BUILDING PERFORMANCE

H1 Energy Efficiency

Verification Method H1/VM3

Energy efficiency of HVAC systems in commercial buildings

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MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
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Preface

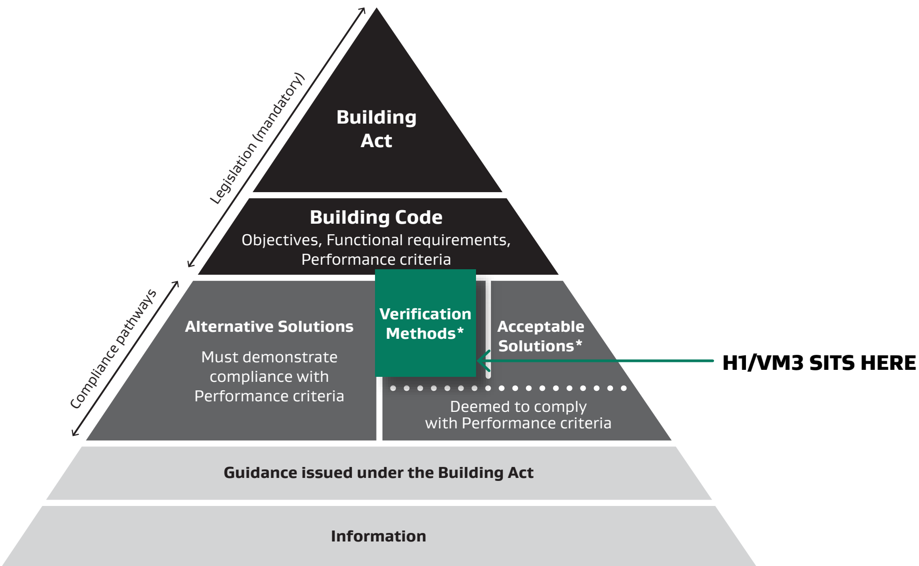
Document status

This document (H1/VM3) is a verification method issued under section 22 (1) of the Building Act 2004 and is effective on 29 November 2021. It does not apply to building consent applications submitted before 29 November 2021.

Building Code regulatory system

Each verification method outlines the provisions of the Building Code that it relates to. Complying with an acceptable solution or verification method is a way of complying with that part of the Building Code. Other options for establishing compliance are listed in section 19 of the Building Act.

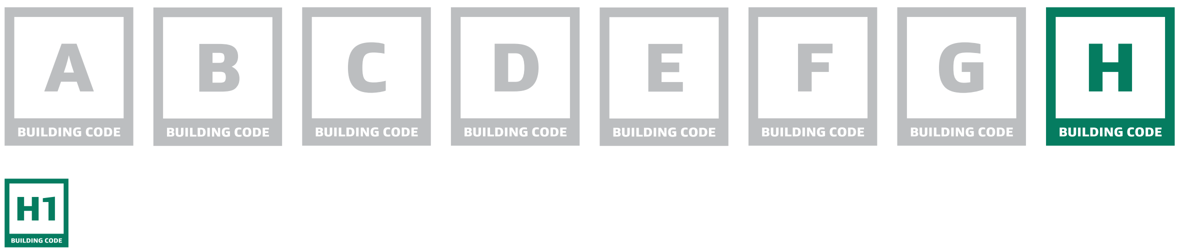
Schematic of the Building Code System



** may include cited standards and information*

A building design must take into account all parts of the Building Code. The Building Code is located in Schedule 1 of the Building Regulations 1992 and available online at www.legislation.govt.nz

The part of the Building Code that this verification method relates to is clause H1 Energy Efficiency. Further information on the scope of this document is provided in Part 1. General.



Further information about the Building Code, the objectives, functional requirements and performance criteria provisions that it contains, and other acceptable solutions and verification methods are available at www.building.govt.nz

Features of this document

› For the purposes of Building Code compliance, the standards and documents referenced in this verification method must be the editions, along with their specific amendments listed in Appendix A.

› Words in *italic* are defined at the end of this document in Appendix B.

› Hyperlinks are provided to cross-references within this document and to external websites and appear with a blue underline.

› Classified uses for buildings, as described in clause A1 of the Building Code, are printed in **bold** in this document. These are denoted with classified use icons for:

H **Housing**

Com **Commercial**

Out **Outbuildings**

CR **Communal residential**

Ind **Industrial**

Anc **Ancillary**

CN **Communal non-residential**

› Appendices to this verification method are part of, and have equal status to the verification method. Figures are informative only and the wording of the paragraphs takes precedence. Text boxes headed 'COMMENT' occur throughout this document and are for guidance purposes only.

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Part 1. General

1.1 Introduction

1.1.1 Scope of this document

Com 1.1.1.1 This verification method can be used for *HVAC systems* in **commercial** *buildings*. It contains requirements for:

a) Air conditioning system controls, and
b) Mechanical ventilation system controls, and
c) Fans, and
d) Ductwork insulation and sealing, and
e) Pumps, and
f) Pipework insulation, and
g) Space heating, and
h) Refrigerant chillers, and
i) Unitary air conditioning equipment, and
j) Heat rejection equipment, and
k) Facilities for energy monitoring, and
l) Maintenance access.

1.1.2 Items outside the scope of this document

1.1.2.1 This verification method does not include requirements for:

a) *HVAC systems* that directly cool cold rooms or heat hot rooms (such as in a butcher's shop, fruit storage rooms or in laboratories); or
b) *HVAC systems* that maintain specialised conditions for equipment or processes, where this is the main purpose of the *HVAC system*.

1.1.2.2 For these, compliance may be demonstrated using an alternative solution.

1.1.3 Compliance pathway

1.1.3.1 This verification method is one option that provides a means of establishing compliance with the performance criteria in Building Code clause H1.3.6.

1.1.3.2 Options for demonstrating compliance with H1 Energy Efficiency through the use of acceptable solutions and verification methods are summarised in Table 1.1.3.2. Compliance may also be demonstrated using an alternative solution.

1.2 Using this Verification Method

1.2.1 Determining the classified use

1.2.1.1 Classified uses for *buildings* are described in clause A1 of the Building Code. Where a specific classified use is mentioned within a subheading and/or within the text of a paragraph, this requirement applies only to the specified classified use(s), and does not apply to other classified uses.

Ind 1.2.1.2 In *buildings* containing both **industrial** and other classified uses, the non-industrial portion shall be treated separately according to its classified use. For example, in a *building* containing both **industrial** and **commercial** classified uses, the **commercial** area shall meet the relevant NZBC energy efficiency requirements.

General

TABLE 1.1.3.2: Demonstrating compliance with H1 Energy Efficiency through acceptable solutions and verification methods

Paragraph 1.1.3.2

Performance clause	Applies to	Relevant acceptable solutions and verification methods
H1.3.1 (a) and (b) *Thermal Envelope*	H **Housing** CR **Communal residential** CN **Communal non-residential** (assembly care only) Com **Commercial**	For **housing**, and *buildings* no greater than 300 m²: H1/AS1 or H1/VM1 For large *buildings*: H1/AS2 or H1/VM2
H1.3.2E *Building performance index*	H **Housing**	H1/AS1 or H1/VM1
H1.3.3 (a) to (f) Physical conditions	All *buildings*	For **housing**, and *buildings* no greater than 300 m²: H1/AS1 or H1/VM1 For large *buildings*: H1/AS2 or H1/VM2
H1.3.4 (a) Heating of hot water	All *buildings*	For **housing**, and *buildings* no greater than 300 m²: H1/AS1 For large *buildings*: H1/AS2
H1.3.4 (b) Storage vessels and distribution systems	Individual storage vessels ≤ 700 L in capacity and distribution systems	For **housing**, and *buildings* no greater than 300 m²: H1/AS1 For large *buildings*: H1/AS2
H1.3.4 (c) Efficient use of hot water	H **Housing**	H1/AS1
H1.3.5 Artificial lighting	Lighting not provided solely to meet the requirements of Building Code clause F6 in: Com CN **Commercial** and **Communal non-residential** having *occupied space* greater than 300 m²	H1/AS2
H.1.3.6 *HVAC systems*	Com **Commercial**	H1/VM3

Part 2. Air conditioning system control

2.1 Demonstrating compliance

2.1.1 System design objectives

2.1.1.1 Energy consumption of an *air conditioning* system is to be limited by providing active and passive controls. The control requirements limit the use of energy during the operation of the *air conditioning* system by reducing the energy that would be otherwise wasted.

2.2 Verification of the design

2.2.1 Overview

2.2.1.1 The verification of the design is achieved by providing an *air conditioning* system that complies with the requirements of:

a) Deactivation, and
b) Zoning, and
c) Operating times, and
d) *Outdoor air economy cycle*, and
e) Control of central plant and of the heating and cooling energy medium flow, and
f) Variable speed of fans, and
g) Commissioning.

2.2.2 Deactivation

2.2.2.1 An *air conditioning* system shall be capable of being deactivated when the *building* or the part of a *building* served by that system is not occupied.

> COMMENT: If an *air conditioning* system serves a whole *building*, it is only required to be capable of being deactivated when the whole *building* is unoccupied. However, if an *air conditioning* system only serves a part of a *building*, the system must be capable of being deactivated when that part of the *building* is unoccupied. The design of the operational arrangements of the *air conditioning* system should be based on logical *building* areas, segments and activities.

2.2.2.2 When deactivated, an *air conditioning* system shall close any motorised damper that is installed within an air pathway between the *air conditioned space* and outside and that is not otherwise being actively controlled.

> COMMENT: This requirement is to reduce the infiltration of unconditioned *outdoor air* when the system is not in use, and reduce the start-up load when the system is next needed.

2.2.3 Zoning

2.2.3.1 When defining *air conditioning* zones, consideration shall be given to how different rooms or areas may require heating or cooling at different rates throughout the day.

COMMENT: For example, if there is only one temperature sensor and it is located in an east-facing room which has become too hot from the morning sun, it may activate more cooling than is needed in other rooms that do not receive morning sun. Using multiple temperature control devices will help prevent this, and mean the *building* uses less energy overall.

2.2.3.2 When serving more than one *air conditioning* zone or area with different heating or cooling needs, an *air conditioning system* shall:

a) Thermostatically control the temperature of each zone or area; and

b) Not control the temperature by mixing actively heated air and actively cooled air; and

c) Limit reheating to not more than:

i) for a fixed supply air rate, a 7.5K rise in temperature; or

ii) for a variable supply air rate, a 7.5K rise in temperature at the nominal supply air rate but increased or decreased at the same rate that the supply air rate is respectively decreased or increased.

COMMENT:

1. The limits on reheating are intended to encourage the grouping of areas with similar heating and cooling demand, rather than sub-cooling all the supply air and reheating excessively to achieve the desired temperature.
2. The limit on reheating for systems with a variable supply air rate constitutes an inverse relationship between allowable temperature rise and supply air rate. During the reheating, if the supply air rate is also reduced then the temperature rise can be proportionally increased above 7.5K at the same rate that the supply air rate has been reduced. For example, the reheat temperature could be increased to 10K when the supply air rate is reduced by 25% or increased to 15K if the supply air rate is reduced by 50%.

2.2.3.3 When two or more *air conditioning* systems serve the same *air conditioning* zone they shall use control sequences that prevent the systems from operating in opposing heating and cooling modes within the same *air conditioning* zone.

2.2.3.4 An *air conditioning* system shall have a control dead band of not less than 2°C, except where a smaller range is required for specialised applications.

2.2.4 Operating times

2.2.4.1 To allow for different operating times, an *air conditioning* system shall have the ability to terminate airflow of each independently operating space of more than 1000 m^2 and of every separate floor of the *building* independently of the remainder of the system.

2.2.4.2 Except where *air conditioning* is needed for 24 hour continuous use, a time switch shall be provided to control:

a) An *air conditioning* system of more than 2 kW_r (kilowatts of refrigeration); and

b) A heater of more than 1 $kW_{heating}$ (kilowatt of heating) used for *air conditioning*.

2.2.4.3 The time switch shall be capable of switching electric power on and off at variable pre-programmed times and on variable pre-programmed days.

2.2.5 Outdoor air economy cycle

2.2.5.1 If providing mechanical ventilation, other than where dehumidification control is needed, an *air conditioning* system shall have an *outdoor air economy cycle* if the total air flow rate of any single airside component of an *air conditioning* system is greater than or equal to 2500 L/s.

2.2.6 Control of central plant and of the heating and cooling energy medium flow

2.2.6.1 An *air conditioning* system shall be capable of automatically stopping the flow of water to system components that have no heating or cooling demand, except for the purpose of residual heat dissipation where required to prevent damage of system components.

> i
>
> COMMENT: This requirement aims to reduce the amount of pump energy needed and reduce the thermal loss through system components like *piping*.

2.2.6.2 An *air conditioning* system shall have the ability to regulate the operation of the central plant in accordance with the heating or cooling demand by using direct signals from the control components responsible for maintaining the internal environmental conditions in the *building*.

> i
>
> COMMENT: This requirement enables regulating the operation and set-points of central plant in coordination with the needs of the *building*, rather than operating central services as a continuous provision.

2.2.7 Variable speed of fans

2.2.7.1 The fan of an *air conditioning* system with an airflow of more than 1000 L/s shall vary its speed in accordance to the required airflow rates.

> i
>
> COMMENT: A variable speed fan is a more energy efficient method of reducing air flow than throttling the air supply with dampers.

2.2.8 Commissioning

2.2.8.1 An *air conditioning* system shall be provided with balancing dampers, balancing valves and/or variable speed fans that ensure the maximum design air or fluid flow is achieved but not exceeded by more than 15% above design at each:

a) Component; or

b) Group of components operating under a common control in a system containing multiple components, as required to meet the needs of the system at its maximum operating condition.

Part 3. Mechanical ventilation system control

3.1 Demonstrating compliance

3.1.1 System design objectives

3.1.1.1 Energy consumption of a mechanical ventilation system is to be limited by providing active and passive controls. The control requirements limit the use of energy during the operation of the mechanical ventilation system by reducing the energy which would be otherwise wasted.

3.2 Verification of the design

3.2.1 Overview

3.2.1.1 The verification of the design is achieved by providing a mechanical ventilation system that complies with the requirements of:

a) Deactivation; and

b) Operating times; and

c) Limiting *outdoor air* flow; and

d) Variable speed of fans.

3.2.2 Deactivation

3.2.2.1 A mechanical ventilation system for the provision of *outdoor air*, including one that is part of an *air conditioning* system, shall be capable of being deactivated when the *building* or the part of the *building* served by that system is not occupied.

> COMMENT: If a mechanical ventilation system serves a whole *building*, it is only required to be capable of being deactivated when the whole *building* is unoccupied. However, if a mechanical ventilation system only serves a part of a *building*, the system must be capable of being deactivated when that part of the *building* is unoccupied. The design of the operational arrangements of the mechanical ventilation system should be based on logical building areas, segments and activities.

3.2.2.2 An exhaust system with an air flow rate of more than 250 L/s shall be capable of stopping the motor when the system is not needed.

> COMMENT:
>
> 1. Examples for exhaust systems include toilet extracts, kitchen hoods, and laundry hoods.
> 2. Consideration should be given to situations where safety is an issue, such as the exhaust from a chemical storage cabinet. In some situations, it may be more appropriate for fume hoods to operate on a reduced flow rather than stop entirely. An alternative solution may be considered more appropriate in such situations.

3.2.3 Operating times

3.2.3.1 Except where mechanical ventilation is needed for 24 hour continuous use, a time switch shall be provided to a mechanical ventilation system with an air flow rate of more than 250 L/s.

3.2.3.2 Where required, the time switch shall be capable of switching electric power on and off at variable pre-programmed times and on variable pre-programmed days.

3.2.4 Limiting outdoor air flow

3.2.4.1 When serving an *air conditioned space*, except in periods when evaporative cooling is being used, a mechanical ventilation system, including one that is part of an *air conditioning* system, shall:

a) If the design *outdoor air* flow rate is more than 1000 L/s, have demand control ventilation in accordance with AS 1668.2 if appropriate to the application, except where an energy reclaiming system preconditions all the *outdoor air* at a minimum sensible heat transfer effectiveness of 60%; and

b) Not exceed the minimum *outdoor air* quantity required by G4/AS1 by more than 20%, except where:

   i) additional unconditioned *outdoor air* is supplied for free cooling; or

   ii) additional mechanical ventilation is needed to balance the required exhaust or process exhaust; or

   iii) an energy reclaiming system preconditions all the *outdoor air* at a minimum sensible heat transfer effectiveness of 60%.

COMMENT:

1. Common situations that require additional mechanical ventilation to balance the required exhaust include areas such as toilets or bathrooms which have high exhaust rates to remove contaminated air or to balance process exhausts. In such situations, an equivalent level of supply air may be required to balance the system.

2. Where demand control ventilation is used, the design peak *outdoor air* flow rate should be determined on the basis of peak occupancy, not average occupancy.

3. A common situation where demand control ventilation may not be appropriate is where a centralised mechanical ventilation or air conditioning system serves multiple spaces that have different ventilation demand profiles throughout the day. In this situation:

   a) Demand control ventilation based on the average of occupancy demands from all spaces may result in some spaces being under-ventilated at times.

   b) Where there is a high probability of at least one space being at or near maximum occupancy throughout normal operating hours, demand control ventilation based on the highest occupancy demand from all spaces may not provide significant annual energy savings.

3.2.5 Variable speed of fans

3.2.5.1 Where a mechanical ventilation system, including one that is part of an *air conditioning system*, has a design airflow greater than 1000 L/s, its fan shall vary its speed in accordance to the required airflow rates unless the downstream airflow is required to be constant.

3.2.5.2 *Car park* exhaust systems shall have a control system in accordance with AS 1668.2 Section 4.11.2 using a variable speed fan, or in accordance with AS 1668.2 Section 4.11.3.

Part 4. Fans

4.1 Demonstrating compliance

4.1.1 System design objectives

4.1.1.1 Energy consumption of fans in *air conditioning* systems or mechanical ventilation systems is to be limited. This is to be achieved by the use of energy efficient motors with a maximum allowable *fan motor power* and by limiting pressure drops throughout the ductwork.

4.1.2 Design applications and exemptions

4.1.2.1 These requirements apply to fans and ductwork used as part of an *air conditioning* system or a mechanical ventilation system.

4.1.2.2 The requirements do not apply to:

a) Fans in unducted *air conditioning* systems with a supply air capacity of less than 1000 L/s; and
b) Smoke spill fans, except where also used for *air conditioning* or ventilation; and
c) Kitchen exhaust systems; and
d) Fans for specialised applications including process-related components.

4.1.2.3 The fan efficiency requirements of Subsection 4.2.2 do not apply to fans that need to be explosion-proof.

4.2 Verification of the design

4.2.1 Overview

4.2.1.1 Fans, ductwork, and duct components that form part of an *air conditioning* system or mechanical ventilation system must:

a) Comply with the requirements of Subsections 4.2.2, 4.2.3, and 4.2.4; or
b) Demonstrate that the fan motor input power-per-unit-of-flowrate for the proposed design does not exceed the fan motor input power-per-unit-of-flowrate achieved when applying Subsections 4.2.2, 4.2.3, and 4.2.4 together.

4.2.2 Fan efficiency

4.2.2.1 The fan efficiency is separated for different static pressures and installation arrangements where:

a) Installation type A means an arrangement where the fan is installed with free inlet and outlet conditions; and
b) Installation type B means an arrangement where the fan is installed with a free inlet and a duct at its outlet; and
c) Installation type C means an arrangement where the fan is installed with a duct fitted to its inlet and with free outlet conditions; and
d) Installation type D means an arrangement where the fan is installed with a duct fitted to its inlet and outlet.

4.2.2.2 Fans in systems that have a static pressure of not more than 200 Pa must have an efficiency at the full load operating point not less than the efficiency calculated with Equation 1.

Equation 1: $\eta_{min} = 0.13 \times \ln(p) - 0.3$

where:
η_{min} is the minimum required system static efficiency for installation type A or C or the minimum required system total efficiency for installation type B or D; and
p is the static pressure of the system (Pa); and
ln is the natural logarithm.

Fans

4.2.2.3 Fans in systems that have a static pressure above 200 Pa must have an efficiency at the full load operating point not less than the efficiency calculated with Equation 2.

Equation 2: $\eta_{min} = 0.85 \times \frac{a \times \ln(P) - b + N}{100}$

where:

η_{min} is the minimum required system static efficiency for installation type A or C or the minimum required system total efficiency for installation type B or D; and
P is the motor input power of the fan (kW); and
N is the minimum performance grade obtained from Table 4.2.2.3A; and
a is the regression coefficient a obtained from Table 4.2.2.3B; and
b is the regression coefficient b obtained from Table 4.2.2.3C; and
ln is the natural logarithm.

TABLE 4.2.2.3A: Minimum fan performance grade

Paragraph 4.2.2.3

Fan type	Minimum fan performance grade	
	Installation type A or C	Installation type B or D
Axial – as a component of an air handling unit or fan coil unit	46.0	51.5
Axial – other	42.0	61.0
Mixed flow – as a component of an air handling unit or fan coil unit	46.0	51.5
Mixed flow – other	52.5	65.0
Centrifugal forward-curved	46.0	51.5
Centrifugal radial bladed	46.0	51.5
Centrifugal backward-curved	64.0	64.0

TABLE 4.2.2.3B: Fan regression coefficient a

Paragraph 4.2.2.3

Fan type	Fan regression coefficient a	
	Fan motor input power < 10 kW	Fan motor input power ≥ 10 kW
Axial	2.74	0.78
Mixed flow	4.56	1.1
Centrifugal forward-curved	2.74	0.78
Centrifugal radial bladed	2.74	0.78
Centrifugal backward-curved	4.56	1.1

TABLE 4.2.2.3C: Fan regression coefficient b

Paragraph 4.2.2.3

Fan type	Fan regression coefficient b	
	Fan motor input power < 10 kW	Fan motor input power ≥ 10 kW
Axial	6.33	1.88
Mixed flow	10.5	2.60
Centrifugal forward-curved	6.33	1.88
Centrifugal radial bladed	6.33	1.88
Centrifugal backward-curved	10.5	2.60

4.2.3 Ductwork

4.2.3.1 The pressure drop in the index run across all straight sections of rigid ductwork and all sections of flexible ductwork must not exceed 1 Pa/m when averaged over the entire length of straight rigid duct and flexible duct. The pressure drop of flexible ductwork sections may be calculated as if the flexible ductwork is laid straight.

4.2.3.2 Flexible ductwork must not account for more than 6 m in length in any duct run.

4.2.3.3 The upstream connection to ductwork bends, elbows and tees in the index run must have an equivalent diameter to the connected duct.

4.2.3.4 Turning vanes must be included in all rigid ductwork elbows of 90° or more acute than 90° in the index run except where:

a) The inclusion of turning vanes presents a fouling risk; or

b) A long radius bend in accordance with AS 4254.2 is used.

4.2.4 Ductwork components in the index run

4.2.4.1 The pressure drop across a coil must not exceed the value specified in Table 4.2.4.1.

TABLE 4.2.4.1: Maximum coil pressure drop

Paragraph 4.2.4.1

Number of rows	Maximum pressure drop (Pa)
1	30
2	50
4	90
6	130
8	175
10	220

4.2.4.2 A high-efficiency particulate arrestance (HEPA) air filter must not exceed the higher of:

a) A pressure drop of 200 Pa when clean; or

b) The filter design pressure drop when clean at an air velocity of 1.5 m/s.

4.2.4.3 Any other air filter must not exceed:

a) The pressure drop specified in Table 4.2.4.3 when clean; or

b) The filter design pressure drop when clean at an air velocity of 2.5 m/s.

TABLE 4.2.4.3: Maximum clean filter pressure drop

Paragraph 4.2.4.3

Filter minimum efficiency reporting value	Maximum pressure drop (Pa)
9	55
11	65
13	95
14	110

4.2.4.4 The pressure drop across intake louvres must not exceed:

a) For single stage louvres, 30 Pa; and

b) For two stage louvres, 60 Pa; and

c) For acoustic louvres, 50 Pa; and

d) For other non-weatherproof louvres, 30 Pa.

4.2.4.5 The pressure drop across a variable air volume box, with the damper in the fully open position, must not exceed:

a) For units with electric reheat, 100 Pa; and

b) For other units, 25 Pa not including coil pressure losses.

4.2.4.6 The maximum pressure drop across other ductwork components must not exceed the values in Table 4.2.4.6.

TABLE 4.2.4.6: Maximum pressure drop for other ductwork components

Paragraph 4.2.4.6

Ductwork component	Maximum pressure drop (Pa)
Rooftop cowls	30
Attenuators	40
Fire dampers (when fully open)	15
Balancing and control dampers in the index run (when fully open)	25
Supply air diffusers and grilles	40
Exhaust grilles	30
Transfer ducts	12
Door grilles	12
Active chilled beams	150

Part 5. Ductwork insulation and sealing

5.1 Demonstrating compliance

5.1.1 System design objectives

5.1.1.1 Energy losses through ductwork are to be limited by providing insulation and sealing of ductwork and fittings in an *air conditioning* system.

5.1.2 Design applications and exemptions

5.1.2.1 The ductwork insulation requirements apply to passive and static components of a ductwork system, but do not apply to:

a) Ductwork and fittings located within and exposed to the only or last room served by the system, provided that the temperature of the air inside the ductwork or fitting is above the dew point of the room air; and

b) Fittings that form part of the interface with the *air conditioned space*; and

c) Return air ductwork in, or passing through, an *air conditioned space*; and

d) Ductwork for *outdoor air* and exhaust air that is either located outside the *thermal envelope* or where the temperature of the air inside the ductwork is above the dew point of the air in the space where the ductwork is located; and

e) The floor of an in-situ air handling unit; and

f) Packaged air conditioners, split systems, and variable refrigerant flow *air conditioning* equipment complying with *Minimum Energy Performance Standards (MEPS)*; and

g) Flexible fan connections; and

h) Active components of a ductwork system that are either located outside the *thermal envelope* or where the temperature of the air inside the ductwork or fitting is above the dew point of air in the space where the active ductwork component is located.

COMMENT:

1. The exemption in Paragraph 5.1.2.1 a) does not apply to ductwork that is located inside a plenum or above a ceiling because, in this case, the ductwork is not exposed to the only or last room.

2. Ductwork insulation is recommended for ductwork for *outdoor air* that is located in spaces outside the *thermal envelope* that may experience extreme temperatures, such as *roof* spaces.

5.1.2.2 The ductwork sealing requirements apply to active, passive and static components of a ductwork system, but do not apply to:

a) *Air conditioning* systems with a capacity of less than 1000 L/s; and

b) Ductwork and fittings located within the only or last room served by the system.

5.1.2.3 Active components of a ductwork system may include air-handling unit components, electric duct heaters, actuated volume control dampers, access panels and doors, fire and smoke dampers, fans or humidifiers.

5.1.2.4 Passive or static components of a ductwork system may include plenums, bends, branches, transitions, reducers, offsets, spigots, cushion heads, attenuators or fixed air balance dampers.

5.2 Verification of the design

5.2.1 Ductwork insulation

5.2.1.1 Verification of the design is achieved by providing ductwork and fittings in an *air conditioning system* with insulation that:

a) Complies with AS/NZS 4859.1; and

b) Has an insulation *R-value* greater than or equal to:

  i) for flexible ductwork, 1.0 m^2K/W; and

  ii) for cushion boxes, that of the connecting ductwork; and

  iii) for rigid ductwork and fittings that specified in Table 5.2.1.1; and

c) Is protected against the effects of weather and sunlight to reduce the likelihood of affecting the insulation properties over time; and

d) Is installed so that it:

  i) abuts adjoining insulation to form a continuous barrier; and

  ii) maintains its position and thickness, other than at flanges and supports; and

e) When conveying cooled air:

  i) is protected by a vapour barrier on the outside of the insulation to avoid condensation forming within the insulation; and

  ii) where the vapour barrier is a membrane, is installed so that adjoining sheets of the membrane overlap by at least 50 mm and are bonded or taped together.

TABLE 5.2.1.1: Ductwork and fittings – Minimum insulation R-value

Paragraph 5.2.1.1

Location of ductwork and fittings	Minimum insulation R-value ($m^2 \cdot K/W$)
Within an *air conditioned space*	1.2
Where exposed to direct sunlight	3.0
All other locations	2.0

COMMENT:

The *R-value* of ductwork insulation can be calculated using the following equations:

a) For ductwork with flat surfaces such as rectangular ducts:

$$R = \frac{t}{k}$$

and

b) For tubular ductwork:

$$R = \frac{d + 2t}{2k} \ln\left(\frac{d + 2t}{d}\right)$$

where:

R is the *R-value* of ductwork insulation ($m^2 \cdot K/W$); and

d is the diameter of the ductwork (m); and

t is the thickness of insulation (m); and

k is the thermal conductivity of the insulation material ($W/m \cdot K$).

5.2.2 Ductwork sealing

5.2.2.1 Verification of the design is achieved by providing ductwork sealing to ductwork and fittings in an *air conditioning* system in accordance with the duct sealing requirements of AS 4254.1 and AS 4254.2 for the static pressure in the system.

Part 6. Pumps

6.1 Demonstrating compliance

6.1.1 System design objectives

6.1.1.1 Energy consumption of pumps that form part of an *air conditioning* system is to be limited by the use of energy efficient motors and by keeping within a limited pipework average pressure drop.

6.1.2 Design applications and exemptions

6.1.2.1 The average pipework pressure drop requirements do not apply:

a) To valves and fittings; and

b) Where the smallest pipe size compliant with Paragraph 6.2.2.1 results in a velocity of 0.7 m/s or less at design flow.

6.2 Verification of the design

6.2.1 Pump motor efficiency

6.2.1.1 The verification of the design of pumps that form part of an *air conditioning* system is achieved when:

a) Circulator pumps that are glandless impeller pumps with a rated hydraulic power output of less than 2.5 kW and used in closed loop systems meet an energy efficiency index (EEI) of 0.27 or less when calculated in accordance with European Union Commission Regulation No. 622/2012.

b) Other pumps that are in accordance with Articles 1 and 2 of European Union Commission Regulation No. 547/2012 meet a minimum efficiency index (MEI) of 0.4 or more when calculated in accordance with European Union Commission Regulation No. 547/2012.

6.2.2 Pipework pressure loss

6.2.2.1 The verification of the design of a pipework network that forms part of an *air conditioning* system is achieved by providing pipework that:

a) In pipework systems that do not have branches and have the same flow rate throughout the entire pipe network, achieve an average pressure drop in straight segments along the index run of not more than:

   i) for constant speed systems, the values nominated in Table 6.2.2.1A; or

   ii) for variable speed systems, the values nominated in Table 6.2.2.1B; and

b) In any other pipework system, achieve an average pressure drop in straight segments along the index run of not more than:

   i) for constant speed systems, the values nominated in Table 6.2.2.1C; or

   ii) for variable speed systems, the values nominated in Table 6.2.2.1D.

TABLE 6.2.2.1A: **Maximum pipework pressure drop – Non-distributive constant speed systems**

Paragraph 6.2.2.1 a) i)

Nominal pipe diameter (mm)	Maximum pressure drop (Pa/m)	
	Systems operating ≤ 5000 hours/annum	Systems operating > 5000 hours/annum
≤ 20	400	400
25	400	400
32	400	400
40	400	400
50	400	350
65	400	350
80	400	350
100	400	200
125	400	200
≥ 150	400	200

TABLE 6.2.2.1B: **Maximum pipework pressure drop – Non-distributive variable speed systems**

Paragraph 6.2.2.1 a) ii)

Nominal pipe diameter (mm)	Maximum pressure drop (Pa/m)	
	Systems operating ≤ 5000 hours/annum	Systems operating > 5000 hours/annum
≤ 20	400	400
25	400	400
32	400	400
40	400	400
50	400	400
65	400	400
80	400	400
100	400	300
125	400	300
≥ 150	400	300

Pumps

TABLE 6.2.2.1C: **Maximum pipework pressure drop – Distributive constant speed systems**

Paragraph 6.2.2.1 b) i)

Nominal pipe diameter (mm)	Maximum pressure drop (Pa/m)		
	Systems operating ≤2000 hours/annum	Systems operating > 2000 hours/annum and ≤ 5000 hours/annum	Systems operating > 5000 hours/annum
≤ 20	400	300	150
25	400	220	100
32	400	220	100
40	400	220	100
50	400	220	100
65	400	400	170
80	400	400	170
100	400	400	170
125	400	400	170
≥ 150	400	400	170

TABLE 6.2.2.1D: **Maximum pipework pressure drop – Distributive variable speed systems**

Paragraph 6.2.2.1 b) ii)

Nominal pipe diameter (mm)	Maximum pressure drop (Pa/m)	
	Systems operating ≤ 5000 hours/annum	Systems operating > 5000 hours/annum
≤ 20	400	250
25	400	180
32	400	180
40	400	180
50	400	180
65	400	300
80	400	300
100	400	300
125	400	300
≥ 150	400	300

Part 7. Pipework insulation

7.1 Demonstrating compliance

7.1.1 System design objectives

7.1.1.1 Energy losses through pipework that forms part of an *air conditioning* system are to be limited by providing insulation to *piping*, vessels, heat exchangers and tanks that contain heating or cooling fluid or refrigerant.

7.1.2 Design applications and exemptions

7.1.2.1 For the purposes of these requirements, heating fluids include heated water, steam and condensate. Cooling fluids include chilled water, brines and glycol mixtures, but do not include condenser cooling water.

7.1.2.2 Condenser cooling water is exempt from the minimum insulation requirements of this section due to the limited temperature difference between the *piping* contents and the surrounding space. However, insulation may be installed for reasons other than energy efficiency such as for acoustics, or to minimise the risk of condensation forming.

7.1.2.3 The required *R-value* is that of the insulation and not the total *R-value* of the wall, air film and insulation of the item.

> COMMENT:
>
> The *R-value* of pipework insulation can be calculated using the following equation:
>
> $$R = \frac{d + 2t}{2k} \ln\left(\frac{d + 2t}{d}\right)$$
>
> where:
>
> R is the *R-value* of pipework insulation ($m^2 \cdot K/W$); and
>
> d is the diameter of the pipe (m); and
>
> t is the thickness of the insulation (m); and
>
> k is the thermal conductivity of the insulation material ($W/m \cdot K$); and
>
> ln is the natural logarithm.

7.1.2.4 The requirements for pipework insulation do not apply to *piping*, vessels, heat exchangers and tanks that are in appliances covered by *Minimum Energy Performance Standards (MEPS)* or for *piping*, vessels or heat exchangers that are:

a) Located within and exposed to the only or last room served by the system, provided they do not contain cooling fluid or are used for a minimum water flow strategy; or

b) Encased within a concrete slab or panel which is part of a heating or cooling system; or

c) Supplied as an integral part of a chiller, boiler or *unitary air conditioner* complying with the requirements of Part 8, Part 9, and Part 10; or

d) Inside an air handling unit, fan-coil unit, or the like.

7.2 Verification of the design

7.2.1 Piping, vessels, heat exchangers, and tanks insulation

7.2.1.1 Verification of the design is achieved by providing insulation to *piping*, vessels, heat exchangers and tanks that form part of an *air conditioning* system and that contain heating or cooling fluid or refrigerant, where the fluid or refrigerant is held at a heated or cooled temperature.

Pipework insulation

7.2.1.2 The insulation shall:

a) Comply with AS/NZS 4859.1; and

b) For *piping* of heating and cooling fluids or refrigerants, have an insulation *R-value* in accordance with Table 7.2.1.2A; and

c) For vessels, heat exchangers or tanks, have an insulation *R-value* in accordance with Table 7.2.1.2B; and

d) For refill or pressure relief *piping*, have an insulation *R-value* equal to the required insulation *R-value* of the connected pipe, vessel or tank within 500 mm of the connection; and

e) Be protected against the effects of weather and sunlight; and

f) Be able to withstand the temperatures within the *piping*, vessel, heat exchanger or tank; and

g) When containing cooling fluid or refrigerant, be protected by a vapour barrier on the outside of the insulation.

TABLE 7.2.1.2A: Piping — Minimum insulation R-value

Paragraph 7.2.1.2 b)

Fluid / refrigerant temperature range	Minimum insulation R-value			
	Nominal pipe diameter ≤ 40 mm	Nominal pipe diameter > 40 mm and ≤ 80 mm	Nominal pipe diameter between > 80 mm and ≤ 150 mm	Nominal pipe diameter > 150 mm
≤ 2°C	1.3	1.7	2.0	2.7
> 2°C but ≤ 20°C	1.0	1.5	2.0	2.0
> 30°C but ≤ 85°C	1.7	1.7	1.7	1.7
> 85°C but ≤ 120°C	2.7	2.7	2.7	2.7
> 120°C	4.0	4.0	4.0	4.0

Note: The minimum required *R-value* may be halved for *piping* penetrating a structural member.

TABLE 7.2.1.2B: Vessels, heat exchangers and tanks — Minimum insulation R-value

Paragraph 7.2.1.2 c)

Fluid / refrigerant temperature range	Minimum insulation R-value
≤ 2°C	2.3
> 2°C but ≤ 20°C	1.8
> 30°C but ≤ 85°C	2.3
> 85°C but ≤ 120°C	3.0
> 120°C	4.0

Part 8. Space heating

8.1 Demonstrating compliance

8.1.1 System design objectives

8.1.1.1 The use of energy that is sourced from a network utility operator or depletable energy resource and used for space heating is to be limited by the selection of appropriate space heating equipment.

8.1.2 Design applications and exemptions

8.1.2.1 These requirements apply to heaters that provide heat directly or indirectly to the space(s) or area(s) they serve.

8.1.2.2 Where a heater is an in-duct heater, the amount of reheat is limited by Paragraph 2.2.3.2 c).

8.2 Verification of the design

8.2.1 Heaters

8.2.1.1 Verification of the design is achieved by providing space heaters that directly use renewable energy, efficient combustion of gas, electricity, biomass, reclaimed heat or a combination of those, and control their operation when used in an outdoor space.

8.2.1.2 A heater used for *air conditioning* or as part of an *air conditioning* system must be:

a) A solar heater, or
b) A flued gas heater, or
c) A heat pump heater, or
d) A biomass heater, or
e) A heater using reclaimed heat from another process such as reject heat from a refrigeration plant, or
f) An electric heater, or
g) Any combination of a) to f).

8.2.1.3 A fixed heating appliance that moderates the temperature of an outdoor space shall be configured to automatically shut down when:

a) There are no occupants in the space served; or
b) A period of one hour has elapsed since the last activation of the heater; or
c) The space served has reached the design temperature.

> COMMENT: Automatic shutdown may be achieved by an outdoor temperature sensor, timer, motion detector, or the like.

8.2.1.4 A gas water heater that is used as part of an *air conditioning system* shall achieve a minimum gross thermal efficiency of 90% when tested under conditions that mirror the expected typical operating conditions, including the expected water inlet/outlet temperatures.

> COMMENT: There are a number of testing standards that can be used to demonstrate compliance with the gross thermal efficiency requirement for gas water heaters. These include BS 7190, ANSI/AHRI 1500 and AS/NZS 5263.1.2. Testing under the expected typical operating conditions is especially important for condensing boilers, where the inlet/outlet temperature of water will greatly impact the overall efficiency.

Part 9. Refrigerant chillers

9.1 Demonstrating compliance

9.1.1 System design objectives

9.1.1.1 Energy consumption by refrigerant chillers is to be limited by the selection of equipment that meets *Minimum Energy Performance Standards (MEPS)* and certain energy efficiency ratio requirements.

9.1.1.2 This applies to air-cooled and water-cooled refrigerant chillers that form part of an *air conditioning* system.

9.2 Verification of the design

9.2.1 Air-cooled and water-cooled refrigerant chillers

9.2.1.1 Verification of the design is achieved by providing a refrigerant chiller that:

a) Complies with *Minimum Energy Performance Standards (MEPS);* and

b) Complies with the minimum full load operation energy efficiency ratio and the minimum integrated part load energy efficiency ratio in Table 9.2.1.1A or Table 9.2.1.1B when determined in accordance with AHRI 551/591.

> COMMENT: Table 9.2.1.1A contains higher full-load performance values, intended to be applicable to chillers which are more likely to operate at full load, while Table 9.2.1.1B contains higher part-load performance values, intended to be applicable to chillers which are more likely to operate at part-load. A designer may choose whether to comply with Table 9.2.1.1A or Table 9.2.1.1B.

Refrigerant chillers

TABLE 9.2.1.1A: Minimum energy efficiency ratio for refrigerant chillers — Option 1

Paragraph 9.2.1.1 b)

Chiller type	Full load operation (W_r / $W_{input\ power}$)	Integrated part load (W_r / $W_{input\ power}$)
Air-cooled chiller with a capacity ≤ 528 kW_r	2.985	4.048
Air-cooled chiller with a capacity > 528 kW_r	2.985	4.137
Water-cooled positive displacement chiller with a capacity ≤ 264 kW_r	4.694	5.867
Water-cooled positive displacement chiller with a capacity > 264 kW_r but ≤ 528 kW_r	4.889	6.286
Water-cooled positive displacement chiller with a capacity > 528 kW_r but ≤ 1055 kW_r	5.334	6.519
Water-cooled positive displacement chiller with a capacity > 1055 kW_r but ≤ 2110 kW_r	5.800	6.770
Water-cooled positive displacement chiller with a capacity > 2110 kW_r	6.286	7.041
Water-cooled centrifugal chiller with a capacity ≤ 528 kW_r	5.771	6.401
Water-cooled centrifugal chiller with a capacity > 528 kW_r but ≤ 1055 kW_r	5.771	6.519
Water-cooled centrifugal chiller with a capacity > 1055 kW_r but ≤ 1407 kW_r	6.286	6.770
Water-cooled centrifugal chiller with a capacity > 1407 kW_r	6.286	7.041

Note: W_r means watt(s) of refrigeration

TABLE 9.2.1.1B: Minimum energy efficiency ratio for refrigerant chillers — Option 2

Paragraph 9.2.1.1 b)

Chiller type	Full load operation (W_r / $W_{input\ power}$)	Integrated part load (W_r / $W_{input\ power}$)
Air-cooled chiller with a capacity ≤ 528 kW_r	2.866	4.669
Air-cooled chiller with a capacity > 528 kW_r	2.866	4.758
Water-cooled positive displacement chiller with a capacity ≤ 264 kW_r	4.513	7.041
Water-cooled positive displacement chiller with a capacity > 264 kW_r but ≤ 528 kW_r	4.694	7.184
Water-cooled positive displacement chiller with a capacity > 528 kW_r but ≤ 1055 kW_r	5.177	8.001
Water-cooled positive displacement chiller with a capacity > 1055 kW_r but ≤ 2110 kW_r	5.633	8.586
Water-cooled positive displacement chiller with a capacity > 2110 kW_r	6.018	9.264
Water-cooled centrifugal chiller with a capacity ≤ 528 kW_r	5.065	8.001
Water-cooled centrifugal chiller with a capacity > 528 kW_r but ≤ 1055 kW_r	5.544	8.001
Water-cooled centrifugal chiller with a capacity > 1055 kW_r but ≤ 1407 kW_r	5.917	9.027
Water-cooled centrifugal chiller with a capacity > 1407 kW_r	6.018	9.264

Note: W_r means watt(s) of refrigeration

Part 10. Unitary air conditioning equipment

10.1 Demonstrating compliance

10.1.1 System design objectives

10.1.1.1 Energy consumption is to be limited by the use of u*nitary air conditioners* that meet *Minimum Energy Performance Standards (MEPS)* and certain energy efficiency ratio requirements.

10.1.2 Design applications and exemptions

10.1.2.1 These requirements apply to air-cooled and water-cooled *unitary air conditioners* including packaged air conditioners, split systems, and variable refrigerant flow systems.

10.2 Verification of the design

10.2.1 Air-cooled and water-cooled unitary air conditioners

10.2.1.1 Verification of the design is achieved by providing *unitary air conditioners* that:

a) Comply with *Minimum Energy Performance Standards (MEPS)*; and

b) For a capacity greater than or equal to 65 kW_r (kilowatts of refrigeration), when tested in accordance with AS/NZS 3823.1.2 at test condition T1, have a minimum energy efficiency ratio of:

   i) 4.0 W_r / $W_{input\ power}$ when water-cooled; and

   ii) 2.9 W_r / $W_{input\ power}$ where air-cooled.

10.2.1.2 The input power includes both compressor and fan input power.

Part 11. Heat rejection equipment

11.1 Demonstrating compliance

11.1.1 System design objectives

11.1.1.1 Energy consumption is to be limited by the use of heat rejection equipment with a fan that does not exceed a maximum allowable fan motor input power.

11.1.2 Design applications and exemptions

11.1.2.1 These requirements apply to fans of cooling towers, closed circuit coolers, evaporative condensers and air-cooled condensers.

11.1.2.2 These requirements exclude:

a) A refrigerant chiller in an *air conditioning* system that complies with the energy efficiency ratios in Part 9; and

b) Packaged air conditioners, split systems, and variable refrigerant flow *air conditioning* equipment that complies with the energy efficiency ratios in Part 10.

11.2 Verification of the design

11.2.1 Fan of heat rejection equipment

11.2.1.1 Verification of the design is achieved by providing heat rejection equipment with a fan that:

a) For a cooling tower, closed circuit cooler and evaporative condenser does not exceed the relevant maximum *fan motor power* in Table 11.2.1.1; and

b) For an air-cooled condenser, does not exceed a maximum *fan motor power* of 42 W for each kW of heat rejected from the refrigerant, when determined in accordance with AHRI 460.

> i
>
> COMMENT: The performance of cooling tower fans, closed circuit cooler fans and evaporative condenser fans can be determined using any nationally or internationally accepted standard such as:
>
> a) CTI STD-201RS(19) and ATC-105(19) which can be used to determine the performance of cooling tower fans; and
>
> b) CTI STD-201RS(19) and ATC-105S(11) which can be used for closed circuit cooler fans; and
>
> c) ATC-106(11) can be used to determine the performance of evaporative condenser fans.

TABLE 11.2.1.1: Maximum fan motor power — Cooling towers, closed circuit coolers and evaporative condensers

Paragraph 11.2.1.1 a)

Type	Maximum fan motor input power (W/kW_{rej})[(1)]		
	Cooling tower	Closed circuit cooler	Evaporative condenser
Induced draft	10.4	16.9	11.0
Forced draft	19.5	[(2)]	11.0

Note:

(1) kW_{rej} means kilowatt(s) of heat rejected from the refrigerant.

(2) A closed circuit, forced draft cooling tower shall not be used.

Part 12. Facilities for energy monitoring

12.1 Demonstrating compliance

12.1.1 System design objectives

12.1.1.1 To enable the required level of energy efficiency of *HVAC systems* to be maintained, certain equipment is to be provided that enables excessive energy use to be detected.

12.2 Verification of the design

12.2.1 Energy meters and energy recording

12.2.1.1 For *buildings* with a floor area of *occupied space* greater than 500 m^2 but less than 2500 m^2, verification of the design is achieved by providing energy meters configured to record the time-of-use consumption of gas and electricity.

12.2.1.2 For *buildings* with a floor area of *occupied space* equal to or greater than 2500 m^2, verification of the design is achieved by:

a) Providing energy meters configured to enable individual time-of-use energy consumption data recording of *air conditioning* plant including, where appropriate:
   - i) individual time-of-use energy consumption data recording of heating plant; and
   - ii) individual time-of-use energy consumption data recording of cooling plant; and
   - iii) individual time-of-use energy consumption data recording of air handling fans; and

b) Interlinking the required energy meters by a communication system that collates the time-of-use energy consumption data to a single interface monitoring system where it can be stored, analysed and reviewed; and

c) Ensuring the single interface monitoring system is able to store the individual time-of-use energy consumption data records of *air conditioning* plant over a minimum period of 12 months.

Part 13. Maintenance access

13.1 Demonstrating compliance

13.1.1 System design objectives

13.1.1.1 To enable the required level of energy efficiency of *HVAC systems* to be maintained, sufficient access for commissioning, maintenance and replacement of equipment is to be provided.

13.2 Verification of the design

13.2.1 Equipment access

13.2.1.1 Verification of the design is achieved by providing sufficient access for commissioning and maintenance of *HVAC system* equipment.

> COMMENT: Good practice guidance on space requirements for equipment access can be found in the UK Defence Works Functional Standard, Design & Maintenance Guide 08: Space requirements for plant access operation and maintenance.

Appendix A. References

For the purposes of Building Code compliance, the Standards and documents referenced in this verification method must be the editions, along with their specific amendments, listed below.

Standards New Zealand		Where quoted
AS/NZS 3823:-	Performance of electrical appliances – Airconditioners and heat pumps	10.2.1.1 b)
Part 1.2: 2012	Ducted airconditioners and air-to-air heat pumps - Testing and rating for performance	
AS/NZS 4859:-	Thermal insulation materials for buildings	
Part 1: 2018	General criteria and technical provisions	5.2.1.1 a), 7.2.1.2 a)
AS/NZS 5263:-	Gas appliances	
Part 1.2: 2020	Gas fired water heaters for hot water supply and/or central heating	8.1.2.4 Comment

These standards can be accessed from standards.govt.nz

Standards Australia		
AS 1668:-	The use of ventilation and airconditioning in buildings	
Part 2: 2012	Mechanical ventilation in buildings Amend 1 and 2	3.2.4.1 a), 3.2.5.2
AS 4254:-	Ductwork for air handling systems in buildings	
Part 1: 2012	Flexible duct	5.2.2.1
Part 2: 2012	Rigid duct	4.2.3.2 b), 5.2.2.1

These standards can be accessed from standards.org.au

British Standards		
BS 7190: 1989	Method for assessing thermal performance of low temperature hot water boilers using a test rig	8.2.1.4 Comment

This standard can be accessed from standards.govt.nz

Air Conditioning, Heating and Refrigeration Institute		
AHRI 460: 2005	Performance rating of remote mechanical-draft air cooled refrigerant condensers	11.2.1.1 b)
AHRI 551/591: 2015	Performance rating of water-chilling and heat pump water-heating packages using the vapour compression cycle.	9.2.1.1 b)
ANSI/AHRI 1500: 2015	Performance rating of commercial space heating boilers	8.1.2.4 Comment

These standards can be accessed from ahrinet.org

References

Cooling Technology Institute		Where quoted
CTI STD 201 RS: 2019	Performance Rating of Evaporative Heat Rejection Equipment	11.2.1.1 Comment
CTI ATC 105S: 2019	Acceptance Test Code for Closed Circuit Cooling Towers	11.2.1.1 Comment
CTI 106: 2011	Acceptance Test Code for Mechanical Draft Evaporative Vapor Condensers	11.2.1.1 Comment

These standards can be accessed from coolingtechnology.org

Defence Estate Organisation (Works)

Defence Works Function Standard, Design and Maintenance Guide 08: Space requirements for plant access operation and maintenance. 1996	13.2.1.1 Comment

This document can be accessed from cibse.org

European Union

Commission Regulation (EU) No. 547/2012	6.2.1.1 b)
Commission Regulation (EU) No. 622/2012	6.2.1.1 a)

These regulations can be accessed from eur-lex.europa.eu

Appendix B. Definitions

These definitions are specific to this verification method. Other defined terms found in italics within the definitions are provided in clause A2 of the Building Code.

Air conditioned space	Means a space within a *building*, including a ceiling or underfloor supply air plenum or return air plenum, where the environment is likely, by the *intended use* of the space, to have its temperature controlled by *air conditioning*.
Air conditioning	Means an *HVAC system* that actively cools or heats the air within a space, but does not include an *HVAC system* that directly: a) cools cold rooms or heats hot rooms (such as in a butcher's shop, fruit storage rooms or in laboratories); or b) maintains specialised conditions for equipment or processes, where this is the main purpose of the *HVAC system*. The *air conditioning* may be achieved without treating the air forced into and through the space. The air in the space may also be conditioned by hot or cool surfaces. This includes residential-type heating systems, such as gas and combustion appliances, that are not always considered to be *air conditioning* in the traditional sense. The conditioning may also be achieved by evaporative coolers.
Building	Has the meaning given to it by sections 8 and 9 of the Building Act 2004.
Car park	Means a *building* that is used for the parking of motor vehicles but is not used for the servicing of vehicles, other than washing, cleaning, or polishing.
Conditioned space	That part of a *building* within the *building thermal envelope* that may be directly or indirectly heated or cooled for occupant comfort. It is separated from *unconditioned space* by *building elements* (walls, windows, *skylights*, doors, *roof*, and floor) to limit uncontrolled airflow and heat loss.
Fan motor power	Means the power delivered to a motor of a fan, including the power needed for any drive and impeller losses.
HVAC system	For the purposes of performance NZBC H1.3.6 and in relation to a *building*, means a mechanical, electrical, or other system for modifying air temperature, modifying air humidity, providing ventilation, or doing all or any of those things, in a space within the building.
Intended use	In relation to a *building*, — a) includes any or all of the following: i) any reasonably foreseeable occasional use that is not incompatible with the intended use; ii) normal maintenance; iii) activities undertaken in response to *fire* or any other reasonably foreseeable emergency; but b) does not include any other maintenance and repairs or rebuilding.
Minimum Energy Performance Standards (MEPS)	Means the minimum energy performance standards for energy using products established through the Energy Efficiency (Energy Using Products) Regulations 2002, amended by the Energy Efficiency (Energy Using Products) Amendment Regulations 2020.
Occupied space	Any space within a *building* in which a person will be present from time to time during the *intended use* of the *building*.
Outdoor air	Means air outside the *building*, typically comprising by volume: i) oxygen 20.94%, and ii) carbon dioxide 0.03%, and iii) nitrogen and other inert gases 79.03%.

Definitions

Outdoor air economy cycle	Means a mode of operation of an *air conditioning* system that, when the *outdoor air* thermodynamic properties are favourable, increases the quantity of *outdoor air* used to condition the space.
Piping	Means an assembly of pipes, with or without valves or other fittings, connected together for the conveyance of liquids and gases.
Roof	Any roof/ceiling combination where the exterior surface of the *building* is at an angle of 60° or less to the horizontal and has its upper surface exposed to the outside.
R-value	The common abbreviation for describing the *thermal resistance*.
Skylight	Translucent or transparent parts of the *roof*.
Thermal envelope	The *roof*, wall, window, *skylight*, door and floor *construction* between *unconditioned spaces* and *conditioned spaces*.
Thermal resistance	The resistance to heat flow of a given component of a *building element*. It is equal to the air temperature difference (K) needed to produce unit heat flux (W/m^2) through unit area (m^2) under steady conditions. The units are $m^2{\cdot}K/W$.
Unconditioned space	Space within the *building envelope* that is not *conditioned space* (for example, this may include a garage, conservatory, atrium, attic, subfloor, and so on). However, where a garage, conservatory or atrium is expected to be heated or cooled these spaces shall be included in the *conditioned space*.
Unitary air conditioner	Means a modular factory assembled *air conditioning* unit. These units are self-contained and include within the unit all the components for heating and/or cooling such as fans, controls, a refrigeration system, heating coil and sometimes the heater. Split systems, packaged air conditioners, variable refrigerant flow and variable refrigerant volume air conditioners are all types of *unitary air conditioners*.

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