

ISSUE 693 **BULLETIN**



DESIGNING ACTIVE FIRE SAFETY SYSTEMS IN HOUSING

July 2024

- Most deaths in residential fires result from smoke inhalation. Working smoke and heat alarms warn occupants and give them time to escape. Domestic sprinklers can also save lives.
- This bulletin outlines the requirements for active fire safety systems in new building work in housing. It does not cover passive fire safety systems.
- This bulletin replaces Bulletin 639 *Domestic active fire protection*.

1 INTRODUCTION

1.0.1 Deaths in residential fires are usually caused by the effects of smoke rather than from heat or flames, particularly when people are asleep. Carbon monoxide and other toxic gases in the smoke and a lack of oxygen can kill a person without them ever waking up.

1.0.2 The sound from an alarm is much more effective than the smell of smoke at rousing people from sleep, so smoke and heat alarms play a crucial role in alerting occupants to a fire. Automatic sprinkler systems can limit fire growth, allowing occupants time to escape and the fire service to arrive. In some cases, sprinklers may also suppress the fire.

1.0.3 The Building Code requires smoke alarms in housing in:

- clause C *Protection from fire*, and C/AS1, C/AS2 and C/VM2
- clause F7 *Warning systems*, and F7/AS1, which references C/AS1 and C/AS2

1.0.4 Automatic sprinklers are not a Building Code requirement for buildings covered by C/AS1 although installing a sprinkler system may reduce some other Building Code requirements. There are a number of circumstances where sprinklers are required in C/AS2.

1.0.5 This bulletin should be read in conjunction with its companion bulletin, BU692 *Designing for fire safety and passive fire safety systems in housing*.

2 BUILDING CODE REQUIREMENTS

2.0.1 Building Code clauses C1–C6 *Protection from fire* give the minimum fire safety requirements. The Building Code objectives are to:

- protect people from fire
- limit fire spread to protect other property
- facilitate firefighting and rescue operations.

2.0.2 The Building Code fire clauses have two Acceptable Solutions and two Verification Methods that housing designers can use to demonstrate compliance. [Note that C/VM1 is only for solid fuel-burning appliances.]

2.0.3 Housing can be in the scope of two Acceptable Solutions:

- C/AS1 applies where each dwelling has an independent escape route and no more than one dwelling unit above another such as detached houses and two-storey townhouses and terraced housing. It includes detached dwellings where fewer than six people (not including members of the residing family) pay for accommodation such as Airbnbs, boarding houses and homestays.
- C/AS2 applies to other buildings including medium-density housing of three or more storeys, all apartment buildings, hotels and motels, backpackers, buildings where six or more people pay for accommodation, wharehous and other community sleeping spaces (even if they are used only occasionally). C/AS2 has more onerous requirements than C/AS1.

2.0.4 This bulletin only covers C/AS1 and the housing component in C/AS2. Transient accommodation and care and detention facilities (such as rest homes and prisons) have additional requirements that are not covered here.

2.0.5 Building Code clause F7 has the functional requirement that “Buildings shall be provided with appropriate means of warning people to escape to a safe place in an emergency.” [Building Code clause C4 has a similar requirement in C4.1.] The detailed requirements set out in earlier versions of F7/AS1 were replaced in November 2023 with a very simple reference: “For means of warning from fire, compliance can be demonstrated by meeting requirements for the applicable fire detection and alarm systems in the relevant Acceptable Solutions C/AS1 and C/AS2 for Building Code clauses C1–C6.”

3 SMOKE ALARMS

3.0.1 C/AS1 and C/AS2 reference NZS 4514:2021 *Interconnected smoke alarms for houses*. The requirement for interconnected smoke alarms in simple housing buildings was introduced in November 2023 with a 12-month transition period ending in November 2024. Interconnected means that, when one smoke or heat alarm is activated, all of them will sound.

3.0.2 Some key points in NZS 4514:2021:

- Smoke alarms must be located on or near the ceiling.
- They must be in all bedrooms, living spaces, hallways and landings [Figure 1] and on each level of a multi-level home. Alarms must be within 10 m of each other in any direction.

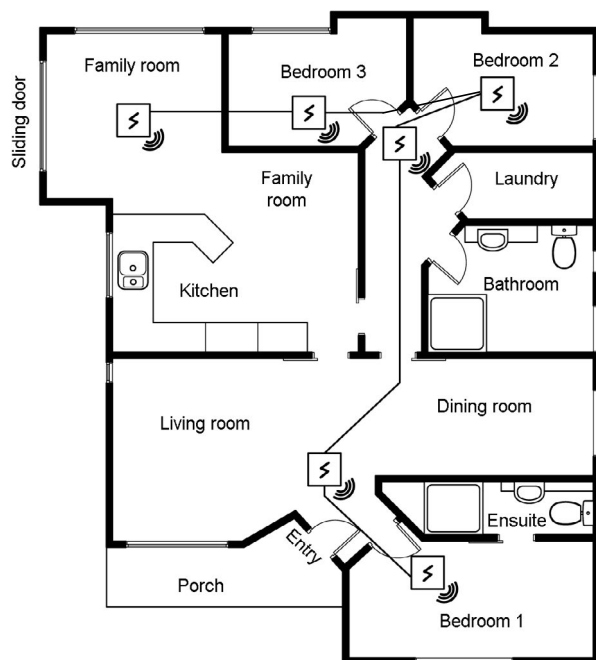


Figure 1. Example of interconnected smoke alarms in a 3-bedroom house from NZS 4514:2021.

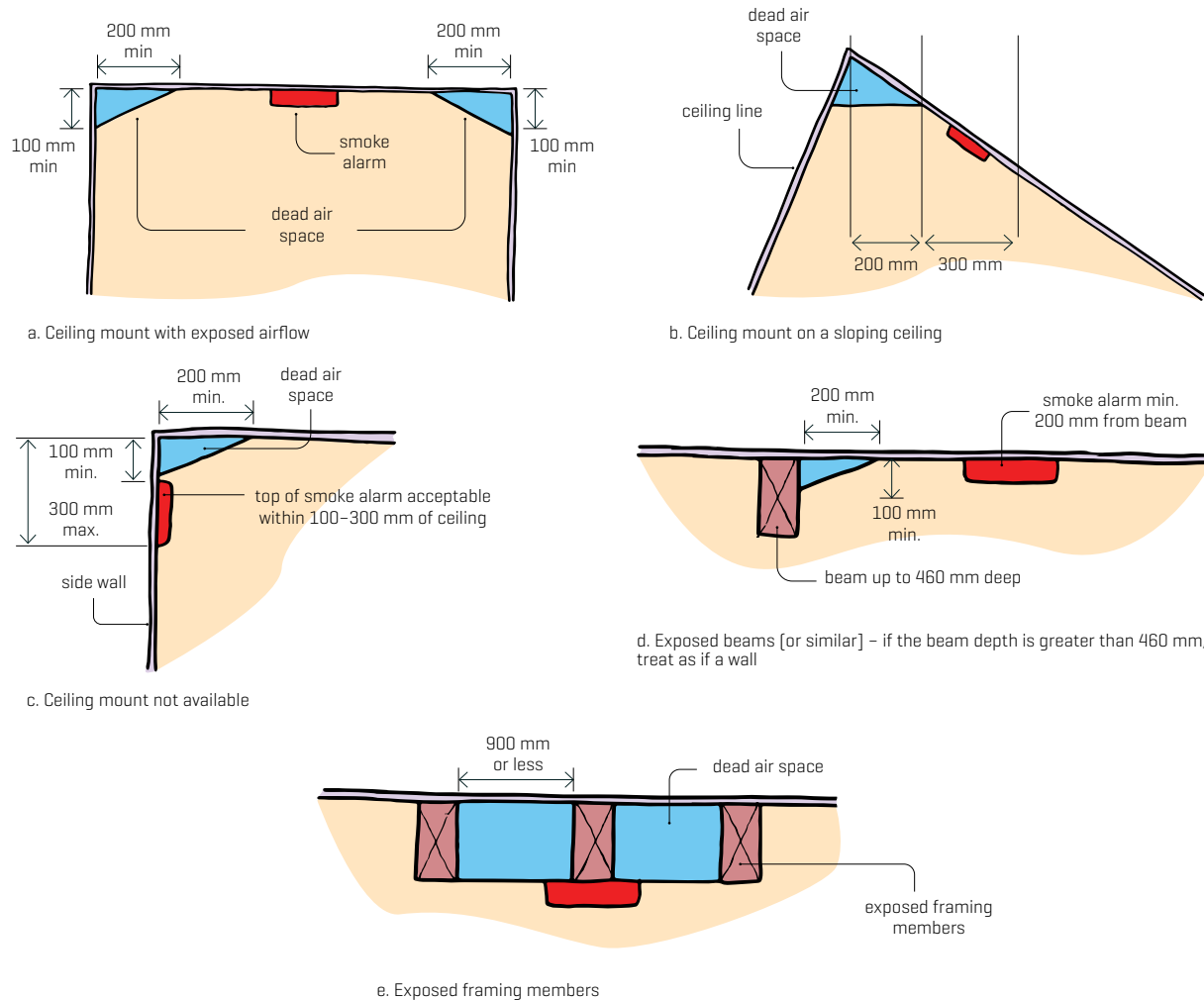


Figure 2. Acceptable locations for smoke alarms following NZS 4514:2021.

- Where doors separate a kitchen from living spaces and hallways, an alarm suitable for kitchens (which may be a heat alarm) must be installed in the kitchen.
- There are requirements about the locations where alarms are mounted (Figure 2) and recommendations around where they should not be located to avoid nuisance alarms.
- The alarms can be hard wired or operated with a long-life [minimum 10-year] sealed and non-removable battery. Where hard wired, they must be tested and certified by a licensed electrical worker.
- The interconnection between the alarms can be wired or wireless and they can be incorporated into a security system.
- Alarms with long-life batteries must be replaced by the manufacturer's replacement date or when the indicator shows low battery, whichever comes first.
- All other alarms must be replaced 10 years after the date of manufacture unless the manufacturer's instructions state otherwise.
- Smoke alarms should comply with one of UL 217, CAN/ULC S531, BS EN 14604, ISO 12239 or AS 3786. This will usually be marked on the device or packaging.
- Alarms must have a hush button either on the alarm itself or another readily accessible location – not in a cupboard for example. These buttons allow temporary disablement of the audible alarm for situations such as nuisance activations.

3.0.3 The requirement for interconnected smoke alarms does not just apply to new houses but also to additions and alterations that require a building consent and to changes of use to existing houses. C/AS1 1.2.4 and C/AS2 1.3 say: "This acceptable solution may be used to determine the compliance of building work [in relation to an existing building]." Under the Building Act, the term 'building work' specifically includes both new construction and alterations. Where existing housing is undergoing additions and/or alterations that require a building consent, interconnected smoke alarms are likely to be required throughout the building if C/AS1 or C/AS2 are being used to demonstrate compliance (after the transition period ends in November 2024) unless an argument can be made that it is not reasonably practicable to install them. The relatively low cost of installing interconnected alarms means that this argument is unlikely to be successful in most circumstances.

3.0.4 Under the Residential Tenancies [Smoke Alarms and Insulation] Regulations 2016, all rental homes must have smoke alarms:

- Alarms must be photoelectric hard wired or battery powered with a battery life of at least 8 years.
- Alarms must be installed in each sleeping space or within 3 metres of the entrance to a sleeping space.
- Alarms must be installed on each floor of a multi-storey home.
- For alarms with replaceable batteries, it is the tenant's responsibility to ensure the battery is replaced at the end of its life.

3.1 SMOKE ALARMS FOR THE HEARING IMPAIRED

3.1.1 There are devices made specifically for the hearing impaired to be alerted to fires. These are the best option for a growing proportion of the population. In Aotearoa New Zealand, around 15% of people aged 60–69 and around 22% of those aged 70 or over have hearing loss. There are indications that the numbers are higher for Māori, with an estimated 32% over the age of 65 saying they experience hearing loss.

3.1.2 For people with more than minor hearing loss, smoke alarms that warn purely through a high-pitched sound may not provide sufficient warning of a house fire, especially overnight when people take out their hearing aids. A specialised device may be required such as a sounder with an extra-loud or lower-pitch alarm sound, flashing strobe lights or under-pillow or bed shakers.

3.1.3 Fire and Emergency New Zealand [FENZ] works with partner agencies such as Your Way | Kia Roha and Deaf Aotearoa to conduct assessments and install hearing assistive technology smoke alarm systems if required. Funding may be available for this.

4 HEAT ALARMS

4.0.1 Tests with real fires show that smoke and other combustion products are detected earlier than heat in nearly all fires. Smoke alarms provide earlier warning of a fire than heat alarms and give more time for escape. More importantly, people sleeping often do not wake up when there is smoke present. They may lose consciousness before enough heat is generated to activate a heat detector.

4.0.2 Heat alarms have specific uses. NZS 4514:2021 requires an alarm in a kitchen that can be separated off by doors. Installing a smoke alarm in this location may lead to false alarms – typically from things like burning toast – unless an alarm system is carefully designed and specified. The standard allows heat alarms to be installed in kitchens to avoid nuisance activations.

4.0.3 Heat alarms activate when there are dangerous increases in temperature and are not activated by burning toast. They must also be part of the interconnected system so it is important that they are compatible.

4.0.4 Heat alarms may also be an appropriate choice in hobby rooms, workshops or garages or potentially even living rooms with a wood burner wherever smoke, dust or steam may result in nuisance alarms.

5 ALARM SYSTEMS IN LARGER OR MORE COMPLEX BUILDINGS

5.0.1 Fire alarm systems in larger or more complex buildings must comply with NZS 4512:2021 *Fire detection and alarm systems in buildings*, which covers design, installation, testing and maintenance requirements. It does not specify what type of alarm system is required for a particular building [this is given in C/AS2]. This standard does not apply to single station or interconnected smoke alarms for houses, which are covered in NZS 4514:2021.

5.0.2 For apartment buildings, large medium-density housing developments and mixed-use developments that include housing that have specified fire protection systems, all specified systems must be listed on the building's compliance schedule and are subject to an annual building warrant of fitness inspection. This includes sprinklers.

5.0.3 Other requirements in larger or more complex buildings:

- Manual activation systems are required by C/AS2 for escape heights up to 10 m if a single escape route serves more than 10 beds, and Type 5 systems are required for escape heights between 10 and 25 m [see C/AS2 Table 2.2].
- Firefighter lift control is required in buildings with escape heights over 10 m.
- HVAC shutdown in accordance with either AS 1668.1:2015 *The use of ventilation and air conditioning in buildings – Part 1: Fire and smoke control in buildings* or NZS 4512:2021 and sprinklers are required by C/AS2 for escape heights above 25 m.
- Building hydrants complying with NZS 4510:2008 *Fire hydrant systems for buildings* [the 2022 version of this standard is not currently cited] are required at all heights if hose run distances exceed 75 m or the height from FENZ vehicle access to any floor exceeds 15 m.
- Other systems may be required depending on the specific aspects of a design – for example, hold-open devices are discussed in C/AS2 3.15.9.

5.0.4 Careful review of the interface design, including operating logic, installation and commissioning, should be undertaken. In particular, single points of failure that could result in cascading effects on the operation of interfaced systems should be considered. Creating a cause-and-effect matrix of how the systems interact is recommended to aid in implementing fire safety system interfaces. The Fire Protection Association of New Zealand [FPANZ] has published a code of practice that includes information on how to create a matrix [see section 7].

5.0.5 Thought should be given to aspects of system operation and configuration that are important for subsequent parties [owners, occupiers, tradespersons and inspectors] to be aware of. These aspects should be documented as part of the design package such that the information is available to these subsequent parties as required.

6 AUTOMATIC SPRINKLER SYSTEMS

6.0.1 Automatic fire sprinklers are not an explicit Building Code requirement in residential buildings following C/AS1 [although longer travel distances on escape routes are allowed in Table 3.3.1.1 of C/AS1 where sprinklers are installed].

6.0.2 Sprinklers in residential buildings are a requirement where the escape route height is greater than 25 m [about 7–8 storeys] [C/AS2 Tables 2.2 and 2.3]. There may be other instances where sprinklers are required such as to protect a neighbouring building or to increase the length of escape routes. The requirements for sprinklers for buildings in the scope of C/AS2 are more onerous than for domestic sprinklers that can be installed in a detached dwelling.

6.0.3 Sprinkler systems are primarily designed to stop a fire from spreading once it has started. Sprinklers operate when the fire generates sufficient heat to cause a sprinkler head to activate. The sprinkler heads closest to the fire will operate by discharging water to control the fire. If a fire develops, not all sprinkler heads will operate – only those closest to the fire.

6.0.4 These are the most recent design standards for sprinkler systems in Aotearoa New Zealand listed in order of increasing cost, complexity and water supply requirements and inspection, testing and maintenance requirements:

- NZS 4517:2010 *Fire sprinkler systems for houses for*

domestic systems [single household units]. The standard is referenced in C/AS1 [and in an appendix in C/AS2]. It has some concessions in aspects such as water supply, coverage and inspection compared to comprehensive systems to make domestic sprinklers more cost-effective so that they are more widely adopted.

- NZS 4515:2009 *Fire sprinkler systems for life safety in sleeping occupancies [up to 2000 square metres]*. This covers buildings used solely as accommodation such as apartment buildings, care institutions, motels, hostels and boarding houses. This standard is referenced in C/AS1, C/AS2 and C/VM2.
- NZS 4541:2020 *Automatic fire sprinkler systems for all other systems*. This standard is referenced in C/AS1, C/AS2 and C/VM2.

6.0.5 For houses, where sprinklers are not a specific requirement, the owner can install a domestic sprinkler system using NZS 4517:2010.

6.0.6 Domestic sprinklers [like all the most common fire sprinkler systems]:

- use a glass bulb as a heat-sensitive element
- activate at about 68°C
- have a flat and wide spray pattern with small and medium droplet sizes
- have sprinkler heads that may be concealed, flush-mounted or side-wall or pendant type.

6.0.7 Domestic sprinkler systems may be integrated into domestic plumbing [Figure 3]. Water pressure at the site must be measured before a system is designed. Limiting valves may need to be installed

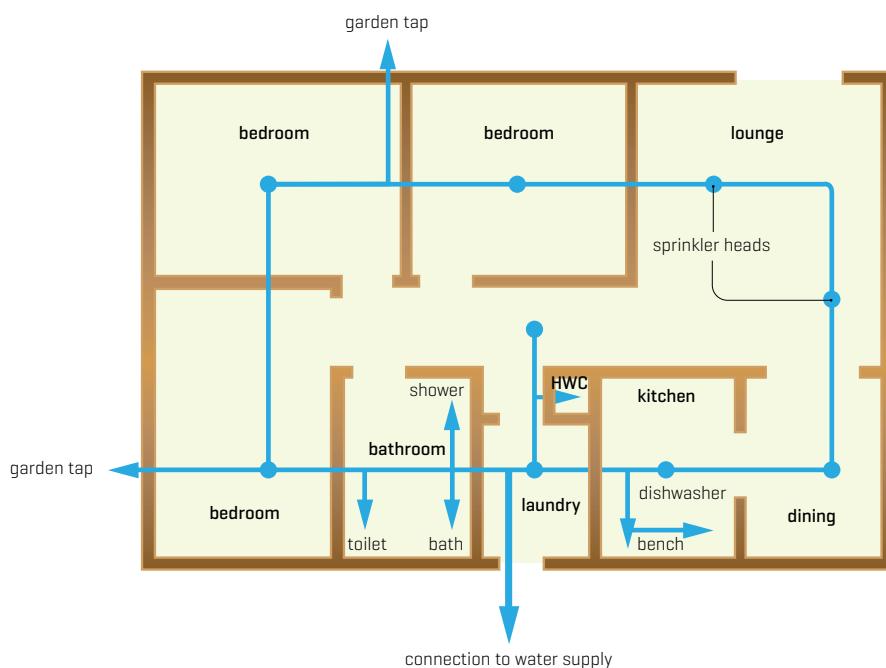


Figure 3. A piping loop in the ceiling plan of the house from which all cold water demand can be drawn.



A sprinkler head directly attached to a piping loop in the ceiling of a house. The sweeping curve of the pipe [on the left] means fewer fittings are required and improves the efficiency of the flow.

where there is very high mains pressure. A home with very low mains water pressure may require a pump or some other modification of the system. Homes not connected to the town water supply such as rural sites will need to have their own sufficient water supply on site.

6.0.8 The design, specification and installation of a sprinkler system following NZS 4541:2020 must be carried out by qualified practitioners. Sprinkler systems built to NZS 4515:2009 or NZS 4541:2020 require independent inspection and certification. The installation must be carried out by suitably qualified plumbers or a listed contractor as required. Maintenance and testing should be in accordance with the relevant standards and in accordance with the manufacturer’s instructions.

6.0.9 Overseas statistics show that sprinklered properties have a strong reduction in civilian death rates and a very good reduction in firefighter injuries. However, there must also be adequate smoke detection and alarms anywhere people are asleep.

6.0.10 There will very likely be some heat and smoke damage before a sprinkler system activates. There will also be water damage from activated sprinklers, but this [and the fire damage] is generally less than would be the case if there is no sprinkler system and the fire service extinguishes the fire.

6.0.11 The effectiveness of sprinkler systems means that the Acceptable Solutions will allow concessions in other areas of fire protection. These include:

- longer escape routes [C/AS1 Table 3.3.1.1 or C/AS2 Table 3.2]

- larger areas of external walls do not need a fire resistance rating [C/AS1 5.1.1.1 or C/AS2 Tables 5.2a–5.2d]
- with protection from a lower roof in multi-unit dwellings, fire rating of the roof is not required [C/AS1 5.2.2.2 or C/AS2 5.7]
- there are reduced requirements around FENZ vehicular access in multi-unit dwellings [C/AS1 6.1.1.1 and C5.4]
- larger [or unlimited] firecell floor area limits [C/AS2 Table 2.1].

7 MORE INFORMATION

BRANZ

[BU692 Designing for fire safety and passive fire safety systems in housing](#) [BRANZ bulletin]

[Automatic sprinklers – perception and reality](#) [Build article]

[Medium-density housing #7: Fire safety](#) [fact sheet]

FENZ

[Installing home sprinkler systems](#)

FPANZ

[Code of practice for the integration of building fire safety systems with other services](#)



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ISSN 2537-7310 [Online]

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