COMMERCIAL VENTILATION MANUAL

Second edition September 2010

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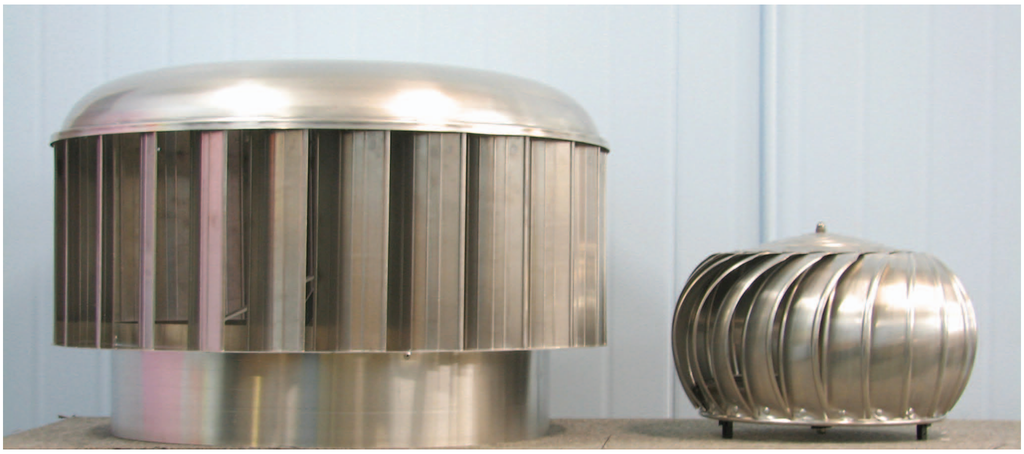
1. COMMERCIAL VENTILATION

1.1 Commercial versus Residential Turbine Ventilators

There is no distinct line between the commercial and residential ventilator markets. It is a hazy boundary. Commercial vents can and do get used on residential buildings. Residential vents get used (incorrectly so) on large sheds and even factories and warehouses. Commercial vents are also used on pipes for the movement of corrosive gases.

FIGURE 1.1 Comparing a 'Commercial' Hurricane™ H600 against a 'Residential' Windmaster™



The basic criteria for defining a need for commercial ventilators rather than residential ventilators are:

- **Project size –** which in turn equates to the exhaust rate required to give the desired air exchange rate (which determines the rate at which heat can be removed). The typical size residential vent does not have the exhaust capacity suitable for large projects. Their use in such applications is purely cosmetic and will not provide tangible results.
- **Air quality –** factories and warehouses are notoriously dusty, some have high airbourne particulate concentrations and some produce corrosive and volatile by-products. These types of environments are not suitable for simple residential vents which have relatively cheap and fully exposed bearing systems.
- **Thermal conditions –** internal air temperatures near the roof in process plants can exceed 80ºC where furnaces or ovens are used. The life of the vent can be compromised by these conditions, unless vents with suitable construction and bearing systems are used.

1.2 Role of Commercial Ventilators

In general, the purpose of all commercial vents is to move air from an internal location to atmosphere and to enable its replacement by fresh, external air. The objective of this function may be one or more of:

1. Reducing air temperature in a workplace or around electronic equipment (thereby improving their reliability or performance).

2. Enabling a more rapid replacement of hot air trapped in buildings at night by cooler night air thereby taking advantage of the thermal storage properties of the building façade and internal structures.
3. Lowering humidity levels inside a work or storage area by introducing air with lower moisture levels or less moisture carrying capacity.
4. Purifying air inside a workplace by reducing the concentration of various contaminants (air quality improvement).
5. Reducing condensation beneath metal surfaces to reduce oxidation.
6. Reducing the concentration of various noxious or explosive gases in storage or process areas by enabling the introduction of clean air.
7. Reducing static electricity levels in air by achieving air exchange.

Most commonly, commercial vents are used to improve conditions for people inhabiting an area. There have been many studies taken in factory environments which establish that beyond 35ºC worker productivity levels begin to decline, concentration falters, and frequency of workplace accidents increases. A well designed ventilatoion scheme can significantly redude the likelihood of temperatures exceeding 35ºC for long periods of time.

1.3 The Characteristics of a Good Commercial Ventilator

The Edmonds commercial Hurricane Turbine Ventilator has been sold to 40 countries. The Hurricane ventilator is currently assembled in 10 countries under licence or from components supplied by Edmonds from Australia. The Hurricane ventilator has been used by many high profile companies including GE globally for power project related applications. In Australia; Coles, Harvey Norman, Tooheys, Visy Industries, Corporate Express, BHP, Boral, P&O have all installed Hurricane ventilators. Overseas; Alcan, Saud Bahwan, Toyota, Al Futtaim, Honda, Siemens, Daewoo, Bluescope, Umicore have also used Hurricane ventilators. Over 600 schools and colleges in Australia have installed Hurricane ventilators.

What makes a good, commercial ventilator?

- **Longevity:** Installation of ventilators on roofs has become an expensive process in recent years due to increasingly stringent requirements for working at heights. Customers therefore want a long, maintenance-free life from natural ventilators. The material used in construction is critical here. Galvanised ventilators can suffer from corrosion. High quality aluminium construction (preferably marine grade or equivalent) will withstand the harshest natural environments.
- **Reliability:** No operational noise and continued ability to rotate for at least 15 years is essential. This characteristic is determined by inherent aspects of product design and critically by the quality of the bearing system.
- **Robustness:** Ability to withstand very strong, continuous wind speeds. In Sydney, maximum wind speeds in excess of 160km/hr have been recorded. With increasing climate change, more frequent extremes of weather are anticipated. A good commercial ventilator should have a certified performance under wind load (AS2050) exceeding 190km/hr.
- **Prevention of Water Ingress:** Many natural ventilators are installed above sensitive items of process equipment. Rain must not enter. A good commercial ventilator must have been certified under AS2428.1

- **Quality Exhaust Perfomance:** The exhaust performance of a ventilator is critical to successful achievement of project objectives. The heavier the head of a vent, the lower the response to wind speed. Light weight materials like aluminium are integral to good commercial vent performance. The performance of a vent should now be specified and quoted under AS4740:2000 – Natural Ventilators, Classification and Performance. This is presently the ONLY recognised world standard for assessing vent performance. Any exhaust figures quoted outside this standard have no scientific support. Contrary to claims by some manufacturers, ASHRAE does not have a test procedure or formula for determining the exhaust rate of a natural ventilator. ASHRAE does have a formula for discharge through 'gravity' ventilators and it has, in the past been applied to natural ventilator due to lack of other options. As a result many older brochures still contain this reference.

1.3.1 Assessment of the Hurricane™ Turbine Ventilator

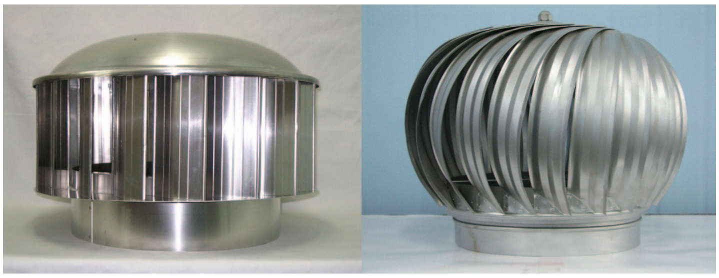
- **Longevity:** Hurricane ventilators are primarily constructed from a range of corrosive resistant aluminium alloys, which will withstand proximity to salt spray. In many cases this will remove the need to powder coat for protective reasons.
- **Reliability:** 'Standard' Hurricane ventilators come with a 15 year warranty supported by CSR. This is underpinned by the use of a double row deep groove ball bearing system utilising special high temperature grease. The bearing has applications in the motor industry as a water pump bearing. The selection of grease type is critical.
- **Robustness:** A representative range of Hurricane vents, from small through to large, has been wind tested to withstand a wind speed of at least 198km/hr. The Hurricane H300 was wind tested in Miami Florida to 241km/hr – the limit of the test facility.
- **Prevention of Water Ingress:** A representative range of Hurricane ventilators, from H300 through to H900 have been tested in accordance with AS2428.1 and found to meet the conditions of the standard.
- **Quality Exhaust Perfomance:** All Edmonds' Hurricane ventilators have been tested in accordance with AS4740:2000 and exhaust rates are reproduced later in this catalogue at a nominal wind speed, stack height and temperature differential. Edmonds has incorporated the results of these tests into a full algorithm consistent with AS4740 to determine the correct Hurricane ventilator for each project and allowing for variations in stack height, wind speed and temperature differential. This algorithm cannot be applied to any other brand of vent since all vents have their own unique discharge and flow coefficients and therefore test differently under AS4740. Customers are encouraged to contact Edmonds should they need to establish a suitable Hurricane ventilation scheme for a project. They are also encouraged to demand exhaust rates in accordance with AS4740 from any other vent supplier to ensure end users achieve required air exchange rates.

1.4 Vertical Vane versus Spherical Vane Ventilators

In Australia the are two main types of commercial turbine ventilator, spherical (onion) and vertical vane ventilators. Whilst there are differences in the apperance of each of these different types of vents, the main difference is in the performance of the different styles.

The Edmonds Hurricane Turbine Ventilator and ecopower Hybrid Ventilator ranges utilise the vertical vane design.

FIGURE 1.2 Comparing a vertical vane against a spherical vane ventilator



Testing undertaken by Edmonds using AS4740:2000 has shown that the Hurricane vertical vane ventilator design has a flow coefficient 37-122% superior (varies, depending on vent size) to the equivalent size spherical vane ventilator designs tested. This may explain why improved project performances have been recorded when some spherical vane ventilators have been replaced by Hurricane ventilators on the same project (see Appendix 9.2.1 – Bunnerong gym project).

1.4 The Parts of a Ventilator

A turbine ventilator can come in a varity of configurations; Complete, Top Only & Top with Special Base.

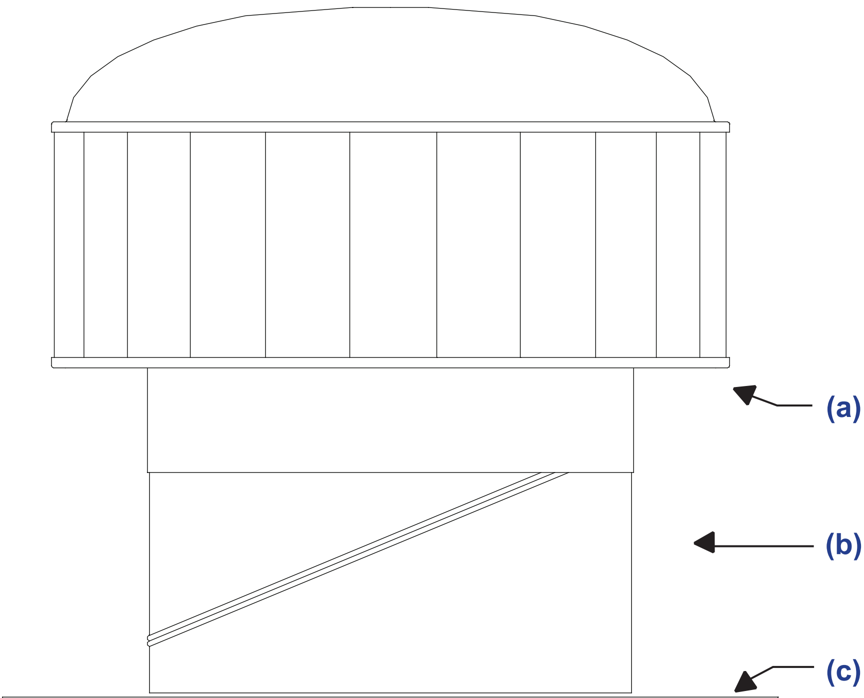
A Complete (or standard) turbine ventilator consists normally of 3 parts (see figure 1.3) referred to as:

(a) the Head (or Turbine)

(b) the Throat (or Varipitch)

(c) the Base Plate (or Flashing)

FIGURE 1.3 Parts of a verticle vane turbine ventilator



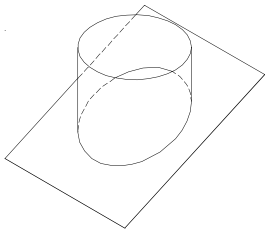
A standard ventilator DOES NOT come with a damper. This is an optional accessory.

When a Varipitch and Flashing are not suitable due to roof pitch, vent turbine weight or desired appearance a ‘special base’ can be used.

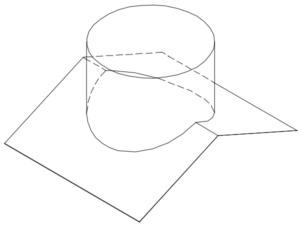
They are referred to as ‘special bases’ insofar as they are non-standard and must be fabricated to suit the pitch of the roof. The throat and base plate are joined together and are not discrete items. They offer minimal net advantage in terms of vent performance and are significantly more costly to produce than a normal Varipitch. There are two types of special base:

Spigot Bases: are generally used where the roof slope exceeds the Varpitch’s maximum angle, where it is necessary to raise the vent’s turbine (to avoid wind shadows) or in cases where an electric damper must be installed in the throat of the vent and not on the base plate (Flashing). They are commonly used on old saw tooth roofs of characteristic steep pitch (see apendix 9.2.8 Tooheys Limited).

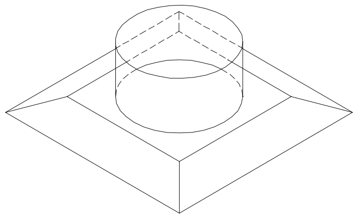
FIGURE 1.4 Spigot Bases: Types 1, 2 and 7.



Type 1
Spigot slope base



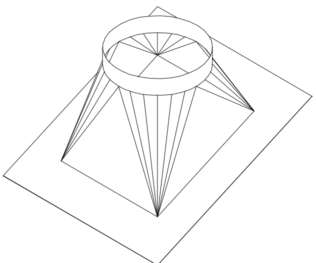
Type 2
Spigot ridge base



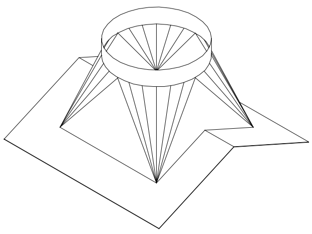
Type 7
Spigot pyramid base

Square to Round Bases: have been used in the industry to support the extra weight of a galvanised turbine. Many architects now consider their use essential for all vents, but this is incorrect. They are expensive to fabricate and offer minimal net advantage apart from structural support for heavy galvanised vent turbines. Light weight aluminium vent turbines, like Hurricane, do not require square to round bases, which provides significant cost savings.

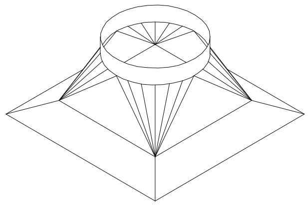
FIGURE 1.5 Square to round bases: Types 3, 4 and 6.



Type 3
Square to round slope base



Type 4
Square to round ridge base



Type 6
Square to round pyramind base

Some ventilators are available as a Top Only, this is useful if an existing turbine needs to be replaced or if the turbine is being fitted to the top of a pipe or duct.

1.6 The Hurricane™ Turbine Ventilator

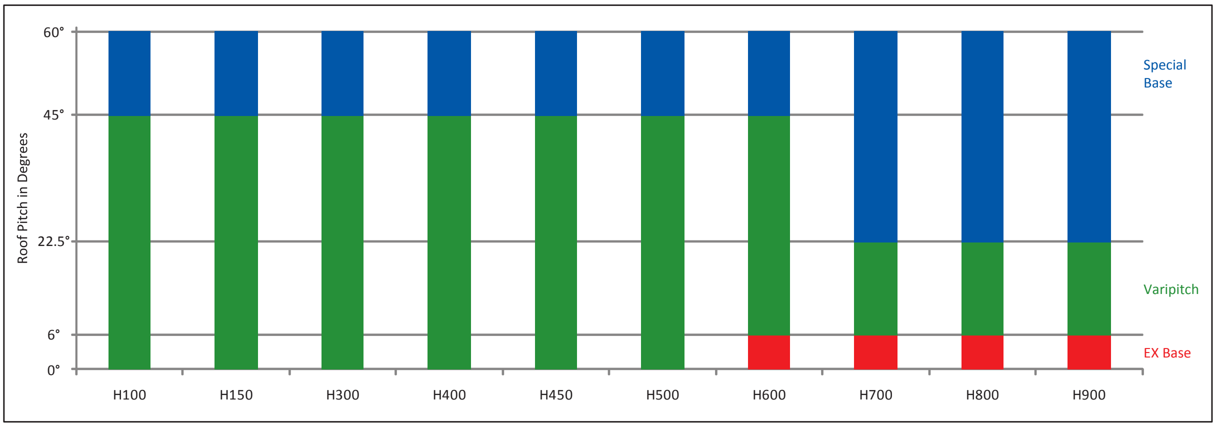
The Hurricane Turbine Ventilator is an example of a ‘vertical vane’ ventilator design. This design has larger gaps between the vanes than virtually all onion shaped ventilators thereby providing less resistance to air passage. This is reflected in higher flow coefficients for this design compared with the older onion shape design.

Hurricane ventilators are named by the throat size as the descriptor i.e. Hurricane H300 refers to a complete Hurricane ventilator in mill aluminium with a 300mm throat.

For the Edmonds’ Hurricane ventilator range, the standard throat is called a ‘Varipitch’. It can be adjusted to suit the roof angle within limits. Where a customer orders a complete Hurricane Hxxx ventilator, the product will always be supplied with the standard Varipitch throat and flashing.

In the case of the Hurricane range, the Varipitch can adjust to varying roof angles. However, different sizes have different adjustment capabilities as listed below.

FIGURE 1.6 Base type and maximum roof angle by size



If a roof angle is steeper than the maximum Varipitch angle, a special base made to the exact roof pitch is required.

1.6.1 EX Base

In recent years Edmonds developed a new base design called an EX Base. This is shown in figure 1.7.

It is a two piece Type 1 Spigot Base using a throat cut to the exact roof angle and a standard flashing. The EX Base is suitable for roofs with a pitch of up to 6º and the angle must be known to within half a degree. The base is supplied in two pieces, the throat is rolled but not riveted, and the flashing is seperate.

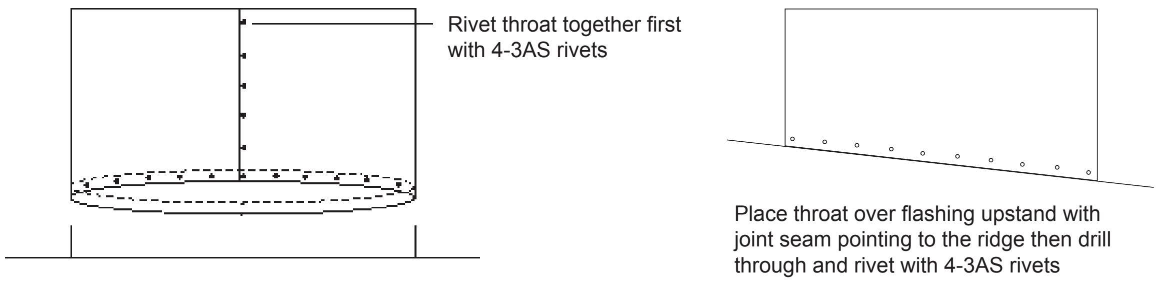
This design enables the throat to be packed either in the same carton as the ventilator turbine, or many throats to be packed together in one carton, thereby offering significant freight savings. Once on the roof, the throat is riveted together then fastened to the base.

The advantages of this base are:

- Much lower freight cost.
- Easier transport of base to roof top.
- Faster installation than a Varipitch as there is no adjustment to the roof angle.

Because of the manufacturing requirements, it is only feasible to produce EX Bases for projects of 6 units or more and only for sizes 600mm-900mm.

FIGURE 1.7 Schematic of an EX Base



2. OPERATION OF A VENTILATOR

2.1 Theory

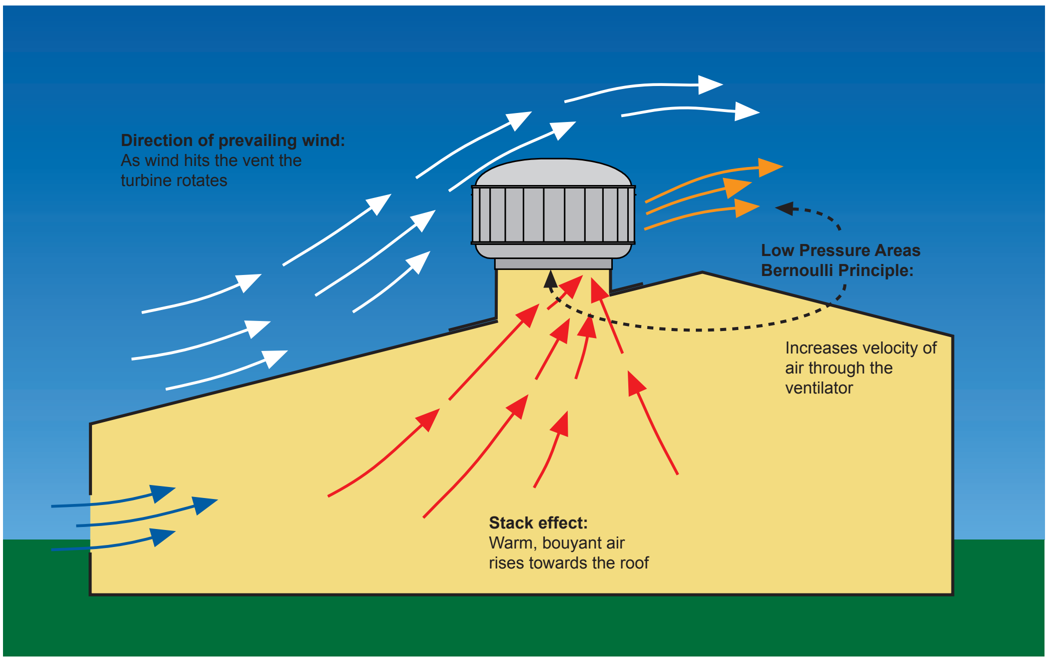
A natural ventilator will exhaust air by two different processes:

1. **Stack Effect:** Is the process by which warm air rises towards the roof of a building, it occurs due to the density of air decreasing as its temperature increases. Regardless of the rotation speed of the vent's turbine, the area of the throat of the vent allows the rising warm air to escape through the vanes. The **discharge coefficient** of a vent indicates how effective a vent is at letting the warm air escape. The higher the discharge coefficient of a vent, the higher the exhaust rate due to stack effect. The discharge coefficient is heavily influenced by internal blockages in the throat of the vent as well the size of the openings between the vanes.

   The stack effect is determined by the difference in temperature between the air at the vent (roof) level and that of the fresh air entering the factory or warehouse, in addition to the height of the 'stack'. The greater the temperature differential, the higher the stack effect. Similarly, the greater the height, the higher the stack effect.

2. **Siphoning Effect:** As a vent rotates in the wind, a low pressure region is created on the leeward side. This phenomenon is known as the Bernoulli Principle (see figure 2.1). This area of low pressure helps create a siphoning effect where the warm internal air of higher pressure escapes and flows to the low pressure area. The **flow coefficient** measures the efficiency of a vent to create this siphoning effect. Edmonds vents have flow coefficients much higher than equivalent size spherical vane vents. The siphoning effect is influenced by vent design, weight of head and friction of the bearing system.

FIGURE 2.1 Operation of a ventilator



Measurement of discharge and flow coefficients is possible using the apparatus and equations of AS4740:2000. Edmonds utilises this test procedure for product evaluation and R&D purposes.

2.2 Mechanism for Temperature Reduction.

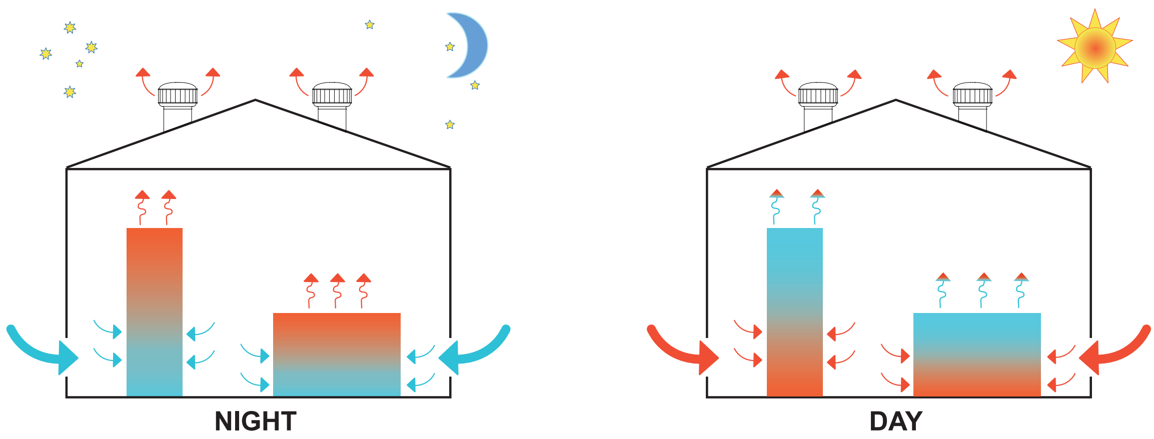
The most successful means of reducing temperatures in a building is strongly linked to the concept of thermal storage or thermal cooling.

The thermal mass (defined as the structure and contents of the building that is capable of thermally interacting with circulating air and achieving temperature transfer) often consists of concrete floors, concrete or panel system walls including internal offices, machinery and stock with high energy storage capability (e.g. plasterboard, steel etc).

During the evenings and night, natural ventilators ensure that air is circulated, the warm air that has built up over the day is removed and cooler, external air enters the building. This cooler air comes into contact with, and cools, the building structures and contents. In turn, the now cooler building structure is available to offset heat gains the following day and maintain temperatures within reasonable comfort limits. Temperatures at midday can be 2-3ºC less than ambient.

Night ventilation in conjunction with thermal mass is a very effective passive cooling measure where the ambient temperatures at night fall well below normal daytime peak. This occurs in most regions of Australia, particularly below the Tropic of Capricorn.

FIGURE 2.2 Ventilation effects on thermal storage



2.3 Importance of Air Exchange Rate

Air exchange rates dictate how well heat load and odours are dissipated. Below about three air changes per hour (3 ACH) there will be little noticeable improvement. There is insufficient air exchange capacity to dilute built-up heat while combating the constant bombardment of external radiant energy from the sun. It is a battle between the rate of heat removal versus the rate of heat gain.

ASHRAE (The American Society for Heating, Refrigeration and Air conditioning Engineers) has long been regarded as the expert source for recommendations on air exchange rates.

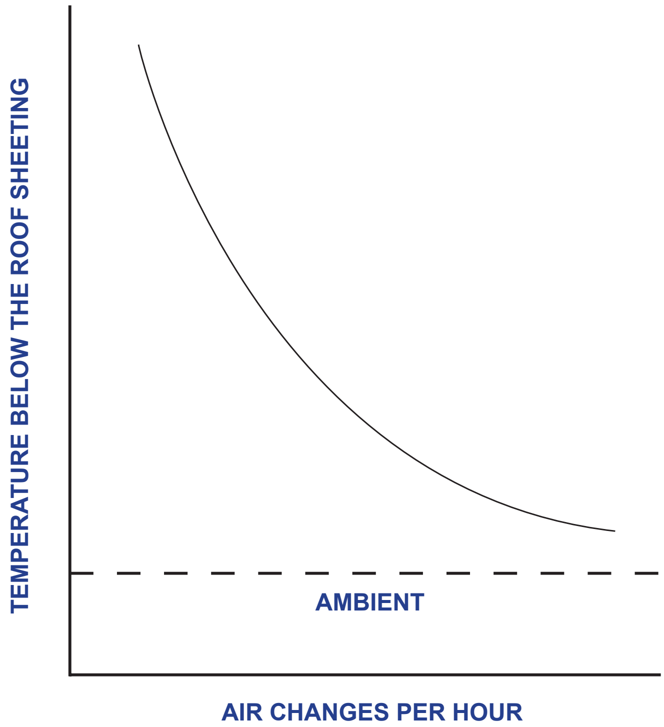
Some of the ASHRAE recommendations include:

TABLE 2.1 ACH recommendations by building type

Activity	Recommended ACH
Factories and Workshops	5 to 10
Warehouses	5 to 8
Gymnasiums	5 to 10
Assembly Halls	10 to 15
Garages	10 to 15
Toilets	12 to 15
Laundries	12 to 20
Poultry Houses	10 to 50 (depends on density)

Ideally an air exchange rate for a particular project should be established on the basis of objectives and thermodynamic analysis. The heat load in the building from all sources (i.e. radiant energy, equipment, processes and machinery, lighting etc) should be determined and calculations undertaken on the number of dilutions per hour required from external air at given temperatures to reduce internal temperatures by the required amount. The resultant cooling curve will approximate that in figure 2.4. The closer the desire is to reduce average factory temperatures to near ambient, the higher the ACH. Clearly it becomes uneconomic to keep adding additional ventilation capacity beyond a point where the marginal improvements are inconsequential.

FIGURE 2.3 Cooling curve



2.4 Achieved Performance in Buildings

The performance of Edmonds' Hurricane ventilators has been assessed using data loggers in several large projects in UAE and Oman, where temperatures during summer frequently exceed 50ºC. The performance curve in figure 2.2 below is typical of the results observed.

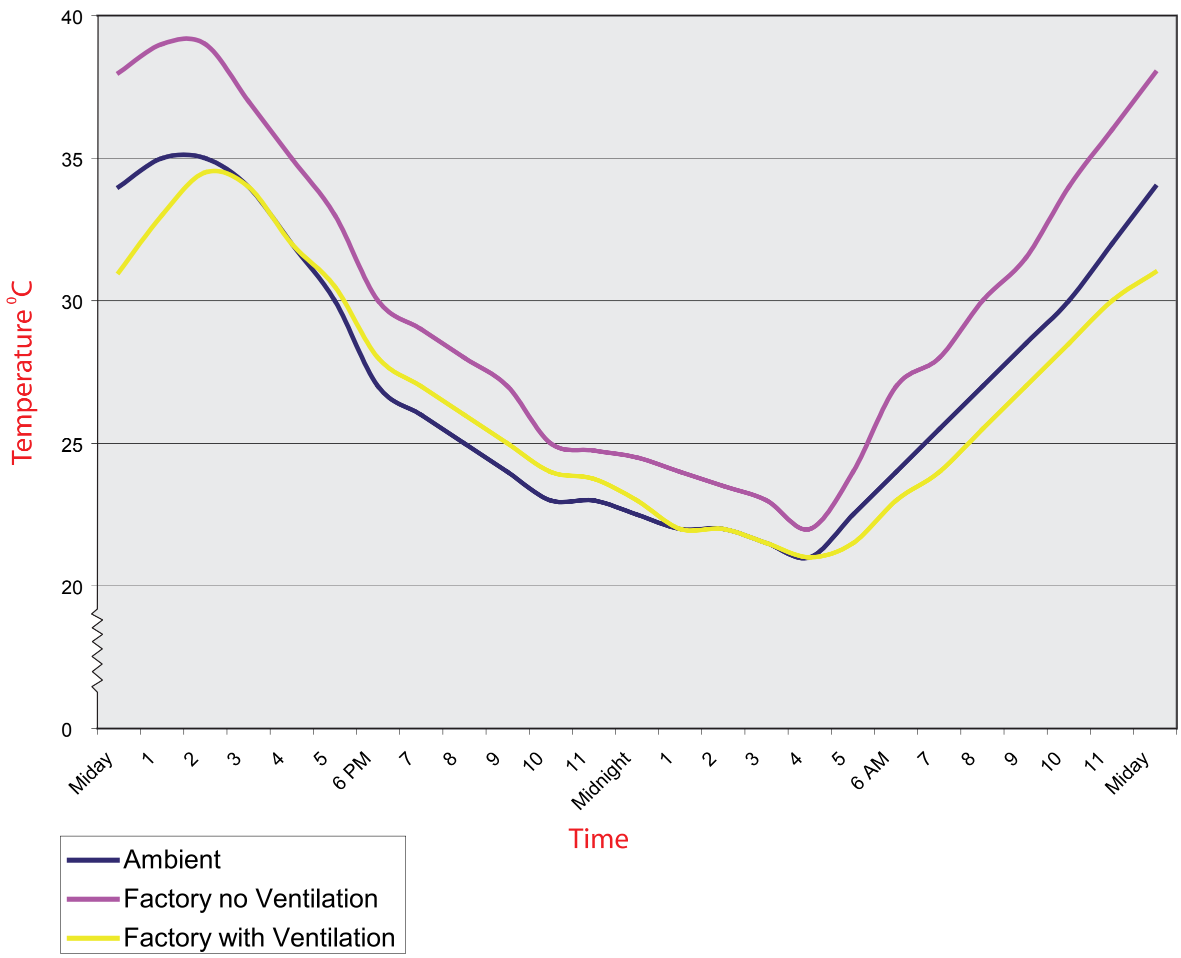
Without vents, building temperatures nearly always exceed ambient due to the accumulation of heat produced by solar radiation and operations. Towards roof height, temperatures can be 8-12ºC above ambient due to (1) accumulation of lower density hot air and (2) radiant heat transfer through roofing materials.

The purpose of a good ventilation system is to maintain temperatures close to, or at, ambient in the zone of occupation (the area 3m above floor level). In reality, it was found that temperatures of well ventilated buildings were often 2-3ºC less than ambient for most of the morning and reached ambient about 2pm. Then about 4pm, when wind speed starts to intensify and temperatures drop, internal cooling quickly follows.

Case studies of ventilated buildings that used Hurricane ventilators showed achievement of below ambient temperatures mid morning and a conclusion that a properly designed Hurricane ventilator scheme could reduce temperatures in a building on very warm days by 4-5ºC compared with a scenario of no ventilation.

In addition the Hurricane ventilators are improving general air quality by ensuring its constant exchange.

FIGURE 2.4 Temperatures inside buildings with and without ventilation

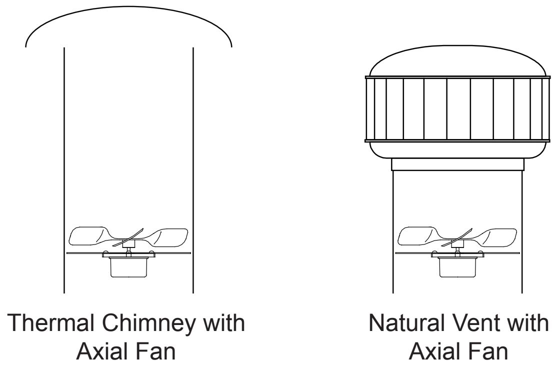


3. HYBRID VENTILATION & THE ecopower

3.1 Hybrid Ventilation

The term ‘hybrid’ or ‘mixed mode’ ventilation is used to describe ventilation systems which utilise a combination of natural and mechanical ventilation. This can be in the form of a thermal chimney or natural ventilator with axial fan fitted to it, to provide a ‘power’ boost when required (see figure 3.1).

FIGURE 3.1 Types of Hybrid Ventilation

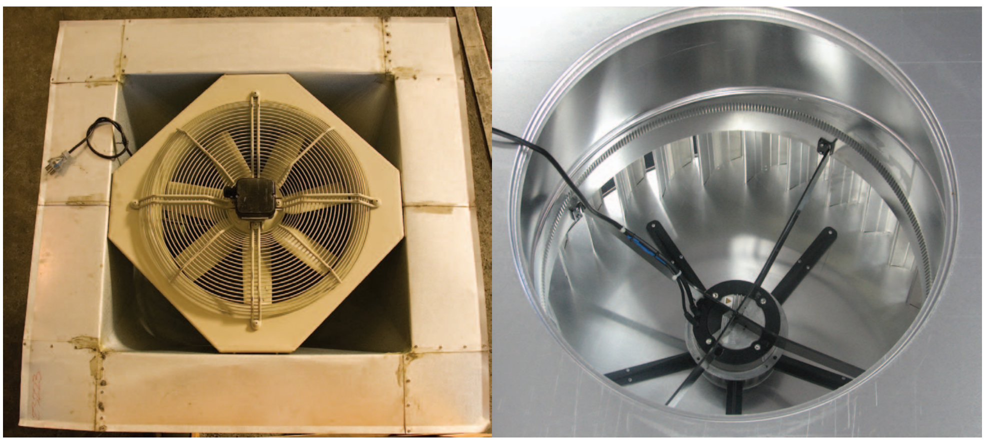


Hybrid ventilation has already been strongly embraced in building designs in Europe. It often consists of high thermal chimneys supported by an axial fan in the throat to boost flows when increased ventilation demands are required. A thermal chimney tends to operates on stack effect alone.

Traditionally, hybrid ventilation have not be embraced as strongly in Australia, as in Europe. To service the limited exisiting demand (generally from schools) some manufactures had taken the approach of fitting an axial fan to the throat of the ventilator.

The main draw back to both of these hybrid ventilation designs is that the axial fan creates a blockage in the throat of the ventilation system when not in use, thus reducing the performance of the system. An example of a blocked throat in a ventilator due to an axial fan and an open throat design is shown in figure 3.2

FIGURE 3.2 Comparing a Blocked and Opened Throat Designed Hybrid Ventilator



3.2 *ecopower*® - World First Australian Technology

Although there has been a recent increase in demand for hybrid ventilation systems, Turbine ventilation technology, with the exception of fitting axial fans to the ventilators throat, has remained relatively stable for 50 years.

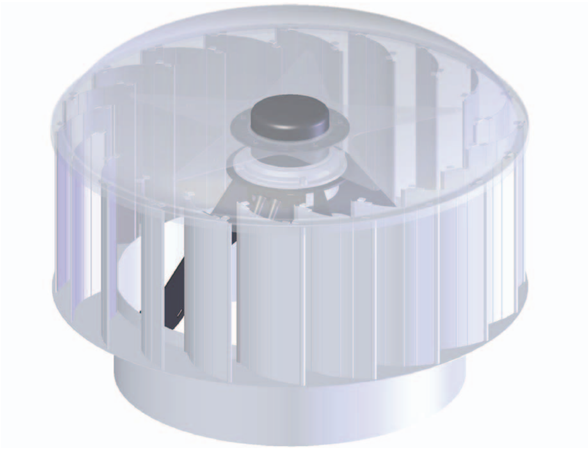
The *ecopower*® hybrid ventilator is the first fully intergrated natural / mechanical ventilator to be developed. The design is based around an open throat concept, by which the motor (to provide mechanical ventilation) is built into the head of the ventilator. Thus removing the need to block the throat of the vent with an axial fan, a result of this design is superior performance in natural mode. This makes it a true Hybrid Ventilator.

The intellectual property is held by CSR.

It has exhaust rates typically THREE times that of the equivalent size Hurricane vent: (later assessed at 12km/hr wind speed – Sydney's average). Of course this superiority increases at lower wind speeds

The Edmonds' *ecopower* is unique insofar as both modes are contained in the one product and can act simultaneously or just in wind/stack action mode alone. The *ecopower* is a standard Hurricane vent but with a very high energy efficient electronic commutating motor located high in the head of the vent. The motor is attached as a direct drive on the shaft which enables the vent to free spin in wind. Unlike previous attempts in Australia to produce Hybrid wind turbines by installing a fan blade and motor in the throat of the vent, the *ecopower* has no obstructions. This is extremely important as research using AS4740 has shown that any obstruction in the throat of a wind turbine will severely decrease vent performance under natural mode (i.e. wind and stack action).

FIGURE 3.3 The *ecopower*® Hybrid Ventilator



The special qualities of this unique technology are:

1. Optional powered ventilation on demand without reducing the performance of wind exhaust levels.
2. Extremely high levels of energy efficiency.
3. Very low levels of operational noise (<40dBA at 3m)
4. Single phase power.
5. Light weight compared with axial fans of same capacity.

The *ecopower* is presently available in five sizes – 100mm, 150mm, 400mm, 600mm and 900mm.

3.3 Applications

The *ecopower* will have uniques applications, in area of ventilation that can't be serviced by natural ventilation systems or where the more expense to install or operate mechanical ventilation systems are currently being used, these include:

3.3.1 Demand Ventilation

The *ecopower* will have a dominant use as a demand ventilator. It provides strong ventilation when required and is not dependent on the vagaries of wind. It is not a general purpose ventilator, where fluctuations in exhaust level are acceptable, therefore should not be used for general ventilation of warehouses and factories where products like the Hurricane H900 should be sufficient, UNLESS there are processes which require strong ventilation at certain times or under varying circumstances.

Typical applications may include school classrooms (where direct ducting to the ceiling is recommended), exhaust of truck fumes, which may intensify at certain times of the day, sited above various process lines where outputs can be noxious and use as a high capacity ventilation device over smaller areas which will not aesthetically handle a large Hurricane turbine ventilator (e.g. H900).

Currently, the *ecopower* is being trialled as a means of reducing heat build up in living areas of homes towards the end of a hot day. During summer, an insulated home is typically slow to heat up but gradually radiant energy enters through windows and is conducted through the building façade. Later in the day, when conditions typically cool, the inside of the home is often hotter than the external environment. An *ecopower* EP400, when ducted to a ceiling and activated by timer, or dual thermostat control, can quickly disperse the heat leaving a home up to 3ºC cooler.

The *ecopower* provides reliability/certainty for energy efficient ventilation. It is an excellent substitute for energy thirsty mechanical exhaust fans and has already found application for use on hotel ventilation shafts replacing the noisier and less economic, axial fans.

3.3.1 Stack Ventilation

An emerging market for the *ecopower* EP600 is that of stack ventilation for multi-rise buildings. A favoured design for ventilating bathrooms in multi-rise buildings particularly Hotels and Apartments is to service multiple bathrooms through a dedicated stack with an axial fan mounted to the top of the stack to provide ventilation. The axial fans although performing better against pressure drop, can have severe draw backs including very high power consumption (often 3 phase) and high noise levels. The *ecopower* EP600 can replace the axial fan offering much lower power consumption and noise levels.

In tests conducted at the Mercure Airport Hotel, Sydney Australia, the chief engineer estimates the performance on the higher floors is on par to a similar sized axial fan with an approximate 20% decrease on the lower levels. When coupled with the noise and power consumption benefits he is recommending the replacement of all axial fans on the building with *ecopower* EP600.

3.3.3 Night Purge

3.3.4 Smart Buildings

3.4 Control Features

The *ecopower* can be controlled by any measure which provides a digital signal. Examples include thermostat (temperature), humidity, wind speed, gas concentration etc. Using a relay box, two or more measures can be combined and even a fire alarm system can be used to activate or disengage. The potential exists to integrate the *ecopower* into an intelligent building management system.

In addition to power control systems, electric dampers can be fitted to the *ecopower* to close all ventilation at certain times of the year. However it is critical that dampers are opened when the vent enters power mode. The wiring scheme can ensure this occurs automatically.

3.5 Installation

Installation of an *ecopower* is identical to a normal Hurricane except that

1. Two strong fixing straps come with the product and should fix the neck to a purlin or trimmer
2. Trimmers are recommended for use with the EP 600 and EP 900 due to the large torque generated by the head which is rotating at up to 230 RPM.

4. VENTILATION STANDARDS

4.1 The Need for a Standard

Until 2000 there was no definitive measure of vent extraction performance nor performance measures for rain ingress or wind tolerance. A standard for water penetration existed – AS2428.1 and wind tolerance was often related to the so-called Darwin Deemed To Comply requirement. However there was no assessment grading for performance of vents under these standards. Likewise flow rates were being determined by each manufacturer separately since there was no scientific standard. In most cases a very old ASHRAE formula pertaining to gravity ventilators was used, with random adjustments for turbine effect. The formula considered only the neck diameter of a vent and therefore provided identical flow rates for all vents of the same diameter – clearly incorrect.

After much agitating by Edmonds, a committee was finally formed and a standard – AS4740:2000 was promulgated. To-date much of the vent industry has ignored this standard. Edmonds takes the view that the outcomes from this standard should prevail even though there are some minor deficiencies evident in the formulae. It would ensure that exhaust performance of various vents is compared on the same basis whereas at present only the imagination seems to control vent performance claims. It would also ensure that customers achieve more precise air exchange rates and hence better project results.

The full test procedure has been set-up by Edmonds at Gosford using external consultants to calibrate the test rig. This is the ONLY location in Australia which has set up permanent test facilities (as at July 2007) and therefore Edmonds is the only manufacturer, at the time of printing, in Australia, to have this data for its full range of vents.

FIGURE 4.1 Edmonds Ventilation Test Rig

4.2 Measures Arising from the Standard

In general the flow rate of a ventilator is a function of its performance measures (flow and discharge coefficients) and the environmental conditions (temperature, stack height, wind velocity). AS4740:2000 prescribes a system for measuring the following performance measures for a vent:

- **Flow coefficient:** The flow coefficient is essentially the ratio of the velocity of the air in the throat of the ventilator to the wind velocity when there is no driving pressure underneath. In effect, it is a measure of the “turbine effect” of the vent which in turn is related to aspects of design of the turbine head. The higher the flow coefficient for a given throat size the greater the “turbine effect”.
- **Discharge coefficient:** The discharge coefficient is a measure of how well a ventilator allows air to flow out, due to the driving force of the “stack effect” (i.e. low density, hot air trying to escape naturally) with no wind speed. A poor ventilator of stipulated size will have a low Cd often caused by blockages in the throat and/or a small escape area between the vanes.
- **Effective Aerodynamic Area (EAA).** The EAA of a ventilator is determined from the discharge coefficient and the throat area. It is a measure of the area of the ventilator that allows air to escape freely. A larger EAA indicates a larger capacity to exhaust air.

4.3 Determination of Vent Exhaust Rates

The procedure of the Standard enables the determination of Cd and Cf and consequently EAA for any vent tested. These determinations are used to establish

(1) the stack pressure (Ps), and

(2) wind siphoning pressure (Pw).

The final flow rate is then determined by the measure-

$$Q = \frac{F \sqrt{(2 (Pw + Ps)}}{\sigma}$$

where Q = Combined volume flow rate, m^3/s

F = EAA

σ = density of air

at 6ºC and ΔT = 14º kelvin.

Applying AS4740:2000, Edmonds determined the following flow rates for its Hurricane Ventilator range at wind speed of 3m/s and stack pressure of 3.37 pascals (6m equivalent).

TABLE 4.1 Hurricane ventilator flow rates

Size (mm)	Exhaust rate m^3/hr
300	404
400	693
450	959
500	1117
600	1153
700	1673
800	2601
900	2856

It cannot be claimed that exhaust rates determined under AS4740 are replicated precisely in practice. In reality, flow rates are likely to be higher. The Standard uses a large fan to simulate wind impact. Obviously this cannot reproduce exactly the amount of wind on an installed ventilator. However, the standard does allow for (1) meaningful comparison between different ventilators and (2) a precise mechanism for determining ventilation schemes for projects. There is presently no valid procedure for measuring the actual performance of a roof vent operating on a building. AS4740 is currently the best approximation.

4.4 Importance of Vent Size

Air exchange rates of at least five times per hour (5ACH) within the zone of occupation* are required to make a noticeable difference to a large building environment. For most projects this means the need to use large vent sizes, i.e. 700-900mm diameter. Research undertaken by Edmonds and its distributor in the Middle East using temperature data logging has shown that large diameter vents clearly outperform smaller units and provide excellent results (and value for money) for customers.

Sometimes customers seek a token expression of ventilation – for example, 'just fit a few Whirlybirds on the roof'. There are many examples around the globe of factories with a few small residential vents and even some, like the Proton car factory in Kuala Lumpur, have over 500 x Whirlybird 360mm units. The result has been a lot of disappointed customers and bad reports about the value of wind ventilators. It is misplaced criticism. Simply the exhaust capacity provided has been clearly insufficient.

* zone of occupation is the region normally from the ground to 3m above the ground.

The performance of any vent within a brand (e.g. Hurricane) increases approximately in proportion to the square of the diameter of the vent such that:

5 x Hurricane 400mm = 1 x Hurricane 900mm

2.25 x Hurricane 600mm = 1 x Hurricane 900mm

On the pure basis of cost of product, it is therefore normally more cost effective to use the larger vent size. However, this cost difference is further amplified by (1) cost of installation for each vent – the less the number the lower the cost (2) a greater probability for leakage associated with installation of a larger number of vents.

The only justification for using smaller vent diameters would be the need to provide a greater distribution of vent exhaust capability. In reality, however, this is rarely justifiable from an effectiveness viewpoint.

As a <u>general rule</u>, where the volume of air in a building exceeds 2,500m^3, the Hurricane 900mm ventilator should be the preferred size.

5. VENTILATION APPLICATIONS AND SCHEME DESIGN

5.1 Introduction

The major applications for Hurricane vents have been:

- **Reduce general heat levels in workplaces:** By utilising thermal storage and air exchange, a well designed turbine vent scheme can reduce mid-day temperatures in a factory by 4-5ºC on a 35ºC day (compared to a situation without vents). This result is caused by the effectiveness of vents overnight in helping to purge heat from the factory, drop the evening temperature in the factory and facilitate the storage of cooler air. Hot, early morning air is partially neutralised by the stored cold thereby helping internal temperatures to remain below ambient for most of the day.
- **Reduce concentration of pungent odours or noxious gases in workplace environment:** By facilitating air exchange, the concentration of pungent odours or impurities in the workplace environment is gradually diluted. This provides an improved workplace environment for employees.
- **Remove heat from specific machinery:** Often the conditions in a process environment are influenced by heat liberated by an oven or furnace. A battery of turbine vents above the heat generating equipment can help to quickly dissipate this heat and prevent its dispersal throughout the factory.
- **Cool electrical/control equipment:** Wind ventilators have been used above electricity transformers in sub stations to replace warm process air with cooler external air. The reduction in temperature improves the capacity of the transformer and hence the entire local electricity network. Similarly Rail authorities have used wind turbines to reduce temperatures in signal control boxes caused by heat generated by electronic components. This improves the reliability of the electronics and therefore the train network.
- **Reduce condensation:** Condensation is a major issue beneath metal or foil surfaces. For metal storage reservoirs, condensation beneath the metal roofs leads directly to oxidation of the metal and hence early replacement. Similarly condensation can occur below foil used under metal deck roofs. This is a huge concern in warehouses storing food products/electronic products/paper etc. Turbine vents, by facilitating air exchange, reduce humidity levels and decrease condensation rates.
- **Remove methane from sewerage systems/rubbish pits:** Special turbine vents (S2 type) have been used on 'stink pipes' owned by sewerage authorities to help reduce methane concentrations in pipes (which can reach explosive concentrations). An iduct vent can provide fresh air inlets. Similarly turbine vents can be used to extract methane from rubbish pits to avoid explosive concentrations being accumulated.
- **Maintaining a fresh air environment in warehouses:** The air in highly fortified warehouses can become musty and stale thereby affecting the smell and life span of some stored products. Turbine vents, in combination with some sort of fresh air intake system, can improve air quality.
- **Remove odours from composting or chemical toilet systems:** Specialised Hurricane S2 ventilators are used to remove odours from chemical or compost toilet systems. Hurricane S2 vents are a common sight in National Parks in NSW and Queensland.

5.2 Developing a Scheme

Every industrial/commercial ventilation project is different. There are several steps that need to be completed to ensure the scheme is correct; these are outlined in this section.

5.2.1 Visit to Site

When asked to quote a supply and installation project, the first stage is normally the factory visit (although occasionally, for new premises, plans will be provided). At the factory visit the following information needs to be gathered:

- The layout of the plant with all relevant dimensions to enable calculation of free air volume.
- Layout of underside of roof if possible showing beams and purlins and indicating purlin spacings.
- Any indication of type of roof profile i.e. trimdek, colorbond, spandek, etc. is best observed where there are fibreglass skylights. Special note if asbestos apparent or possible, seek specialist advice.
- Draw the factory floor showing where particular activities occur including main labour points, heat generating equipment, noxious gas liberation (ie welding fumes). Is there a mezzanine and what activities occur on that level? Indication of all main doors, windows and louvres. What remains open while the factory is in operation? What make up air capacity is there when factory is closed?
- Hours of operation of factory.
- Is there any ventilation capacity already installed on the roof? For example, ridge vents, mechanical units even if not functioning.
- Geographic direction of factory. Direction of main summer breezes in relation to doors etc (indicates passive pressurisation).
- The objective of the client – is it cooling, removal of dust, removal of gas vapours etc.
- Access to roof. The installer and the vents need to get to the roof. Is there easy access? If over 6m a scissors lift will be needed and will also be required for H700-900 if a reasonable number even at lower heights. If purlins span greater than 1800mm then trimmers will be required. Is there capacity for internal lifts or does machinery preclude?
- Observe if roof slope could be potentially less than 6ºC (i.e. EX Base)

5.2.2 Use of Algorithm

Edmonds has developed a unique algorithm to determine the number of vents required to produce a decent outcome for each application. The algorithm is based on testing of all Hurricane vents to AS4740:2000. Their flow and discharge coefficients have been established and stored in the algorithm. This information is proprietary to Edmonds and is strategically sensitive information. The Edmonds' algorithm does not apply to competitor's products as their coefficients are dissimilar (and generally quite inferior) to Edmonds.

A copy of an algorithm result sheet appears on the next page. It is based on 'air exchange rates' and 'zone method'. The flow and discharge coefficients are not shown. Edmonds uses ASHRAE recommendations as a basis but overlays its own experiences with the Hurricane vent.

The other variables required are temperature differential and average wind speed. The latter is based on meteorologic data and the former on observations gathered from thermal laser measures.
The principal method used for establishing the required number of vents to achieve the task is referred to as the ZONE METHOD. The ‘zone of occupation’ refers to the air zone 0-3m from ground. The ‘zone of occupation’ is where workers are performing their function. As warm air rises and is extracted by vents, colder air will enter at ground level. The ventilation scheme aims to achieve satisfactory air exchange within the ‘zone of occupation’. The BUILDING method can be used where work is performed at varying levels, such as a mezzanine floor.

Edmonds is prepared to develop a proprietary ventilation scheme for any building on the basis of using Hurricane vents and the scheme can be denoted as developed under AS4740. This gives substantiation to the scheme and provides a Roofer with confidence that his quote was developed using performance figures established under an Australian standard and relevant to the project at hand (i.e. wind speed, temperature differential and ACH). It also provides a process which is fully auditable by a consulting engineer or architect.

Figure 5.1 Ventilation Algorithm

EDMONDS
Technologies for a Sustainable Future

AS4740 Ventilation Formula

Enter Data in Red boxes...

Building Data

Building Height	9	(m) - average
Building Length	40	(m) - average
Building Width	20	(m) - average
Building Volume	7200	(m3)

Environment Data

Wind Speed	11	(km/hr)
Temp Difference	8	(deg C)

Recommended Temp difference is between 5 to 12 deg C

Ventilation Scheme - Please select ventilator from drop-down menu

Natural

Hurricane	900	
ACH Method	Zone	Method
ACH Required	8	
Flow Coefficient (Cf)		
Discharge Coefficient (Cd)		
Flow Rate (each)	2846	(m3/hr)
Flow Rate (total)	19920	(m3/hr)

*** To find flow rate in L/s, divide m3/hr by 3.6*

Powered

EcoPower	600	
ACH Method	Zone	Method
ACH Required	8	
Power (each)	88	(W)
Power (total)	440	(W)
Flow Rate (each)	3940	(m3/hr)
Flow Rate (total)	19700	(m3/hr)
Hours "on" per day	12	
Annual Running Cost approx	$ 229	

Number of Ventilators to achieve desired ACH

Ventilators required 7

Ventilators required 5

Summary

The natural scheme you have chosen is
7 x Hurricane 900
This will result in approximately
8 Zone ACH

The powered scheme you have chosen is
5 x EcoPower 600
This will result in approximately
8 Zone ACH

Annual cost will be approximately **$ 229**
for use 12 hours per day

Notes
The Zone of Occupation is the volume of air up to 3m from the ground.
These figures are based on extensive test results by CSR Edmonds and calculations made from AS 4740:2000. The testing is in accordance with this Standard. Practical results may vary however due to building, construction, environmental and installation considerations.

CSR

5.3 The Importance Of Adequate Make Up Air

5.3.1 General

Wind ventilators have a weak capacity to pull against pressure. At -2 pascals they will not operate. Therefore it is critical to the performance of wind ventilators that an adequate capacity be provided in all buildings for the easy entry of make-up air i.e. that fresh air required to replace the stale air exhausted by the vent.

In general, make-up air is be provided by open doors, windows and louvres. Edmonds recommends that the free area of the openings equal 1.5 times the free area of the ventilators. When using louvres, the free area will be determined by the equation

Free area of louvre = Discharge coefficient x total area of louvre.

As a general rule, the discharge coefficient of a louvre can be taken as 30%.

It is also important to consider the situation at night, when night flushing is required but a factory may be closed. If doors and windows are closed for security reasons, the adequacy of night flush capacity can be compromised. And, in worse cases, during heavy storms involving gale force winds, one or more vents may become air supply sources for the remaining vents. The result, in this rare scenario, is night leakage. Edmonds therefore strongly advocates the installation of good louvre capacity with vents.

5.3.2 The need for building pressurisation

Occasionally a project will involve a building where supply of make-up air to the building or important parts thereof cannot be achieved through external openings. This may be due to security concerns, restrictions with the location of the building (e.g. abuts other buildings, or cliffs) or concerns about entry of dust (e.g. a food factory). In these cases it will be necessary to pressurise the building by locating input fans on the roof with large supply capacity. Often a duct is used on the underside to deliver the cool air closer to ground level.

Edmonds has used this concept of Pressurised Ventilation (PV) on four projects in Sydney and one project in Fiji, with very good outcomes. Further details are available from Edmonds technical centre on 1300 858 674.

6. EDMONDS' INDUSTRIAL PRODUCTS

6.1 Introduction

The Edmonds Industrial product range currently consists of the following:

Ventilators:

- Standard Hurricane vents: H100, H150, H300, H400, H450, H500, H600, H700, H800 and H900. Available in Mill and powder coated finish
- Specialised Hurricane vents: Hurricane S2, Hurricane H900FR and Hurricane H900HI (polyolefin coatings also available)
- *ecopower*®: EP100, EP150, EP400, EP600, and EP900
- Static vents: sizes 400mm, 500mm and 700mm

Ventilator Accessories:

- Dampers – both electric and manual
- Special bases - spigot, square to round and EX

Other Accessories:

- EC Damper Grilles - 400 x 400 and 600 x 600
- EC Grilles (wide range)
- Louvres - aluminium (in future)

6.1.1 Product Lead Times

Edmonds endeavours to maintain all standard Hurricane vent sizes and *ecopower* hybrid vent product in stock in Mill finish but occasional stock-outs may occur for a few days in the peak of summer.

No coloured stock is maintained but rather is produced on receipt of order. Once coloured product is produced Edmonds will not accept cancellation of an order or return of product. Lead times are approx 10-15 working days from receipt of order.

Similarly no special or EX bases are maintained in stock as each requires knowledge of a roof angle. Lead times are approx 10-14 days from receipt of order.

Dampers (both electric and manual) and Static vents are made to order only. Lead times are approx 10-14 days from receipt of order.

Limited stock of both EC grilles and EC Damper grilles is maintained.

6.2 Standard Hurricane™ Ventilators

A standard Hurricane as described in section 1 is supplied with:

- A Head (Turbine)
- A Varipitch (Neck)
- A Flashing (Base plate)

All in Mill finish

If the ventilator is required to match a roof colour then the unit can be powder coated by Edmonds. It is generally not feasible to powder coat a ventilator after it has been assembled owing to the effect of baking temperature on bearing grease and polymer components.

6.2.1 Powder Coating

The standard powder coating of a Hurricane allows the unit to be matched in colour to the popular Bluescope colour range. Not only will this match the colour of the roof but it offers some additional protection to the aluminium surfaces of the ventilator.

If additional protection for the ventilator is required then the unit can be powder coated inside and out. This may be necessary if the unit is being used near chemicals. For further information please see section 4.3.

Where a ventilator is expected to be subjected to harsh chemical vapours, it is recommended that a polyolefin finish be used on both internal and external surfaces. Polyolefin is a thermoplastic coating powder only available in white colour. It is based on an alloy of acid modified polyolefin. It is typically used on fence posts, white goods, battery boxes, sign posts etc.

6.3 Specialised Hurricane™ Ventilators

This section covers the various niche market Hurricane vent types.

The most common specialised Hurricane vent sold in Australia is the Hurricane S2, which is used with water storage reservoirs to reduce condensation, and by National Parks as a toilet exhaust vent.

In future years we anticipate a rise in the use of the H900FR which is designed to be used for both continuous ventilation and as a smoke release vent. At present, smoke release vents tend to be fixed items that only commence to ventilate when smoke is emanating from a fire. These units consist of a roof hatch controlled by pneumatic arms. A fusible link controls the arms. When smoke is produced the link breaks allowing the arms to push open. These items are very expensive and only operate when a fire occurs. They are simply an insurance policy to avoid loss of life due to smoke inhalation. They also have a lead time before activation. The level of smoke concentration must reach a critical level before the link fuses.

On the other hand, the Hurricane 900FR allows constant ventilation and immediate smoke release. Its cost is less than 50% that of a traditional smoke release vent. The Hurricane 900FR uses special thermal plastics for its long arms and bearing holder so that it can withstand high temperatures for times, established under AS1668.1-1998.

Another specialised Hurricane ventilator is the H900HI which is designed to be used to ventilate areas within very harsh chemical environments.

6.3.1 Hurricane™ S2 Ventilator

Applications:

The Hurricane S2 ventilator is specially designed to ventilate environments that are subject to harsh, oxidative or slightly acidic conditions (not caustic). These include:

- Exhaust of pit gases, methane, sulphur dioxide etc
- Minimisation of condensation under metal roofs on water storage reservoirs
- Exhaust of chlorine fumes in pool complexes
- Ventilation of very gritty environments, where it is possible that airbourne particles may clog an exposed bottom bearing
- Removal of odours from pit and composting toilet systems

It's most successful application has been for reduction of condensation on the underside of metal roofs over water reservoirs, thus greatly prolonging the life of the metal.

FIGURE 6.1 Installation over water storage

Unique Features:

- The Hurricane S2 ventilator is currently manufactured in sizes H100, H150, H300, H400, H450, H500 and H600
- No bottom bearing
- The top bearing is fully enclosed inside the dome and protected by use of a deflector cone
- The ventilator is powder coated inside and out to provide additional protection to the marine grade aluminium construction
- All brackets are Aluminium 6060 T591, with the fasteners being stainless steel
- The Hurricane S2 is also available in a white polyolefin coating for extremely harsh conditions

The absence of a bottom bearing, the isolation in the head of the critical top bearing, the protection of all exposed aluminium parts by powder coat enables the Hurricane S2 ventilator to withstand conditions where traditional wind ventilators fail after short periods of time.

Technical Data

FIGURE 6.2 Hurricane S2

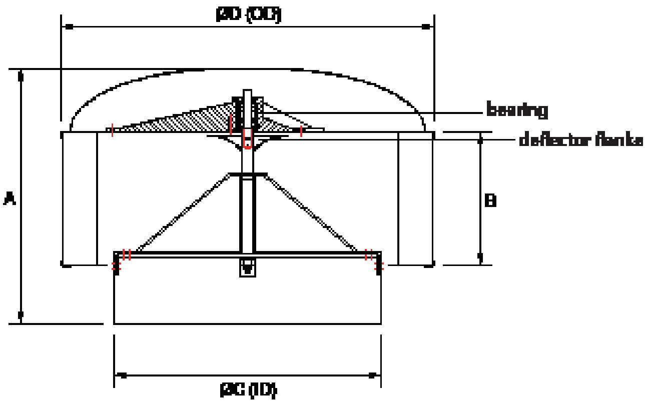


TABLE 4.1 Hurricane S2 Dimensions

MODEL	A (mm)	B (mm)	∅C (mm)	∅D (mm)	Weight (kg)
H100	253	100	107	290	1.4
H150	283	125	155	332	2.0
H300	384	175	308	477	3.8
H400	389	205	410	561	4.6
H450	443	230	462	648	6.3
H500	**459**	**265**	**511**	**702**	**7.0**
H600	**484**	**275**	**602**	**766**	**8.1**

Specifications:

Material: Turbine & throat: Aluminium 5005 H34
Shaft: Aluminium 2011 T3
Dome & skirt: Aluminium 1200 H0
Deflector (Main Bearing shield): Aluminium 1200 H0
Brackets: Aluminium 6060 T591
Fasteners: Stainless Steel

Rotation Bearings: Main bearing: Double row ball bearing, Carbon Steel single shield

Finish: Powder coated on inside and outside surfaces

Wind Speed Rating: 205.2km/h (57m/s) – Performance level 1 (As per AS 4740:2000 Natural ventilators-Classification and performance)

Warranty:

The standard warranty for a Hurricane S2 ventilator is 5 years. This is considerably less than the 15 year warranty for the normal Hurricane ventilator as it is based on the enormous range of applications applied to the S2 ventilator. For a specific project, where Edmonds is fully conversant with the environment and the associated risks, a tailored warranty will be considered.

Cost:

The standard cost of a Hurricane S2 ventilator is roughly about 50% greater than the standard colour coated Hurricane vent due to (1) incorporation of the bearing shield (2) powder coating of all internal and external vent surfaces (3) use of stainless steel fasteners.

6.3.2 Hurricane H900FR Ventilator

Applications:

The Hurricane H900FR ventilator has been designed to provide factories and warehouses with both continuous ventilation (to improve comfort levels for building occupants) and smoke release capability (in the event of a fire).

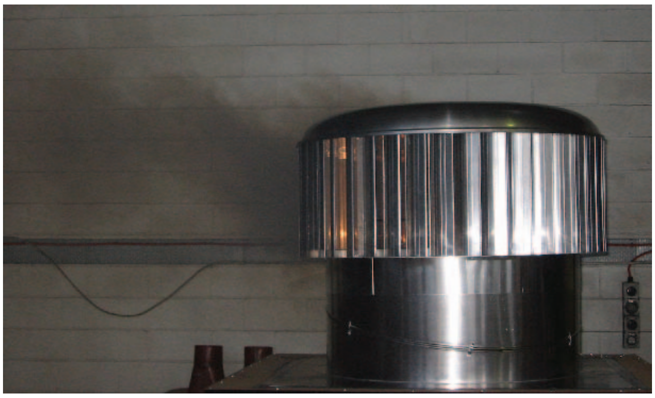
Traditionally, when a building requires smoke release ventilators to be installed. the choice of ventilator type has been limited to only one: a pneumatically released ventilator. While these products provide efficient smoke release they suffer from the following deficiencies:

- Expensive
- Only provide a benefit if there is a fire
- Most operate using a fusible link mechanism which when activated by smoke detection or heat will break and thereby enable the hatch to open
- There needs to be a reasonable amount of heat/smoke build-up before the hatch opens. This delay can be hazardous to employees

In comparison, the Hurricane FR –

- Offers both constant ventilation and smoke release capacity which will be boosted by the buoyancy effect of rising hot air
- Reacts immediately to smoke emission
- Does not compromise ESFR (Early Suppression Fast Response) sprinkler systems. The exhaust velocity through the vents is not sufficient to activate automatic sprinkler systems. Complies with FM Global Property Loss prevention Data Sheet 2.2.6 (Sept 2001)

FIGURE 6.3 Hurricane H900 FR during testing



Unique Features:

The Hurricane H900FR ventilator is available in one size only – 900mm.

It differs from the standard Hurricane H900 through the use of a special thermal plastic for the bearing holder and long arms. This material is glass reinforced polyphenylene sulphide. Bearings contain special greases formulated to Edmonds' specification, while the shaft is specially machined to cater for metal expansion.

As a result the Hurricane H900FR ventilator will operate for at least 120 minutes at 200°C and for 30 mins at 300°C as required by Australian Standard 1668.1-1998 Section 4.8.1. In fact, during testing performed by CSIRO, the Hurricane H900FR ventilator operated successfully at over 400°C for an additional hour.

Technical Data:

FIGURE 6.4 Hurricane H900FR ventilator

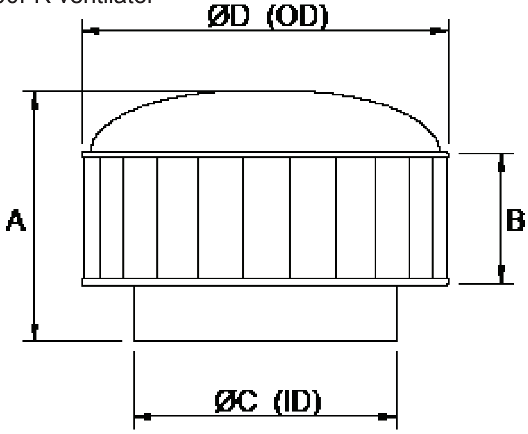


TABLE 4.3.2 Hurricane H900FR Dimensions

MODEL	A (mm)	B (mm)	∅C (mm)	∅D (mm)	Throat Area (m^2)	Weight (kg)
H900FR	643	400	897	1096	0.6319	18.3

Tolerances: Size +/- 2mm Weight +/- 0.1kg

Specifications:

Material:
Turbine & throat: Aluminium 5005 H34
Dome & skirt: Aluminium 1200 0
Brackets: Aluminium 6060 T591
Spider: Zinc passivate plated mild steel
Shaft: 303 Stainless Steel
Main bearing holder assembly: Glass Reinforced Polyphenylene Sulphide (PPS)

Rotation Bearings:
Main bearing: Double row ball bearing, Carbon Steel Single Shield
Spider bearing: Single row ball bearing

Wind Speed Rating:
205.2km/h (57m/s) – Performance level 1
(As per AS 4740:2000 Natural ventilators-Classification and performance)

Fire Rating:
Ability to operate for 120 minutes at 200^{0}C
Ability to operate for 30 minutes at 300^{0}C
Ability to operate for 60 minutes at over 400^{0}C

(As per AS 1668.1-1998 Section 4.8.1 The use of ventilation and airconditioning in buildings, Part 1: Fire and smoke control in multi-compartment buildings)

Warranty:

The standard Hurricane 15 year warranty applies unless vent is subject to fire conditions. After any exposure to prolonged heat, the life of a bearing will likely be reduced due to changes in grease chemistry.

Cost:

The standard cost of a Hurricane H900FR ventilator is roughly about 10% greater than the standard Hurricane H900 vent due to the additional cost associated with the use of thermo plastics, bearings and shaft.

6.3.3 Hurricane BFR Ventilator

Applications:

The Hurricane H900FR ventilator has been designed to provide factories and warehouses with both continuous ventilation (to improve comfort levels for building occupants) and smoke release capability (in the event of a fire).

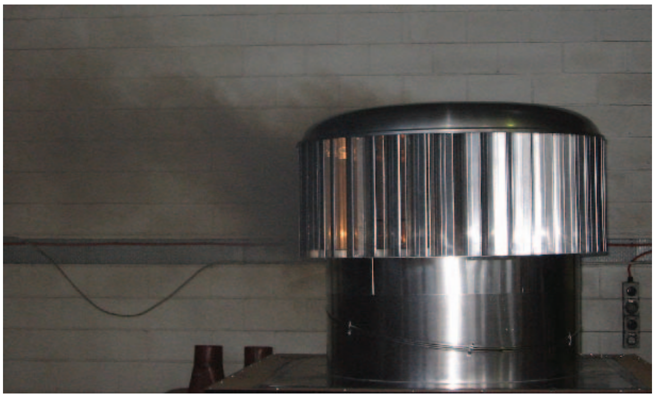
Traditionally, when a building requires smoke release ventilators to be installed. the choice of ventilator type has been limited to only one: a pneumatically released ventilator. While these products provide efficient smoke release they suffer from the following deficiencies:

- Expensive
- Only provide a benefit if there is a fire
- Most operate using a fusible link mechanism which when activated by smoke detection or heat will break and thereby enable the hatch to open
- There needs to be a reasonable amount of heat/smoke build-up before the hatch opens. This delay can be hazardous to employees

In comparison, the Hurricane FR –

- Offers both constant ventilation and smoke release capacity which will be boosted by the buoyancy effect of rising hot air
- Reacts immediately to smoke emission
- Does not compromise ESFR (Early Suppression Fast Response) sprinkler systems. The exhaust velocity through the vents is not sufficient to activate automatic sprinkler systems. Complies with FM Global Property Loss prevention Data Sheet 2.2.6 (Sept 2001)

FIGURE 6.3 Hurricane H900 FR during testing



Unique Features:

The Hurricane H900FR ventilator is available in one size only – 900mm.

It differs from the standard Hurricane H900 through the use of a special thermal plastic for the bearing holder and long arms. This material is glass reinforced polyphenylene sulphide. Bearings contain special greases formulated to Edmonds’ specification, while the shaft is specially machined to cater for metal expansion.

As a result the Hurricane H900FR ventilator will operate for at least 120 minutes at 200°C and for 30 mins at 300°C as required by Australian Standard 1668.1-1998 Section 4.8.1. In fact, during testing performed by CSIRO, the Hurricane H900FR ventilator operated successfully at over 400°C for an additional hour.

Technical Data:

FIGURE 6.4 Hurricane H900FR ventilator

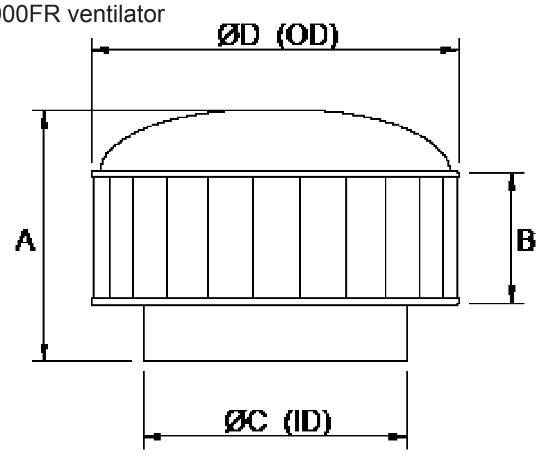


TABLE 4.3.2 Hurricane H900FR Dimensions

MODEL	A (mm)	B (mm)	∅C (mm)	∅D (mm)	Throat Area (m^2)	Weight (kg)
H900FR	643	400	897	1096	0.6319	18.3

Tolerances: Size +/- 2mm Weight +/- 0.1kg

Specifications:

Material:

Turbine & throat: Aluminium 5005 H34
Dome & skirt: Aluminium 1200 0
Brackets: Aluminium 6060 T591
Spider: Zinc passivate plated mild steel
Shaft: 303 Stainless Steel
Main bearing holder assembly: Glass Reinforced Polyphenylene Sulphide (PPS)

Rotation Bearings:

Main bearing: Double row ball bearing, Carbon Steel Single Shield
Spider bearing: Single row ball bearing

Wind Speed Rating:

205.2km/h (57m/s) – Performance level 1
(As per AS 4740:2000 Natural ventilators-Classification and performance)

Fire Rating:

Ability to operate for 120 minutes at 200^{0}C
Ability to operate for 30 minutes at 300^{0}C
Ability to operate for 60 minutes at over 400^{0}C

(As per AS 1668.1-1998 Section 4.8.1 The use of ventilation and airconditioning in buildings, Part 1: Fire and smoke control in multi-compartment buildings)

Warranty:

The standard Hurricane 15 year warranty applies unless vent is subject to fire conditions. After any exposure to prolonged heat, the life of a bearing will likely be reduced due to changes in grease chemistry.

Cost:

The standard cost of a Hurricane H900FR ventilator is roughly about 10% greater than the standard Hurricane H900 vent due to the additional cost associated with the use of thermo plastics, bearings and shaft.

6.3.4 Hurricane™ H900HI Ventilator

Applications:

The Hurricane H900 HI ventilator is used in large factory applications where the environmental conditions are considered potentially harmful to steel. The normal steel spider assembly has been replaced by a stainless steel unit while the normal bottom bearing has been substituted by a stainless steel double shield. The extra shielding on the bottom bearing is also appropriate where the factory process may produce a considerable quantity of fine, airbourne dust. Some specific applications include:

- Ceramic plants
- Fertiliser plants
- Sulphuric acid plants
- Processes where fumes have pH <7 and >4

FIGURE 6.5 Installation of Hurricane H900HI Ventilators

Unique Features:

The Hurricane H900HI ventilator is available in one size only – 900mm.

It differs from the standard Hurricane H900 through use of a stainless steel spider assembly, main bearing deflector flange, and a stainless steel double shield bottom bearing. It can be powder coated in the polyolefin finish to protect the aluminium against aggressively reactive agents.

Technical Data:

FIGURE 6.6 Hurricane H900HI ventilator

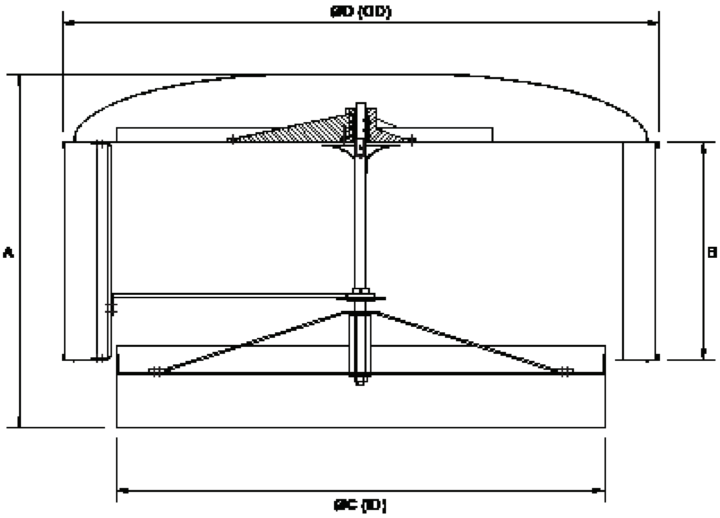


TABLE 4.3 Hurricane H900HI Dimensions

MODEL	A (mm)	B (mm)	∅C (mm)	∅D (mm)	Throat Area (m²)	Weight (kg)
H900HI	643	400	897	1096	0.6319	18.3

Tolerances: Size +/- 2mm Weight +/- 0.1kg

Specifications:

Material:
Turbine & throat: Aluminium 5005 H34
Shaft: 303 Stainless Steel
Dome & skirt: Aluminium 1200 0
Deflector (Main Bearing shield): Aluminium 1200 0
Brackets: Aluminium 6060 T591
Spider: 304 Stainless Steel

Rotation Bearings:
Main bearing: Double row ball bearing, Carbon Steel single shield
Spider bearing: Single row ball bearing, Stainless Steel double shield

Wind Speed Rating:
205.2km/h (57m/s) – Performance level 1
(As per AS 4740:2000 Natural ventilators-Classification and performance)

Warranty:

Provided the Hurricane H900 HI ventilator application is considered suitable by Edmonds, the Hurricane H900 HI ventilator can be warranted for 15 years. In some cases, Edmonds will require a special polyolefin powder coat protection on the aluminium for the 15 year warranty to apply. These precautions must be taken because of the wide range of possible applications and varying OH&S requirements around the globe.

Cost:

The standard cost of a Hurricane H900HI ventilator is about 50% greater than the standard Hurricane H900 vent, later due to the large cost increase for the bottom bearing, use of stainless steel spider and attachment of main deflector flange for top bearing.

6.6 Ventilator Accessories

6.6.1 Dampers

In various applications, and in colder climates, customers often require the capacity to close industrial ventilators during colder periods of the year. Dampers are used for this purpose. They constrict the supply of make-up air through the throat. This in turn causes a large pressure drop and a corresponding large decrease in flow rate.

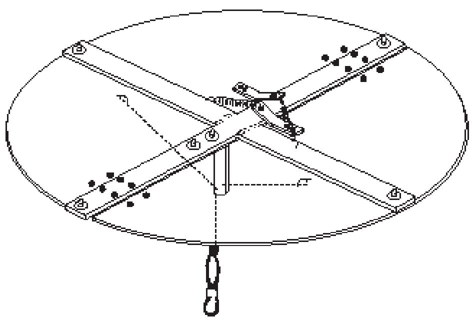
Edmonds manufactures two types of damper systems:

1. Manual / Chord operation or
2. Electric / Remote

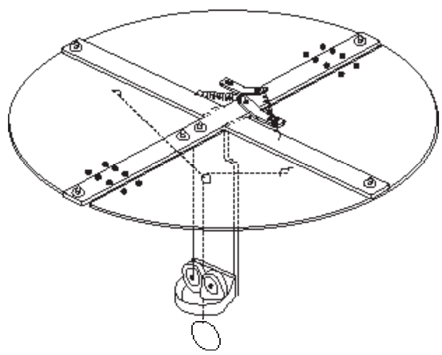
6.6.1.1 Manual Dampers

The manual / chord operated damper (type 1 and 2) is a butterfly design damper that opens and closes by tensioning a chord. For standard varipitch bases, the damper fits into the hole in the flashing and opens downwards. However, in cases where there is no capacity for the damper to open downwards due to obstructions, the damper must be fitted into a special base (see figure 4.10).

FIGURE 6.7 Type 1



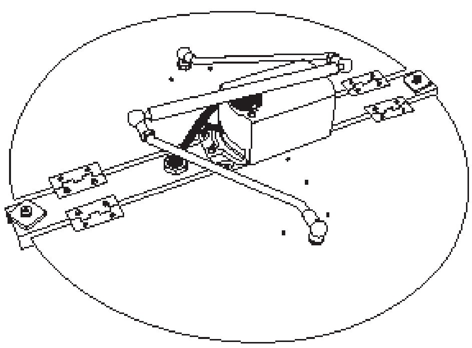
Type 2



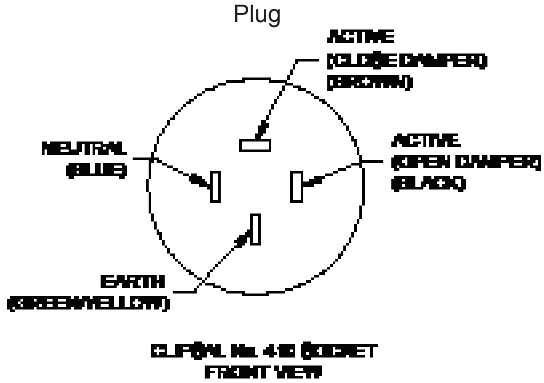
6.6.1.2 Electric Dampers

The electric damper (type 5) is a butterfly design damper that uses a high torque Siemens motor to control the open and close mechanism. For standard varipitch bases, the damper fits into the hole in the flashing and opens downwards. Again, if there are obstructions below the vent, the damper must be fitted higher in the throat and a special base must be used. (See figure 4.8) The cost of the electric damper can be high relative to the vent cost due to expensive nature of the high torque German motor

FIGURE 6.8 Type 5

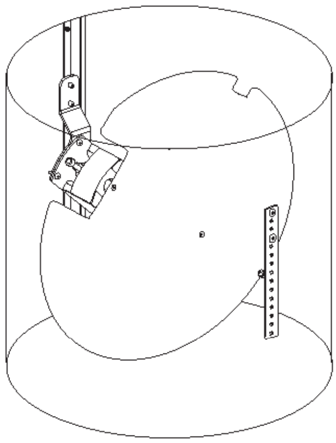


Plug



The electric damper (type 6) is a relatively new addition to the product range. The damper has been designed to have a lower cost than the type 5 damper. It uses a Siemens motor and disk operation to open and close rather that a butterfly design. However it can only be used with the Hurricane H300, H400, H450 and H500 and *ecopower* EP400, and **must** be supplied in a special base.

FIGURE 6.9 Type 6



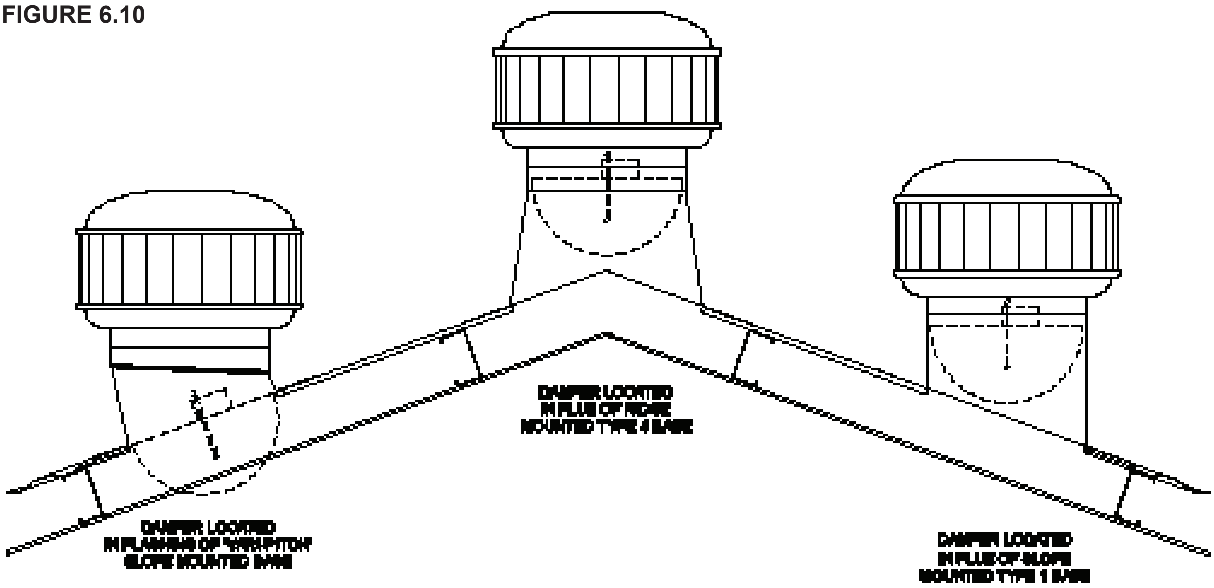
Note

Dampers never fit precisely. There is always a gap of about 1 cm around the disc because

1. ventilator necks/special bases can be bent during installation
2. if a partial vacuum was formed in the neck there is a real risk of water entry

A small flow is advisable.

FIGURE 6.10



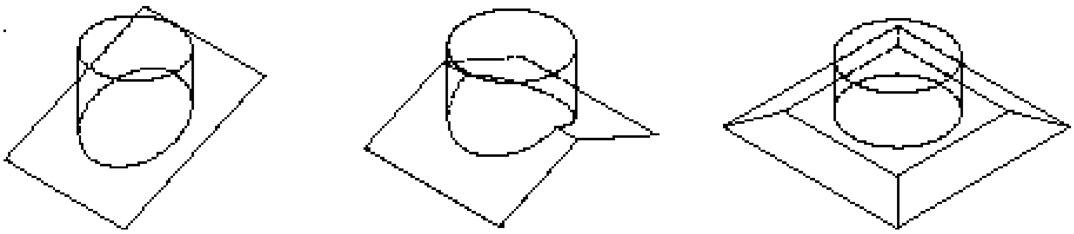
6.6.2 Special Bases

For the installation of ventilators where the roof pitch is greater than the adjustment provided by a standard varipitch or where additional clearance is needed (eg. inclusion of a damper), custom special bases can be used. Edmonds has 3 primary types of special bases: Spigot bases, Square to Round bases and EX bases. All bases are made to order and the exact pitch of the roof is required to produce the correct base angle.

6.6.2.1 Spigot Bases

Are used where roof slopes exceed the varipitch maximum adjustment angle, where it is necessary to raise the vent head (to avoid wind shadows) or in cases where an electric damper must be installed in the throat of the vent and not on the base plate (flashing). They are commonly used on old saw tooth roofs of characteristic steep pitch.

Figure 6.11 Spigot Bases: Types 1, 2 and 7.



Type 1 Spigot slope base

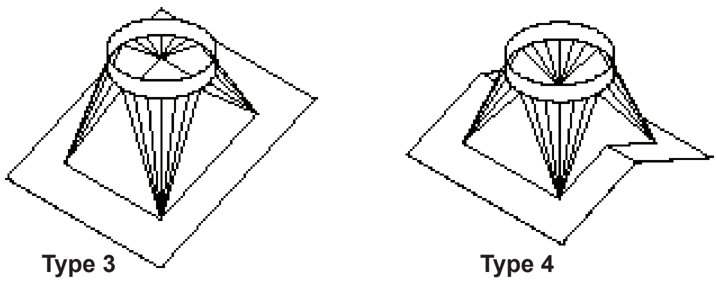
Type 2 Spigot ridge base

Type 7 Spigot pyramid base

6.6.2.2 Square to Round Bases

Are commonly used in the industry where galvanised vent heads are selected. The weight of a galvanised vent head typically requires the extra support of this base type. Aluminium vent heads like Hurricane, with a much lower weight, do not require square to round bases, and provide a significant cost saving to the customer.

Figure 6.12 Square to round bases: Types 3, 4 and 6.



Type 3 Square to round slope base

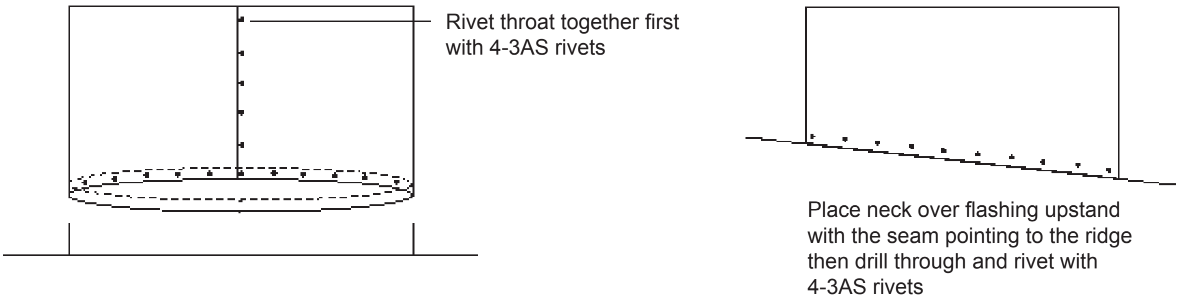
Type 4 Square to round ridge base

Type 6 Square to round pyramind base

6.6.2.3 EX Bases

In recent years Edmonds has devised a new throat design called an EX base. This is shown in figure 6.13. It is in essence a quick spigot throat made by using laser cutting operation. It can only be produced for roof angles up to 6º and the angle must be KNOWN to within half a degree. The laser cuts the throat to this angle and provides rivet holes. The throat is sent to site rolled but not fastened. This enables many throats to be sent in the one carton thereby saving on freight. The roofer simply rivets the two ends of the rolled throat together on site using the holes provided.

Figure 4.13

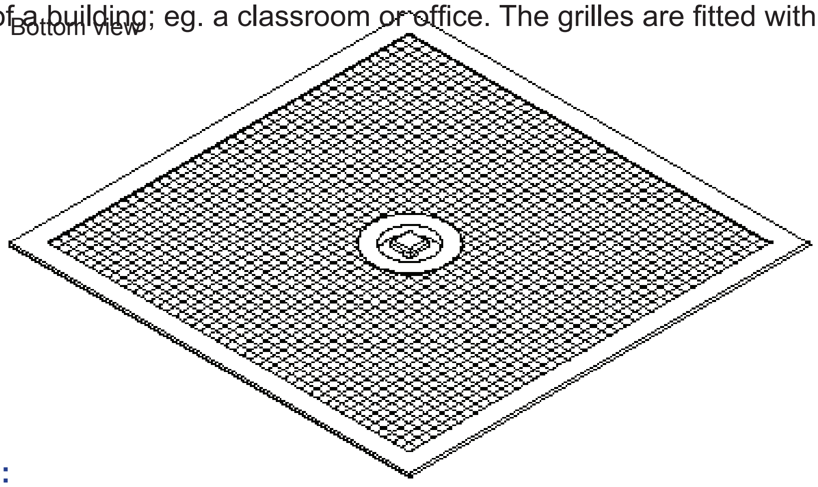


6.7 Grilles

EC Damper Grilles

EC Damper grilles are used to allow supply air for a Hurricane ventilator to be drawn from the internal area of a building; eg. a classroom or office. The grilles are fitted with an openable

Figure 4.14 Bottom view



Specification:

Material: Grille: Aluminium – Powder coated white
Damper: ABS, ASA & PVC Plastic

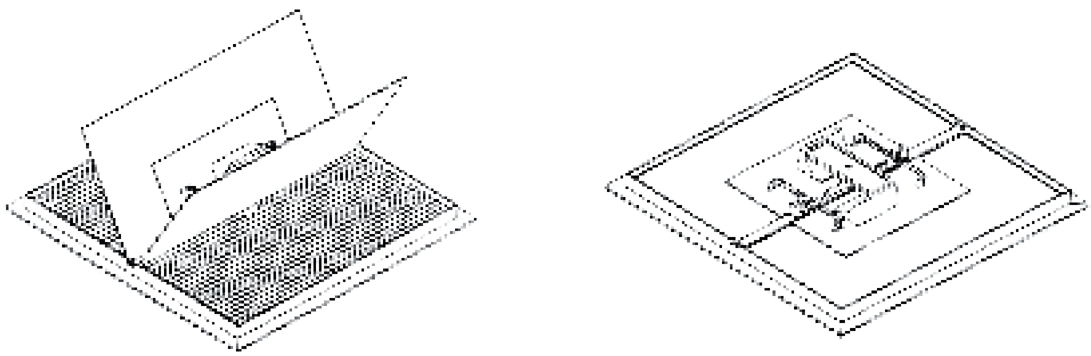
Operation: Rotate square knob anti-clockwise to open and clockwise to close

Table 4.4 EC Damper Grille Dimensions

Model	Overall Size (mm)	Opening Size (mm)	Grille Area (mm)	Overall Height (with damper open) (mm)	Weight (kg)
400	443 x 443	395 x 395	385 x 385	175	1.6
595 ‘lay-in’	595 x 595	550 x 550	540 x 540	250	2.4

Tolerances: Size +/- 2mm Weight +/- 0.1kg

Figure 4.15 Top View (open) Top View (closed)

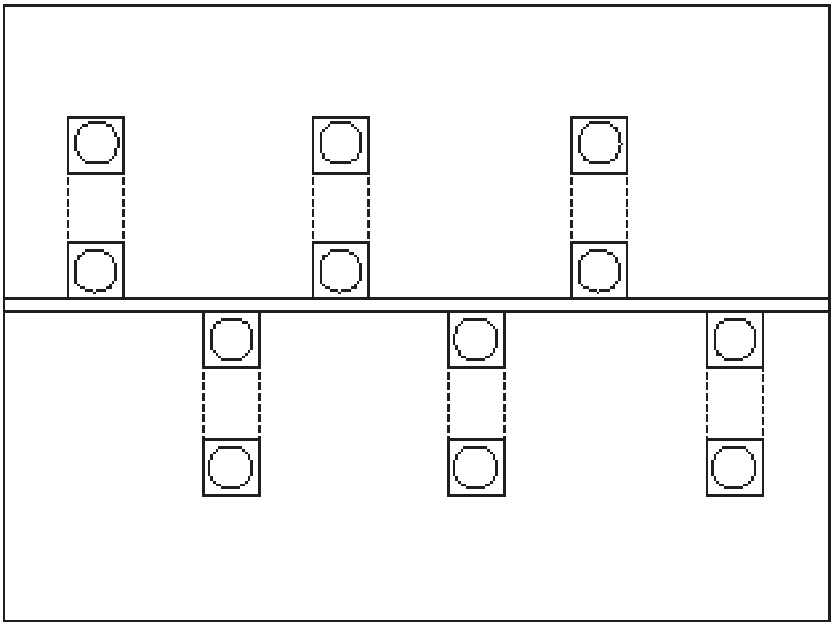


7. INSTALLATION PROCEDURES

7.1 Ventilator Location

Until recent years, the favoured location for all wind turbines was to slope mount the vents adjacent to the ridge cap with the flashing tucked under the ridge cap. This practice was based on the reasonable slope of most roofs (greater than 12º pitch) which caused hot air to gravitate to the higher section. However, with roof slopes now commonly 2-4º, it is preferable to run vents in at least two rows on each side of ridge. First row is located adjacent to ridge with a second row about 25-30% down slope. See figure 6.1.

FIGURE 7.1 Ventilator Location on the Roof



Where vents are located down the slope, either back trays or soakers will be needed to ensure there are no leaks. A back tray overlaps the top of the flashing and is run back to the ridge capping. A soaker will normally take the vent flashing back to the sheet finishing above the vent. The soaker is tucked under this sheet.

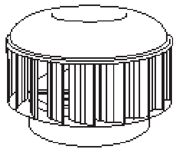
If a lower row of ventilators is positioned in line with the upper row the quantity of back flashing is reduced.

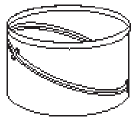
The following pages provide installation guidelines. However various roofers have their own proprietary methods for installation with the common objective to ensure a weather tight installation.

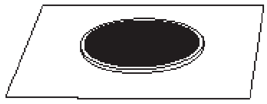
7.2 Assembly And Installation Procedures

HURRICANE VENTILATOR COMPONENTS

The Standard Hurricane Ventilator consists of these components: Turbine, Varipitch and Base Flashing. Set out below are stepwise installation instructions.


Turbine

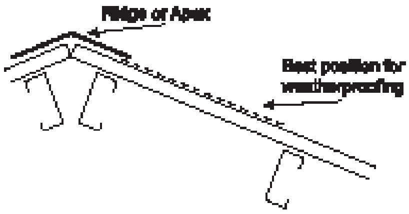

Varipitch


Base Flashing

Stepwise Installation Instructions

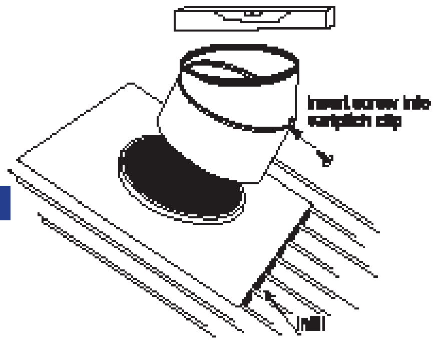
Step 1

Select the appropriate positions on the roof as referred to in (Fig 1): place the base flashing under the ridge capping. Note: When selecting the position of the vent, the means of weather proofing needs to be taken into account, the most efficient means is to locate the flashing under the ridge cap.



Step 2

Ensure that the base flashing covers the corrugations or ribs equally, then mark a circle using the base as a template. Cut hole. Once the hole has been cut, turn up the corrugations or pans and secure the flashing to the roof (for no. of fasters see table 1). It is recommended that an infill be used on the low side of the flashing. Coat all fasteners with silicon to ensure weatherproof.

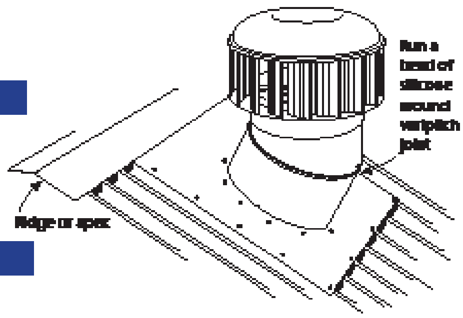


Step 3

When a varipitch base is being used. Sit the varipitch on the flashing and rotate the top and bottom halves until the top of the varipitch is horizontal, it is recommended that a level be used. Secure the two halves of the varipitch by inserting self tapping screws into the varipitch clips. Run a bead of silicon around the inside of the varipitch seam.

Step 4

Place the varipitch on the flashing and double check the level. Fix the varipitch to the flashing (for number of fasters see table 1).



Step 5

Fit the turbine to the varipitch. Check that it is level and adjust by tilting if necessary. Fasten the turbine to the top of the varipitch (for number of fasters see table 1).

Table 1 - Minimum number of fasteners

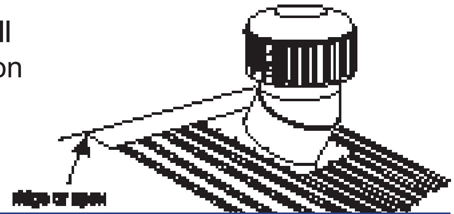
Unit Size (mm)	Head to Varipitch	Varipitch to Flashing	Flashing to Roof (Locate 4 close to varipitch)
300	4	4	10
400	4	4	12
450	5	5	12
500	5	5	12

Unit Size (mm)	Head to Varipitch	Varipitch to Flashing	Flashing to Roof (Locate 4 close to varipitch)
600	6	6	16
700	6	6	16
800	8	8	20
900	8	8	20

Either 10 gauge 16mm tek screws with neo or 4-3 blind rivets are recommended. When rivets are used apply silicone over the rivets to seal.

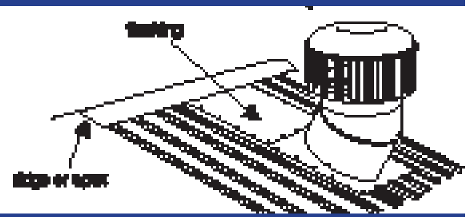
Situation 1 - Under Ridge Cap

On a sheeted roof, the best method of avoiding a leak is to install the ventilator at the peak of the roof where the volume of water on the roof is minimal.



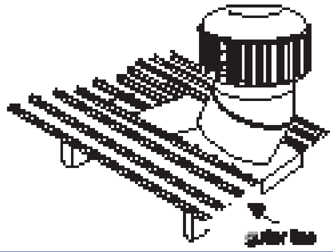
Situation 2 - Away from Ridge Cap

If the ventilator must be installed further down the slope, it is wise to provide a fat flashing to extend back to the ridge or apex.



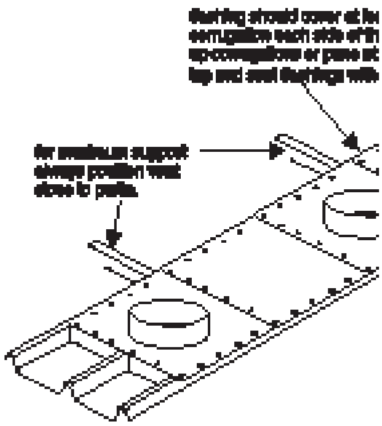
Situation 3 - Above the Gutter Line

If the ventilator must be installed at the gutter line or just above, it is wise to provide a tray beneath the sheeting as shown.



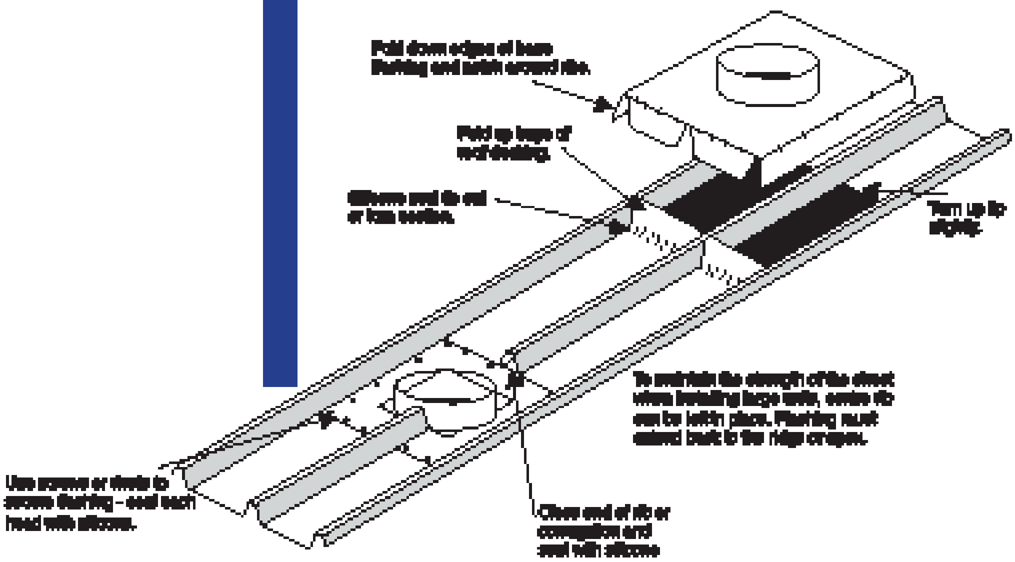
Situation 4 - Installation on Trim Deck

Simple and safe method of weatherproofing by running a series of flashing back to the ridge. Secure fastening to purlins.



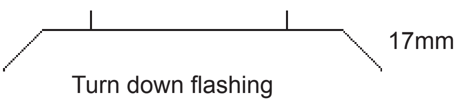
Situation 5

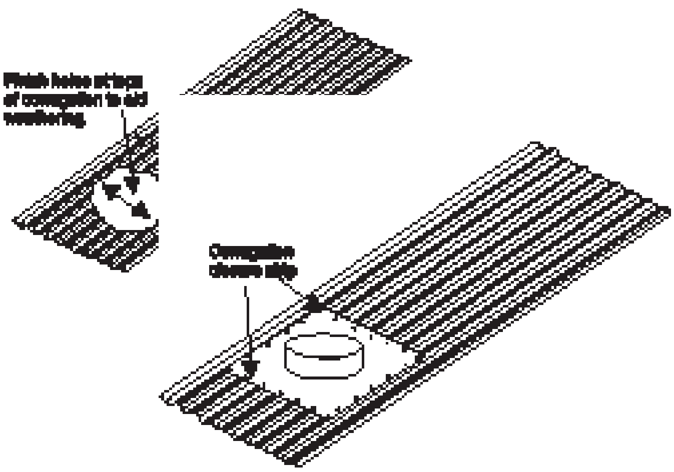
When installing down a slop, and flashing back to the ridge or apex is not practical. Cut flashing down to suit decking width. Seal well with silicone.



Situation 6 - Installation on Corrogated Profile

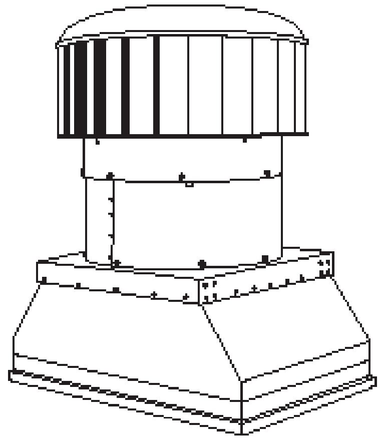
When installing down the slope on corrogated profile metal and it is not practical, to flash back to the ridge or apex. Turn the sides of the flashing down 17mm. Cut a line in the sheet. Push the flashing into the cut. Insert an infil on both top and bottom of the flashing and silicone seal.





Situation 7 - Installation on a Curb Mount

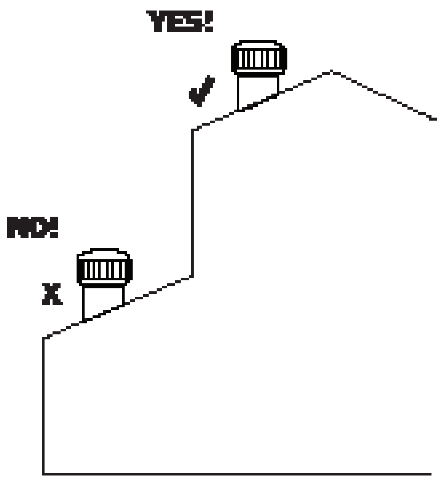
Installation of a ventilator onto a curb mount or spigot. The use of an Ex Base is recommended. However, a standard variptich is also suitable. If the OD of the curb and required length of turn down is provided. The flashing can be folded to enable easier installation.



Locating The Ventilator

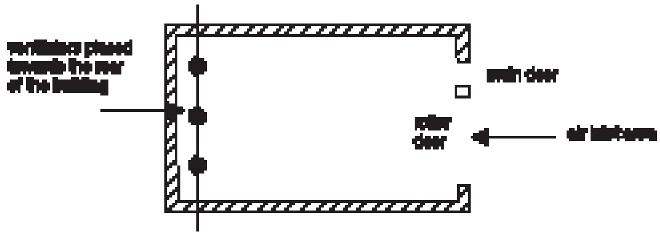
To ensure that the ventilator is properly positioned, we must understand the pattern of the wind as it blows across a building and locate the ventilator in the most advantageous position. Most of the art placing a ventilator on a roof is common sense, however, there are a few do's and don'ts:

1. Do try to locate the ventilator in undisturbed air from all directions. This is not always possible, however there will be some positions which are better than others. Choose the best.
2. Don't install a ventilator on a low roof adjacent to a vertical wall. This area will experience extreme turbulence in most winds. If the lower area must be ventilated, suggest an extension slack to get above the high roof.
3. Don't install a ventilator below a parapet, always elevate the unit to catch the direct wind.
4. Don't install a ventilator on a chimney below the ridge height.



Locating the Inlet

The ideal location for inlets is close to the floor level and evenly spaced around the parimeter walls.



When this is not possible locate the vent as far away from the inlet as possible.

These recomendations are not going to apply to all situations for further or more specific installation infomation please contact Edmonds Technical Centre on 1300 858 674

SUITABILITY OF ALUMINIUM FOR ATTACHMENT TO VARIOUS ROOF METAL TYPES

7.3 Galvanic Reactivity

Metal corrosion is a major concern whenever two different metal items are brought into direct contact. Corrosion is basically an electrochemical process. If two different metals are placed in electrical contact and bridged by an electrolyte (such as water), a current can flow through the solution from the anodic (more active) to the cathodic (less active) metal. As a result, the cathodic metal tends to be protected but the anodic metals may suffer great corrosion. This particularly applies when metals such as copper and lead are used in conjunction with ZINCALUME zinc/aluminium alloy-coated and COLORBOND prepainted steel sheet.

7.4 Acceptability Of Aluminium

The following table shows the acceptability of direct contact between aluminium and various metals.

TABLE 7.1 Aluminium Contact Table

CLADDING MATERIAL	ALUMINIUM ALLOYS	
	SI and VS	Mild
Aluminium alloys	YES	YES
Stainless steel	NO	NO
Zinc coated steel and zinc	YES	YES
Aluminium/zinc alloy coated steel (Colorbond)	YES	YES
Lead	NO	NO
Copper and copper alloys	NO	NO

* Table based on SAA HB39

Aluminium quickly obtains an oxide coating under weathering which further insulates its surface against corrosive impacts.

Hurricane aluminium ventilators therefore have no corrosive impacts on ZINCALUME or COLORBOND roofs.

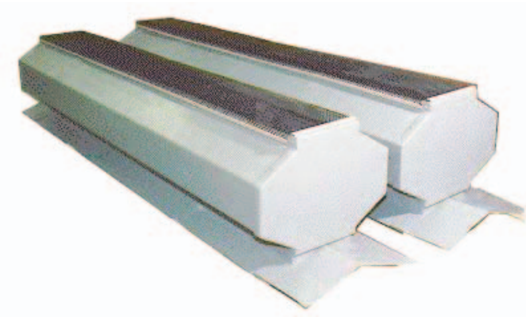
8. RIDGE VENTILATORS – TECHNOLOGY OF A BYGONE ERA

8.1 The Need for Ventilation

In America during the 1920's the Steel and Allied industries were booming. With this boom there were many factories being built for the production of steel and similar products. The production of these products created huge amounts of uncontrolled heat and a large amount of pollution. The buoyant moist air would condense on the inside of the roof and precipitate onto the workers below.

Because of the polluted and hazardous working conditions in these factories, unions began to pressure the manufacturers to improve the working environments for the workers. This union pressure brought about the need to develop a more efficient system of ventilation in these buildings.

Introduction of the Ridge Ventilator



The leading American ventilation engineers at the time came up with the ridge ventilator design. Many factories of the time were of a tall and narrow design. The roof slope of these factories was generally around 35° in order to withstand snow loadings. The shape of these tall buildings created an excellent stack effect and directed enormous amounts of buoyant, hot air into the throat of the ridge ventilator for extraction.

However, the ridge ventilators did not respond very well to wind action. The high amounts of polluted buoyant air exhausting from the ridge ventilator was often the only factor in preventing rain from entering the building during bad weather conditions.

Occasionally ridge ventilators were installed along the slope of the factory roofs on the windward side of the building. The entry of rain through back drafting was a consistent problem with this type of installation.

8.2 Ridge Ventilator Issues

Advances in process machinery technology saw the development of new machines that were more efficient and generated less heat. Consequently with less heat being generated, there was a reduction in the quantity of buoyant air produced from within the factory.

The calculations used to determine the size of the ridge ventilators were frequently based on the total dissipated heat loads generated by the plant and its process equipment.

Miscalculations in choosing the ridge ventilator size would occur often.

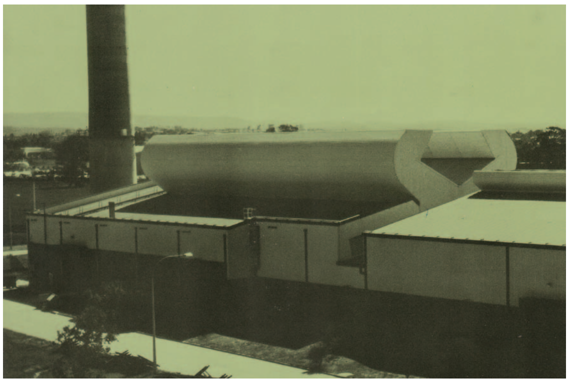
The actual dissipated heat load was often less than the estimated amount because there was now a reduction in the level of buoyant air generated by the updated factory machinery.

Back drafting and the entry of rain through ridge ventilators then became very prominent due to the volume reductions of rising buoyant air in these factories. There was now insufficient amounts of buoyant air leaving the ridge ventilator to prevent the entry of rain.

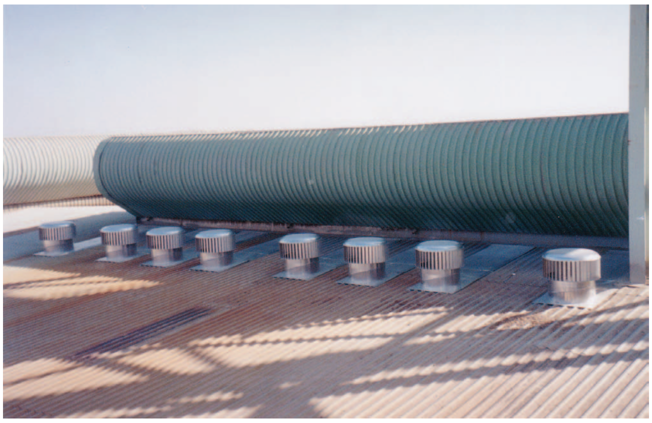
In conclusion, ridge ventilators had their time and place. Ridge ventilators were the most effective in buildings whose design favoured their performance and at a time where the industries that operated inside these buildings produces enormous volumes of heat and polluted air.

Ridge Ventilators no longer suit modern, industrial building types due to a number of factors:

- Weatherproofing and preventing rain entry through ridge ventilators is now difficult due to low pitched roofs on modern buildings.
- Under adverse conditions, the light weight roof structures employed today can act like a diaphragm in high wind gusts. High winds can cause the buildings roof to deflect under the high gusts and recover in the lulls.
- When the ridge ventilator aspirates from this action, this can allow the entry of rain due to the negative pressure that has built up inside the building from this roof pumping action.
- Modern building techniques allow the construction of much wider buildings with roof pitches typically less than 6 degrees. These wide, modern buildings are of a design that does not direct air into the throat of ridge ventilators. This is one of the major factors behind the decline in operating efficiency of ridge ventilators.
- Under certain conditions when the wind hits the side of buildings, wind turbulence can jump and create negative pressure before the ridge vent. This condition, also known as backdrafting, can cause the ridge vent to aspirate and allow the entry of rain into the building.



- Because of the difficulty of preventing rain entry, it is a tacit admission that ridge vents can leak as some ridge ventilator manufacturers provide sensor operated dampers to seal the vent when it rains.
- Only the Edmonds Hurricane Ventilator can efficiently exhaust air in all weather conditions for today's industrial building types
- The Hurricane Ventilator responds unidirectional to wind from any direction. Hurricanes will not leak, cannot backdraft and are easy to install and weatherproof.
- The Hurricane is constructed entirely from light weight, corrosion resistant aluminium.
- Light weight ensures the turbine can spin easier and reduces the need for structural support requirements.



Edmonds Hurricane ventilators are the most efficient, healthier and cost effective natural ventilation system on offer.

9. APPENDICES

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9.1 Vent Specification

Hurricane Specification

The roof ventilators shall be CSR Edmonds Hurricane Hxxx (size to be inserted) ventilator with wind catch lip, constructed from Aluminium, with vertical vane design and incorporate the Tandaco double row bearing system. Performance under AS4740 at 3m/s, 3.37 Pa stack pressure shall be at least (insert figure from table below) cm/hr.

Table of Flow Rates under AS4740 at wind speed= 3m/sec and stack pressure of 3.3720 Pa.

Table 9.1

Hurricane vent throat size	Flow rate cu.m/hr
300mm	404
400mm	693
450mm	959
500mm	1117
600mm	1153
700mm	1673
800mm	2601
900mm	2856

ecopower Specification

The roof ventilators shall be CSR Edmonds *ecopower* EPxxx (size to be inserted) with no fan blade to impede airflow, and which can be driven by ambient wind/stack action and/or motor. The hybrid ventilator must have an e.c.motor directly connected between the stator and turbine such that the airflow under wind power is not impeded. The dBA @1m must be less than 54 and energy efficiency 40m^3/hr/watt or better.

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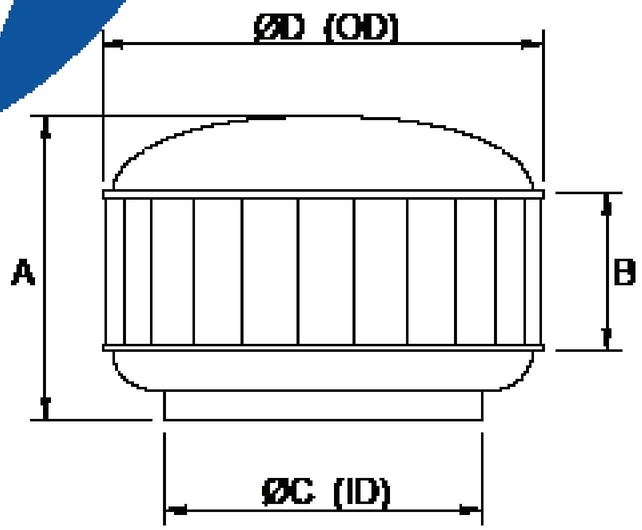
DATA SHEET

HURRICANE™

TURBINE VENTILATORS



DIMENSIONS:

MODEL	A (mm)	B (mm)	ØC (mm)	ØD (mm)	Throat Area (m^2)	Weight (kg)
H100	253	100	107	290	0.0090	1.3
H150	263	125	155	332	0.0189	1.9
H300	384	175	306	477	0.0745	3.7
H400	388	205	410	561	0.1320	4.5
H450	419	230	482	646	0.1876	6.2
H500	458	265	511	702	0.2051	6.9
H600	464	275	602	786	0.2846	8.1
H700	558	320	705	876	0.3904	11.6
H800	580	345	799	1009	0.5014	14.9
H900	643	400	897	1096	0.6319	18.1

Tolerances: Size +/- 2mm Weight +/- 0.1kg

SPECIFICATIONS:

MATERIAL:
Turbine & throat: Aluminium 5005 H34
Shaft: Aluminium 2011 T3
Dome & skirt: Aluminium 1200 O
Brackets: Aluminium 6060 T591
Spider (H600-H900 only): Zinc passivate plated mild steel
Shaft (H900 only): 303 Stainless Steel
Main bearing holder assembly: Glass Reinforced Nylon 6

ROTATION BEARINGS:
Main bearing: Double row ball bearing - BWF30-119Z
Spider bearing (H600-H900 only): Single row ball bearing – AS204

WIND SPEED RATING:
205.2km/h (57m/s) – Performance level 1
(As per AS 4740:2000 Natural ventilators-Classification and performance)

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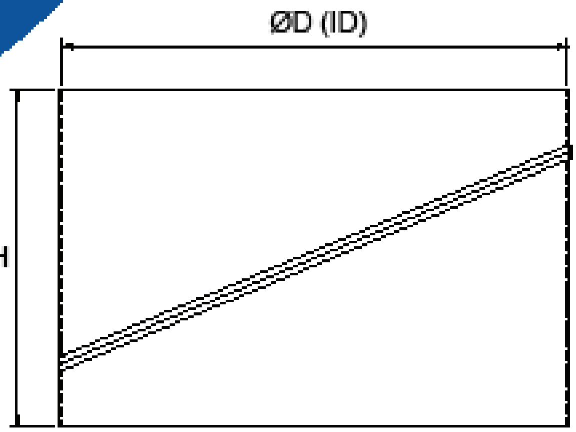
DATA SHEET

HURRICANE™

TURBINE VENTILATORS



DIMENSIONS:

MODEL	H (mm)	ØD (mm)	Suit Roof Pitch	Weight (kg)
H100	110	103.5	0° - 45°	0.07
H150	130	152	0° - 45°	0.11
H300	190	305	0° - 45°	0.42
H400	250	405	0° - 45°	0.72
H450	290	457.5	0° - 45°	0.82
H500	315	508.5	0° - 45°	1.37
H600	340	597.5	0° - 45°	1.69
H700	340	690	0° - 22.5°	2.44
H800	385	795	0° - 22.5°	2.97
H900	390	895	0° - 22.5°	3.57

Tolerances: Size +/- 2mm Weight +/- 0.1kg

NOTE

The Varipitch fits inside the throat of the Hurricane ventilator. Therefore the effective total height of the Varipitch is reduced by the overlap of the Hurricane throat. This overlap can vary from 50-110mm. Revolving the Varipitch to suit a roof slope also reduces its height.

SPECIFICATIONS:

MATERIAL: Aluminium 5005 H34

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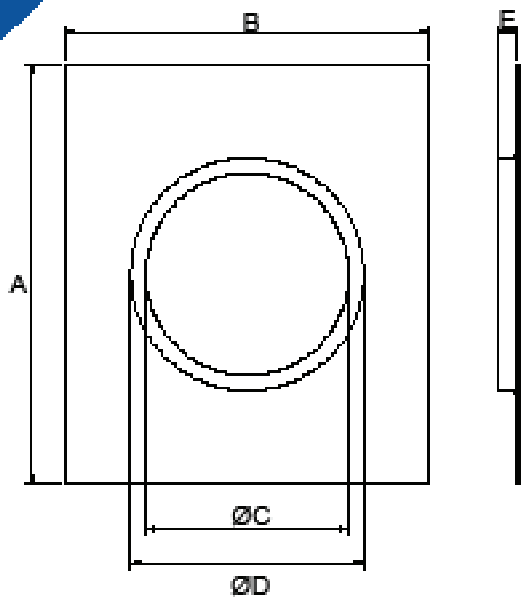
HURRICANE™
TURBINE VENTILATORS



DIMENSIONS:

MODEL	A (mm)	B (mm)	ØC (mm)	ØD (mm)	E (mm)	Weight (kg)
H100	430	430	80	100	22	0.40
H150	430	430	127	147	22	0.55
H300	600	500	275	300	22	0.80
H400	750	700	378	403	24	1.10
H450	750	700	425	454	24	1.00
H500	750	700	472	504	24	0.93
H600	1000	1000	572	594	24	2.05
H700	1000	1000	675	697	24	1.78
H800	1200	1200	770	794	24	2.75
H900	1200	1200	870	893	24	2.45

Tolerances: Size +/- 2mm Weight +/- 0.1kg

SPECIFICATIONS:

MATERIAL: H100 & H150: Aluminium 5005 O
H300 – H900: Aluminium 5005 H34

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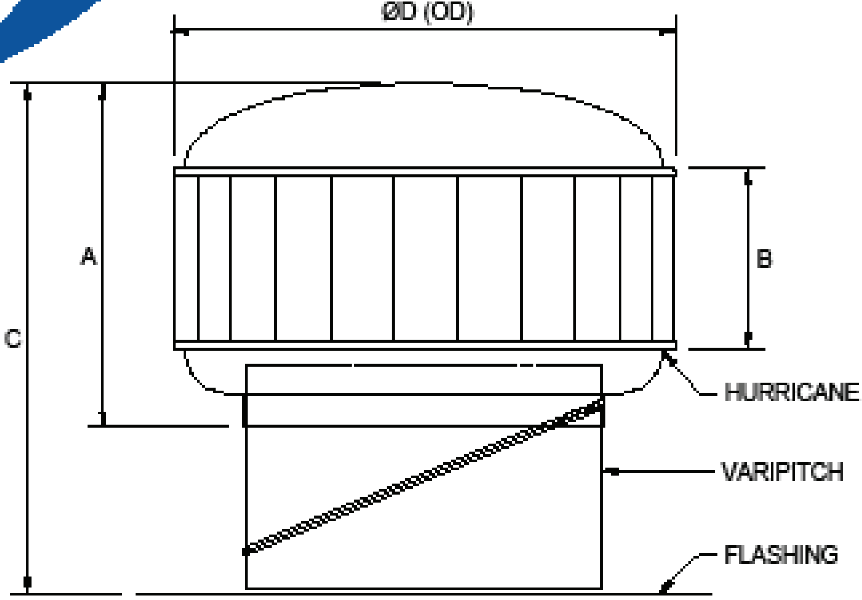
HURRICANE™

TURBINE VENTILATORS



DIMENSIONS:

MODEL	A (mm)	B (mm)	C (mm)	ØD (mm)	Throat Area (m^2)	Weight (kg)
H100	253	100	313	290	0.009	1.8
H150	283	125	383	332	0.019	2.4
H300	364	175	460	477	0.075	4.8
H400	399	205	584	581	0.132	6.3
H450	419	230	634	646	0.168	8.1
H500	459	265	700	702	0.205	9.2
H600	484	275	724	766	0.285	11.6
H700	556	320	796	876	0.380	15.6
H800	580	345	848	1003	0.501	20.6
H900	643	400	938	1096	0.632	24.1

Tolerances: Size +/- 2mm Weight +/- 0.1kg

NOTE

The Hurricane throat overlaps the Varipitch. The height listed above is with the maximum overlap (lowest overall height). Revolving the Varipitch to suit a roof slope also reduces its height.

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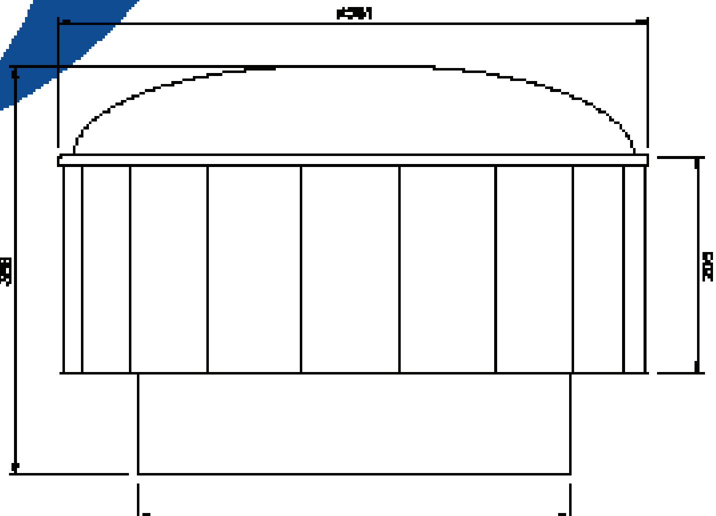
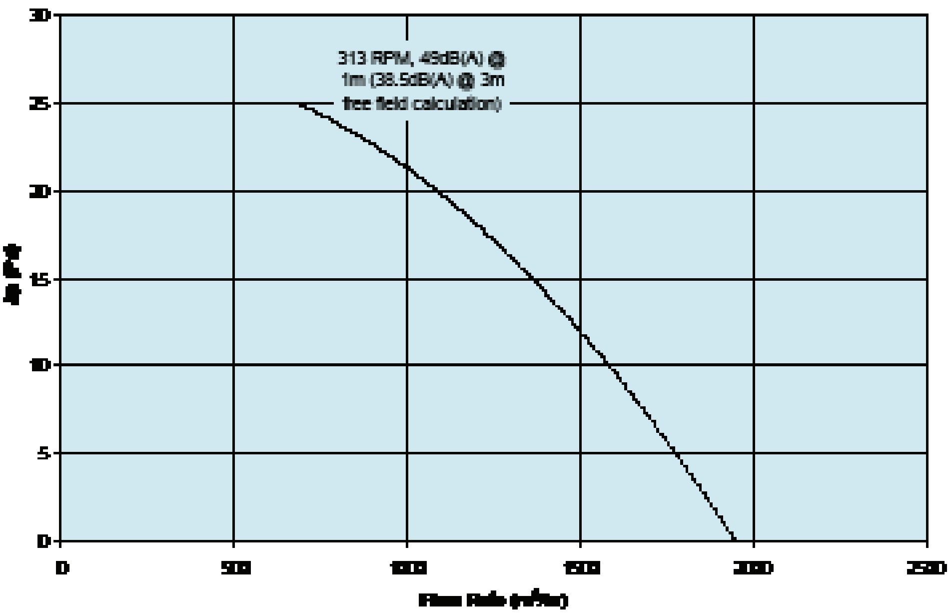


SPECIFICATIONS:

MATERIAL:	Turbine & throat: Aluminium 5005 H34
	Dome: Aluminium 1200 0
	Brackets: Mild Steel (Powdercoated)
WEIGHT:	10.7kg
ELECTRICAL:	Electronic commutating (EC) motor 200-277V AC
	Max. running current draw: 0.16A
	Max. running power consumption: 39W
	Specific flow rate (@ Δp=0): 51 m3/hr/W



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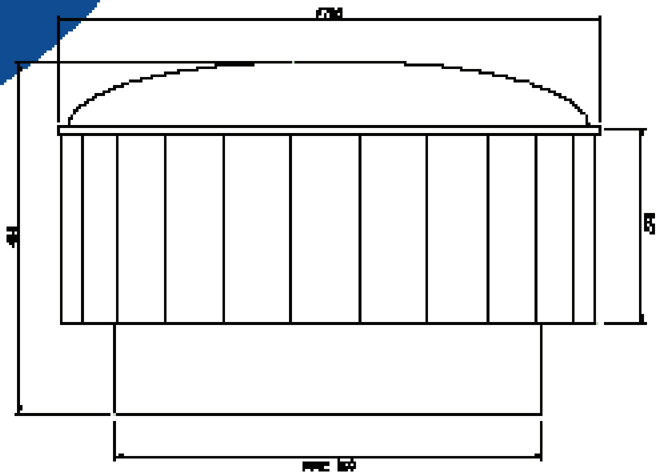
DATA SHEET

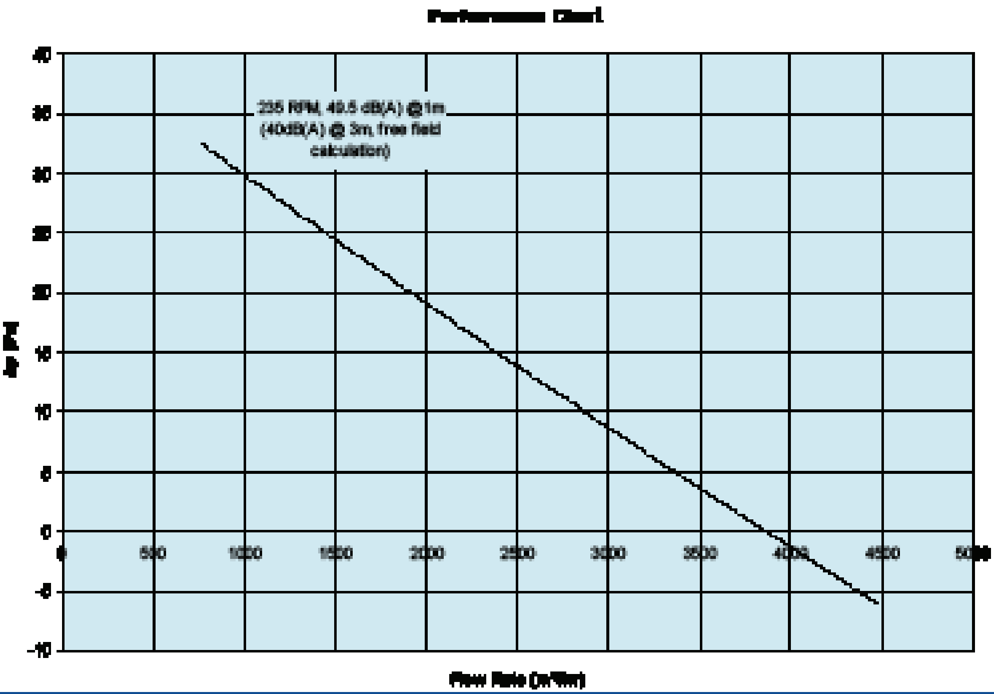
ecopower® 600

energy efficient ventilator technology



SPECIFICATIONS:

MATERIAL:	Turbine & throat: Aluminium 5005 H34 Dome: Aluminium 1200 O Brackets: Mild Steel (Powdercoated)
WEIGHT:	14.4kg
ELECTRICAL:	Electronic commutating (EC) motor 200-277V AC Max. running current draw: 0.36A Max. running power consumption: 88W Specific flow rate (@ Δp=0): 45.3 m3/hr/W



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DATA SHEET

HURRICANE™
TURBINE VENTILATORS

PRODUCT	PACKED WEIGHT (kg)	BOX WIDTH (mm)	BOX DEPTH (mm)	BOX HEIGHT (mm)
H100 COMPLETE	2.4	380	360	450
H150 COMPLETE	2.6	380	360	450
H300 COMPLETE	6.9	510	510	620
H400 COMPLETE	10.8	740	720	780
H400 TOP	8.8	670	670	470
H450 COMPLETE	12.1	740	720	780
H450 TOP	9.6	670	670	470
H500 COMPLETE	13.1	740	720	780
H600 TOP	15.7	910	910	600
H600 V/P	3.7	740	740	385
H600 FLASHING	2.4	1060	1080	40
H700 TOP	18.8	910	910	600
H700 V/P	4.4	740	740	385
H700 FLASHING	2.2	1060	1080	40
H800 TOP	24.7	1130	1130	700
H800 V/P (X2)	9.0	910	910	770
H900 TOP	27.3	1130	1130	700
H900 V/P (X2)	9.6	910	910	820
ecopower EP400 COMPLETE	17	740	720	780
ecopower EP400 TOP	14.8	670	670	470
ecopower EP600 TOP	22	910	910	600
EC DAMPER GRILLE (400)	2.1	455	470	85
EC DAMPER GRILLE (595)	3.3	605	625	85

Tolerances: Size +/- 5mm Weight +/- 0.2kg

NOTE:

Box dimensions are overall outside dimensions.

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PROJECT PROFILE

HURRICANE™
TURBINE VENTILATORS

LOCATION:
Bunnerong Gymnasium
Matraville Road, Bunnerong.

BUSINESS:
A gymnasium.

TASK:
Substantially improve air quality in the gym. The six IVR 760mm vents were allegedly having little impact on ventilation. Two were inoperative.

SOLUTION:
Edmonds proposed the replacement of the 6 steel IVR vents with 7 aluminium Hurricane™ H700 Ventilators. The Hurricane™ Ventilators exhaust considerably more air than the same sized heavier steel units.

RESULT:
Customer found that air in the gymnasium was considerably fresher due to the more efficient performance of the Hurricane™ ventilators. This result is consistent with independent tests carried out by the University of Technology that showed a Hurricane™ H400 outperformed an IVR 400mm vent by 206% on flow coefficient.

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PROJECT PROFILE

HURRICANE™
TURBINE VENTILATORS

LOCATION:
VISY PAPER
Smithfield, Sydney, Australia.

BUSINESS:
A paper recycling mill. Considerable quantities of process steam and heat are produced by the two process lines. Size approx. 180m x 36m x 12m

TASK:
Edmonds requested to consult. Client wanted the heat and steam exhausted from the building and a better working environment for employees. Condensation had caused corrosion of the roof and purlins which were all replaced at considerable cost to Visy.

SOLUTION:
Edmonds recommended the installation of 100 X Hurricane™ H900 Ventilators to provide 15 air changes per hour. Client elected to proceed initially with 50 X Hurricane™ H900 Ventilators. Powered ventilation is not an efficient method to exhaust hot moist air because of its low density.

RESULT:
The 50 x H900 are achieving the objective set. Consideration now being given to the additional 50 units.

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PROJECT PROFILE

HURRICANE™
TURBINE VENTILATORS

LOCATION:

QANTAS Engineering Workshops
Mascot, Sydney

BUSINESS:

Workshop for repair and maintenance work associated with QANTAS operations.

TASK:

Need to improve ventilation for employees. Roof required replacement so opportunitytaken to overcome inadequate ventilation.

SOLUTION:

Edmonds supplied 93 X Hurricane™ H900 Turbine Ventilators. Products supplied within tight four week deadline.

RESULT:

Very satisfactory, air quality in workshops greatly improved.

CONSULTANTS:

Woolacotts, Consulting Engineers

INSTALLATION:

M.G.W. Roofing Pty Ltd

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PROJECT PROFILE

HURRICANE™
TURBINE VENTILATORS

LOCATION:
Water Storage Facilities.

PROBLEM:
Breakdown of steel roofing over water storage reservoirs is a major problem throughout the world, although more prone to occur in warmer climates. It is caused by constant evaporation and condensation of stored water and is particularly severe if the water has been treated with chemicals or chlorine.

SOLUTION:
The Hurricane S2, purpose built to withstand constant condensation and corrosive environments, is used to cause a constant influx of fresh air. This reduces humidity levels and hence the rate of condensation on the underside of the metal roofing. The Hurricane S2 comes in sizes of 100mm, 150mm, 300mm, 400mm, 450mm, 500mm and 600mm throat diameters each containing a deflector flange located beneath the bearing. The bearing is located above the top plate of the vent to reduce exposure to harsh vapours. This ensures a longer life which is not possible with normal vents.

RESULT:
The Hurricane S2 has been very successfully employed on over 30 water storage tank projects to reduce the rate of oxidation of metal surfaces. Financial savings have been very significant.

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PROJECT PROFILE

HURRICANE™
TURBINE VENTILATORS

LOCATION:
Corporate Express
Richlands, Brisbane, Qld

BUSINESS:
Warehousing

TASK:
To provide a natural ventilation system to the building to ensure the comfort of the staff in the warehouse.

PROBLEM:
The warehouse is fitted with the ESFR (Early Suppression Fast Response) sprinkler system. Edmonds were asked to comply with FM Global Property Loss prevention Data Sheet 2.2.6 (Sept 2001) to account for the effect of the ventilation openings and subsequent airflows on the ESFR sprinkler installation.

SOLUTION:
Edmonds supplied and installed 42 x Hurricane™ H900 Ventilators powder coated Off White.

RESULT:
Edmonds complied to all recommendations by the building owners and were awarded the job over other ventilation companies.

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PROJECT PROFILE

HURRICANE™
TURBINE VENTILATORS

LOCATION:
Amcor Beverage Cans
Rocklea, Queensland

INSTALLER:
Skyhook Cladding and Ventilation

BUSINESS:
Manufactures of aluminium cans

TASK:
Remove the heat that was building up inside the building, excess heat was being generated by plant and equipment.

SOLUTION:
Edmonds recommended the installation of 40 x Hurricane™ H900FR Ventilators some of which were installed over existing smoke release vents that were no longer working and leaking.

RESULT:
Customer more than happy with end result and very pleased the installation over the old vents solved the leaking.

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PROJECT PROFILE

HURRICANE™
TURBINE VENTILATORS

LOCATION:
Gavan Warehouse

BUSINESS:
Distribution Warehouse

TASK:
Smoke Release Ventilation/Natural ventilation

SOLUTION:
Hutchinson Builders and their fire engineers recommended the installation of 174 x Hurricane™ H900FR Ventilators (Fire Rated) to provide adequate smoke relief ventilation.

RESULT:
Customer more then happy with end result and will have no hesitation in recommending the Hurricane Ventilators.

INSTALLER:
Queensland Roofing Systems (QRS) - QLD

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PROJECT PROFILE

HURRICANE™
TURBINE VENTILATORS

LOCATION:
Alzajir Glass Fatory
Dubai, United Arab Emirates

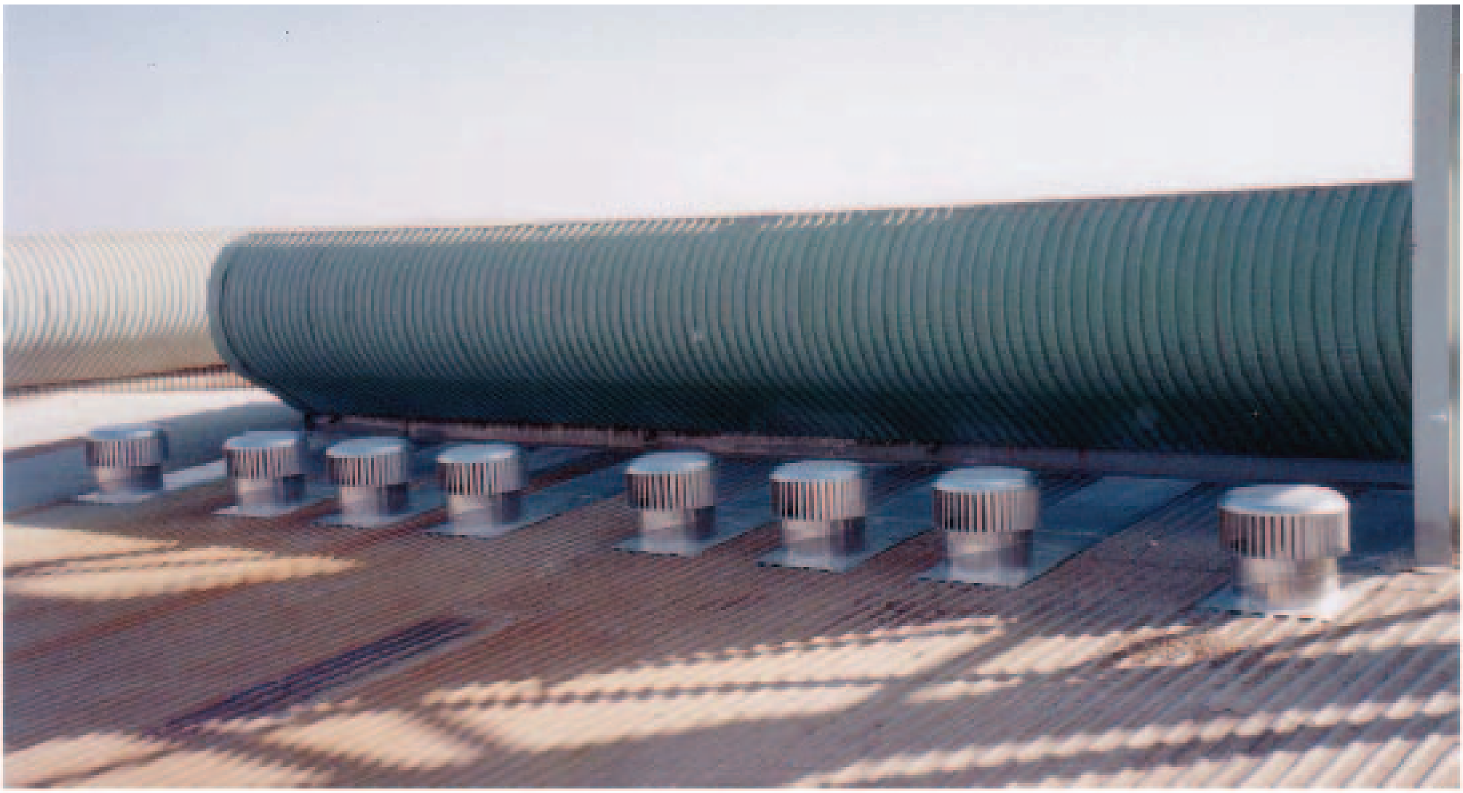
BUSINESS:
Manufacture of glass bottles with daily output of one million units.

TASK:
To overcome the failure of the main ridge ventilator located above the melt furnace which is not allowing ample heat to escape. Prevailing winds are causing the ridge vent to backdraft.

SOLUTION:
Edmonds supplied 16 x Hurricane™ H900 Ventilators that were installed, 8 down either side of the large ridge vent. Temperature of exhausted gases exceeds 80°C.

RESULT:
Customer is sufficiently pleased with the result, requested a full hurricane scheme for the entire plant.

CONSULTANT:
Al Mutaiwie – Barrie Harmsworth



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HURRICANE™
TURBINE VENTILATORS

LOCATION:

Tooheys Limited
Auburn Brewery, Sydney

CONSULTANTS:

Michael McGorman and Associates

BUSINESS:

Bottling floor for Tooheys Brands of beer.

TASK:

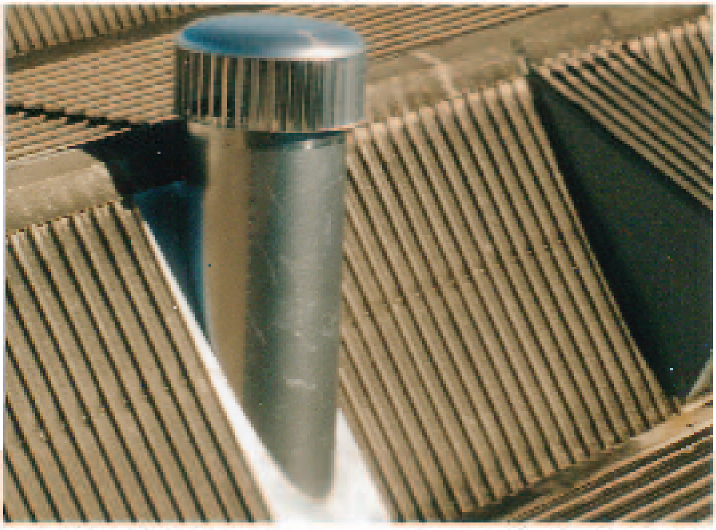
To provide an improved environment for employees and operation of filling machines. The building has an old saw tooth roof with a pitch of 62°.

SOLUTION:

Edmonds supplied 30 X H900 Hurricane™ Turbine Ventilators with spigot bases to suit 62° roof slope.

RESULT:

A very successful ventilation scheme which has greatly improved the air quality in the plant.



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PROJECT PROFILE

ecopower®

LOCATION:

The Park at Pearl Ridge
Pearl Harbour, HI, USA.

BUSINESS:

The Park at Pearl Ridge is a residential complex in the Pearl Harbour district of Oahu Hawaii. The complex consists of 3 residential towers, each 18 levels high.

TASK:

Skylights of Hawaii were asked to consult on the conversion of bathroom shaft mechanical fans to a more economical ventilator on the Manuka Tower. The exisiting axial fans for the shafts were 3/4 HP, which were high consumers of electricity, and noisy.

SOLUTION:

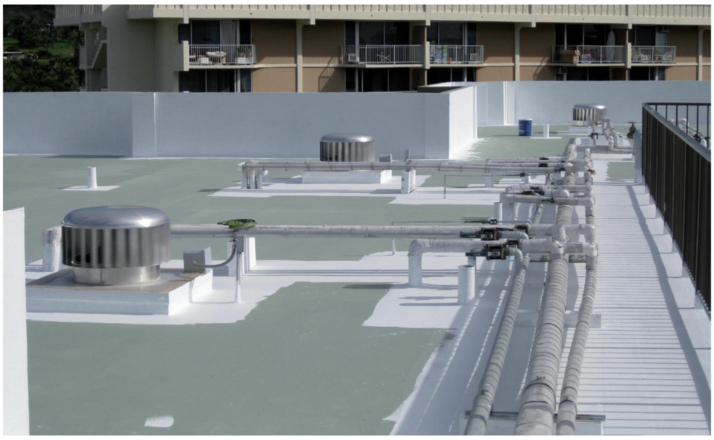
Skylights of Hawaii recommended the use of the ***ecopower* EP600**, to provide ventilation to the bathroom shafts of the 18 level building. The Manuka Tower has 8 ventilation shafts in total.

RESULT:

The building manager is very pleased with the ***ecopower*** EP600. "The tenants are very happy with the new ventilators, there has been no complaints about neighbouring smells" he said. He was also pleased with the lack of noise from the ***ecopower*** when compared to the fans they replaced. The energy savings are being compiled, with the first estimates showing the ***ecopower*** consuming 20% of the power the existing fans consumed.

CONTACT:

Building Manager



PROJECT PROFILE

ecopower®
energy efficient ventilator technology

LOCATION:

Alexandra Hills SHS, Queensland

BUSINESS:

State High School

TASK:

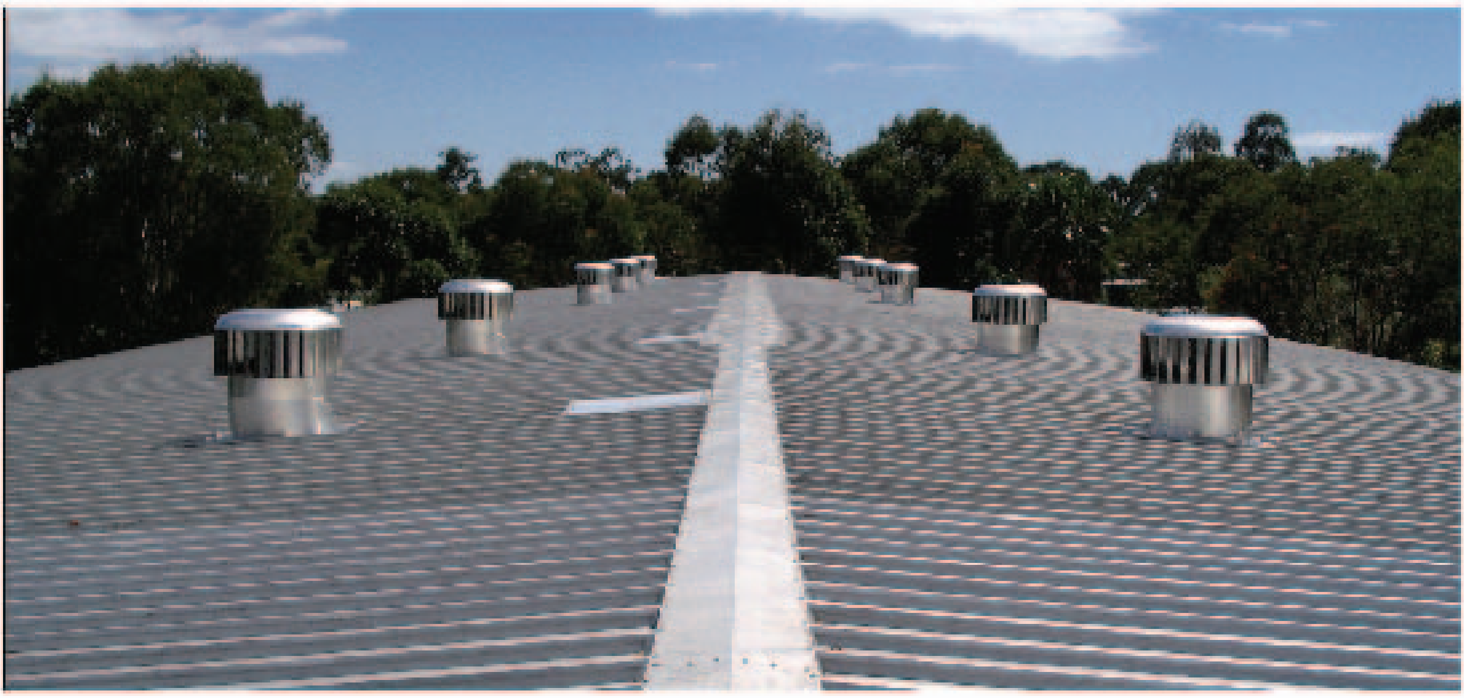
To provide adequate ventilation to the school auditorium that was previously under ventilated. This caused heat to continue to build up, which in turn was causing events in the auditorium to become uncomfortable.

SOLUTION:

Edmonds designed a hybrid ventilation system to replace the existing 500mm natural ventilators with 12 x EP600 ecopower hybrid ventilators.

RESULT:

The environment in the auditorium has greatly improved and comfort levels for occupants can be sustained for much longer periods of time. Customer is more than satisfied with results of the ecopower.



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2.4.1 Australian Standards and BCA requirements

In terms of ventilation needs there appear to be two general prescriptions applying to the rates prescribed for general buildings.

AS1668.2 – 1991 specifies levels of general exhaust ventilation for enclosures required to be ventilated by a Regulatory Authority. Exhaust airflow rates are specified in Appendix A to the standard corresponding to a minimum per person or per unit area. For example, for warehouses, the requirement is 0.5L/s/m^2.

The various State BCAs generally have a stipulation that 5% of the floor area of factories and warehouses should be 'openable area'. This requirement however doesn't guarantee air exchange, and hence building ventilation, unless a pressure difference is naturally created i.e. from wind hitting an open door or window. In this respect, the requirements of AS1668.2 appear more meaningful and are sometimes used as an alternate to the BCAs. Any decision by specifiers or building owners must be based on their consulation with appropriate Regulatory Authorities.

Ultimately, of course, building users have a responsibility under Occupation Health and Safety Requirements to provide a safe working environment which encompasses workplace conditions.