

Australian/New Zealand Standard™

Natural ventilators—Classification and performance



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This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee ME/62, Ventilation and Airconditioning. It was approved on behalf of the Council of Standards Australia on 22 December 1999 and on behalf of the Council of Standards New Zealand on 22 February 2000. It was published on 30 March 2000.

The following interests are represented on Committee ME/62:

Air Conditioning and Mechanical Contractors Association of Australia
Air-conditioning and Refrigeration Equipment Manufacturers Association of Australia
Australasian Fire Authorities Council
Australian Building Codes Board
Australian Institute of Building Surveyors
Australian Institute of Refrigeration, Air Conditioning and Heating
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This Standard was issued in draft form for comment as DR 97303.

Australian/New Zealand Standard™

Natural ventilators—Classification and performance

First published as AS/NZS 4740:2000.

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Jointly published by Standards Australia International Ltd, PO Box 1055, Strathfield, NSW 2135 and Standards New Zealand, Private Bag 2439, Wellington 6020

ISBN 0 7337 3246 1

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME/62, Ventilation and Airconditioning.

The objective of this document is to provide standardized requirements and performance test methods for natural ventilators for use by manufacturers, suppliers, testers, specifiers and consumers of these products.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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Australian/New Zealand Standard
Natural ventilators—Classification and performance

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies minimum requirements for ventilators designed to provide ventilation of enclosures by means of the natural flow of air.

This Standard includes classification, performance and marking requirements. It also includes appendices outlining the performance test methods. It does not apply to electrically powered ventilators or to smoke and heat exhaust ventilators.

1.2 APPLICATION

The method of tests used for the performance assessment of natural ventilators will depend on the required type, performance and application of the ventilator. This document should not be called up in contracts without specifying the detail to be derived from it.

NOTES:

- 1 Purchasing guidelines are provided in Appendix A.
- 2 This Standard is a product Standard and does not include requirements for the design or installation of natural ventilation systems. Manufacturers and suppliers should be contacted for design and installation information appropriate to their products.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1199	Sampling procedures and tables for inspection by attributes
1399	Guide to AS 1199—Sampling procedures and tables for inspection by attributes
1745	Outdoor weathering of plastics in the Australian environment
1745.2	Part 2: Guide for design purposes
2360	Measurement of fluid flow in closed conduits
2360.1.1	Part 1.1: Pressure differential methods—Measurement using orifice plates, nozzles or Venturi tubes—Conduits with diameters from 50 mm to 1200 mm
2427	Smoke/heat release vents
AS/NZS	
2312	Guide to the protection of iron and steel against exterior atmospheric corrosion
2728	Prefinished/prepainted sheet metal products for interior/exterior building applications—Performance requirements
ISO	
5801	Industrial fans—Performance testing using standardized airways

ISO	
9000	Quality management and quality assurance standards
9000.1	Part 1: Guidelines for selection and use
9004	Quality management and quality system elements
9004.1	Part 1: Guidelines
SAA	
HB.18	Guidelines for third-party certification and accreditation
HB.18.28	Guide 28—General rules for a model third-party certification scheme for products
ANSI/ASHRAE	
70	Method of testing for rating the performance of air outlets and inlets

1.4 DEFINITIONS

For the purpose of this Standard the definitions below apply.

1.4.1 Discharge coefficient (coefficient of discharge)

A coefficient determined for each natural ventilator by type testing in accordance with Appendix D.

1.4.2 Effective aerodynamic area

The equivalent area of a theoretical aerodynamically perfect orifice (i.e. theoretically perfect opening with a coefficient of discharge of 1.0), and equals the throat area multiplied by the discharge coefficient.

1.4.3 Final upper limit load

The maximum load at which results of a load test have been obtained.

1.4.4 Flow coefficient (coefficient of flow)

The velocity ratio of the exhaust air, drawn through the ventilator, to the air passing over a ventilator.

1.4.5 Functional integrity

The ability of a product or part to meet its design performance after undergoing test.

1.4.6 Natural ventilator (herein referred to as ventilator)

A ventilating unit that has no external power source other than wind or temperature gradients.

1.4.7 Permanent deflection

The deformation of a part or product, when a part does not return to its original shape, after the load has been applied and removed.

1.4.8 Pitch

The angle of a roof from the horizontal plane.

1.4.9 Scale model

A model of a ventilator with all dimensions scaled down or up by the same ratio.

1.4.10 Stack height

The mean height between the natural ventilation inlets and outlets of a building.

1.4.11 Stack pressure

The pressure difference between the inside and outside of a building, created by buoyancy effects which are in turn created by changes in density caused by air temperature variations.

1.4.12 Static load test

A test carried out using a static load.

1.4.13 Streaming

Continuous visible signs of non-airborne water particles.

1.4.14 Structural integrity

The ability of a product or part or any component to remain, without partial or full dislodgment from the structure, after undergoing test.

1.4.15 Throat area

The minimum cross-sectional area of a ventilator through which air can pass.

NOTE: Throat area is not equal to free area which is a quantity that is not used in this Standard but if quoted should be calculated in accordance with the procedures of ANSI/ASHRAE 70.

1.4.16 Vent pressure drop

The pressure difference across a natural ventilator, at a specified flowrate, as measured by the vent pressure meter.

1.4.17 Wind siphoning pressure

The pressure difference between the immediate inside and outside of a roof-mounted ventilator created by air passing over the top of the ventilator.

1.5 CLASSIFICATION

1.5.1 Type classification

Ventilators shall be classified according to type as follows:

- (a) Type 1: Fixed grilles, louvre panels.
- (b) Type 2: Fixed roof ventilators, hoods, ridge vents.
- (c) Type 3: Wind directional vane ventilators.
- (d) Type 4: Rotating wind-driven roof ventilators.

Typical ventilator designs are illustrated by type in Figure 1.1.

1.5.2 Performance classification

Ventilators shall be classified according to their performance requirements in accordance with Tables 1.1 and 1.2 as applicable. For a ventilator to be classified in accordance with Tables 1.1 and 1.2 it shall be tested in accordance with the requirements of Section 2.

1.5.3 Dual classification

Where smoke and heat release ventilators are intended to be used also as natural ventilators they shall comply with the requirements of this Standard and AS 2427.

1.5.4 Corrosion resistance

Corrosion resistance requirements for ventilators shall be by agreement (see Appendix A).

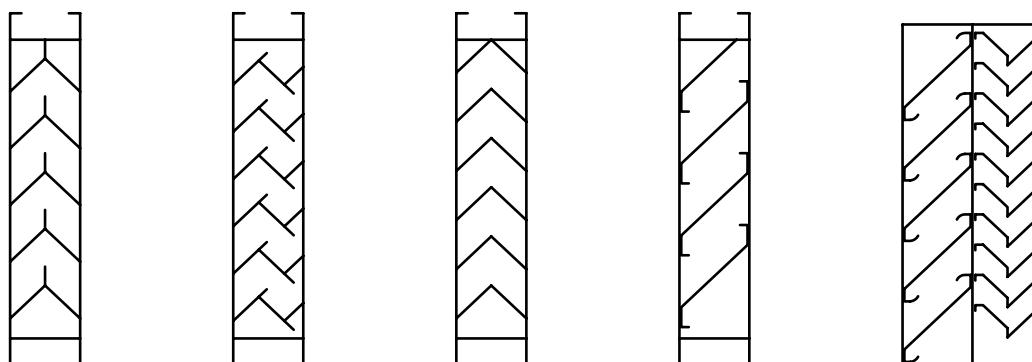
NOTE: Corrosion resistance of ventilators should be designed in accordance with an appropriate Standard such as AS 1745.2, AS/NZS 2312 or AS 2728.

TABLE 1.1
PERFORMANCE CLASSIFICATION—TYPE 1 VENTILATORS

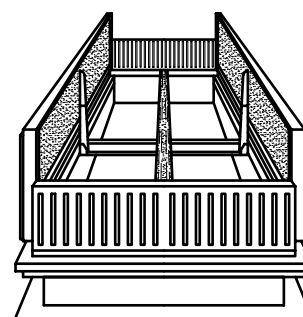
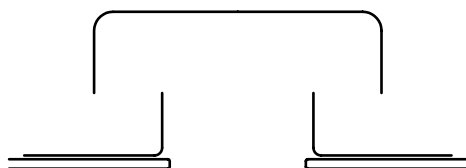
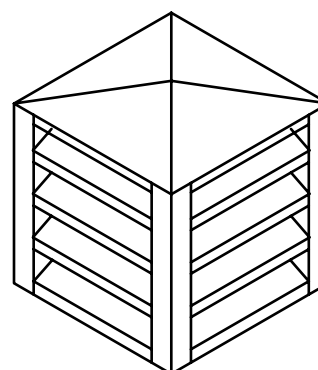
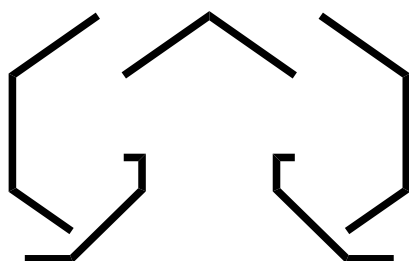
Characteristic	Performance level	Summary
Rain resistance (Appendix B)	Class A	A – 1 to 0.99% effectiveness
	Class B	B – 0.989 to 0.95% effectiveness
	Class C	C – 0.949 to 0.80% effectiveness
	Class D	D – Below 0.80% effectiveness
Effective aerodynamic area (Appendix D)	Class 1	1 – $C_d = 0.7$ and above
	Class 2	2 – $C_d = 0.5$ to 0.699
	Class 3	3 – $C_d = 0.3$ to 0.499
	Class 4	4 – $C_d = 0.1$ to 0.299
Wind loading (Appendix F)	Level 1	Pass criteria at 57 m/s
	Level 2	Pass criteria at 44 m/s
	Level 3	Pass criteria at 31 m/s
	Level 4	Pass criteria at 16 m/s

TABLE 1.2
PERFORMANCE CLASSIFICATION—TYPE 2, 3 OR 4 VENTILATORS

Characteristic	Performance level	Summary
Rain resistance (Appendix C)	Class A	A – No water at 50 m/s min.
	Class B	B – No water at 35 m/s min.
	Class C	C – No water at 20 m/s min.
	Class D	D – No rain resistance requirement
Effective aerodynamic area (Appendix D)	Class 1	1 – $C_d = 0.7$ and above
	Class 2	2 – $C_d = 0.5$ to 0.699
	Class 3	3 – $C_d = 0.3$ to 0.499
	Class 4	4 – $C_d = 0.1$ to 0.299
Flow coefficient (Appendix E)	Class 1	1 – $C_f = 0.7$ and above
	Class 2	2 – $C_f = 0.5$ to 0.699
	Class 3	3 – $C_f = 0.3$ to 0.499
	Class 4	4 – $C_f = 0.1$ to 0.299
Wind loading (Appendix G or H)	Level 1	Pass criteria at 57 m/s
	Level 2	Pass criteria at 44 m/s
	Level 3	Pass criteria at 31 m/s
	Level 4	Pass criteria at 16 m/s

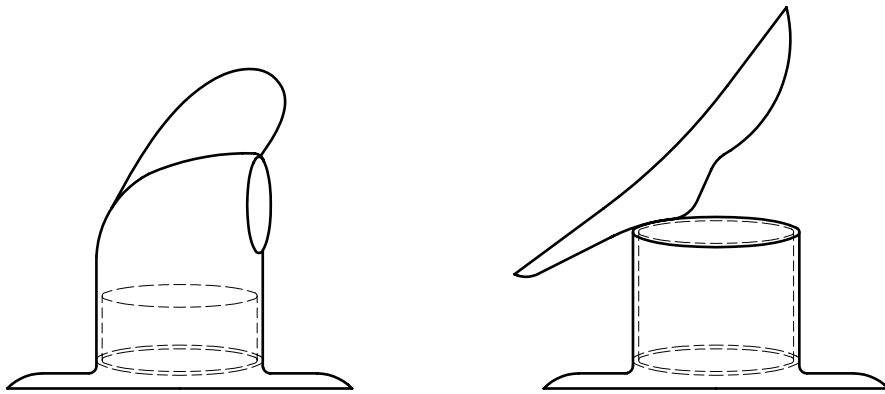


(a) Type 1

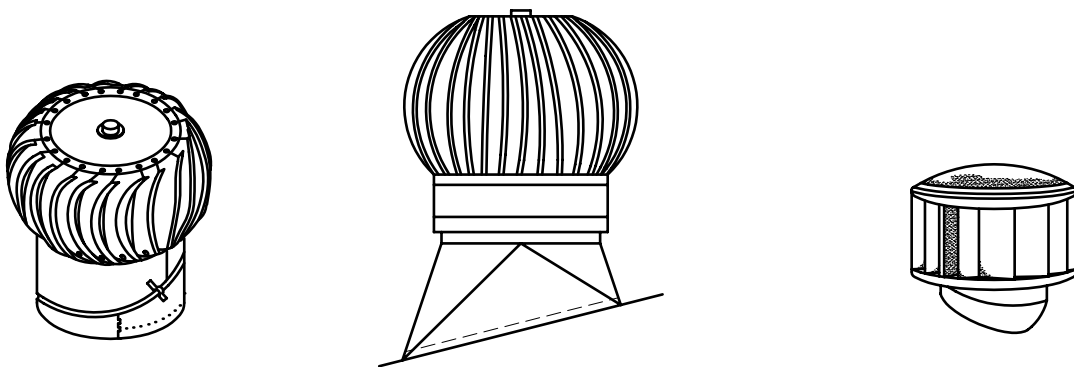


(a) Type 2

FIGURE 1.1 (in part) TYPICAL VENTILATORS BY TYPE



(a) Type 3



(a) Type 4

FIGURE 1.1 (in part) TYPICAL VENTILATORS BY TYPE

SECTION 2 PERFORMANCE TESTING

2.1 TYPE APPROVAL

For type approval, tests shall be carried out in accordance with Clauses 2.2 and 2.3. For each test a report shall be prepared in accordance with Section 5.

2.2 TYPE TESTING

2.2.1 General

For the purpose of type approval it is not necessary to test every size of ventilator in a product range, provided that the range complies with Clauses 2.2.2 to 2.2.4. Classification of ventilators by performance is given in Clause 1.5.2.

2.2.2 Range type

The range shall comprise the same ventilator classification type, and shall be manufactured to a similar design and with similar materials.

2.2.3 Specimen size

For type approval, at least the smallest, largest and median size of a ventilator range shall be tested. For continuous Type 1 units, tests shall be carried out on a 1.0 m × 1.0 m panel. For continuous Type 2 units, tests shall be carried out on a full size unit with a sectional length sufficient to include one full structural span along its length. Where the largest ventilator cannot be tested due to practical problems with physical size, the test may be carried out on a scaled model subject to the requirements of Clause 2.2.4. Wind load testing shall not be carried out on a scale model.

2.2.4 Scale models

Where allowed by Clause 2.2.3, test specimens may be accurately scaled-down models. Where testing of scale models is undertaken, the models shall be as large as is practicable for the test rig in use. For testing scaled-down models, flow similarity shall be proven.

NOTE: Flow similarity is always achieved if the Reynolds Numbers of the scaled-down model and the full-scale ventilator are identical.

The Reynolds Number similarity requirement usually prescribes model scales of 1/10 or larger. When testing scaled-down models, all features of the ventilators in contact with the airflow (e.g. opening elements, details of flaps, and similar) shall be included and shall satisfy the similarity requirement.

NOTE: Experience has shown that it is difficult to model Type 2 ridge ventilators and Type 1 louvre ventilators.

2.3 PERFORMANCE REQUIREMENTS

2.3.1 Rain resistance

Type 1 ventilators shall be tested in accordance with Appendix B. Types 2, 3 and 4 ventilators shall be tested in accordance with Appendix C.

2.3.2 Effective aerodynamic area

All ventilator types shall have their coefficient of discharge and effective aerodynamic area calculated in accordance with Appendix D.

2.3.3 Flow coefficient

Where ventilators are required to have their coefficient of flow established, it shall be determined in accordance with Appendix E.

2.3.4 Wind loading

2.3.4.1 Static load tests

Type 1 ventilators shall be tested in accordance with Appendix F and the resistance to wind loads shall be determined. Type 2 and 3 ventilators shall be tested in accordance with Appendix G or Appendix H and the resistance to wind loads shall be determined.

2.3.4.2 Free field tests

Type 4 ventilators shall be tested in accordance with Appendix H and the resistance to wind loads shall be determined. Tests shall not be carried out on a scale model. As an alternative to Clause 2.3.4.1, Type 2 and 3 ventilators may be tested in accordance with Appendix H.

NOTE: It should be noted that compliance with the test requirements of Clause 2.3.4 does not automatically provide compliance with the wind loading requirements of building regulations which need to be complied with on an installation-specific basis.

2.4 INSTRUMENTATION

2.4.1 Airflow rate

2.4.1.1 Measurement

Airflow meters shall have the ranges and accuracies given in Table 2.1.

Airflow meters may be calibrated in situ by means of pitot-static tube traverse techniques.

TABLE 2.1
AIRFLOW METER ACCURACIES

Range m ³ /s	Accuracy of measurement %
From 0.07 to 7	±2.5
From 0.007 to 0.07	±5

2.4.1.2 Calibration

Airflow meters shall be checked at intervals, as appropriate, but not exceeding 12 months. This check may take the form of one of the following:

- (a) A dimensional check of all flow meters not requiring calibration.
- (a) A check calibration over their full range using the original method employed for initial calibration or meters calibrated in situ.

2.4.2 Pressure

2.4.2.1 Measurement

Pressure in the duct shall be measured by means of a liquid-filled calibrated manometer, or any other device complying with this Clause.

The maximum scale interval shall not be greater than the characteristics given in Table 2.2.

For airflow measurements, the minimum pressure differential shall be as follows:

- (a) 25 Pa with an inclined tube manometer or micro-manometer.
- (b) 500 Pa with a vertical tube manometer.

TABLE 2.2
MAXIMUM SCALE INTERVAL

Range, Pa	Maximum scale interval, Pa
≤ 25	1.0
$> 25 \leq 250$	2.5
$> 250 \leq 500$	5.0
> 500	25.0

2.4.2.2 Calibration

Calibration standards shall be as follows:

- (a) for instruments with a range ≤ 25 Pa, a micro-manometer accurate to ± 0.5 Pa;
- (b) for instruments with a range $> 25 \leq 500$ Pa, a manometer accurate to ± 2.5 Pa (hook gauge or micro-manometer);
- (c) for instruments with a range > 500 Pa, a manometer accurate to ± 25 Pa (vertical manometer).

2.4.3 Temperature measurement

Measurement of temperature shall be by means of mercury-in-glass thermometers, resistance thermometers or thermocouples. Instruments shall be graduated to give readings in intervals not greater than 0.5 K and calibrated to an accuracy of 0.25 K.

2.4.4 Water flow meters

Water flow meters shall have an accuracy of measurement within 0.5% of the indicated flow rate. Water flow meters shall be calculated against a known weight of water flowing for a measurement time period.

2.4.5 Timers

Timers for determining flow rates shall have a minimum accuracy of 0.2 s.

2.4.6 Rain gauge

Rain gauges shall have an accuracy of $\pm 2\%$ of reading.

SECTION 3 CALCULATIONS

3.1 SCOPE

This Section outlines a method of calculation to assess the airflow performance of a ventilator under assumed conditions. Airflow due to stack pressure, wind siphoning pressure; or a combination of both, may be calculated.

3.2 STACK PRESSURE AIRFLOW

3.2.1 Stack pressure

Stack pressure shall be calculated in accordance with the following equation:

$$P_s = \rho g h \Delta T / T \quad \dots 3(1)$$

where

- P_s = stack pressure (Pa)
- ρ = air density at ambient temperature (kg/m^3)
- g = gravitational constant (9.81 m/s^2)
- h = stack height (m)
- ΔT = assumed temperature differential between air intake and air exhaust (K)
- T = assumed outside ambient temperature (K)

3.2.2 Airflow

The airflow due to the stack pressure shall be calculated in accordance with the following equation:

$$Q_s = F \times \left(\frac{2 P_s}{\rho} \right)^{1/2} \quad \dots 3(2)$$

where

- Q_s = stack volume flow rate (m^3/s)
- F = effective aerodynamic area of the ventilator calculated in accordance with Appendix D (m^2)
- P_s = stack pressure (Pa)
- ρ = air density at ambient temperature (kg/m^3)

3.3 WIND SIPHONING AIRFLOW

3.3.1 Wind siphoning pressure

Wind siphoning pressure shall be calculated in accordance with the following equation:

$$P_w = (\rho / 2) (C_f V_t)^2 \quad \dots 3(3)$$

where

- P_w = wind siphoning pressure (Pa)
- ρ = air density at ambient temperature (kg/m^3)
- C_f = flow coefficient, calculated in accordance with Appendix E
- V_t = assumed wind velocity (m/s)