Guide to the Acceptable Solutions: Protection from Fire
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INTRODUCTION

This guide has been developed for architects, designers and building consent officers to help provide a better understanding of the New Zealand Building Code (NZBC) Acceptable Solutions for Clause C Protection from fire. It is not intended as a basic introduction but assumes readers have some knowledge of the documents. Some of the content, such as tables that summarise requirements (for example, fire safety systems and surface finish requirements), may also prove to be useful to those who have a good working knowledge of the documents.

This guide should be used in conjunction with Acceptable Solutions C/ASI-7, as reference is made to various paragraphs within those documents.

The Acceptable Solutions provide one way of meeting the objectives of the NZBC. Buildings designed using the Acceptable Solutions will comply with clauses C1–C6 of the NZBC.

An Acceptable Solution may apply to the whole or part of a building, depending on the activities and uses within the building. Therefore, it may be necessary to refer to more than one Acceptable Solution when determining if a building complies.

Some building features or systems (for example, atria) may result in the design falling outside the scope of any Acceptable Solution. In those cases, alternative methods for demonstrating compliance will be necessary, usually requiring the services of a chartered professional engineer.
The New Zealand Building Code (NZBC) is the regulatory instrument that is intended to help meet the purposes of the Building Act 2004. This is largely achieved through setting performance standards to ensure that, amongst other things:

- people who use buildings can do so safely and without harm
- people who use a building can escape from the building if it is on fire.

Section 4 of the Building Act sets out principles that territorial authorities must follow when applying the law. One of them is “the need to provide protection to limit the extent and effects of the spread of fire”, particularly with regard to household units and other property. Another is the expectations of firefighters to be protected from injury or illness.

Building owners need to be aware that there is no requirement for protection of their own property in the NZBC.

The NZBC provides for the safety and wellbeing of occupants of buildings. The primary section of the NZBC that deals with fire safety matters is clause C Protection from fire. While other clauses (particularly clauses D, E and F) also have an impact on fire safety matters, most of these are in some way referenced in clause C Acceptable Solutions.

The scope of the Acceptable Solutions is limited to ‘all out’ evacuation - that is, where all occupants are expected to leave the building in the event of fire.
The 2012 revision of NZBC clause C has six subparts - clauses C1-C6. Clause C1 gives the specific objectives of clauses C2-C6, which are to:

- a. safeguard people from an unacceptable risk of injury or illness caused by fire,
- b. protect other property from damage caused by fire, and
- c. facilitate fire-fighting and rescue operations.

Clauses C2-C6 contain the functional requirements that a building’s systems and design features have to meet to achieve the objectives.

These requirements are to safeguard people from the effects of fire:

- Firstly, fires should have a low likelihood of starting. Clause C2 (Prevention of fire occurring) requires that building materials that can easily catch fire are kept away from sources of heat and appliances (such as heaters and lighting). It also requires that sources of heat and appliances must be installed in such a way that reduces the likelihood of a fire starting.
- Secondly, if a fire does occur, the building must be designed so that occupants are unlikely to be injured and other property is unlikely to be damaged as a result of fire spreading from its place of origin to elsewhere in the building (clause C3 Fire affecting areas beyond the fire source).
- Thirdly, people in the building must be able to escape from the building if a fire does occur (clause C4 Movement to place of safety).
- Lastly, the building must be able to remain standing for long enough so that people in and around the building are not in danger (clause C6 Structural stability).

To help firefighters (clause C5 Access and safety for firefighting operations), there must be:

- Fire Service vehicular access to the building
- access within the building
- a means of delivering water to all parts of the building
- clear information so that firefighters can establish the general location of the fire, what fire safety systems are available and whether there are hazardous substances or processes present in the building
- a low likelihood of firefighters suffering illness or injury
- construction that is unlikely to collapse and endanger firefighters during firefighting operations.

Each of the clauses C2-C6 also sets out specific performance requirements relating to its functional requirements.

Each part of the Acceptable Solutions and the paragraphs it contains can be related back to one or more of the performance requirements of the NZBC.
The Acceptable Solutions for NZBC clauses C1-C6 Protection from fire are presented as seven separate documents. Each document addresses a different type of fire risk. The risks have been grouped according to occupant familiarity with the building, ability to escape unaided and the expected fire growth rate and/or fire size. These factors influence the overall risk in the building and the systems required to keep people safe.

The scope of each Acceptable Solution is limited to a certain group of buildings:
- C/AS1 is for typical houses, small multi-unit dwellings and outbuildings.
- C/AS2 is for other multiple-unit accommodation buildings such as apartments, hotels, motels and hostels.
- C/AS3 is for buildings where care or detention is provided - i.e. where there is a delay to evacuation (excluding prisons).
- C/AS4 is for public access buildings such as schools and other educational facilities and places where people gather - halls and recreation centres, cinemas, shops, restaurants and cafés, hairdressers and so on.
- C/AS5 is for many workplaces such as offices, laboratories, workshops, most factories and low-level storage facilities.
- C/AS6 is for high-level storage areas in buildings such as warehouses, temperature-controlled storage, trading and bulk retail.
- C/AS7 is for vehicle parking and storage, including car parks, truck and bus parks, stacked boat storage and light aircraft hangars.

Table 1.1 of each Acceptable Solution gives examples of building types.

This structure was developed to make it easier to find the requirements for each category, based on a building’s use and the activities of its occupants. However, it does
mean that a little extra effort is necessary if the building being designed has multiple uses/risk groups.

The flowchart in Figure 1 below provides a way to identify the most appropriate Acceptable Solution to use for a particular building.

**C/AS1 - risk group SH - houses, small multi-unit dwellings and outbuildings.**
Detached houses only need to be located at least 1 metre from a boundary, typically no fire-rated construction is required and only domestic smoke alarms are required, although there are some exceptions (for example, some surface finish requirements apply where foamed plastics or combustible insulation are used). The Acceptable Solution also describes multi-unit buildings (such as townhouses) that have very straightforward requirements. Outbuildings are also included in the scope of C/AS1. (Note that outbuildings are defined under the legislation.)

**C/AS2 - risk group SM - buildings with sleeping (non-institutional, multi-unit dwellings).** This addresses more complex buildings with sleeping, whether permanent (apartments) or temporary (hotels, motels, short-stay serviced apartments and backpackers).

**C/AS3 - risk group SI - buildings where care or detention is provided.** This final sleeping category covers hospitals, residential care homes, community care houses, courts and police detention areas.

**C/AS4 - risk group CA - buildings with public access or educational facilities.** This provides for buildings where people congregate in group activities, such as schools and other educational facilities, shops and shopping malls, childcare centres, churches, halls, recreation centres and so on.

**C/AS5 - risk group WB - buildings for business, commercial or low-level storage.** This is for buildings where occupants are working. This includes offices, factories, industrial and commercial buildings as well as storage buildings where the storage is relatively low level or low risk.

**C/AS6 - risk group WS - high-level storage or other high-risk uses.** This covers warehouses, temperature-controlled storage and high-hazard buildings. Due to the high fire load, these buildings must be protected with an automatic fire sprinkler system.

**C/AS7 - risk group VP - vehicle parking.** This is for buildings and parts of buildings where vehicles are parked or stored. This is a very much reduced Acceptable Solution, and the requirements contained in the document are either additional to or replacements for the requirements specified by C/AS5. C/AS7 therefore has to be used in conjunction with C/AS5 to determine the design requirements for car parking buildings.

More details of the scope of each Acceptable Solution is provided in paragraph 1.1.1 of each Acceptable Solution.
WHICH ACCEPTABLE SOLUTION?

Note: for a building with multiple uses, apply the flowchart process separately for each space.

Figure 1 Flowchart to identify which Acceptable Solution to use for a particular building.
THE CONTENT OF EACH ACCEPTABLE SOLUTION

Each Acceptable Solution contains seven parts:
- Part 1 General
- Part 2 Firecells, fire safety systems and fire resistance ratings
- Part 3 Means of escape
- Part 4 Control of internal fire and smoke spread
- Part 5 Control of external fire spread
- Part 6 Firefighting
- Part 7 Prevention of fire occurring

C/AS2–C/AS6 are very similar in structure and content, with the paragraphs presenting requirements for the same subject matter according to its number (indicated in brackets in this guide). This allows for ease of navigation once the structure is understood. For example, paragraph 3.3.2 contains the requirements for widths of escape routes in all five of these Acceptable Solutions. If for a particular paragraph there is no requirement or the requirement is not applicable to the risk group covered by the Acceptable Solution, the paragraph is left blank and is identified as such with the phrase “deliberately left blank”.

C/AS1 and C/AS7 differ slightly to this arrangement. C/AS7 is a reduced Acceptable Solution and must be used in conjunction with C/AS5 to determine the design requirements for car parking buildings. C/AS1 is different because the simplicity of the requirements would mean that the document would contain a large number of pages with nothing but paragraphs that were deliberately left blank.
Part 1 General
This part describes the scope of the Acceptable Solution - what is included or excluded. It includes an explanatory table (Table 1.1), which enables a user to determine whether or not the correct Acceptable Solution has been chosen, and if not, which is more appropriate. The Acceptable Solution commentary section 1.1.1 and Table 1 provide further details on which Acceptable Solution addresses which risk. This part also explains how to use the document and what information is required to establish the requirements for a particular building.

There are some specific features of buildings and types of buildings that cannot be designed using the Acceptable Solutions. This is either because the feature introduces complex building features that means that fire growth and smoke spread cannot be assumed to fall within the parameters of the Acceptable Solutions or that the evacuation processes may not be consistent with those assumed.

Examples of the former are atria in buildings, multiple intermediate floors at different levels or even the maximum number of storeys in the building. Examples of the latter include correctional facilities where prisoners cannot be immediately released to escape.

Each of the Acceptable Solutions describes the limitations on scope where it can be applied.

Calculating occupant load
The final aspect included in Part 1 is the method of calculating the number of occupants for design of a building and parts of the building. This is important as the number of occupants is used to ascertain the fire safety systems required and the number and geometry of escape routes required.

There are two main methods for determining occupant numbers:
- Where there is sleeping in the building, the occupant number is the number of bed spaces provided. Bunkrooms would be based on the number of single bunks provided.
- For non-sleeping areas, the occupant load is based on the use of each room or area. Table 1.2 in C/AS4, C/AS5 and C/AS6 provides occupant densities to calculate the occupant load according to the gross floor area. This method merely requires the user to determine the gross floor area and divide by the occupant density relevant to that room or area. The user can ignore the presence of furniture, fittings and other contents since this is taken into account by the occupant density provided.

The occupant density usually provides for a higher than likely occupant load - the Acceptable Solution is a conservative solution. In some cases, this considerably overstates the actual occupant load intended for the building. A typical example is an industrial building with a small number of occupants in a large floor area with large machinery or products. There is an allowance for using an occupant load lower than that determined using Table 1.2. However, this will need to be supported by a thorough justification, and it also restricts the flexibility of the building for the future, particularly if the lower occupant load permits a significantly lower level of protection.
or fewer escape routes. Conversely, if there is a known higher occupant load than that determined from Table 1.2, this should be used to specify fire safety systems and escape routes.

Part 2 Firecells, fire safety systems and fire resistance ratings
This part specifies the systems and features that are required in a building and the fire resistance ratings to be used where construction features must be fire rated.

The various systems are applied to a building according to the:
- risk group
- escape height
- number of occupants
- storage height.

Many existing users of the Acceptable Solutions for clause C Protection from fire are familiar with the categorisation of systems and features by ‘type’. This has been retained in the latest edition of the Acceptable Solutions. However, many of the more sophisticated systems are no longer specified by the Acceptable Solutions, hence the non-sequential series.

The descriptions of the fire safety systems are detailed below, and Table 1 (a and b) and Table 2 below show how to calculate the type of fire safety system required.

Type 1: Domestic smoke alarm. Single-point smoke alarms that may be battery powered and installed in accordance with Acceptable Solution F7/AS1. Locations of alarms are specified in NZS 4514:2009 Interconnected smoke alarms for houses. These are required in all houses and residential units where other alarm systems are not required.

Type 2: Manual call point alarm system. This system is manual call point operated. The system has to be installed in accordance with NZS 4512:2010 Fire detection and alarm systems in buildings. The manual call points are typically located close to final exits.

Type 3: Heat detection system. This system includes manual call points as per a Type 2 system and provides heat detection (usually point-type detectors) throughout a building. It is designed and installed in accordance with NZS 4512:2010.

Type 4: Smoke detection system. Smoke detection throughout a building with manual call points as per a Type 2 system. Where such a system is required but the environment is such that unwanted alarms are likely, the smoke detectors may be replaced with heat detection, up to a set maximum area of heat detection coverage. It must be designed and installed to NZS 4512:2010.

Type 5: Enhanced smoke detection system. This system is designed for use in sleeping occupancies. The smoke detectors within the rooms where people are (hotel rooms, apartments and so on) are designed to activate the sounder in that room/space only. This gives the occupant time to rectify an unwanted alarm caused by such things as cooking or steam from showers/bathrooms, without alerting the rest of the building. In addition to the smoke detector, there will be a heat detector or sprinkler in the room that, if activated, will sound alarms throughout the building. Activation of a smoke
Table 1a Fire safety system required: sleeping

<table>
<thead>
<tr>
<th>ESCAPE HEIGHT</th>
<th>≤10 m</th>
<th>&gt;10 – ≤25 m</th>
<th>&gt;25 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk group SH</td>
<td>Type 1</td>
<td>Type 2</td>
<td>Type 5</td>
</tr>
<tr>
<td>Permanent accommodation</td>
<td>Type 2</td>
<td>Type 5</td>
<td>Type 5</td>
</tr>
<tr>
<td>Temporary accommodation</td>
<td>Type 5</td>
<td>Type 18</td>
<td>Type 9</td>
</tr>
<tr>
<td>Education accommodation</td>
<td>Type 5</td>
<td>Type 7, Type 9, Type 18</td>
<td>Type 18</td>
</tr>
<tr>
<td>Care or detention</td>
<td>Type 5, Type 7, Type 9, Type 18</td>
<td>Type 18</td>
<td></td>
</tr>
</tbody>
</table>

Table 1b Fire safety system required: non-sleeping*

<table>
<thead>
<tr>
<th>ESCAPE HEIGHT</th>
<th>≤4 m</th>
<th>&gt;4 m – ≤25 m</th>
<th>&gt;25 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 100 people with storage &lt;3 m</td>
<td>Type 2</td>
<td>Type 2</td>
<td>Type 2</td>
</tr>
<tr>
<td>100 to 249 people with storage &lt;3 m</td>
<td>Type 2</td>
<td>Type 4 (C/AS5)</td>
<td>Type 4</td>
</tr>
<tr>
<td>Risk group WB (C/AS5) 250 to 1,000 people, or storage 3–5 m, or storage &gt;5 m but apex height &lt;8 m and floor area &lt;4,200 m²</td>
<td>Type 3</td>
<td>Type 3</td>
<td>Type 7</td>
</tr>
<tr>
<td>Risk group CA (C/AS4) 250 to 1,000 people</td>
<td>Type 4, Type 9, Type 18</td>
<td>Type 7</td>
<td>Type 7</td>
</tr>
<tr>
<td>More than 1,000 people</td>
<td>Type 7, Type 9, Type 18</td>
<td>Type 7, Type 9, Type 18</td>
<td>Type 7, Type 9, Type 18</td>
</tr>
</tbody>
</table>

Table 2 Fire safety system required for storage in risk group WB and escape height of ≤4 m

<table>
<thead>
<tr>
<th>STORAGE</th>
<th>Height</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupant load</td>
<td>&lt;1,000</td>
<td>&lt;3 m</td>
</tr>
<tr>
<td>3–5 m</td>
<td></td>
<td>Type 3, Type 18</td>
</tr>
<tr>
<td>&gt;5, apex &lt;8 m area &lt;4,200 m²</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
* Including storage where heights given.
1. In some situations, Type 3 or Type 6 may be substituted (see C/AS4 and C/AS5 2.2.1).
2. Direct connection to fire service required for cinema, theatre or early childhood centre.
3. Refer to the relevant Acceptable Solution to determine if a Fire Service connection for the alarm is required or not.
4. Refer to the relevant Acceptable Solution for requirements for Type 18 fire safety system. May depend on hose run distance and height from the Fire Service attendance point.

(Construction to Table 1 with specific requirements for storage, based on storage height and apex height for escape height of ≤4 m, otherwise Table 1 applies.)
detector in a common area (such as corridors or common lounge areas) will also sound the alarm throughout the building. This system must be designed and installed in accordance with NZS 4512:2010.

**Type 6: Automatic sprinkler system.** An automatic fire sprinkler system installed throughout the building in accordance with NZS 4541:2013 *Automatic fire sprinkler systems* or NZS 4515:2009 *Fire sprinkler systems for life safety in sleeping occupancies (up to 2000 square metres).*

**Type 7: Automatic sprinkler system with smoke detection.** This system is a combination of Type 6 and Type 4 (or Type 5 as appropriate).

**Type 9: Smoke detection in air-handling systems.** Smoke detection is used to shut down the heating, ventilation and air-conditioning (HVAC) system and close any mechanical smoke dampers to reduce the spread of smoke through the building via ducting.

**Type 18: Fire hydrant systems for buildings.** These systems, complying with NZS 4510:2008 *Fire hydrant systems for buildings*, are required where the size or geometry of the building requires that firefighters would be required to carry or lay out more than 75 m of hose to reach all parts of a building.

The second half of Part 2 describes the required fire-rated separations. The Acceptable Solutions separate the requirements for the necessary fire rating into two:

1. **Life rating** - used to determine the protection required for fire separations that protect occupants while they are escaping. It is used for most internal fire separations such as walls and any fire separation.
2. **Property rating** - used for any fire separation whose purpose is to protect other people’s property. It is also used for parts of the structure that prevent the building or parts of it collapsing, whether or not the collapse could cause damage to other people’s property. It also applies to escape stairs and exitways in buildings with over 10 m escape height.

In general terms, if a building is protected with an automatic sprinkler system, the fire resistance rating (FRR) will be reduced by 50%. This does not apply in C/AS3 and C/AS6, which both require sprinkler protection regardless.

Table 3 below outlines life and property ratings and Acceptable Solutions for sprinklered and unsprinklered areas.

There are additional requirements for specific areas, such as plant and boiler rooms (4.10.3), waste storage (4.10.2) and intermediate floors (4.13.4).
Part 3 Means of escape
This part assists compliance with NZBC clause C4 Movement to place of safety. It specifies all the features of the routes that an occupant must take to escape the building. It specifies the geometry of the escape routes and whether or not they have to be protected to any degree - for example, by fire-rated walls/ceilings. In particular, the design of doors that are on an escape route are specified, including the final exit door.

For the most part, the provision of escape routes required by the NZBC is founded on the premise that an occupant can turn their back on a fire and walk away from it to an escape route and an exit out of a building. At no point should the escape route have to pass the location of a fire - there should generally be an alternative route to take except where single means of escape are permitted (3.13).

There are some limited circumstances where the Acceptable Solution permits a single escape route, and these are generally for short escape routes that may be taken by a small number of people. The maximum number of occupants of a room or group of rooms that can have a single way out is 50, with limits to travel distances (3.13). Two routes are required for a higher occupant load.

The parts of escape routes in a building are described in the Acceptable Solutions in accordance with the level of protection that the characteristics of the route provide:

- **Open path** - usually the initial part of an escape route where there is no protection from fire or smoke. In many small buildings, the open path may be the only category of escape route all the way to the final exit. The Acceptable Solutions limit the lengths of open paths permitted.

- **Exitways** - these are the protected routes that will be required in larger buildings and those with upper floors. Exitways are subcategorised:
  - Smoke lobbies - these are required in certain circumstances and are separated using construction that has the capability to resist the passage of smoke.
  - Horizontal safe paths - these are the corridors and passageways in the building that are required to be separated from the rooms in the building with fire-rated walls, floors and ceilings. Horizontal safe paths are usually required as a result of the need to restrict the open path travel distance to that permitted by the Acceptable Solutions. The lengths of horizontal safe paths are also limited in length unless the building is sprinkler protected and there are at least two directions to escape along the horizontal safe path.
• Vertical safe path - these are the stairways in the building required to be separated from other spaces in the building with fire-rated construction. There is no restriction in the length of vertical safe paths. Horizontal safe paths and vertical safe paths have to be separated with a fire-rated wall and door.
• External safe paths - these are the routes outside the building between the final exit and the safe place. They may be protected by external walls that are fire rated or by distance from the external walls.
  ■ Final exit - the external doors that lead outside. However, the final exit door may not be the end of the escape route. The escape route finishes at the safe place, which may be at a location outside of an enclosed or fenced area completely away from the building.

The fundamental rule of the hierarchy of escape routes is that an occupant will always move from a lower level of protection to a higher level of protection and shall not traverse from a higher level of protection to a lower - that is, they will not move from an exitway back to an open path.

**Length of escape route**
The lengths of the parts of the escape route are generally limited (Table 4 and Table 5 below). The permitted lengths of both open paths and horizontal safe paths are

### Table 4 Maximum dead-end open path distances (m)

<table>
<thead>
<tr>
<th></th>
<th>TYPE 1</th>
<th>NO SYSTEM OR TYPE 2</th>
<th>TYPE 3</th>
<th>TYPE 4 OR 5*</th>
<th>NZS 4517 AND TYPE 1**</th>
<th>TYPE 6</th>
<th>TYPE 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/AS1</td>
<td>25</td>
<td>na</td>
<td>na</td>
<td>35</td>
<td>35</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>C/AS2</td>
<td>na</td>
<td>20</td>
<td>na</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>C/AS3</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>20</td>
</tr>
<tr>
<td>C/AS4</td>
<td>na</td>
<td>20</td>
<td>na</td>
<td>40</td>
<td>na</td>
<td>40</td>
<td>50</td>
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<td>C/AS5</td>
<td>na</td>
<td>25</td>
<td>35</td>
<td>50</td>
<td>na</td>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>C/AS6</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>50</td>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>C/AS7</td>
<td>na</td>
<td>35</td>
<td>45</td>
<td>na</td>
<td>70</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>

Notes:
* Type 5 only for C/AS2.
** For single household units only. Refer NZS 4517 Fire sprinkler systems for houses.

### Table 5 Maximum total open path distances permitted (m)

<table>
<thead>
<tr>
<th></th>
<th>TYPE 1</th>
<th>NO SYSTEM OR TYPE 2</th>
<th>TYPE 3</th>
<th>TYPE 4 OR 5*</th>
<th>NZS 4517 AND TYPE 1**</th>
<th>TYPE 6</th>
<th>TYPE 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/AS1</td>
<td>60</td>
<td>na</td>
<td>na</td>
<td>75</td>
<td>75</td>
<td>90</td>
<td>120</td>
</tr>
<tr>
<td>C/AS2</td>
<td>na</td>
<td>50</td>
<td>na</td>
<td>75</td>
<td>na</td>
<td>75</td>
<td>100</td>
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<td>C/AS3</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>50</td>
</tr>
<tr>
<td>C/AS4</td>
<td>na</td>
<td>50</td>
<td>na</td>
<td>100</td>
<td>na</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>C/AS5</td>
<td>na</td>
<td>60</td>
<td>75</td>
<td>120</td>
<td>na</td>
<td>120</td>
<td>150</td>
</tr>
<tr>
<td>C/AS6</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>120</td>
<td>120</td>
<td>180</td>
</tr>
<tr>
<td>C/AS7</td>
<td>na</td>
<td>90</td>
<td>110</td>
<td>na</td>
<td>180</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>

Notes:
* Type 5 only for C/AS2.
** For single household units only. Refer NZS 4517 Fire sprinkler systems for houses.
defined in Tables 3.2 and 3.4 respectively in the Acceptable Solutions. These maximum lengths are extended by the inclusion of alarms and sprinklers. In the case of alarms, the assumption is that, with early warning by an automatic detection and warning system, the occupants have a longer time to escape. In the case of a sprinkler system, it is assumed that the fire will be controlled so that a survivable environment will be maintained for a considerable time, as well as a warning given.

The open path length is determined in one of two ways:

- If the actual layout, including furniture, can be established, the actual route length can be used (use orthogonal routes).
- If this is not possible, the route taken orthogonally from the most remote location in the firecell to the point where the open path finishes is used (see Figure 2 below).

While the lengths of escape routes are given for occupant movement at the floor level of a fire compartment, the Acceptable Solutions provide multiplying factors for other situations. If the escape route traverses an intermediate floor, the actual length of the escape route is multiplied by 1.5 to determine if the escape route is within the permitted maximum length. This factor recognises that occupants at a higher level in the room will be exposed to heat and smoke sooner than those at floor level. Similarly, where the escape route includes an open stair, such as an accommodation stair from an intermediate floor, the plan length of the stair is multiplied by a factor of 1.2.

Note there are limitations on corridor length - long corridors will need dividing with smoke stop doors if they are over 40 m in an open path or 80 m in a safe path unsprinklered, or 60 m and 120 m if sprinklered (4.12.1).

Figure 2 Elements of the escape route and the factors to determine maximum escape route length

dead-end open path (DEOP) = (ABC × 1.5) + (CD × 1.2)
total open path = DEOP + DE or DF
Smoke lobbies
Smoke lobbies are a specific part of an exitway, only required in particular circumstances. They are required adjacent to the entrance to a stairway where the floor served by the stair has 150 or more occupants, there isn't a horizontal safe path leading to the stair, the space is unsprinklered or the building has only a single stair (3.13.1). Smoke lobbies are also required at basement levels in some circumstances (3.5.1) and outside of lift landings (although as these are not part of the escape route, they do not need to be sized). If a smoke lobby is required, the Acceptable Solutions provide the methodology to calculate its size (3.9.2). Note that the limitations of NZBC clause DI Access routes DI/ASI still apply for separation of door swings even if the Acceptable Solution calculation shows that there is no size restriction for a smoke lobby.

Other application of smoke lobbies are specified in:
- lift smoke lobbies (3.10.5)
- escape through adjoining buildings (3.4.6)
- escape from basements (3.5).

Other important parts of means of escape include:
- requirements for external escape routes (3.11)
- control of exitway activities (3.10).

Part 4 Control of internal fire and smoke spread
This part provides requirements that contribute to compliance with NZBC clauses C3 Fire affecting areas beyond the fire source and C4 Movement to place of safety. The items included here are fire stopping, plant rooms, intermediate floors and internal surface finishes.

Fire stopping
The construction of fire-rated separations (sometimes referred to as passive fire protection) is an important part of the fire protection system of a building yet is too often poorly completed. While walls and floor construction are installed as per the tested specimens and to the systems supplier's specification, the care taken at the installation stage is commonly defeated by the poor attention paid when services such as electrical cables, ducting, plumbing and heating pipework and even fire protection services are installed through them. The Acceptable Solution requires that such penetrations are installed correctly and in accordance with the manufacturer's specifications. These specifications will be based on the specimens tested when establishing the FRR of the fire-stopping system. It is important that the fire stop is adequately supported where necessary. Many fire-stopping systems in lightweight framed systems (dry lined) need to have additional support added, either through installing timber noggings or applying additional layers of lining in the area of the penetration.

Note that the fire stopping of floors and fire-rated walls such as between apartments is to the outside of the external cladding, so consider any drainage cavities that span these firecells.

Firewalls also need to extend to the ground where there are subfloor spaces, unless these subfloor areas are a separate firecell from the floor above and fire stopped, with the structure fire rated to support the firecells above.
Consideration also needs to be given to:
- smoke separation between sales, exhibition or trade fair space with an occupant load greater than 500 and areas used for storage, receiving goods or workshops (4.7.1)
- requirements for concealed spaces (4.15.6)
- solid waste storage (4.10.2).

**Plant rooms**

Plant rooms containing equipment that uses solid, liquid or gaseous fuels must be separated from other areas in the building (4.10.3–4.10.4). This separation must have an FRR of 90/90/90. If the building is sprinklered, the FRR can be reduced to 60/60/60. Another requirement of plant rooms is that they have access direct from the outside (see Figure 3 below).

If gas-fired plant such as boilers are in the room, the floor must be at or above ground level to avoid a dangerous gas build-up.

**Intermediate floors**

Intermediate floors need to be supported with a structure that has an FRR 30/-/- with the floor construction having an FRR of 30/30/30. The stairs giving access must have the same FRR.
It is a requirement of the Acceptable Solutions that there may be only two intermediate floors in any single firecell, and these must have a maximum vertical height difference of 1.0 m (see Figure 4 below). The area of the intermediate floor(s) is also limited to the maximum capacity of 100 persons as well as the combined area of 20% of the floor area of the firecell if it is enclosed or 40% of the floor area if it is open (or if enclosed and has a smoke detection system installed).

**Internal surface finishes**

Part 4 also specifies the requirements for internal surface finishes of walls, floors and ceilings. These are controlled by the NZBC because certain types of finish have been found to contribute significantly to an increase in fire hazard. This has been a factor in many multiple fatality fires around the world.

**Walls and ceilings**

Both the base material and any treatments or surface-applied coatings affect the fire properties of surface linings. To determine a group number, the complete surface lining system is evaluated using one of two alternative test methods:


In the ISO 9705 test, a small bedroom-sized room is lined with the test material on the walls and ceiling. A gas burner - representing a burning waste paper basket - is placed in a corner very close to the wall surfaces.
In the 20-minute test, the gas burner provides 100 kW output for 10 minutes and then 300 kW for the second 10 minutes. The burner flame may ignite the linings. The time at which the room reaches flashover or full room involvement - defined as exceeding 1000 kW for this test scenario - determines the group number. The best performing to the worst is:
- group 1 = no flashover during test
- group 2 = flashover between 10 and 20 minutes
- group 3 = flashover between 2 and 10 minutes
- group 4 = flashover before 2 minutes.

The alternative ISO 5660 test method uses 100 mm square specimens that are placed under a heating coil and subjected to an imposed heat flux of 50 kW/m². The resulting heat release rate data is used to predict the time to flashover in the ISO 9705 test, and a group number is assigned.

The ISO 5660 test is suitable for most lining materials and offers a cheaper and quicker alternative to the ISO 9705 test.

Smoke production levels are measured in both the full-scale room and cone calorimeter tests. If a material achieves a result within the NZBC limits for group 1 or 2 materials, it is denoted with an S postscript - for example, group number 1-S. Table 6 below gives required group numbers for risk groups and locations in the building.

---

**Table 6 Required group numbers**

<table>
<thead>
<tr>
<th>SURFACE FINISHES</th>
<th>EXITWAYS IN ALL BUILDINGS AND ALL OCCUPIED SPACES IN IMPORTANCE LEVEL 4 BUILDINGS</th>
<th>WALL FINISHES IN SLEEPING SPACES (NOT IN HOUSEHOLD UNITS)* AND CROWD SPACES</th>
<th>CEILING FINISHES IN SLEEPING SPACES (NOT IN HOUSEHOLD UNITS)* AND CROWD SPACES</th>
<th>ALL OTHER OCCUPIED SPACES (INCLUDING HOUSEHOLD UNITS)</th>
<th>DUCTS FOR HVAC SYSTEMS: INTERNAL SURFACES</th>
<th>DUCTS FOR HVAC SYSTEMS: EXTERNAL SURFACES***</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/AS1 Unsprinklered Sprinklerized</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>3**</td>
<td>na</td>
</tr>
<tr>
<td>C/AS2 Unsprinklered Sprinklerized</td>
<td>1-S 2</td>
<td>2-S 3</td>
<td>2-S 2</td>
<td>3</td>
<td>1-S 2</td>
<td>3</td>
</tr>
<tr>
<td>C/AS3 Unsprinklered Sprinklerized</td>
<td>na 2</td>
<td>na 2</td>
<td>na 2</td>
<td>na 2</td>
<td>na 3</td>
<td>na 2</td>
</tr>
<tr>
<td>C/AS4 Unsprinklered Sprinklerized</td>
<td>1-S 2</td>
<td>2-S 3***</td>
<td>2-S 2</td>
<td>3</td>
<td>1-S 2</td>
<td>3</td>
</tr>
<tr>
<td>C/AS5 Unsprinklered Sprinklerized</td>
<td>1-S 2</td>
<td>na na</td>
<td>na na</td>
<td>na 3</td>
<td>na na</td>
<td>na 3</td>
</tr>
<tr>
<td>C/AS6 Unsprinklered Sprinklerized</td>
<td>na 2</td>
<td>na na</td>
<td>na na</td>
<td>na 3</td>
<td>na 2</td>
<td>na 3</td>
</tr>
</tbody>
</table>

Notes:
- * Including treatment areas in C/AS3.
- ** Only applies to foamed plastics and combustible insulation materials or to surface linings covering such. Foamed plastics to also meet AS 1366.
- *** Including acoustic treatment and pipe insulation within air-handling plenum in C/AS2 and C/AS3.
- **** Applies to crowd spaces in C/AS4.
A surface finish achieving a lower group number may be used where a higher group number is required.

Table 7 below gives group numbers for some substrate and coating combinations that do not need to be tested (Table A1 from C/VM2 Appendix A).

<table>
<thead>
<tr>
<th>Coating (coating in good condition and well adhered to substrate)</th>
<th>Substrate</th>
<th>Performance (with or without coating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterborne or solvent borne paint coatings ≤ 0.4 mm thick</td>
<td>Concrete and masonry ≥ 15 mm thick</td>
<td>G1-S</td>
</tr>
<tr>
<td>Polymeric films = 0.2 mm thick</td>
<td>Sheet metal = 0.4 mm thick, or Fibre-cement board = 6.0 mm thick</td>
<td></td>
</tr>
<tr>
<td>Waterborne or solvent borne paint coatings ≤ 0.4 mm thick</td>
<td>Gypsum plasterboard with or without paper facing ≥ 9.5 mm thick</td>
<td>G2-S</td>
</tr>
<tr>
<td>Waterborne or solvent borne paint coatings, varnish or stain ≤ 0.4 mm thick</td>
<td>Solid wood or wood product ≥ 9.0 mm thick</td>
<td>G3</td>
</tr>
<tr>
<td>≤ 100 g/m²</td>
<td>≥ 600 kg/m² for particle boards, or ≥ 400 kg/m² for all other wood and wood products</td>
<td></td>
</tr>
</tbody>
</table>

Table 7 Deemed-to-satisfy group numbers for some materials

Materials that are classified non-combustible when tested to AS 1530.1:1994 *Methods for fire tests on building materials, components and structures - Combustibility test for materials* or ISO 1182:2010 *Reaction to fire tests for products - Non-combustibility test* (meeting the criteria specified in C/VM2 4.7) can be assigned a material group number of 1 or 1-S without further evaluation using Appendix A.

Materials that are classified in accordance with EN 13501-1 *Fire classification of construction products and building elements. Classification using test data from reaction to fire tests* may also be acceptable for use. For further information, see *Achieving NZBC Group Numbers for surface finishes from tests to overseas standards*.

**Flooring**

Flooring must be either deemed non-combustible when tested in accordance with AS 1530.1:1994 or, when tested to ISO 9239-1:2010 *Reaction to fire tests for floorings - Part I: Determination of the burning behaviour using a radiant heat source*, have a critical radiant flux (CRF) of not less than that specified in Table 4.2 of the Acceptable Solutions, other than C/ASI where there is no requirement.

Table 8 below gives the minimum CRF for risk groups and locations in a building.

Table 9 below gives the CRF for some flooring materials that do not need to be tested (Table B1 from Appendix C/VM2 Appendix B).
Surfaces of ductwork

Surfaces of rigid and flexible ductwork for HVAC systems shall be assigned either:
- a material group number of 1-S when the ductwork complies with the fire hazard properties set out in AS 4254–2012 Ductwork for air-handling systems in buildings (Parts 1 and 2), or
- a material group number as determined by C/VM2 Appendix A1.2 or A1.3.

C/AS7 surface finishes

All surface finish requirements for C/AS5 apply to C/AS7.

**Part 5 Control of external fire spread**

This provides requirements that contribute to NZBC clause C3 Fire affecting areas beyond the fire source. It gives the requirements that prevent the spread of fire beyond the building horizontally or up a building vertically via the outside of the façade. It specifies where external walls are required to have a fire resistance rating and features that prevent fire spread.

**Horizontal fire spread from external walls**

Horizontal spread (5.5) is prevented by a combination of distance, protection (by fire rating) of the external walls, controlling the surface finish of the external walls and sprinkler protection of the firecell.

The need to fire rate the wall, based on the property rating, is dependent on the distance to the boundary, the dimensions of the wall facing a boundary (particularly the width of the firecell) and whether or not the space is sprinklered. Other factors that influence
it are the angle between the boundary and the external wall and which risk group is behind the external wall. Walls within 1 m of the boundary are to be two-way fire rated. If they are more than 1 m, the rating is from the inside only. Note that, if the wall is fire rated, other structures that can collapse and bring down the wall (such as unprotected roofing and portals) will also need to be protected or designed so the fire-rated wall can remain standing.

Only very small unprotected areas are allowed within 1 m of the boundary and there are limitations on size and spacing. Larger areas need to have fire-rated glazing or similar. There is an allowance for limited areas of fire-rated uninsulated glass (-/x/) and any areas larger than this will need to meet the insulation rating (-/x/x) – refer to paragraph 5.4 of the Acceptable Solutions.

Small unprotected areas and integrity-only glazing are limited in area and in the spacing between individual panes. Figure 5.1 of the Acceptable Solutions shows the spacing limitations, and Table 5.1 gives distances to the boundary based on areas of integrity-only glass and whether sprinklers are installed.

The requirements specified in the Acceptable Solutions are intended to be conservative. They are presented in table format. Figure 5 below gives an example from C/AS4.

The angle between the wall and relevant boundary is shown as X in Figure 5 below.
Table 10 above can be used to determine:
- the distance from the boundary required for a particular maximum unprotected area (for example, 100% unrated)
- given the building is a given distance from the boundary, how much wall can be unrated.

If the designer wants to know the distance from the boundary, the information required is:
- whether the building is protected with a fire sprinkler system
- the angle between the external wall being assessed and the boundary
- the width of the firecell wall being assessed
- the proportion of the wall that is unprotected (for example, windows and doors)
- whether there are any roof projections and eaves (5.6.3).

Given these five pieces of information, the designer can determine the distance from the boundary the building can be located (column 1 in the table).
If a designer wants to know how much of the wall is permitted to be unprotected given the location of the building, the information required is:
- whether the building is protected with a fire sprinkler system
- the angle between the external wall being assessed and the boundary
- the width of the wall being assessed
- the distance to the boundary.

**Example 1:** An unsprinklered risk group CA building that has an external wall that is parallel to the boundary (angle 0–45°) and is less than 10 m wide has to be at least 11 m from the boundary to be completely unprotected (i.e. it requires no fire rating at all).

If 35% of the wall area is windows and doors and the rest of the wall is fire-rated construction, the wall is required to be no closer than 5 m from the boundary. No interpolation is permitted, and the next most onerous value is taken using the Acceptable Solutions.

If a designer wants to know how much of the wall is permitted to be unprotected given the location of the building, the information required is:
- whether the building is protected with a fire sprinkler system
- the angle between the external wall being assessed and the boundary
- the width of the wall being assessed
- the distance to the boundary.

**Example 2:** A sprinklered risk group CA building that has an external wall that is parallel to the boundary (angle 0–45°), is 12 m wide and a distance of 4 m from the boundary is permitted to have 60% of its area unprotected. (The next most onerous value is taken from the table.)

If the same building is not fire sprinkler protected, 30% of the wall area is permitted to be unprotected.

Having determined whether or not the wall complies with the maximum unprotected area requirement, there is a final check to undertake to ensure compliance. Although in the above example 60% of the wall can be unprotected, it may not be permitted to be a single unprotected area (for example, the upper 60% of the wall in a single area). Table 5.3 in the Acceptable Solution specifies the maximum single unprotected area permitted and the minimum distance to any adjacent unprotected area.

**Example 3:** An unsprinklered risk group CA building that has an external wall that is parallel to the boundary (angle 0–45°), is 12 m wide and a distance of 6.8 m from the boundary is permitted to have 35% of its area unprotected. (The next most onerous value is taken from the table.)
For the building in example 3, if the height of the wall is 4 m, the elevation area is 48 m² and the permitted unprotected area is 16.8 m² (35% of 48 m²). From Table 5.3 of C/AS4 (see Table 11 below), for an unsprinklered building at a distance of 6.8 m, the permitted largest single unprotected area is 31 m² with a separation of 8.5 m to the adjacent unprotected area, using the 6 m distance to the relevant boundary as being more conservative. Therefore, as a single unprotected area, the 16.8 m² is permitted (see Figure 6 below).

For an unprotected opening with a height of 2 m, the length is 8.4 m and will fit anywhere into the 12 m wide façade. At one end, 3.6 m will be left, which is not sufficient for a second unprotected area.

Figure 6 Elevation of building with a single unprotected area.

If the unprotected area is divided into two 8.4 m² areas (16.8 ÷ 2), this means that at 2 m height, there are two 4.2 m lengths. For an 8.4 m² maximum unprotected area, the separation is 5 m (Table 5.3 of C/AS4) using the 10 m² value. With only 3.6 m between the unprotected areas, this does not comply (see Figure 7 below). For this to be possible, the façade would have to be 13.4 m long - that is, (2 x 4.2) + 5.

Figure 7 Elevation of building with two unprotected areas, which is non-compliant as the separation needs to be 5 m.
Table 11 Maximum size of largest permitted single unprotected area in external walls (Table 5.3 from C/AS4)

<table>
<thead>
<tr>
<th>Minimum distance to relevant boundary (m) (see Figure 5.3)</th>
<th>Unsprinklered firecell</th>
<th>Minimum distance to adjacent unprotected areas (m)</th>
<th>Maximum largest single unprotected area (m²)</th>
<th>Minimum distance to adjacent unprotected areas (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0.5</td>
<td>15</td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1</td>
<td>35</td>
<td>2.5</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>5</td>
<td>60</td>
<td>3.5</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>7</td>
<td>96</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>23</td>
<td>8</td>
<td>139</td>
<td>4.5</td>
</tr>
<tr>
<td>6</td>
<td>31</td>
<td>8.5</td>
<td>No requirement</td>
<td>No requirement</td>
</tr>
<tr>
<td>7</td>
<td>40</td>
<td>9.5</td>
<td>No requirement</td>
<td>No requirement</td>
</tr>
<tr>
<td>8</td>
<td>51</td>
<td>11</td>
<td>No requirement</td>
<td>No requirement</td>
</tr>
<tr>
<td>9</td>
<td>64</td>
<td>13</td>
<td>No requirement</td>
<td>No requirement</td>
</tr>
<tr>
<td>10</td>
<td>77</td>
<td>13.5</td>
<td>No requirement</td>
<td>No requirement</td>
</tr>
</tbody>
</table>

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Figure 8 Separate firecells on upper and lower storeys
In Figure 8 above, the upper and lower floors are each a separate firecell and can be assessed independently. The lower firecell has areas A, B and C unprotected, and Table 5.2 (see Table 10 above) provides the maximum aggregated area proportional to the area of the entire external wall of the lower firecell. In addition, none of the unprotected areas can be larger than the maximum area specified in Table 5.3 of C/AS4 (Table 11 above) nor closer to an adjacent area (within the same firecell) than the distance specified in the same table.

Unprotected areas D and E in Figure 8 above are only relevant for the upper firecell, and the analysis of these has to be repeated for that firecell.

**Open-sided buildings (5.6.6)**
There are requirements for open-sided buildings, such as carports, which may be detached or attached to a building. Limitations exist on roof area and distance to the other building to be considered as detached. Paragraph 5.6.6 of the Acceptable Solutions gives the details.

**Vertical fire spread**
Vertical spread is prevented/mitigated by a combination of control of external surface finishes, architectural/structural features (such as spandrels and aprons) and sprinkler protection.

External surface finishes must comply with specified criteria (5.8.1) ascertained by testing if the wall is within a specified distance to the boundary in combination with the wall’s height to the junction with the roof. Table 12 below gives the requirements based on rate of heat release determined by testing to ISO 5660 and Appendix C C7.1 of the Acceptable Solutions.

<table>
<thead>
<tr>
<th>Table 12 Building height distance to boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BUILDING HEIGHT</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Up to 7 m</td>
</tr>
<tr>
<td>Up to 10 m</td>
</tr>
<tr>
<td>Up to 25 m</td>
</tr>
<tr>
<td>Over 25 m</td>
</tr>
</tbody>
</table>

**Notes:**
* No requirement if sprinklered.
** No requirement if single storey.

<table>
<thead>
<tr>
<th><strong>PEAK HEAT RELEASE RATE (KW/M²)</strong></th>
<th><strong>TOTAL RELEASE RATE (MJ/M²)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>( \leq 100 )</td>
</tr>
<tr>
<td>B</td>
<td>( \leq 150 )</td>
</tr>
</tbody>
</table>
**Spandrels and aprons**
The specification of spandrels and aprons (5.7.10–5.7.13) to prevent vertical fire spread from openings such as windows is given in Table 5.4 and Figure 5.7 of the relevant Acceptable Solution (see Table 13 and Figure 9 below).

Note that spandrels are two-way fire rated (inside and outside) and therefore consider the detailing of cavities and where the fire-rated section stops and its supports and the effect of the unrated wall on the fire-rated areas. Aprons are rated underneath and extend past the edge of the opening.

| Table 13 Combinations of aprons and spandrels (Table 5.4 from the Acceptable Solutions) |
|----------------------------------|----------------------------------|
| Aperture projection (m) | Spandrel height (m) |
| 0.0 | 1.5 |
| 0.3 | 1.0 |
| 0.45 | 0.5 |
| 0.6 | 0.0 |

Where spandrels and aprons are used, Table 13 above gives the relative aperture projection for spandrel height. For example, for an aperture projection of 0.6 m, no spandrels are required (0.0 m height).

The requirement for spacing of unprotected areas is given in C/AS4 5.7.11. Unprotected areas in the external walls of the firecells (see Figure 9 below) shall be separated by no less than:
- 1.5 m where any parts of the unprotected areas are vertically aligned above one another, or
- 900 mm where the unprotected areas on one level are horizontally offset from those on the other level. This offset is two-thirds the height of the lower unprotected area.

**Part 6 Firefighting**
This provides requirements that contribute to NZBC clause C5 *Access and safety for firefighting operations* and deals with access to the building and the firefighting facilities required. C/ASI for multi-unit dwellings has a requirement for access to be provided when there are more than two building units remote from the street. The access has to be a hard standing area for the fire appliances.

Care facilities have additional requirements in C/AS3 for aerial appliance parking, access and staging areas. These should be agreed with the Fire Service.
Part 7 Prevention of fire occurring
This provides requirements that contribute to NZBC clause C2 Prevention of fire occurring.

It mostly deals with heating appliances in buildings and their installation so that a fire does not occur, for the most part by calling up New Zealand standards as the installation requirement. The requirements for downlights and open fires are also specified.

Table 14 below lists the applicable standards.

Table 14 Heating appliance standards

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS/NZS 2918:2001</td>
<td>Domestic solid fuel burning appliances – Installation</td>
</tr>
<tr>
<td>AS/NZS 5601:2013 sections 6.7, 6.8 and 6.9 and Appendix H</td>
<td>Gas installations – Part 1: General installations</td>
</tr>
<tr>
<td>AS 1691–1985</td>
<td>Domestic oil-fired appliances – installation</td>
</tr>
</tbody>
</table>

All are subject to modification by C/AS Part 7 paragraphs.
Having established which Acceptable Solution(s) to use based on the building risk, it is now time to design or check the design of the building.

Table 15 below provides guidance on finding some key information or making the calculations required in the Acceptable Solutions. The paragraph and table references given here are for the appropriate point in the Acceptable Solutions. Some do not apply for specific risk groups. For example, Table 1.2 on the number of occupants is not required for some risk groups such as SM (apartments, hotels, motels, hostels).
Table 15 Key (high-level) design considerations for Acceptable Solution design

<table>
<thead>
<tr>
<th>DESIGN CONSIDERATION</th>
<th>DATA</th>
<th>ACCEPTABLE SOLUTION PART OR PARAGRAPH NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of occupants</td>
<td></td>
<td>Paragraph 1.4 and Table 1.2</td>
</tr>
<tr>
<td>- in the building</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- per floor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- in each firecell on each floor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single or (number of storeys if) multi-storey</td>
<td></td>
<td>Part 2</td>
</tr>
<tr>
<td>If multi-storey, escape height (m)</td>
<td></td>
<td>Part 2</td>
</tr>
<tr>
<td>If multi-storey, number of stairs</td>
<td></td>
<td>Paragraph 3.2.1</td>
</tr>
<tr>
<td>If single stair – more than 10 m escape height (about 4 floors) – sprinklers are required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of final exits from each firecell on the ground floor</td>
<td></td>
<td>Paragraph 3.2.1</td>
</tr>
<tr>
<td>Maximum size of unseparated spaces</td>
<td></td>
<td>Paragraph 2.1</td>
</tr>
<tr>
<td>Based on occupant load and escape height, establish fire safety systems</td>
<td></td>
<td>Paragraph 2.2</td>
</tr>
<tr>
<td>Fire resistance ratings required: Life*</td>
<td></td>
<td>Paragraph 2.3</td>
</tr>
<tr>
<td>Fire resistance ratings required: Property**</td>
<td></td>
<td>Paragraph 2.3</td>
</tr>
<tr>
<td>Intermediate floor size and occupant load</td>
<td></td>
<td>Paragraph 4.13</td>
</tr>
<tr>
<td>Plant rooms</td>
<td></td>
<td>Paragraph 4.10</td>
</tr>
<tr>
<td>Support activities</td>
<td></td>
<td>Paragraph 4.10</td>
</tr>
<tr>
<td>Solid waste storage</td>
<td></td>
<td>Paragraph 4.10</td>
</tr>
<tr>
<td>Internal surface finishes</td>
<td></td>
<td>Paragraph 4.17</td>
</tr>
<tr>
<td>Location of the building on the site (distance between each external wall and the boundary)</td>
<td>North South East West</td>
<td>Paragraph 5.2</td>
</tr>
<tr>
<td>Multi-storey buildings – vertical fire spread</td>
<td></td>
<td>Paragraphs 5.7.10–5.7.15</td>
</tr>
<tr>
<td>External surface finishes</td>
<td></td>
<td>Paragraph 5.8.1</td>
</tr>
</tbody>
</table>

Notes:
* The fire resistance rating applied to building elements that allow people in a building to move to a place of safety.
** The fire resistance rating applied to building elements that allow for protection of other property and where the building is more than 10 m escape height.

Basis of the fire design
To form the basis of the fire design, some key information about the building is required:
1. Establish the escape height for the building (see Figure 10 below). The escape height is the difference in height of the lowest or highest floor and the level at which occupants would leave the building (whichever is greater). If there is more than one risk group in a building, find the escape height for each risk group. An example of this is shown in Figure 10 below (and applied in paragraph 2.2 of the Acceptable Solutions). If there is more than one exit, it is to the lowest exit (or highest where it is escape from a basement) in order to maximise the distance.
2. Establish the gross floor areas (total floor area including furniture and fixings) of each floor. If there are separate areas within a floor, those will need to be considered separately (see Figure 11 below. Also see Figure 1.1 and paragraph 1.4 of the Acceptable Solutions).

3. Is there a subfloor space below ground level? If so, the ground floor must be fire rated (4.14) unless the specific limitations are met regarding access, no storage or plant and construction of fire separations.

Figure 10 Calculating the escape height for a building

Figure 11 Building with separate floor areas that will need to be considered individually
4. Are there roof spaces or suspended ceilings (4.15)?
5. Determine the distances of each elevation to the closest boundary (5.2) and the distance of any eaves or canopies to the boundary.
6. Determine the height and width of each floor of the building facing a boundary (5.2).
7. Determine the building height - this is the height of the wall from lowest level to the top of the wall (5.8.1).
8. Establish the position of the Fire Service attendance point (Part 6).

**Fire design**

Having established the above information, design or checking compliance of the design can begin.

1. Calculate occupant load for discrete areas of floors and for the building (paragraph 1.4 and Table 1.2). Occupant load is used to determine a number of features of the fire safety design for means of escape from fire.
2. Using occupant load, escape height and (if appropriate) building height to which storage can be achieved, determine the fire safety systems required (2.1). If the building contains multiple risk groups, the most onerous fire safety system requirement will also have to be established.
3. The life and property ratings can be noted from the specified requirements in paragraph 2.3. The life fire resistance rating applies to building elements that allow people in a building to move to a place of safety. The property fire resistance rating applies to building elements that allow for protection of other property or where structural stability is needed.
4. Using the information from step 1, establish:
   - the number of escape routes required - in multi-storey buildings, this includes the number of stairwells (3.2)
   - the width of aggregated escape routes required (3.3.2)
   - the total escape width required (3.3.2).

The Acceptable Solutions state that, if the building is not sprinkler protected, the widest of the escape routes or final exits available has to be considered blocked and not usable. To be considered separate escape routes in an open path situation, there needs to be a distance of 8 m separation. The number of people able to use an escape route or final exit is taken as the width in millimetres divided by 7 for horizontal routes and divided by 9 for stairs (3.3.2a). Tiered seating such as used in theatres has special allowances for the spacing between the seats, the number of seats in a row and aisle widths.

5. Also include the width of doors on the escape route in the calculation in step 4 (3.3.6d).
6. Establish the maximum lengths of open paths - both dead-end open paths for the single direction of escape and total open paths where there is more than one route (Table 3.2). Using the calculations explained in the Acceptable Solutions, work out if the design is acceptable or if more doors from the room being considered are required.
7. If present or required, repeat step 6 for the horizontal safe path portions of the exitways, again taking account of whether or not there is one or more than one direction of escape. Smoke lobby requirements must also be considered.
8. Doors on the escape route (3.15) need to:
   - be wide enough (restriction on reduction of width of exitways)
   - open in the correct direction or two-way swing
   - have hold-open devices where required
Example
An unsprinklered building with three floors that has offices on the first and second floors and retail on the ground floor. The occupant load for each floor is 250, 260 and 750 people respectively.

Therefore, using Table 3.1 in the Acceptable Solutions, the building requires two stairs (occupant load of each upper floor up to 500) and the ground floor requires three escape routes/final exits. Each stair (3.3.2d) must be able to accommodate the total capacity of the largest occupant load of a floor (3.3.2i), therefore each is required to be 9 mm x 260 persons (3.3.2a), or 2.34 m wide.

The ground floor retail requires exit width (discounting the largest exit) of 750 x 7 mm = 5.25 m. This could be achieved with four double doors 1800 mm wide, with one of these being ignored as it is assumed it is blocked.

- have panic fastenings where required
- have lever door handles to D1/AS1 if there are no panic bars
- allow escape from the stair onto other floors during a fire in case it becomes untenable
- have vision panels if required.

9. Establish where building elements with fire resistance ratings are required given:
- the maximum permitted area of a firecell (2.1)
- where horizontal and vertical safe paths are required to reduce the length of open path travel (3.4.2)
- specific requirements of the Acceptable Solutions such as:
  - formation of protected shafts, such as lifts (4.11)
  - separation of plant rooms (4.10)
  - floors, including fire rating of intermediate floors (4.13)
  - subdivision of concealed spaces (4.15).

10. Establish the required internal surface finish requirements for spread of fire (4.17.1).

11. Establish the flooring requirements with respect to the spread of fire (4.17.3).

12. Determine the extent of openings in external walls permitted (5.2).

13. Establish the percentage of an external wall that is required to be fire rated (5.2).

14. If a multi-storey building, determine the protection requirements for preventing spread of fire vertically (5.7.10–5.7.15).

15. Establish the requirements for external surface finishes of walls (5.8.1).

16. If the building is remote from a street, determine if there are requirements for access of Fire Service vehicles (6.1).

17. Establish whether control equipment for Fire Service monitoring is required and in what locations (6.2).
DEFINITIONS

building height
The vertical distance between the floor level of the lowest occupied space above the ground and the top of the highest occupied floor, but not including spaces located within or on the roof that enclose stairways, lift shafts or machinery rooms.

escape height
The height between the floor level in the firecell being considered and the floor level of the required final exit, which is the greatest vertical distance above or below that firecell.

escape route
A continuous unobstructed route from an occupied space in a building to a final exit to enable occupants to reach a safe place.

exitway
An escape route protected by fire or smoke separations, or by distance when exposed to open air, that ends at a final exit.

firecell
Any space within a building (including adjoining spaces on the same or different levels) that is enclosed by fire separations, external walls, roofs and floors.

fire load
The total calorific value of combustible contents that can reasonably be expected to burn in a firecell, including building elements and furnishings.
fire resistance rating (FRR)  Three numbers that give the minutes for which the requirements of structural adequacy, integrity and insulation of building elements are satisfied. For example, an FRR of 60/60/30 means that, in a standard test for fire resistance, the building element will resist structural collapse for 60 minutes, has the integrity to resist the passage of flame for 60 minutes and will resist the transfer of heat to a specified level for 30 minutes.

Building elements such as walls and floors typically require structural adequacy, integrity and an insulation performance for a certain minimum period of time.

The rating for a building element is established by standard test methods. The methods referenced by the Acceptable Solutions are AS 1530.4:2014 Methods for fire tests on building materials, components and structures - Fire-resistance tests for elements of construction and BS 476-21:1987 Fire tests on building materials and structures. Methods for determination of the fire resistance of loadbearing elements of construction. Typically, a sample of the building element is tested in a furnace until failure occurs.

fire safety system  All active and passive protection methods used in a building to:
- warn people of an emergency
- provide for safe evacuation
- provide for access by and the safety of firefighters
- restrict the spread of fire
- limit the impact of fire on structural stability.

fire separation  A building element that separates firecells or firecells and safe paths and provides a specific fire resistance rating.

occupant load  The greatest number of people likely to occupy a particular space in a building.

open path  The part of an escape route in a firecell where occupants may be exposed to fire or smoke while making their escape.

outbuilding  Outbuilding is a classified use (NZBC clause A1). The term applies to a building or use that may be included within each of the other classified uses but is not intended for human habitation and is accessory to the principal use of associated buildings. Examples include a carport, farm building, garage, greenhouse, machinery room, private swimming pool, public toilet, or shed. Refer to the Commentary for Acceptable Solutions C/AS1 to C/AS7 for guidance on the interpretation of what constitutes an outbuilding.
relevant boundary  The boundary of the site on which the building is situated. Distances from the external walls of the building to the boundaries are calculated to determine whether or not a part of the external wall needs to be fire rated. There are some complicating factors in determining which is the relevant boundary. For example, if there is a road adjacent to the site boundary, the relevant boundary is deemed to be the boundary on the other side of that road. Similarly, if land adjacent to the site boundary is classified as reserve in the district plan, the relevant boundary is deemed to be that on the other side of the reserve from the site boundary.

risk group CA  Buildings where members of the public gather - halls and recreation centres, cinemas, shops, schools, restaurants and cafés, hairdressers, early childhood centres and so on. Covered by C/AS4.

risk group SH  Houses and multi-unit dwellings no more than two units high. Does not include buildings where there is a corridor/stairway serving more than one dwelling. Outbuildings not intended for human habitation are also included in this risk group. Covered by C/AS1.

risk group SI  Accommodation where occupants are unable to evacuate without help or would be delayed - typically, institutions such as hospitals, rest homes and detention spaces in police stations and courthouses (but not prisons). Covered by C/AS3.

risk group SM  Multiple unit accommodation buildings not included in risk group SH - apartments, hotels, motels, hostels and so on. Covered by C/AS2.

risk group VP  Any place where vehicles are parked or stored, including car parks, truck and bus parks, stacked boat storage and light aircraft hangars. Covered by C/AS7.

risk group WB  Workplaces such as offices, laboratories, workshops, most factories and so on. Does not include personal services (doctors, hairdressers, beauticians and so on.) which are risk group CA. Covered by C/AS5.

risk group WS  Buildings where large quantities of commodities are stored or where the risk is higher than in other risk groups - including warehouses capable of 5 m or more storage, temperature-controlled storage, and trading and bulk retail with 3 m or more storage. Covered by C/AS6.

unprotected area  In relation to an external wall of a building, this means:
- any part of the external wall that is not fire rated or has less than the required FRR, and
- any part of the external wall that has combustible material more than 1.0 mm thick attached or applied to its external face, whether for cladding or any other purpose.
Guide to the Acceptable Solutions: Protection from Fire