

# Acceptable Solution G4/AS1

## 1.0 Ventilation

### 1.1 Introduction

**1.1.1** Ventilation of spaces within *buildings* is required to maintain air purity by a flow of *outdoor air* through the *building* envelope, with or without mechanical assistance.

#### COMMENT:

If activities or environmental conditions adjacent to external natural ventilation openings produce air pollution in any of the forms listed in NZBC G4.3.3, it may be necessary to relocate the openings or use mechanical ventilation.

**1.1.2** Ventilation of spaces within *buildings* must be provided by natural ventilation (refer to Paragraphs 1.2 and 1.3), mechanical ventilation (refer to Paragraph 1.5), or a combination of mechanical and natural ventilation (refer to Paragraph 1.4).

**1.1.3** *Buildings* containing Type 5 fire alarm systems must have mechanical extract ventilation installed in kitchens.

#### COMMENT:

Refer to Acceptable Solution F7/AS1 and Acceptable Solutions C/AS1– C/AS6 Appendix A for information on Type 5 fire alarms.

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### 1.2 Natural ventilation – General

**1.2.1** Where natural ventilation is available via adjacent spaces, specific ventilation is not required to small spaces such as hallways and lobbies in *household units*.

**1.2.2** Natural ventilation of *occupied spaces* must be achieved by providing a *net openable area* of windows or other openings to the outside of no less than 5% of the floor area. The 5% floor area requirement does not apply to:

- a) *occupied spaces* in Commercial and Industrial *buildings* where products listed in NZBC Clause G4.3.3 are generated (mechanical ventilation of these spaces is required), and
- b) *household units* and accommodation units where there is only one external wall with opening windows (refer to Paragraph 1.3 for additional requirements if natural ventilation is used).

**1.2.3** Openable *building elements* shall be constructed in a way that allows them to remain fixed in the open position as a means of ventilation during normal occupancy of the *building*.

#### COMMENT:

1. The net openable area of windows or doors is measured on the face dimensions of the *building element* concerned.
2. Fixing in an open position of doors and windows used for ventilation is necessary to avoid injury or damage from sudden closure in the event of strong winds or other forces.
3. Keeping water from entering the *building* must be considered for compliance with NZBC Clause E2 External Moisture.

**1.2.4** Natural ventilation of car parks shall comply with the natural ventilation part of AS 1668.2 Section 7.

### 1.3 Natural ventilation of household units and accommodation units with one external wall

#### Scope

**1.3.1** Paragraphs 1.3.2 to 1.3.9 specify the natural ventilation to both *household units* and accommodation units with only one external wall, such as those often found in apartments, hotels and motels.

#### Kitchens, bathrooms, toilets and laundries that have an external wall

**1.3.2** For kitchens, bathrooms, toilets and laundries located on the external wall, moisture and other contaminants must be ventilated to the outside by natural ventilation using either:

- a) windows and/or other openings to the outside with a *net openable area* of no less than 5% of the floor area, or
- b) high level *trickle ventilators* located through the external wall or *building elements* within the external wall (see Paragraph 1.3.9 for *trickle ventilators*), where the distance between the external wall and opposing wall is less than 6 metres.

### Kitchens, bathrooms, toilets and laundries without an external wall

**1.3.3** For kitchens, bathrooms, toilets and laundries **not** located on the external wall, moisture and other contaminants must be ventilated to the outside by natural ventilation having:

- a) a *passive stack ventilator*, located in the kitchen, bathroom, toilet or laundry, designed to extract a continuous airflow through the surrounding *habitable spaces* (see Paragraph 1.3.7 for *passive stack ventilators*), and
- b) high level *trickle ventilators*, located within the external wall or in *building elements* that are integrated within the external wall (see Paragraph 1.3.9 for *trickle ventilators*), and
- c) *permanent openings* for airflow between the surrounding *habitable spaces* and the kitchen, bathroom, toilet or laundry of no less than 5% of the combined floor area of the spaces, and not compromising the privacy of the toilet or bathroom, and
- d) a combined distance of the *habitable space* and the kitchen, bathroom, toilet or laundry measured between the external wall and furthest opposing wall of less than 10 metres.

### Habitable spaces that have an external wall and open to a kitchen, bathroom, toilet or laundry with a passive stack ventilator

**1.3.4** For *habitable spaces* with both an external wall and a *permanent opening* to a kitchen, bathroom, toilet or laundry, ventilation shall be achieved by:

- a) installing high level *trickle ventilators*, located within the external wall or *building elements* within the external wall (see Paragraph 1.3.9 for *trickle ventilators*), and
- b) having a *passive stack ventilator* installed in the kitchen, bathroom, toilet or laundry, and

- c) having an area of *permanent opening* between the two spaces of no less than 5% of the combined floor area of the *habitable space* and the kitchen, bathroom, toilet or laundry, and not compromising the privacy of the toilet or bathroom, and
- d) windows and/or other openings to the outside with an *net openable area* of no less than 5% of the floor area, and
- e) having a maximum dimension between the external wall and the furthest internal opposing wall, when measured across the combined *habitable space* and the kitchen, bathroom, toilet, or laundry, of less than 10 metres.

### Habitable spaces that have an external wall and do not open to a kitchen, bathroom, toilet or laundry with a passive stack ventilator

**1.3.5** For *habitable spaces* with an external wall and no *permanent opening* to surrounding spaces, ventilation must be achieved by having:

- a) windows and/or other openings to the outside with an *net openable area* of no less than 5% of the floor area, and
- b) high level *trickle ventilators*, located within the external wall or in *building elements* within the external wall (see Paragraph 1.3.9 for *trickle ventilators*), and
- c) a distance between the external wall and opposing wall of the *habitable spaces* of less than 6 metres.

### Habitable spaces ventilated via another habitable space

**1.3.6** Ventilation of a *habitable space* without openings to the exterior via another *habitable space* must be achieved by:

- a) providing from the other *habitable space* to outside, openable windows and/or other openings of *net openable area* of no less than 5% of the combined floor area of the combined *habitable spaces*, and

- b) providing high and low level *trickle ventilators* located on the external wall (see Paragraph 1.3.9 for *trickle ventilators*), sized according to the combined floor area, and
- c) providing an area of *permanent opening* between the two spaces of no less than 5% of the combined floor area of the *habitable spaces*, and
- d) having a combined distance of the *habitable spaces*, measured between the external wall and furthest opposing wall, of less than 6 metres.

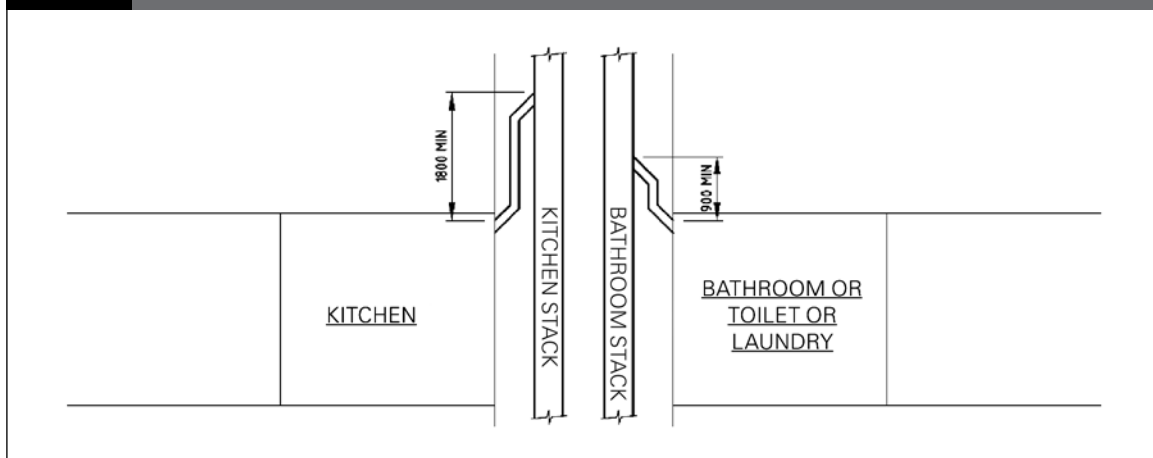
### Passive stack ventilators

**1.3.7** *Passive stack ventilators* consist of a vertical ventilation shaft which uses air buoyancy to ventilate spaces. *Passive stack ventilators* shall:

- a) have no connections from spaces other than kitchens connecting to the kitchen *passive stack ventilator*, and
- b) not be used in *household units* in combination with mechanical ventilation systems, and
- c) be designed in accordance with AS/NZS 4740 Section 3, and
- d) be designed to achieve extract airflow rates specified in AS 1668.2 Table B1, using the following parameters:
  - e) be integrated into the *building* without decreasing the performance of the *building* envelope and the partition walls of the *building* for external moisture, fire and acoustics, and
      - f) be capable of drawing air through *trickle ventilators* or *permanent openings* from the room or adjacent spaces. The *permanent openings* to the surrounding spaces and *trickle ventilators* to the outside shall have an *equivalent aerodynamic area* greater than the *equivalent aerodynamic area* of the *passive stack ventilator*. This is to ensure air can be drawn through the *passive stack ventilator* effectively.
      - g) when extracting from kitchens:
        - i) maintain the *fire separation* of the fire separated shaft with a pressure-forming intumescent fire collar around a collapsible duct, and
        - ii) have ducting, downstream of the fire collar, made of non-combustible material, and
        - iii) have connections that contain no more than two bends and do not have any duct that is more than 45° to the vertical, and

Air Density	$\rho = 1.2 \text{ kg/m}^3$
Gravitational Constant	$g = 9.81 \text{ m/s}^2$
Temperature Differential	$\Delta T = 3\text{K}$
Outside Ambient Temperature	$T = 300\text{K}$
Wind Velocity	$V_t = 0\text{m/s}$ , and

**Figure 1:** Fire Shunt System  
Paragraph 1.3.7



- iv) have the branch connection to the common duct via a fire shunt of 1800 mm in height (see Figure 1), and
  - v) have the fire shunt and the stack located in a *fire separated* shaft.
- h) when extracting from bathrooms, toilets and laundries:
- i) be installed in a *fire separated* shaft, and
  - ii) have the branch connection to the *common extract duct* via a fire shunt of 900 mm in height (see Figure 1), and
  - iii) have connections that contain no more than two bends and do not have any duct that is more than 45° to the vertical, and
  - iv) be ducting made of non-combustible material, unless the *common extract duct* is the only duct in the fire separated shaft.
- i) have ventilation ducts and stacks that are insulated in any unheated areas with a minimum thickness of 25 mm of a material having a thermal conductivity of no less than 0.04W/m<sup>2</sup>K, and
- j) have a condensation trap fitted to the part of the duct above the roof level.

Table 1: Number of occupants Paragraph 1.3.9	
Household unit accommodation unit type	Number of people
Studio	2
1 bedroom	2
2 bedroom	3
Greater than 2 bedrooms	Add 1 per bedroom

**1.3.8** The terminal of a *passive stack ventilator* shall:

- a) have an *equivalent aerodynamic area* greater than the cross-sectional area of the stack, and
- b) extend above the roof to at least the ridge height.

**COMMENT:**

To comply with b) the outlet of the *passive stack ventilator* should be placed at the ridge of the roof to reduce the adverse effects of wind gusts.

**Trickle ventilators**

**1.3.9** *Trickle ventilators* are devices that have an opening to the outside. *Trickle ventilators* shall:

- a) have an opening of no less than 2000 mm<sup>2</sup> *equivalent aerodynamic area*, and
- b) be located to minimise draughts, and
- c) be secured to keep pests and insects out, and
- d) have acoustic attenuation, if required by NZBC G6 Airborne and Impact Sound, and
- e) be controllable and closable in all conditioned spaces, and
- f) be installed in *household units*, providing they do not contain mechanical supply ventilation, and
- g) have the sum of the *equivalent aerodynamic area* greater than the sum of the equivalent area of the *passive stack ventilator(s)*, if installed in a *household unit*, and
- h) have the *equivalent aerodynamic area*, based on the number of occupants, for the space as given in Tables 1 and 2, and

Table 2: Total required equivalent aerodynamic area per space (mm <sup>2</sup> ) Paragraph 1.3.9					
Ventilator locations	Number of occupants				
	1	2	3	4	5
High and low level	4000	8000	12,000	16,000	20,000
High level only	3000	6000	9000	12,000	15,000

- i) have, where high and low level *trickle ventilators* are required, the high and low level *trickle ventilators* of approximately the same *equivalent aerodynamic area* and separated by a minimum of 1 metre. High level *trickle ventilators* are located in the top half of the wall. Low level *trickle ventilators* are located in the bottom half of the wall.

**COMMENT:**

There are a range of *trickle ventilators*, sometime called background ventilators, on the market.

#### 1.4 Combined natural ventilation and mechanical ventilation

##### Scope

**1.4.1** This section specifies the combined natural and mechanical ventilation requirements for both *household units* and accommodation units, with one external wall, such as those often found in apartments, hotels and motels.

*Habitable spaces* will be naturally ventilated, and kitchens, bathrooms, toilets and laundries will be ventilated by continuous or intermittent mechanical extract ventilation.

##### Combination ventilation with continuous mechanical extract

**1.4.2** For *habitable spaces* with both one external wall and a *permanent opening* to a kitchen, bathroom, toilet or laundry, within which a continuous mechanical extract system is installed, ventilation shall be achieved by:

- a) integrating high level *trickle ventilators*, located within the external wall or *building elements* that are integrated within the external wall (see Paragraph 1.3.9 for *trickle ventilators*), and
- b) having a *net openable area* of windows and/or other openings to the outside of no less than 5% of the floor area, and
- c) having the kitchen, bathroom, toilet, or laundry door undercut by 20 mm, and

- d) having a maximum dimension between the external wall and the furthest internal opposing wall, when measured across the combined *habitable space* and the kitchen, bathroom, toilet, or laundry, of less than 10 metres.

##### Combination ventilation with intermittent mechanical extract

**1.4.3** For *habitable spaces* with one external wall and a *permanent opening* to a kitchen, bathroom, laundry, or toilet, within which an intermittent mechanical extract system is installed, ventilation shall be achieved by:

- a) integrating high and low level *trickle ventilators*, located within the external wall or *building elements* that are integrated within the external wall (see Paragraph 1.3.9 for *trickle ventilators*), and
- b) having a *net openable area* of windows and/or other openings to the outside of no less than 5% of the floor area, and
- c) having the kitchen, bathroom, toilet, or laundry door undercut by 20 mm, and
- d) having a maximum dimension between the external wall and the furthest internal opposing wall, when measured across the combined *habitable space* and the kitchen, bathroom, toilet, or laundry, of less than 6 metres.

**COMMENT:**

If Paragraphs 1.4.2 and 1.4.3 both apply, then ventilation shall be achieved by complying with Paragraph 1.4.3.

## 1.5 Mechanical ventilation

**1.5.1** Mechanical ventilation systems must satisfy the following conditions:

- a) **outdoor air supply** shall be designed and equipment installed to comply with NZS 4303, or AS 1668.2 (excluding Table A1 and Sections 3 and 7), and to provide outdoor air to *occupied spaces* at the flow rates given in NZS 4303 Table 2, and
- b) **air-handling systems** shall be installed and maintained to the requirements of AS/NZS 3666.1 and AS/NZS 3666.2, and
- c) **extract ventilation** shall:
  - i) be constructed so that any products listed in Clause G4.3.3 are removed, collected or diluted by ventilation rates and methods set out in AS 1668.2 Section 5

### COMMENT:

Commercial kitchen extract ventilation is included in AS 1668.2 Section 5.

- ii) where provided to remove moisture and other contaminants from kitchens, bathrooms, toilet spaces and laundries in *household units*, exhaust the air to the outside at flow rates given in AS 1668.2, Table B1, and
  - iii) where provided for extract from kitchens, bathrooms, toilets and laundries in *buildings* containing *household units* or accommodation units, refer to Paragraphs 1.5.2 and 1.5.3.
- d) **outdoor air intakes** shall be located to avoid contamination from any local source in accordance with AS 1668.2 Clause 4.3.1 and NZS 4303 Clause 5.5, and
- e) **recirculated air systems** shall comply with AS 1668.2 Clause 4.5, and
- f) **contaminated air discharge systems** shall discharge contaminated air in a way that complies with AS 1668.2 Clause 5.10, and
- g) **filtration** shall comply with AS 1668.2 Clause 4.4, and
- h) **commissioning** shall comply with CIBSE Code Series A.

## Extract ventilation from buildings containing household units and accommodation units

**1.5.2** Extract ventilation from kitchens must:

- a) maintain the *fire separation* of the fire separated shaft with a pressure-forming intumescent fire collar around a collapsible duct, and
- b) have ducting, downstream of the fire collar, made of non-combustible material, and
- c) have the branch connection to the *common extract duct* located in a fire separated shaft, and
- d) have the fire shunt and *common extract duct* located in a separated shaft.

**1.5.3** Extract ventilation from bathrooms, toilets and laundries must:

- a) be installed in a fire separated shaft, and
- b) have the branch connection to the *common extract duct* via a fire shunt of 900 mm in height, and
- c) be ducting made of non-combustible material, unless the *common extract duct* is the only duct in the fire separated shaft.

## Car park ventilation

**1.5.4** Mechanical ventilation of car parks shall comply with the mechanical ventilation part of AS 1668.2 Section 7.

## Positive and negative pressure

**1.5.5** *Building* interiors ventilated by mechanical systems incorporating filtration shall, except where Paragraph 1.4.4 applies, be maintained at a positive pressure.

### COMMENT:

Positive pressure allows good control of intake air filtration, whereas under negative pressure, unfiltered air may be drawn through gaps and openings in *building elements*.

**1.5.6** Spaces in which mechanical ventilation is used to remove or collect contaminants shall be maintained at negative pressure relative to other spaces in the *building*.

### COMMENT:

Negative pressure reduces the likelihood of contaminants being spread to other spaces.

## 2.0 Ventilation of Spaces Containing Gas-fuel Appliances

### 2.1 Natural ventilation

**2.1.1** Natural ventilation systems for appliances burning gas fuel designed to operate under *natural draught* conditions shall:

- a) Supply air under equal pressure conditions to the burners and to the *draught diverter* i.e. in the same room and as close as possible to the appliance, and
- b) For non *room-sealed appliances* having a combined gas input exceeding 1 kW for each m<sup>3</sup> of the space in which they are installed, be provided with vents, in addition to the ventilation required by Paragraphs 1.1 and 1.2. The vents shall be sized and located according to Paragraphs 2.1.3 to 2.1.8.

**2.1.2** Domestic gas cookers in non room-sealed spaces which are also used for sleeping, require permanent venting to the outside. The size of the vent shall be appropriate to the gas input to the cooker and shall be subject to specific design.

#### 2.1.3 Vent sizes

Two permanent vent openings, one high level and one low level, shall be provided, each with a free ventilation area per kW of gas input (of all appliances in the space) of no less than:

- a) 1200 mm<sup>2</sup> for spaces vented directly to the outside, and
- b) 2300 mm<sup>2</sup> for spaces vented via adjacent spaces.

**2.1.4** The vent opening areas given in Paragraph 2.1.3 may be halved for plant rooms and boiler rooms infrequently occupied by people.

**2.1.5** Vent openings shall have vertical dimensions of no less than 50 mm, and no dimension of less than 6.0 mm in any other direction.

**2.1.6** Low-level vents shall have their lower edge no more than 100 mm above floor level, and upper-level vents shall have their lower edge no less than 75 mm above the top of the draught diverter relief opening.

**2.1.7** A louvred door is also an acceptable method of ventilation provided the bottom of the free area extends to not less than 100 mm above the floor, and the requisite high-level free area is available from the level of 75 mm above the *draught diverter* relief opening.

**2.1.8** In plant room or boiler room installations, low- and high-level vents may be combined into a single opening, provided it reaches from floor to ceiling and has a total free area equivalent to that required for the two separate vents.

### 2.2 Mechanical ventilation

**2.2.1** When mechanical ventilation is used, the system shall have either:

- a) Mechanical supply with mechanical extraction, or
- b) Mechanical supply with natural exhaust.

**2.2.2** A mechanical ventilation system shall:

- a) For each kW of gas consumption (of all appliances in the plant room) provide *outdoor air* at the rate of:
  - i) 3.6 m<sup>3</sup>/h for *forced or induced draught appliances*, and
  - ii) 7.2 m<sup>3</sup>/h for appliances with *atmospheric burners*, and
- b) Remove exhaust air from the room either:
  - i) mechanically at one third the inlet rate, or
  - ii) naturally via high-level openings having a free ventilation area of no less than 600 mm<sup>2</sup> per kW of total gas consumption for all appliances in the room.

### 2.3 Flue construction

**2.3.1** A *flue* system shall have:

- a) The cross-sectional area of a *natural draught flue* system external to the appliances, no less than the cross-sectional area of the appliance outlet, or
- b) The *flue* designed to comply with AS/NZS 5601.1, section 6.7 and Appendix H, and
- c) If a *draught diverter* is not fitted:

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- i) *flue* products discharged to the atmosphere only at the *flue* terminal, unless the discharge at other locations can be achieved without hazard to *persons*, property or appliance operation, and
- ii) a method of automatically shutting down the main burners of *forced or induced draught appliances*, should the normal free discharge of the *flue* be interrupted.

### 2.3.2 Draught diverters

*Draught diverter* installations shall discharge the total *flue* products including excess air and *draught diverter* dilution air, at the *flue* terminal without spillage from the skirt of the *draught diverter*.

## 2.4 Flue locations on dwellings

**2.4.1** The location of a *flue* terminal on a dwelling shall have:

- a) Outlets from *natural draught flues* or *chimneys*, positioned relative to surrounding *construction* to avoid wind causing down draughts in the *flue*,
- b) *Flue* pipes which extend through the roof, terminated no closer than:
  - i) 500 mm to the nearest part of any roof,
  - ii) 2.0 m to the roof level of a flat roof intended for personal or public use, and
  - iii) 500 mm above any parapet, and
- c) *Flues* which terminate on the wall of a *building* located clear of inlets for outside air in accordance with the minimum clearances specified in AS/NZS 5601.1, section 6.9 and Figure 6.2.

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## 3.0 Another Solution for Gas-fuel Appliances

**3.0.1** AS/NZS 5601.1 Sections 1, 3, 4, 5 and 6 and Appendices A – M and O – R is an Acceptable Solution, but may exceed the performance criteria of NZBC G4.

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