MIC smoke profiles*

- 53.4.1.1: All five devices must activate on or before the 12 %/ft obscuration limit

* Exact arrangement may be varied to obtain valid test

Smoldering Polyurethane Foam Test

ANSI/UL 217 8th Edition: Section 53

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Cooking Nuisance Smoke Test

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- ANSI/UL217 8th Edition
  - Section 54 Cooking Nuisance Smoke Test
- ANSI/UL 268 7th Edition
  - Annex I4 Cooking Nuisance Smoke Test

Cooking Nuisance Smoke Test

ANSI/UL 217 8th Edition, Section 54

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- 54.2.1: Electric range shall be used with electric coils used for broiling.
- 54.3.1: *Sample Size: 75/25 blend frozen hamburger, Approximately 3/4” thick x 4” diameter
- 54.3.2 Sample Conditioning -4 to -13F for at least 72 hours.
- 54.4.2.1 Two fresh-frozen hamburgers placed on broiler tray inside the electric range. With the door having an open gap of 4.5in. ± 1 in.

- 54.4.6.1: Smoke Profile Criteria
  - The smoke build rate must be in accordance with the beam and MIC smoke profiles
  - The CO limit shall not exceed 4.72 ppm @ 1.5 %/ft
  - All four devices must NOT activate prior to the 1.5 %/ft obscuration limit
  - The hamburgers cannot transition into flame

* Size may vary based on templates from butcher and packaging

Cooking Nuisance Smoke Test

ANSI/UL 217 8th Edition, Section 54

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Top of cooktop

Front of cooktop/range

Baking rack

Inside surface of range door

Front surface

Smoke Signatures

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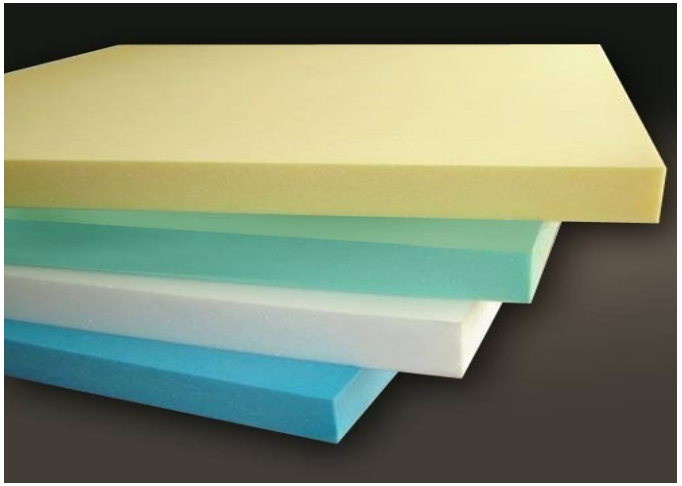
- Flaming Polyurethane Foam
  - Produces small particles 0.05um
  - Black
  - Dense
- Smoldering Polyurethane Foam
  - Produces medium particle size 0.09um
  - Brownish gold
  - Medium to heavy build
- Cooking Nuisance Resistance
  - Initially small particles (0.06um) followed by larger particles (0.09um)
  - Light gray
  - High MIC response – 59 to 49



Challenges to Manufacturers

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- Conventional photoelectric or ionization will not meet the new requirements
- Smarter detection required: multi-criteria
- Cost effective solutions
- Narrow production limits
  - 1.5 %/ft cooking nuisance limit
  - 5 %/ft flaming polyurethane foam limit
  - 12 %/ft smoldering polyurethane foam limit
- Compliance date

Compliance Dates

Vision matters.

- ANSI/UL 217 8th Edition: May 29, 2020
- ANSI/UL 268 7th Edition: May 29, 2020

- NFPA 72, 2016 Edition: January 1, 2022
- NFPA 72, 2019 Edition: January 1, 2022

Compliance Dates

NFPA 72, 2013 Edition

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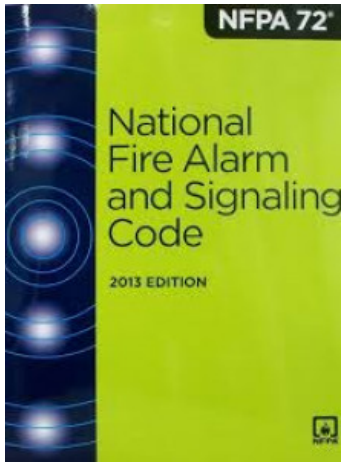
- NFPA 72, 2013 Chapter 29.7.3: **Resistance to Nuisance Source.** Effective January 1, 2019, smoke alarms and smoke detectors used in household fire alarm systems shall be listed for resistance to common nuisance sources.

- NFPA 72, 2013 Chapter 29.8.3.4(5): Effective January 1, 2016 smoke alarms and smoke detectors used in household fire alarm systems installed between 6 ft (1.8 m) and 20 ft (6.1 m) along a horizontal flow path from a stationary or fixed cooking appliance shall be listed for resistance to common nuisance sources from cooking.



Compliance Dates

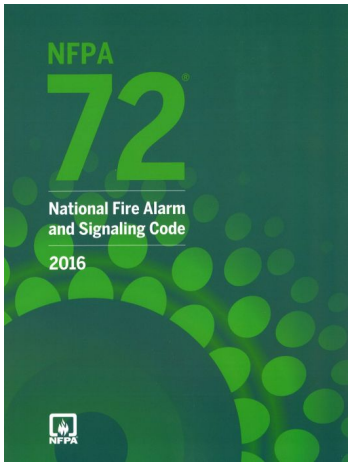
NFPA 72, 2016 Edition

Vision matters.

- NFPA 72, 2016 Chapter 29.7.3: **Resistance to Nuisance Source.** Effective January 1, 2019, smoke alarms and smoke detectors used in household fire alarm systems shall be listed for resistance to common nuisance sources.

- NFPA 72, 2016 Chapter 29.8.3.4(5): Effective January 1, 2019, smoke alarms and smoke detectors used in household fire alarm systems installed between 6 ft (1.8 m) and 20 ft (6.1 m) along a horizontal flow path from a stationary or fixed cooking appliance shall be listed for resistance to common nuisance sources from cooking.

- Tentative Interim Amendment (TIA)
  - TIA 1346 deleted in its entirety 29.7.3
  - TIA 1345 revise 29.8.3.4(5) to have an effective date of to January 1, 2022



Compliance Dates

NFPA 72, 2019 Edition

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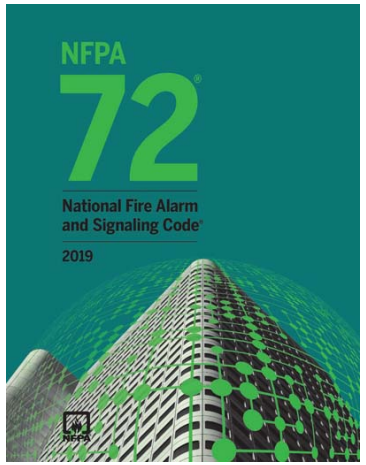
- NFPA 72, 2019 Chapter 29.11.3.4(6): Effective January 1, 2022, smoke alarms and smoke detectors installed between 6 ft. (1.8 m) and 20 ft. (6.1 m) along a horizontal flow path from a stationary or fixed cooking appliance shall be listed for resistance to common nuisance sources from cooking.



NFPA 72 Compliance

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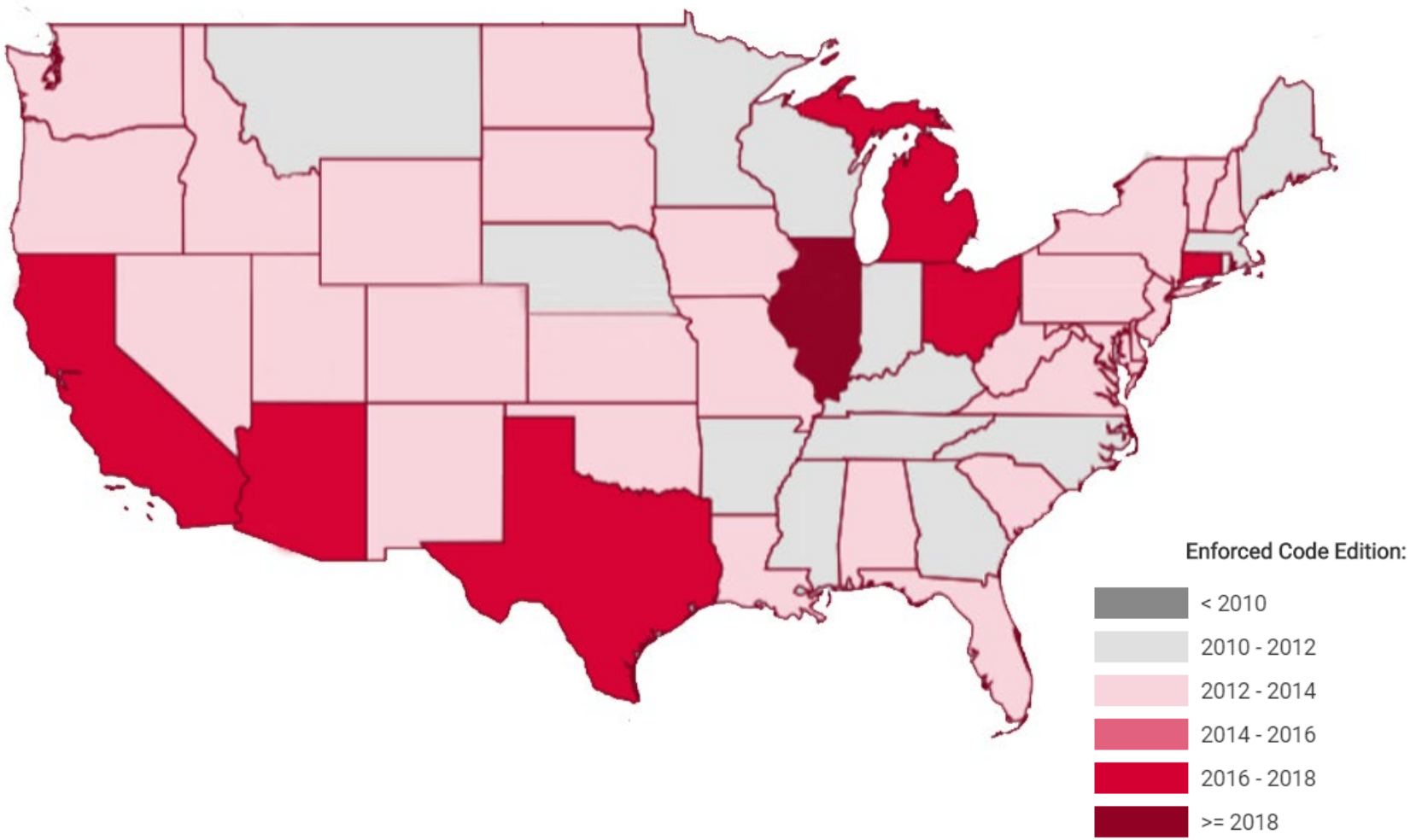

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