Position Statement

PS 01

Selection of residential smoke alarms

Version 1

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FPA AUSTRALIA

Selection of residential smoke alarms

1.0 Purpose Statement

FPA Australia aims to promote the protection of life, assets and the environment from fire and related emergencies.

The purpose of this position statement is to provide information and education about the selection of smoke alarms for residential buildings.

This Position Statement is intended for:

2.0 Audience

(i) FPA Australia members;

(ii) Key stakeholders in the Fire Safety and Construction Industry;

(iii) The general public.

3.0 Background

Residential fire safety is an ongoing concern for the fire safety industry, authorities and the community. A significant amount of fire deaths and injuries in Australia occur in residential buildings. It is reasonable to assume that the speed at which fires develop is increasing due to the properties of materials now commonly found in residential buildings. This has the effect of reducing the time available to escape from a building.

Working smoke alarms provide early warning to building occupants to allow them to escape the effects of fire prior to being exposed to the products of combustion which can result in injury or death.

Legislation throughout Australia has required new residences and residences being renovated to be fitted with smoke alarms hard wired to mains electricity and fitted with a battery backup since 1995. Most States and Territories also require smoke alarms to be retrospectively installed in residences, with some providing a concession to allow battery operated smoke alarms only. You should check with your local regulatory authority to determine what specific requirements apply to you.

The Building Code of Australia (BCA), as referenced by State and Territory regulations, currently requires smoke alarms to be installed in new residential buildings as indicated in Table 1 below.

BCA Class	Typical Use	Applicable Australian Standard
1	Dwellings & residential housing	AS 3786
2	Residential apartment	AS 3786 or AS 1670.1
3	Residential shared accommodation	AS 3786* or AS 1670.1 *Except if the Class 3 part is located more than 2 storeys above ground level or accommodates more than 20 residents and is used as a residential part of a school or accommodation for the aged, children or people with disabilities, then only a system complying with AS1670.1 is permitted.
4	Single dwelling in a commercial building	AS 3786 or AS 1670.1

Table 1 – Installation Requirements

All of the retrospective legislative requirements refer to these Australian standards.

Currently compliance with Australian Standard AS 3786 as referenced by the BCA, can be achieved in residential buildings by installing photoelectric or ionisation smoke alarms.

Australian Standard AS 1670.1 as referenced by the BCA currently requires photoelectric smoke alarms to be installed in all sleeping areas and exits, passageways, corridors, hallways, or the like, that are part of a path of travel to an exit.

Within the fire protection community there has been an ongoing debate as to which type of smoke alarm provides the optimal performance to achieve sufficient early warning of occupants in residential buildings.

Note: For the purpose of this document a reference to a smoke alarm is also a reference to a smoke detector despite the fact that smoke detectors are connected to a fire detection and alarm system and do not generally include a self-contained alarm sounder.

The focus of this position statement is on the two primary detection technologies; photoelectric and ionisation.

4.0 Issues

4.1 Residential Buildings – Risk Environment

Both photoelectric and ionisation smoke alarms are effective in detecting most types of fires. However, FPA Australia considers that it is important to measure this effectiveness in the context of the risk environment within residential buildings when selecting smoke alarms.

Residential buildings contain a wide spectrum of fire safety risks due to diversity in lifestyle and culture, occupant characteristics, construction types and contents such as furniture and equipment. Activities such as cooking and sleeping also impact, as they can introduce heat sources and reduce the alertness of occupants respectively.

Considering all these risk factors, the level of fire safety risk to building occupants is expected to peak most commonly when occupants are sleeping. This is because human senses are dulled during sleep and response time to any fire that is likely to start is increased, meaning that the occupants may have insufficient time to avoid the effects of fire.

Accordingly detection of the type of fires most likely to start while occupants are sleeping is considered to be critical to enhancing life safety and reducing injury.

This is not to say that fire risks do not exist at other times, however alert occupants who are more intimate with their surroundings are likely to respond more quickly to fire in these instances and accordingly the overall risk is less. It remains important to understand however that detection and alerting occupants to fire risks at other times also plays an important factor in enhancing life safety and reducing injury.

4.2 Types of Fires

Building fires can commonly be separated into two categories; smouldering fires and flaming fires. There are a large range of possibilities for smouldering and flaming fires to occur in buildings and there is no available data to suggest that one of these fire types happens more frequently than the other overall.

However given the types of materials used in furnishings and floor coverings etc. and the likely ignition sources within a residential occupancy, the most likely fire type to be encountered whilst occupants are asleep is a smouldering fire.

Smouldering Fires

Smouldering fires represent a slow surface reaction between a solid fuel and oxygen in the air resulting in inefficient burning of the fuel. Oxygen required for smouldering fires is consumed at a much lower rate than flaming fires but smouldering fires can produce more visible smoke and gases as products of incomplete combustion.

It is difficult to predict if and/or when transition from smouldering to flaming may happen, but it usually occurs after conditions near the fire's point of origin have already become untenable due to the elevated concentration of carbon monoxide gas and/or other toxic gases.

Flaming Fires

Flaming fires result when heat transferred to the surface of a burning fuel (that may have been initially smouldering) forms combustible volatiles or gases which mix with oxygen in the air and burn in a hot luminous region referred to as the flame. Flaming fires develop rapidly and produce fine particles of smoke.

Flaming fires in residential buildings commonly occur in kitchens where stoves and ovens create high sources of heat and gas cooktops introduce naked flame. The instances of flaming fires can also be considered to correlate with direct occupant involvement or activity, or after a fire has been smouldering for some time.

4.3 Type of Smoke Alarm

The issue that this position statement addresses is specifically the selection of the type of smoke alarm in residential buildings.

As mentioned above, currently compliance with AS 3786 as referenced by the BCA, can be achieved in residential buildings by installing photoelectric or ionisation smoke alarms.

Each smoke alarm type performs differently as described below.

Photoelectric

Photoelectric smoke alarms contain a chamber with a light source projected into it. When visible smoke enters the chamber, it scatters and disturbs the light source which is detected by a light sensitive receiver, causing the alarm to sound.

Due to this detection method, published research has shown that photoelectric smoke alarms are superior to ionisation smoke alarms in detecting visible smoke produced by smouldering fires. However they can be slower to respond in relation to flaming fires. As many fires in residential buildings begin as smouldering fires, photoelectric smoke alarms provide effective all-round detection and alarm.

Ionisation

Ionisation smoke alarms contain a chamber that is charged with electrical particles, called ions, by a small amount of radioactive material. This chamber is sensitive to small particles of combustion (typically not seen by the human eye) that enter the chamber and disrupt the balance of ions in the chamber causing the alarm to sound.

Due to this detection method, published research has shown that ionisation alarms are marginally superior to photoelectric smoke alarms in detecting efficiently burning flaming fires that produce significantly smaller amounts of visible smoke than smouldering fires. Ionisation alarms therefore provide good response to flaming fires when they are located in close proximity however, most flaming fires are likely to occur when the occupants will already be alert such as when cooking.

Table 2 below, provides an indication of the likely responses from photoelectric and ionisation smoke alarms to common residential triggers.

Event	Response	
	Photoelectric	Ionisation
Smouldering fire	Fast responding.	Slow responding or delayed until flames break out.
Flaming fire	Slower responding.	Fast responding if close to fire.
Visible smoke	Typically respond to 50% visibility in a 7 metre long corridor.	May not respond to visible smoke blocking all visibility in a corridor.
Nuisance alarm from toast, grillers, candle smoke	Less responsive to normal household activities.	Likely to false alarm. Relocation may not help.
Nuisance alarm from bathroom steam	Likely to alarm. Relocation by a few metres will resolve problem.	Less likely to alarm.
Flammable liquid storage	Suitable if other combustibles are present.	Most suitable.

Table 2 - Likely Alarm Responses

It should be noted that AS 1670.1 as referenced by the BCA requires photoelectric smoke alarms to be installed in all sleeping areas and exits, passageways, corridors, hallways, or the like, that are part of a path of travel to an exit. This addresses both the most likely fire type and the impact that visibly dense smoke has on the occupants ability to see their way to and along the exit.

4.4 Cost

Historically photoelectric smoke alarms have been more expensive than ionisation smoke alarms. Over the years refinement in technology and production costs has meant that photoelectric alarms have become more affordable in the Australian marketplace relative to ionisation alarms. It is therefore considered that any previous options offered that may have been driven by cost and availability concerns are no longer relevant.

4.5 Summary

In summary;

(i) The BCA allows both photoelectric and ionisation alarms to be installed in residential buildings in order to achieve compliance with the code. Residential apartments, shared accommodation or single dwellings in commercial buildings must have photoelectric detectors installed in sleeping areas and paths of travel to exit only if compliance with AS 1670.1 is chosen. Retrospective installation requirements generally reflect these requirements also; and

(ii) Smouldering fires are considered to be the most likely fire risk to the health and safety of sleeping occupants in residential buildings; and

(iii) Photoelectric smoke alarms are generally more effective than ionisation smoke alarms in detecting smouldering fires.

(iv) Previous cost discrepancies no longer exist to any significant measure.

5.0 FPA Australia Position Statement

Based on the information currently available regarding the relative performance of photoelectric and ionisation smoke alarms, FPA Australia considers that all residential buildings should be fitted with photoelectric smoke alarms in the first instance in order to treat the highest fire safety risk in residential buildings. Ionisation smoke alarms are effective in detecting fast flaming fires that contribute to some of the fire risk in residential buildings but should be considered supplementary to photoelectric alarms.

As a minimum, FPA Australia recommends the placement of smoke alarms in all sleeping and living areas and having these smoke alarms interconnected to ensure all occupants are alerted in the event of an alarm.

FPA Australia reminds consumers that whilst working smoke alarms play an important role in addressing fire safety risks in residential dwellings, they are only one aspect of a range of complementary safety measures that should be incorporated in a dwelling to reduce fire risk and should not be relied upon as a single source of protection against the effects of fire.

6.0 Associated Actions

1. FPA Australia supports further review and development of Australian Standards and the BCA.
2. FPA Australia is aware that Victoria University (VU) is undertaking research in "The role of location on the effectiveness of smoke alarms". Findings of this research are yet to become publicly available. The result of this Australian research may lead to changes to the Building Code of Australia and this Position Statement.
3. FPA Australia will continue to cooperate with other key industry stakeholders to promote selection of smoke alarms consistent with this Position Statement and advocate change to regulators across Australia.

7.0 Disclaimer

The opinions expressed in this correspondence reflect those of FPA Australia however are subject to change based on receipt of further information regarding the subject matter. You should interpret the technical opinion or information provided carefully and consider the context of how this opinion / information will be used in conjunction with the requirements of regulation (state and/or federal); relevant standards, codes or specifications; certification; accreditation; manufacturer's documentation and advice; and any other relevant requirements, instructions or guidelines. FPA Australia does not accept any responsibility or liability for the accuracy of the opinion / information provided, nor do they accept either directly or indirectly any liabilities, losses and damages arising from the use and application of this opinion / information.

8.0 References

1. National Construction Code Series – Volumes 1 and 2, Building Code of Australia – Published by Australian Building Codes Board, Canberra.

2. Australian Standard AS 3786-1993 Smoke alarms– Published by Standards Australia International Ltd.

3. Australian Standard AS 1670.1-2004 Fire detection, warning, control and intercom systems – Systems design, installation and commission – Published by Standards Australia International Ltd.

4. NFPA Fire Protection Handbook – 19th Edition – Volume 1 – Section 2 Basics of Fire and Fire Science-Published by the National Fire Protection Association, Inc., Quincy, MA, USA – 2003.

5. Home Smoke Alarms – The data as context for decision, Marty Ahrens Fire Analysis and Research Division, National Fire Protection Association – January 2008 - Published by the National Fire Protection Association, Inc., Quincy MA, USA – 2008.

6. Smoke Alarms in U.S. Home Fires, Marty Ahrens Fire Analysis and Research Division, National Fire Protection Association – September 2009 - Published by the National Fire Protection Association, Inc., Quincy, MA, USA – 2009.

7. An Analysis of the Performance of Smoke Alarms, Thomas G. Cleary Fire Research Division, Engineering Laboratory, National Institute of Standards and Technology, Gaithersburg, MD, USA.

8. Full-Scale Residential Smoke Alarm Performance, Thomas G. Cleary Fire Research Division, Engineering Laboratory, National Institute of Standards and Technology Gaithersburg, MD, USA.

9. Australasian Fire and Emergency Service Authorities Council (AFAC) Position on Smoke Alarms in Residential Accommodation.
   www.afac.com.au/positions/AFAC_Position_on_Smoke_Alarms_in_Residential_Accommodation

10. Australian Research Council Linkage Project Funding to commence 2008, Victoria University.
    www.arc.gov.au/pdf/LP08_R2/Rd2_VicU.pdf

11. Fire Protection Association Australia Technical Advisory Committee 2 (TAC 2) – Fire Detection and Alarm Systems.

For more information, please see www.fpaa.com.au or contact FPA Australia on: (03) 9890 1544.