Smoke Alarms

Why are people dying in fires with working Smoke Alarms?

Andrea Dennis, Kyle Raulin, Al Schlessman, Erin DeMarco, and Christine Wilson

These five students died at Ohio State University on April 13, 2003

Julie Turnbull, Kate Welling & Steve Smith died in this house on April 10th, 2005 at Miami University

This Happens too Often

- **Nashville, TN**
- **(posted, Nov. 5, 2007)**

- **Debuty family loses three of their children in a fire.**

- **Reporter Krause: "At what point did you hear your smoke detector?" Amanda Debuty: "Never. They never went off."**

This Happens too Often

- **Chickasaw, Alabama**
- **(May 28, 2008)**

- **11-year-old Kentarian Williams died after he could not make it out of the family house.**
- **The Williams family blames smoke detectors that never went off.**
- **“they do not work when a house fills with smoke or they sound very late..”..Williams attorney Richard Taylor**

This Happens too Often

- **Cleveland Plain Dealer**
- **October 17, 2008**

- **Fire started by electrical problem kills 27 year old Brett McDavid.**

- **"McDavid's battery-powered smoke detector failed to operate investigators said in their initial report."**

This Happens too Often

- **Montpelier VT.**
- **(December 18, 2005)**

- **Mother and three children die in apartment fire.**

- **"The apartment had three hardwired ionization smoke detectors, including one in the girls room…none of them went off despite thick smoke."….Russell Ashe, Deputy Chief for the Barre City Fire Department**

This Happens too Often

- **Ft. Wayne, IN**
- **(January 23, 2009)**

- **Three college girls die from smoke inhalation after being rescued from apartment complex.**

- **"at least two residents of the apartment told the News-Sentinel they woke around 5 a.m. not to a smoke alarm but to a roommate coughing…Heid said she heard from other students whose apartment was completely full of smoke and their alarms did not sound either."**

HOME STRUCTURE FIRES
Marty Ahrens
January 2009
National Fire Protection Association
Fire Analysis and Research Division

"Roughly half of all home fire deaths result from incidents reported between 11:00 p.m. and 7:00 a.m."

Fire Deaths and Injuries: Fact Sheet
Centers For Disease Control and Prevention

- **Most victims of fires die from smoke or toxic gases and not from burns** (Hall 2001).

- **Smoking is the leading cause of fire-related deaths** (Ahrens 2009a).

THE SMOKING-MATERIAL FIRE PROBLEM

John R. Hall, Jr.
Fire Analysis and Research Division
National Fire Protection Association
November 2007

Home smoking-related fire deaths are more likely to occur in fires that start in the living room, family room, or den than in the bedroom.

" these rooms together account for roughly two-thirds of home smoking-related fire deaths, but **the combination of living rooms, family rooms and dens account for more fire deaths than bedrooms."**

Activity at Time of Victim's Fatal Injury
by Smoke Alarm Presence and Operation
in Home Structure Fires Reported in Version 5.0 of NFIRS
1999-2001 Annual Averages

Activity	Present and Operated	Present but Didn't Operate	None Present
Sleeping	**38%**	57%	49%
Escaping	**21%**	20%	27%
Unable to Act	10%	14%	11%
Fire Control	9%	2%	1%
Rescue Attempt	7%	2%	4%
Irrational Act	7%	0%	5%
Unclassified Activity	5%	4%	1%
Returning to Vicinity of Fire before control	4%	0%	2%
Total	100%	100%	100%

Note: Percentages were calculated on known data only.
Source: **National estimates based on NFIRS and NFPA survey**

Smoke Detector History

- **SMOKE DETECTORS – "FIRE SAFETY'S GREATEST SUCCESS STORY" – NIST**

- **Smoke Detector usage rose from 10% in 1975 to 95% in 2000 while home fire deaths were cut in half.**
- "The home smoke alarm is credited as the greatest success story in fire safety in the last part of the 20th century, because **it alone** represented a highly effective fire safety technology with leverage on most of the fire death problem that went from token usage to nearly universal usage in the short term."

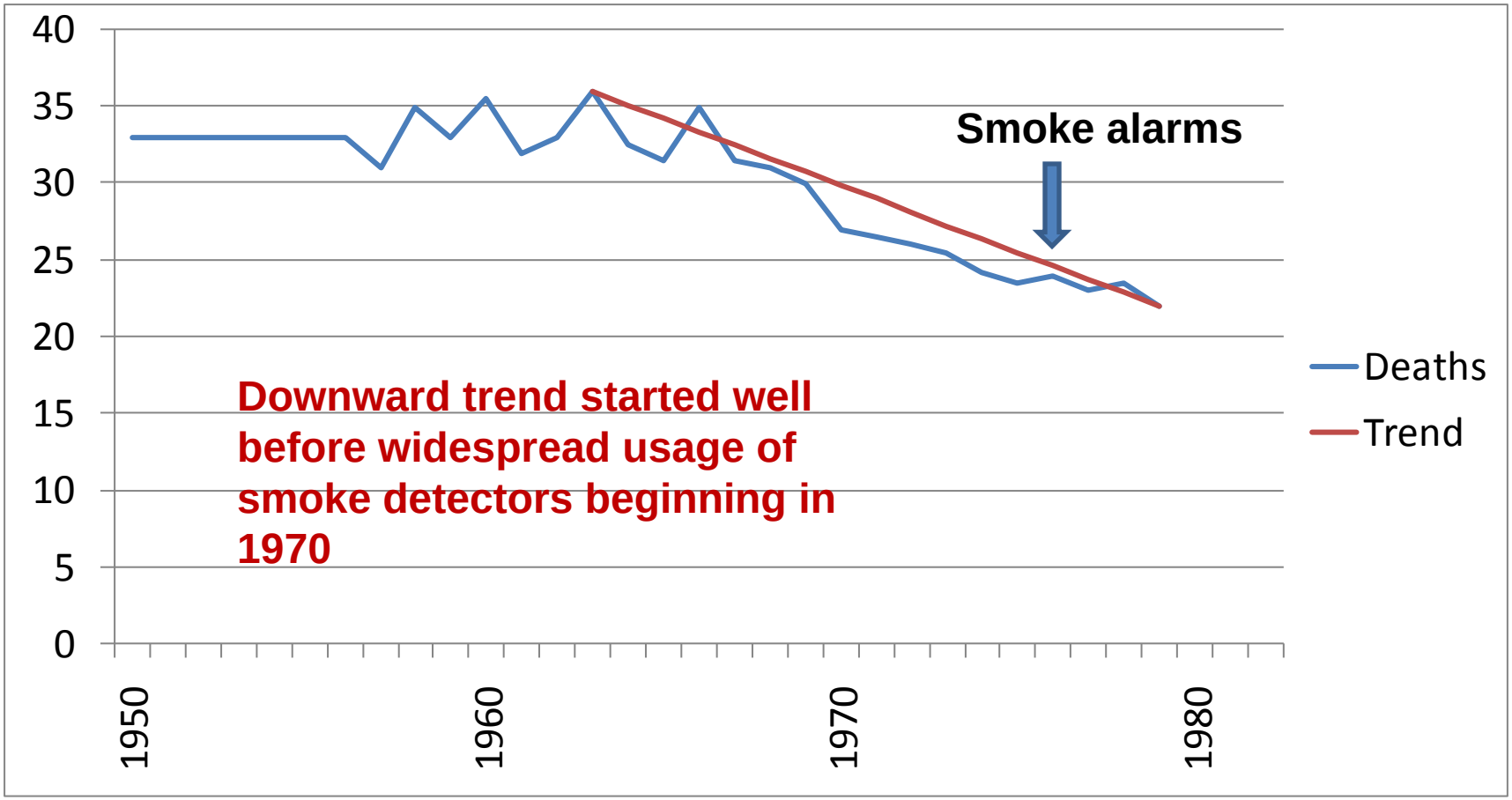
- NIST, 2004

IS THE REDUCTION IN FIRE DEATHS DUE TO SMOKE DETECTORS?

- There has been a dramatic increase in full spectrum burn centers.
- Significant reduction in people who smoke.
- Fire retardants have been added to mattresses and furniture.
- Building codes and inspections have improved.
- Improvements in wiring and fire related construction.
- Home-heating deaths have decreased by over 70%.

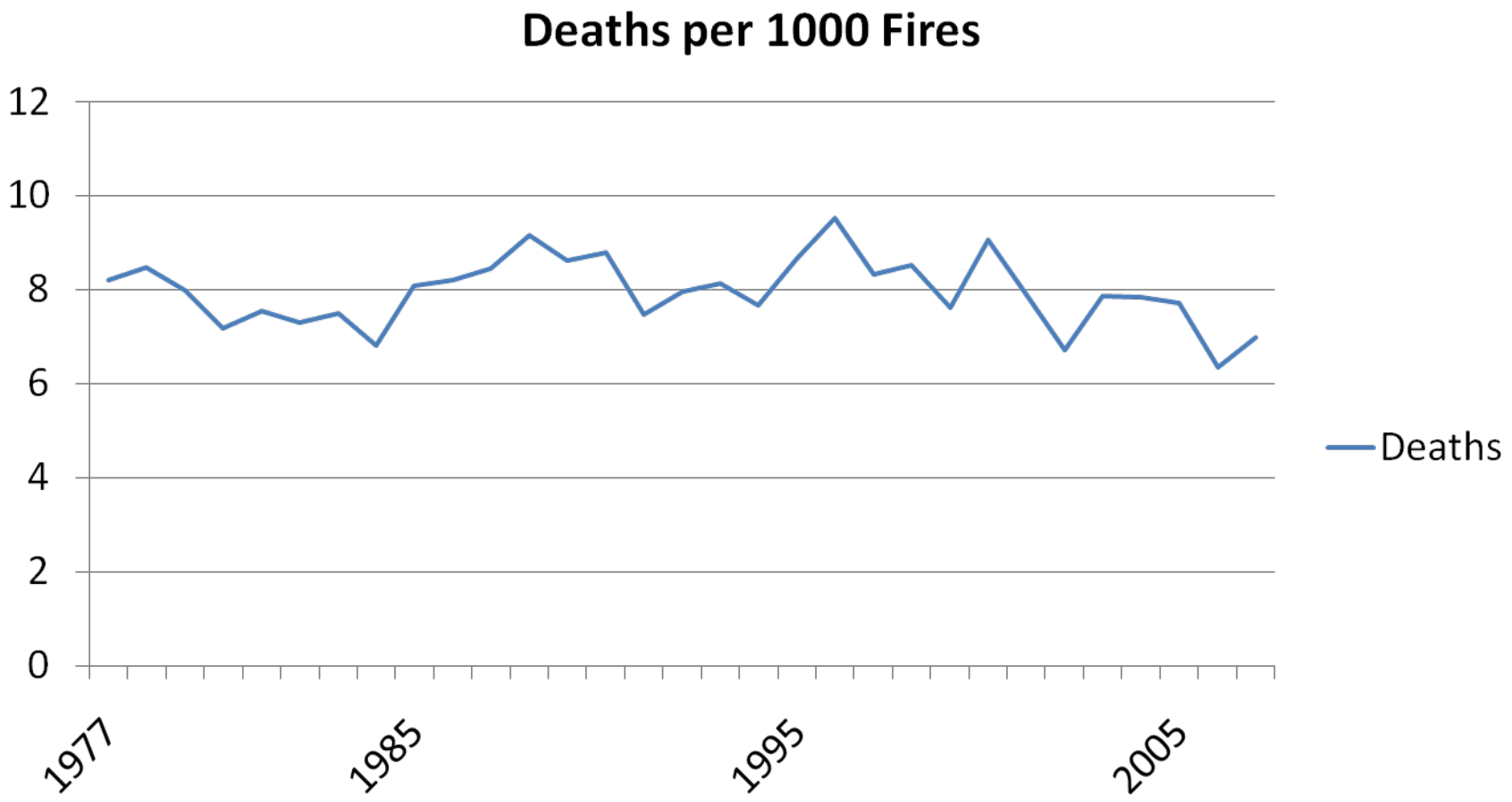
Fire deaths have gone down because there are fewer fires

Fire Deaths per Million People 1950 - 1980



Civilian deaths per million people from fire and flame in the United States, (1950, 1955-1979) Source: National Safety Council

The number of deaths has remained constant for the last 30 years, 8 deaths for every 1,000 fires.



National Fire Protection Association
The authority on fire, electrical, and building safety

The U.S. fire problem

Residential structure fires

Year	Fires	Civilian Deaths
1977	750,000	6,135
1981	733,000	5,540
1989	513,500	4,435
1997	406,500	3,390
2005	396,000	3,055

Source: NFPA survey

WHITE PAPER

HOME SMOKE ALARMS
AND OTHER FIRE DETECTION
AND ALARM EQUIPMENT
Public/Private Fire Safety Council
April, 2006

"The home fire death rate relative to number of fires is essentially unchanged from 1977 to 2003.[3]"

3. Rates are calculated using fire statistics from reference [1] and previous reports in series, and population data from *Statistical Abstract of the United States 2004-2005, U.S. Census Bureau, Washington, DC, 2004.*

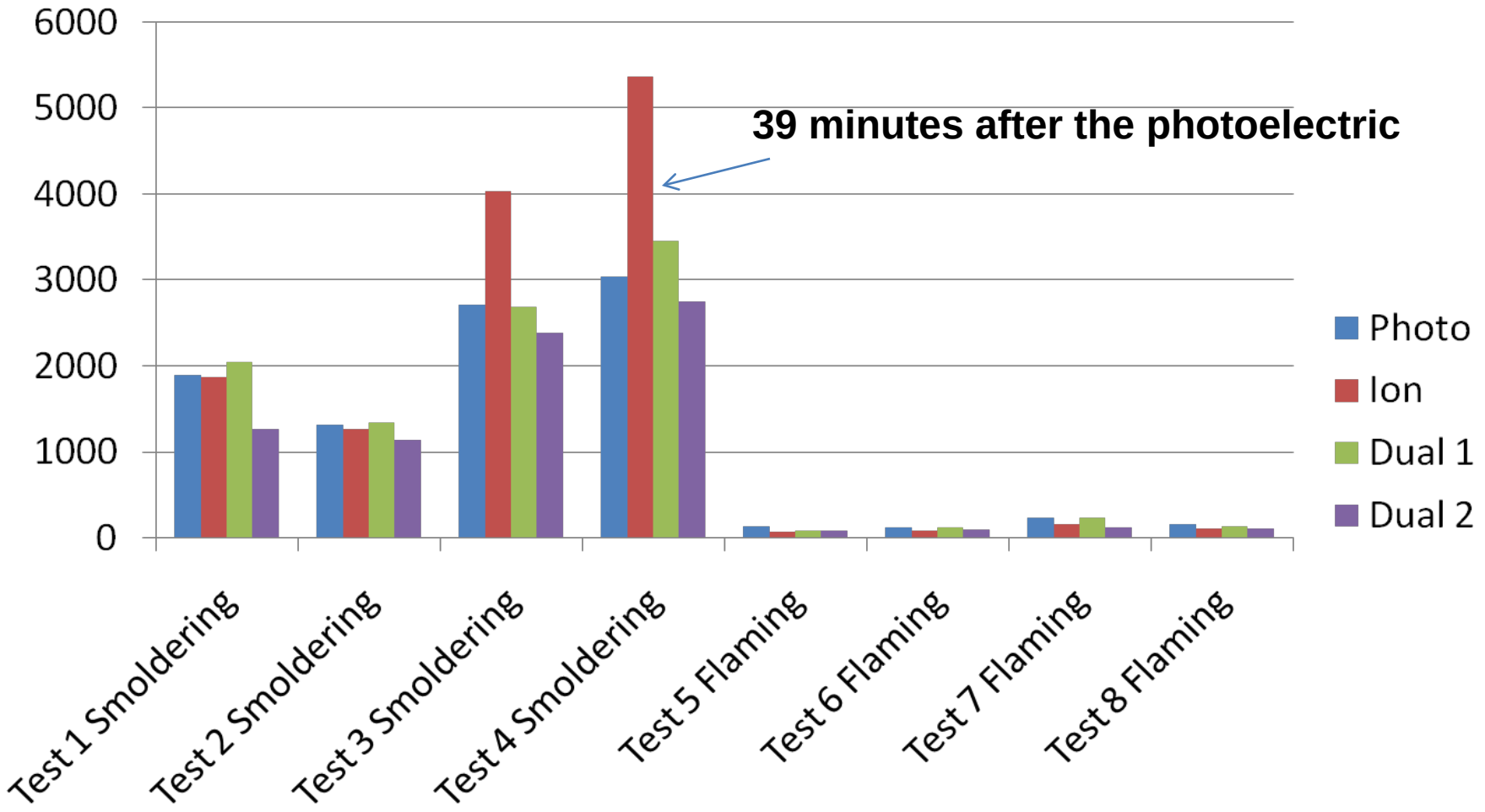
IONIZATION: Contains a small amount of radioactivity that conducts electricity. Electric current flows continuously between two electrodes in the chamber. When smoke particles enter, they disturb the flow, causing the alarm to go off.

PHOTOELECTRIC: Contains a beam of light and a photocell within the chamber. When smoke enters, it deflects the beam, causing it to strike the photocell and set off the alarm.

IONIZATION VS. PHOTOELECTRIC: Ionization alarms are more sensitive to the tiny particles of combustion that can't be seen or smelled, those emitted by flaming fires. Photoelectric alarms are more sensitive to the large particles of combustion emitted by smoldering fires.

NIST 2008

ALARM TIMES IN SECONDS



The photoelectric is blue

The ionization is red

A S E T
How much time you have to escape a fire

Flaming	Photoelectric	Ionization	Dual Ion/Photo
Living Room	108	152	
Living Room (Rep)	134	172	
Full-Furnish (LM)	144	172	
Bedroom	350	374	
Bedroom (closed)	3416	3438	
SMOLDERING	SMOLDERING	SMOLDERING	SMOLDERING
Living Room	**3298 (55min)**	**16**	3332
Living Room (AC)	**2773 (46min)**	**(-54)**	2108
COOKING	COOKING	COOKING	COOKING
Kitchen	952 (16min)	278 (5min)	934

NIST Technical Note 1455-1 (page 243 and is two story alarm on each level, ASET in seconds) February 2008 Revision Performance of Home Smoke Alarms Analysis of the Response of Several Available Technologies in Residential Fire Settings

A Message from the U.S. Fire Administrator about Home Smoke Alarms

Posted on August 27, 2008 by Gregory B. Cade, U.S. Fire Administrator

In co-operation with the United States Fire Administration (USFA), other sponsors, and U.S. Consumer Product Safety Commission (CPSC), NIST has conducted an evaluation of current and emerging smoke alarm technology responses to common residential fire scenarios and nuisance alarm sources**.**

- **Smoke alarms of either the ionization type or the photoelectric type consistently provided time for occupants to escape from most residential fires**, although in some cases the escape time provided can be short.
- **Consistent with prior findings, ionization type alarms provided somewhat better response to flaming fires than photoelectric alarms, and photoelectric alarms provide (often) considerably faster response to smoldering fires than ionization type alarms.**

NIST sponsored conference-response times are given in seconds

UL 268 Tests Ionization 1.3% Photoelectric 2.5%		Distance From Test Fire (Ceiling Position #)					
		8.0 ft		17.7 ft.		19.2 ft.	
Test	Device	(2)	(3)	(5)	(6)	(1)	(2)
UL 268 Smold. Smoke	Ion	3459	3317	3843	3614	3864	3591
	Photo	2421	2253	2916	2916	2726	2823
Diff. of Avg. Time (Ion – Photo)		**1038**	**1064**	**927**	**698**	**1138**	**768**
UL 268 Flamm. Liquid	Ion	31	36	61	56	65	65
	Photo	26	29	55	55	57	57
Diff. Avg. Time (Ion – Photo)		**5**	**7**	**6**	**1**	**8**	**8**

[4] Qualey, J, Desmarais, L, and Pratt, J.; Fire Test Comparisons of Ion and Photoelectric Smoke Detector Response Times; Fire Suppression and Detection Research Application Symposium, Orlando, FL, February 7 - 9, 2001

UL 268 Tests Ionization 0.5% Photoelectric 0.5%		Distance From Test Fire (Ceiling Position #)					
		8.0 ft		17.7 ft.		19.2 ft.	
Test	Device	(2)	(3)	(5)	(6)	(1)	(2)
UL 268 Smold. Smoke	Ion	3318	3236	3691	3471	3677	3474
	Photo	1556	1577	2008	2008	1854	2002
Diff. of Avg. Time (Ion – Photo)		**1762**	**1659**	**1683**	**1463**	**1823**	**1472**
UL 268 Flamm. Liquid	Ion	29	31	60	56	65	63
	Photo	18	20	45	45	53	52
Diff. Avg. Time (Ion – Photo)		**11**	**11**	**15**	**11**	**12**	**11**

[4] Qualey, J, Desmarais, L, and Pratt, J.; Fire Test Comparisons of Ion and Photoelectric Smoke Detector Response Times; Fire Suppression and Detection Research Application Symposium, Orlando, FL, February 7 - 9, 2001

From the AUBE ’01 Conference/ NIST

Results of the Tests

The data for the smoldering smoke tests show that typically the **photoelectric detectors set to 2.5 %/ft responded 12 - 18 minutes earlier than the Type A ion detectors set to 1.3 %/ft.** Table 2 shows that **when both were evaluated at 0.5%/ft, the photoelectric detectors typically responded 25 - 30 minutes faster than the Type A ion detectors**. As Tables 1 and 2 show, **in the UL 268 Flammable Liquid Fire tests, there was no significant difference in response time between the photoelectric** and Type A ion detectors whether compared at their default sensitivities (2.5 %/ft and 1.3 %/ft) or the same, higher sensitivity (0.5 %/ft).

- **Statement in Report: "Note that not all ions alarmed in all smoldering tests."**

  According to NIST in 2001

Manufacturers Adjusting Sensitivity Levels (Dual Sensor Alarms)

In current practice manufacturers may set alarm sensitivities in dual photoelectric/ionization alarms less sensitive than in individual sensor alarms with the intent to reduce nuisance alarms.

Ideally the response of dual ionization/photoelectric units should not lag significantly behind the collective response of individual units, especially to flaming fires. Further evaluation of the dual ionization/photoelectric smoke alarms should be conducted to establish the set point characteristics that allow for effective alarm response comparable to individual units, while recognizing that set point changes may also be beneficial in the reduction of false alarms.

(NFPA Task Group of Technical Committee, February 2008)

Performance of Dual Photoelectric/Ionization Smoke Alarms in Full-Scale Fire Tests

Thomas Cleary
Building and Fire Research Laboratory
National Institute of Standards and Technology
Gaithersburg, MD
(301) 975-6858
thomas.cleary@nist.gov

Abstract

The UL Standard 217, "*Single and Multiple Station Smoke Alarms" allows for dual sensor alarms so long as the each sensor is primarily a smoke sensor and the design meets the Standard [6]. The alarm logic is an {OR}-type such that the alarm is activated if either the photoelectric sensor or ionization sensor alarm threshold is met.* ***The individual sensor sensitivities are not tested separately. Therefore, manufacturers have the freedom to set each sensor's sensitivity separately. Since an individual sensor can be set to meet all current sensitivity standards, it is not obvious what overall benefit is achieved from a dual alarm with an additional sensor technology that could be more or less sensitive than what would be found in a standalone unit employing such a sensor****. Additionally, another potential benefit of a dual sensor alarm may be realized by adjusting each sensor's alarm threshold to reduce nuisance alarms. Thus, the sensitivity of each sensor factors into the overall performance of a dual alarm.*

- *Presented at the Fire Protection Research Foundation's 13th annual Suppression and Detection Research & Applications Symposium (SUPDET 2009**), February 24-27, 2009**, Orlando, FL*

"The individual sensor sensitivities are not tested separately. Therefore, manufacturers have the freedom to set each sensor's sensitivity separately. Since an individual sensor can be set to meet all current sensitivity standards, **it is not obvious what overall benefit is achieved from a dual alarm** *with an additional sensor technology that could be more or less sensitive than what would be found in a standalone unit employing such a sensor".*

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Abstract

Over a range of ionization sensor settings examined, dual alarm response was insensitive to the ionization sensor setting for initially smoldering fires and fires with the bedroom door closed, while dual alarm response to the kitchen fires was very sensitive to the ionization sensor setting. **Tests conducted in the National Institute** of Standards and Technology (NIST) fire emulator/detector evaluator **showed that the ionization sensors in off-the-shelf ionization alarms and dual alarms span a range of sensitivity settings.** While **there appears to be no consensus on sensitivity setting for ionization sensors,** it may be desirable to tailor sensor sensitivities in dual alarms for specific applications, such as near kitchens where **reducing nuisance alarms may be a goal**, or in bedrooms where higher smoke sensitivity may be a goal.

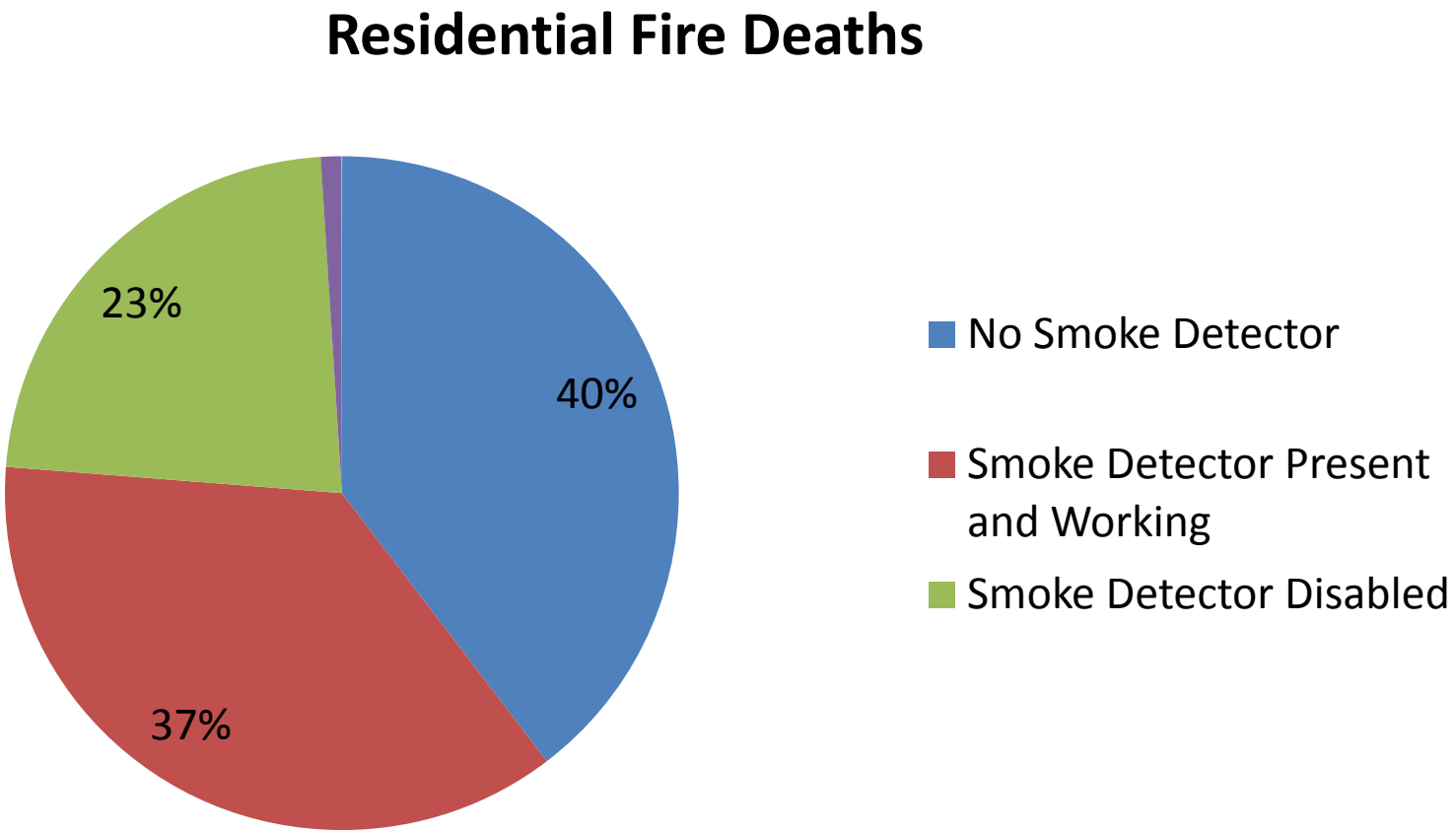
Presented at the Fire Protection Research Foundation's 13th annual Suppression and Detection Research & Applications Symposium (SUPDET 2009), **February 24-27, 2009, Orlando, FL**.

Video

- UL Testing Video

Smoke Alarm Presence and Performance

September 2009 NFPA Report by Marty Ahrens



Everyone That Purchased a Smoke Alarm but Died Anyway

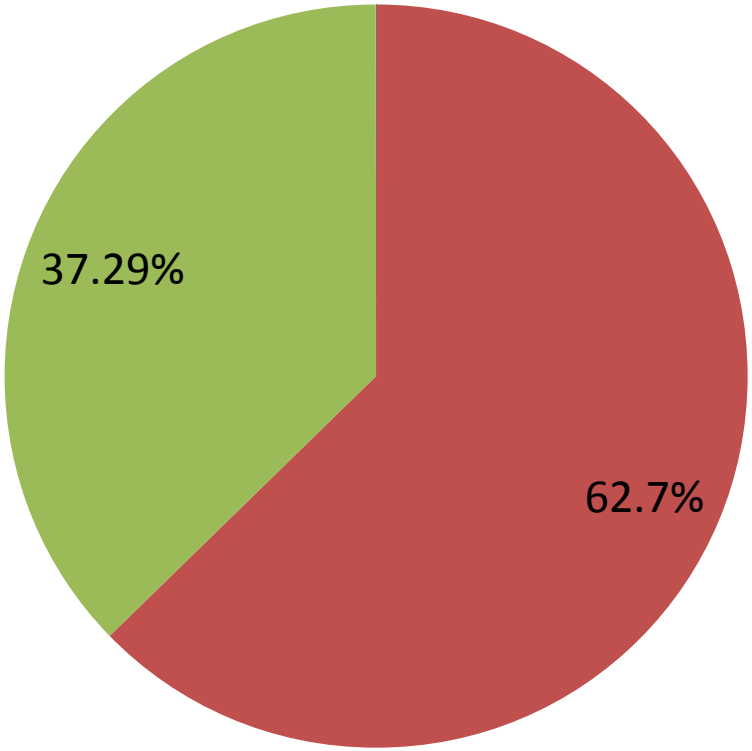
Non-Working Alarm

Factors

Dead Battery

Removal of Battery

Removed due to Nuisance alarm problems



Working Alarm

Factors

Victim Intimate with fire

Behavioral /Physical Factors

Technology Failure (Alarm didn't operate) (Signaled too late)

Additional Statement of Record to Boston City Council Committee on Public Safety from NIST on August 6, 2007

In NIST's smoke alarm research, and in applications in the field, it is documented that most common ionization detectors have a propensity to produce nuisance alarms during cooking activities. NIST examined a broad range of activities (including cooking) that yield nuisance alarms. The published field observations guided the nuisance alarm scenarios studied. Specifically, the sensitivity to alarm threshold, distance from the source, background air flows, and alarm sensor (photoelectric or ionization) were examined. Additional measurements were made with aerosol instrumentation to provide a more fundamental understanding of nuisance alarm sources than has been previously published. **Given the scenarios examined, both photoelectric and ionization alarms produced nuisance alarms, but NIST does not mean to imply that they are equally susceptible to such nuisance alarms**. **Most field data suggest that ionization alarms have a greater propensity to nuisance alarm than photoelectric alarms,** possibly indicating that certain activities such as cooking dominate reported nuisance alarms in the field.

- **Here you can see NIST goes on record that ionization alarms have "greater propensity" to nuisance alarm problems.**

Alaskan Nuisance Alarm Study

- A study of Alaskan Eskimo villages, published in 2000, found that ionization smoke alarms had a significantly higher number of nuisance alarms than photoelectric smoke alarms when installed 10 to 15 feet from a nuisance source. (Fazzini, Perkins & Grossman 2000) For the study, the researchers installed both ionization and photoelectric type smoke alarms in homes with less than 1,000 square feet of living space. The smoke alarms were installed on the ceiling between 10 to 15 feet from a cooking and the heating sources. **The study found 92% of homes with ionization smoke alarms experienced nuisance alarms compared with only 11% of homes with photoelectric smoke alarms, a ratio of more than 8 to 1. After six months, 19% of the installed ionization smoke alarms had been disconnected compared to only 4% of the installed photoelectric smoke alarms,** which had batteries removed. The authors report that **even though the ionization smoke alarms had silencing or hush buttons that allowed quieting the unit for 10 minutes, the batteries were still removed from the unit because of frequent nuisance alarming.**

- **(Harborview Injury and Research Center, Seattle, WA, NIST Report)**

"False Alarms and Unwanted Activations"

From:

U.S. EXPERIENCE WITH SMOKE ALARMS
AND OTHER FIRE DETECTIONAL/ALARM EQUIPMENT

By: Marty Ahrens
Fire Analysis and Research Division
National Fire Protection Association

- **Ionization devices had a disproportionate share of nuisance alarms**.
- Cooking smoke tends to contain more of the smaller particles (less than one micron) that activate an ionization-type device rather than the larger particles that activate a photoelectric-type device. In the National Smoke Detector Project, **97% of the devices tested for involvement in nuisance alarms were ionization-type devices.**
- Most people do not automatically assume a sounding smoke alarm is an emergency situation. In some cases, they know what caused the alarm and know that they are safe. However, lives have been lost when real alarms were mistakenly considered false. Unwanted activations can generate a dangerous sense of complacency.

The National Fire Protection Association commissioned Harris Interactive to conduct the *Fire Prevention Week Survey.*
(Below are a few of the finding)

Virtually all Americans currently have a smoke alarm installed in their homes.

Four out of ten have had their smoke alarms go off in the past twelve months.

****Fewer than one in ten thought that their smoke alarm going off meant there was a fire or that they had to get out. Those with children are more likely than those without to think this.***

* ***The actual number is 8% thought there was a fire or they had to vacate.***

Marty Ahrens
Fire Analysis and Research Division
National Fire Protection Association
November 2004

1/3 of alarms cited for nuisance activations were located incorrectly.
Nuisance alarm problems often can be addressed by moving the device to a different location or by switching from ionization-type to photoelectric-type devices. One-third of the devices studied for nuisance alarms in the National Smoke Detector Project were reportedly in locations that made nuisance alarms more likely, often less than five feet from a potential source of smoke, steam, or moisture sufficient to produce nuisance alarms.

Move your alarm or switch to a photoelectric alarm.

Everyone That Purchased a Smoke Alarm but Died Anyway

Non-Working Alarm

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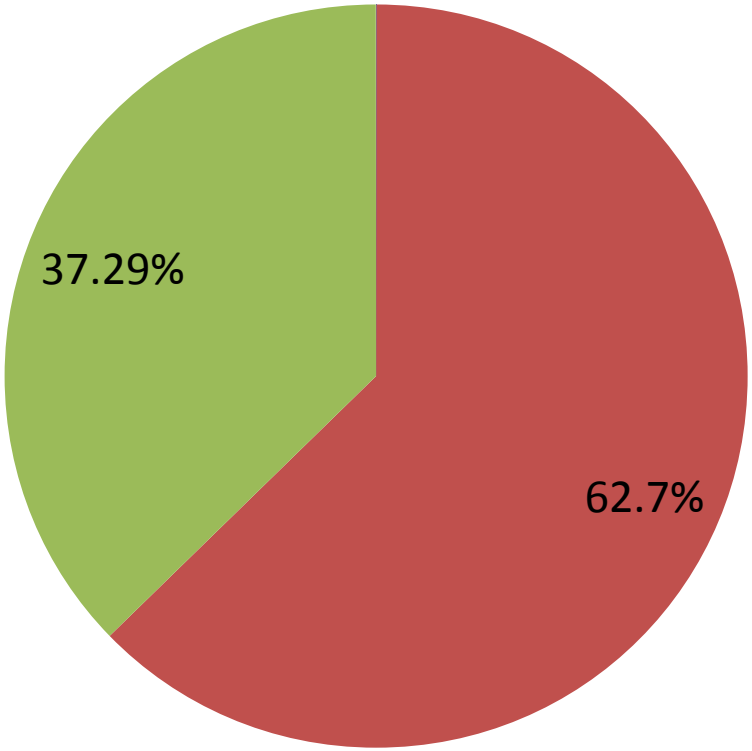
Removal of Battery

Removed due to Nuisance alarm problems



Working Alarm

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Technology Failure (Alarm didn't operate) (Signaled too late)

Statement for the Record

National Institute of Standards and Technology

To the

Boston City Council Committee on Public Safety

August 6, 2007

- **In summary, the research conducted by NIST staff leads to the conclusion that both ionization and photoelectric alarms provide enough time to save lives for most of the population under many fire scenarios; however, ionization alarms may not always alarm even when a room is filled with smoke from a smoldering fire,** exposing the most sensitive populations with mobility limitations to an undetermined risk**. Photoelectric detectors** can provide **a lot more warning time** than ionization detectors in a smoldering fire; at the same time a smoldering fires can take a longer period to become dangerous. **Ionization detectors** can provide **a little more time** than photoelectric detectors in a flaming fire; in this case there can be little time to spare. Changes in furnishing materials and construction over the past decades have reduced the time available for safe egress in any fire. NIST is currently conducting research to assess whether or not modifications may be needed in the standard test method for certifying residential smoke alarms to accommodate the changing threat.

Statement for the Record
National Institute of Standards and Technology
To the
Boston City Council Committee on Public Safety
August 6, 2007

"however, ionization alarms may not always alarm even when a room is filled with smoke from a smoldering fire."

Texas A&M Study

Risk Analysis of Residential Fire Detector Performance

- "The development of the risk analysis offered a clear insight into why **there continues to be a high residential death rate in spite of an increase in the residences reported to have smoke detectors installed**.

- The current thought process demonstrated by fire officials in the position to make recommendations, has been to just install a smoke detector in the home without consideration as to the type of potential fire ignition that most frequently occurs or to the quality of the fire detector."

- "A review of the risk analysis provides a clear example of the probability of a detector failure if there is no consideration as to the risk involved with the use of the various types of fire detectors."

- "As illustrated in the article, the various types of fire detectors provide different levels of risk which supports the need for a change in the current thought process of many fire officials. Certain types of fire detectors are more reliable for the different types of fires, therefore, recommendations as to the type and location of the fire detector should include the type of fire ignition that would most likely occur and the most reliable detector that can be installed in that location."

- "For example, during a smoldering ignition fire, the photoelectric smoke detector offered the most reliable method of detecting the fire while the room of origin was still in a tenable condition."

- **"The probability of the failure of the photoelectric detector to detect a smoldering ignition fire is 4.06% while the ionization detector provided a 55.8% probability of a failure in a similar type of fire.** This high probability of a failure of the ionization detector can be contributed to a number of factors such as performance under normal conditions and an inability to consistently detect smoldering smoke particles. This is a very important consideration since most of the fires that occur in residences start out as smoldering ignition fires."

- **"During a flame ignition fire, the photoelectric smoke detector had a 3.99% probability of a failure to detect the fire while the ionization smoke detector probability of failure to detect the fire is 19.8%."**

Detection of Smoke:
Full-Scale Tests With Flaming and Smouldering Fires
ØYSTEIN MELAND and LARS EINAR LØNVIK SINTEF
NBL- Norwegian Fire Research Labaratory
N-7034 Trondheim Norway

During smoldering fires it is only the optical detectors that provide satisfactory safety.

With flaming fires the ionization detectors react before the optical ones. If a fire were started by a glowing cigarette, optical detectors are generally recommended.

If not, the response time with these two types of detectors are so close that it is only in extreme cases that this difference between optical and ionization detectors would be critical in saving lives.

Everyone That Purchased a Smoke Alarm but Died Anyway

Non-Working Alarm

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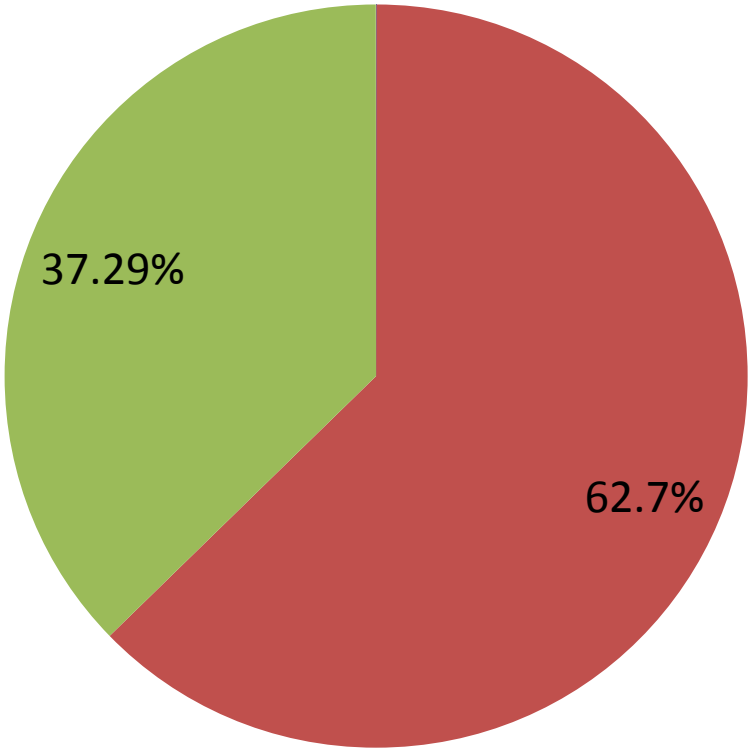
Dead Battery

Removal of Battery

Removed due to Nuisance alarm problems



Working Alarm

Factors

Victim Intimate with fire

Behavioral /Physical Factors

Technology Failure (Alarm didn't operate) (Signaled too late)

Endorsements

	Ion	Photo	Dual Sensor	Buy one of each
IAFF (International Association of Fire Fighters)		X		
IAFC (International Association or Fire Chiefs)			X	
NFPA (National Fire Protection Association)				X
USFA			X	X
CPSC				X
NIST				X
World Fire Safety Foundation		X		
AFAC (Australasian Fire Authorities Council)		X		
NASFM			X	X

Don't Just Change Your Batteries – Change Your Smoke Detector, Too

- *Washington, DC* – The International Association of Fire Fighters (IAFF) is urging households to change more than just smoke alarm batteries when Daylight Savings Time ends November 2. The IAFF also recommends changing to a photoelectric smoke alarm. About 90 percent of homes are equipped with ionization smoke alarms.

Click

The International Association of Fire Chief's Residential Smoke Alarm Report (9/80, excerpt)

The Fire Chief's Recommendation

What kind of detector should the fire chief recommend - ionization or photoelectric? The answer to this question, in the subcommittee's opinion, is clear.

It is the subcommittee's belief that only the photoelectric detector will meet the requirements reliably when subjected to both open flame and smoldering fires.

The subcommittee believes this has been proven time after time throughout the country in actual tests conducted by manufacturers and fire departments (see Appendix A).

To: Local Fire Service Administration
From: First Alert
Date: July 17, 2008
Re: Photoelectric-Specific Legislation

The Vermont State Legislature recently approved Senate Bill 226 requiring photoelectric-type smoke alarms to be installed in new and existing single-family homes. This bill was signed by Governor Jim Douglas on Thursday May 29, 2008 for passage into law. Massachusetts already abides by a state law that mandates the usage of photoelectric smoke alarms near specified rooms. Similar legislation is pending in Tennessee House Bill 2528 and Senate Bill 2600. Smoke sensing technology type policy discussions are also being discussed in Indiana, Iowa, Ohio, Utah, and California. **Clearly there is a growing consensus within state legislatures as well as the fire service community that favors photoelectric technology.** First Alert has played a crucial role in a tremendous industry effort to inform consumers on the importance of the home safety technologies; and more specifically the differences between smoke sensing technologies. In light of recent studies and ongoing industry-performed field research regarding the comparison of photoelectric and ionization smoke alarms, First Alert is offering the following two scientifically substantiated determinations:

BRK/First Alert Letter (continued)

- **1. Field research indicates photoelectric smoke alarms exhibit significantly fewer nuisance alarms than ionization smoke alarms.** (1 2)

- **2. To silence a triggered smoke alarm, about 22% of consumers will remove the battery, leaving the alarm inoperable and potentially putting the residence and its occupants at risk should a true fire occur.** (3)

- **Considering photoelectric smoke alarms are determined by industry experts to be significantly less prone to nuisance alarm and potential disabling of the batteries by consumers, we support and encourage fire service administration and lawmakers that are moving toward the use of photoelectric smoke sensing technology.** In addition, First Alert aims to reassure all public safety advocates that ours is an organization that actively supports our consumers amidst this safety-related legislation.

- 1 Cleary, Thomas. *Residential Smoke Alarm Performance. Building and Fire Research Laboratory, National Institute of Standards and Technology. UL Smoke and Fire Dynamics Seminar. November, 2007.*
- 2 Mueller, B.A. *Randomized controlled trial of ionization and photoelectric smoke alarm functionality. Injury Prevention BMJ, 2008; 14;80-86.*
- *3 1997 Fire Awareness/Escape Planning Study for National Fire Protection Association, Quincy, MA, August 1997, Tables 3 & 4.*

Applied Research
Office of the Fire Marshal
March 2005
(updated February 2006, as related to Ontario Fire Code smoke alarm requirements)

Ionization models are best suited **for rooms that contain highly combustible materials that can create flaming fires.** These types of materials include flammable liquids, newspapers, and paint cleaning solutions.

Photoelectric models are best suited **for living rooms, bedrooms and kitchens.** This is because these rooms often contain large pieces of furniture, such as sofas, chairs, mattresses, counter tops, etc. which will burn slowly and create more smoldering smoke than flames.

Australasian Fire Authorities Council
Position on Smoke Alarms in Residential Accommodation
June 1, 2006

“That all residential accommodation be fitted with photo-electric smoke alarms.”

Vermont Legislation

- **Photoelectric Smoke Alarms**
- Senate Bill S226, passed and requires that "single-family owner occupied homes have a photoelectric smoke detector on each floor and outside any bedrooms. Combination photoelectric and ionization smoke detectors cannot be used as an alternative for these locations because of the false alarms that are more common with ionization. People disarm the detectors. 38% of the smoke detectors in fatal fires had smoke detectors that had been disabled by the occupant. **These detectors must be photoelectric only.** Ionization can be used in addition to the photoelectrics that are required, but must be separate."

- The Governor of Vermont signed the bill on May 29th, 2008 at the Barre City Fire Department

New Maine Statute

- **Maine Revised Statutes**
- §2463-A§2465 Title 25: INTERNAL SECURITY AND PUBLIC SAFETY
- Part 6: FIRE PREVENTION AND FIRE PROTECTION
- Chapter 317: PREVENTIVE MEASURES AND RESTRICTIONS

§2464. Smoke detectors

- 1. Definition. "Smoke detector" means a device that, when activated by the presence of smoke, provides an alarm suitable to warn the occupants within the individual dwelling unit in which it is attached and that has been listed for use by a nationally recognized independent testing laboratory.
- [1997, c. 728, §27 (AMD) .]
- 2. Smoke detectors required. The owner shall properly install, or cause to be properly installed, smoke detectors in accordance with the National Electric Code and the manufacturer's requirements. In single-family dwellings, at least one smoke detector, which may be photoelectric, ionization or a combination of both, must be installed in each area within, or giving access to, bedrooms. These smoke detectors may be powered by the electrical service in the dwelling, by battery or by a combination of both.
- **Any smoke detector located within 20 feet of a kitchen or a bathroom containing a tub or shower must be a photoelectric-type smoke detector.**

CHANGES TO MASSACHUSETTS SMOKE DETECTOR LAW:

UNDERSTANDING THE STATE'S NEW REGULATIONS

Under the new regulation, a smoke detector utilizing both technologies is required in all the same locations, except within 20 feet of a kitchen or a bathroom containing a bathtub or shower. **Within 20 feet of a kitchen or bathroom containing a bathtub or shower, only a photoelectric smoke detector is allowed.** An ionization detector is prohibited in these places due to their tendency to be set off by steam.

GENERAL ASSEMBLY OF NORTH CAROLINA
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"The smoke detectors shall utilize either photoelectric or dual ionization and photoelectric sensor technology"

THE END

Thank you for inviting us to present,

Dean and Doug