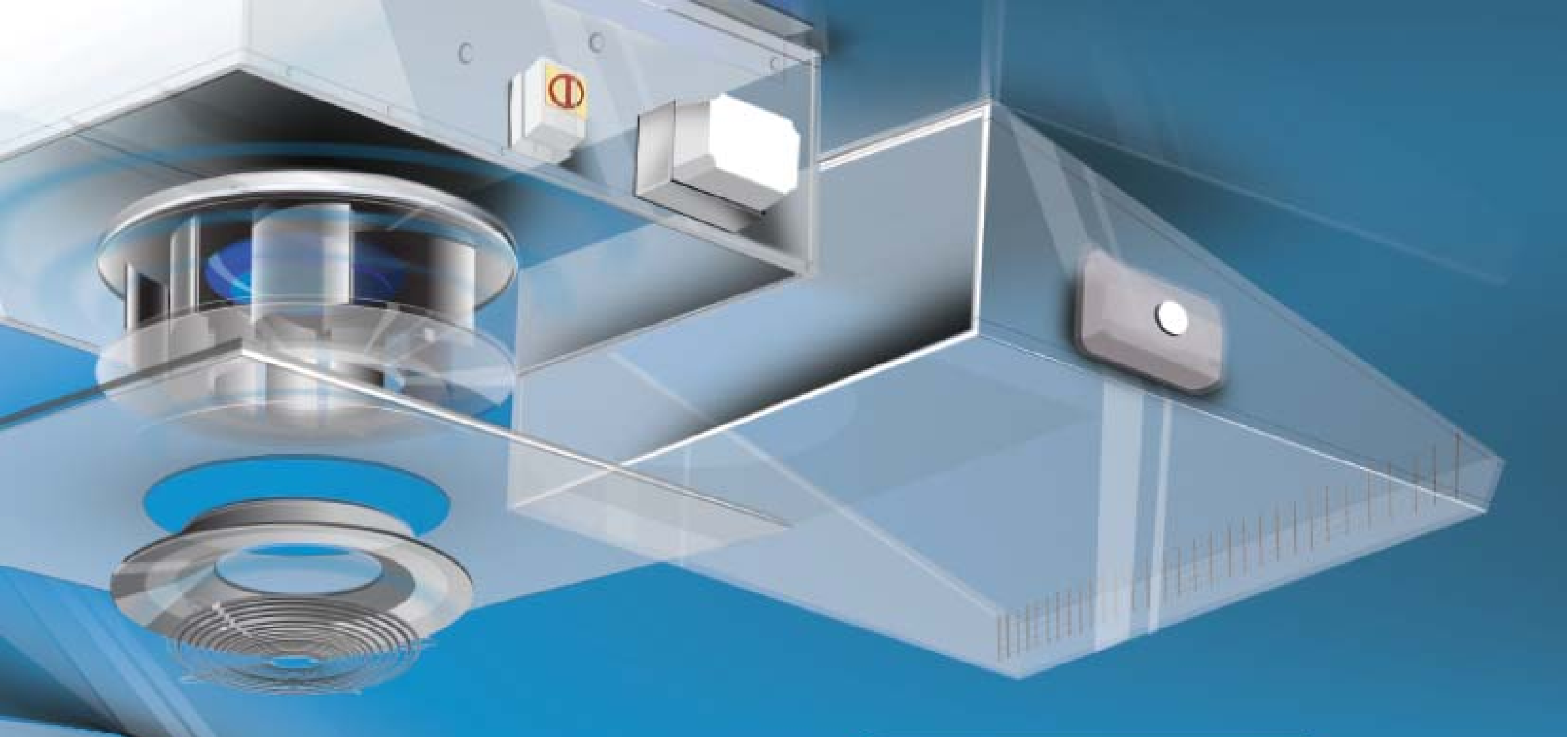


JETVENT

The car park ventilation solution

A Practical Guide for Selection & Application

2 0 1 4

Third Edition

FANTECH

Intelligent Ventilation

Introduction to Car Park Impulse Ventilation

The ventilation of car parks is essential for removing vehicle exhaust fumes containing harmful pollutants. Some of these pollutants include Carbon Monoxide (CO), Nitrous Oxides (NO_x), Sulphur Dioxide (SO_2) and heavy metal compounds.

The most significant development in car park ventilation design has been the introduction of Impulse Ventilation. It is an innovative alternative to traditional systems and provides a number of significant benefits. An Impulse Ventilation System is based on a number of small high velocity 'JetVent Fans' that either replace traditional distribution ductwork in closed car parks or increase cross-flow ventilation in open car parks.

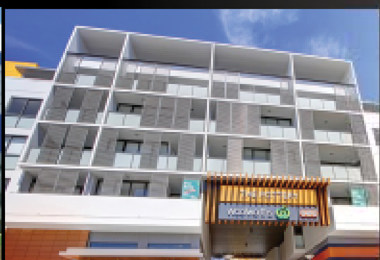
In addition to removing pollutants, the ventilation systems may also provide assistance to fire fighters by either limiting the spread of smoke in the event of a fire or clearing smoke after the fire is extinguished. Impulse Ventilation y originated in Europe and has been widely used around the world for both car park ventilation and smoke management control systems. The JetVent Impulse ventilation system is being installed to increase the efficiency of car parks through out Australia, New Zealand and South East Asia.

Industry award winner

The JetVent Digital EC was presented with the 2012 ARBS Industry Product Excellence Award in recognition of it's simplicity, energy efficiency and its ability to adapt to most car parks. The award was also confirmation of Fantech's commitment to innovation, continuous improvement and its drive to develop innovative cost effective solutions.

Main Projects

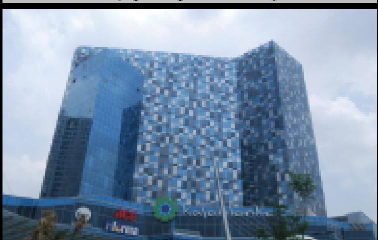
Ikea
(Victoria Australia)



The Pottery Mashman
(Kingsgrove, Australia)

DFO Homebush
(Sydney, Australia)

Ocean Keys
(Western Australia)



Kota Kasablanca,
South Jakarta, Indonesia

Countdown
New Zealand

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JETVENT

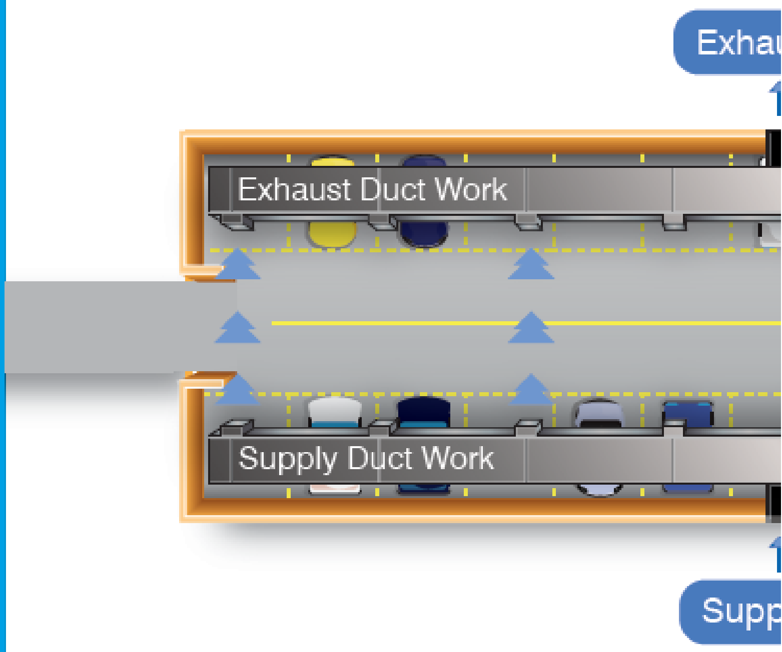
How it works

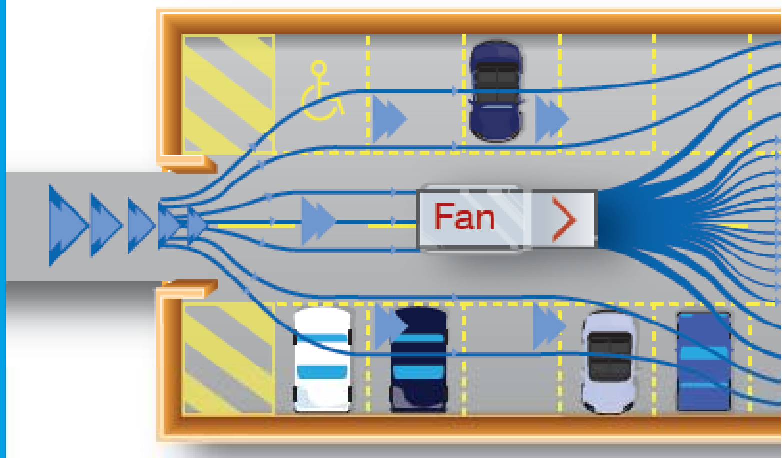
JetVent Fans operate on well proven longitudinal tunnel ventilation principles. The fans produce a high velocity jet of air, in turn moving a larger quantity of air surrounding the fan through a process known as entrainment. The amount of air entrained by a single fan increases with the velocity and the quantity of air being discharged by the fan. These characteristics directly relate to the thrust rating of the fan, which is measured in Newtons (N).

Figures 1(a) and 1(b) show the difference in principle between the ventilation systems.

Advantages

- Largely eliminates the need for air distribution ductwork within the car park.
- The mechanical supply and exhaust systems have less resistance and therefore require smaller fans that consume less power.
- Ventilation risers and plant rooms reduce in size and quantity, making the car park more open and possibly yielding additional car park spaces.
- Increasing the number of control zones in the car park maybe possible. This can increase the energy efficiency of the system over and above the best ducted car park ventilation systems.
- Great potential for reduced excavation and construction costs. System is small in vertical profile and the placement of fans can be very flexible resulting in lower floor-to-ceiling heights.





Fan Specifications

The capacity of a single fan increases with its thrust rating. All JetVent car park fans are rated according to this in Newtons (N) of thrust. See page 21 for further information.

All JetVent Fan types are tested to the following Standards:

- Thrust performance based on tests to BS848: Part 10:1999.
- Noise data based on tests to BS848: Part 2:1985.
- Axial and Centrifugal units tested for smoke spill requirements as outlined in AS4429:1999.

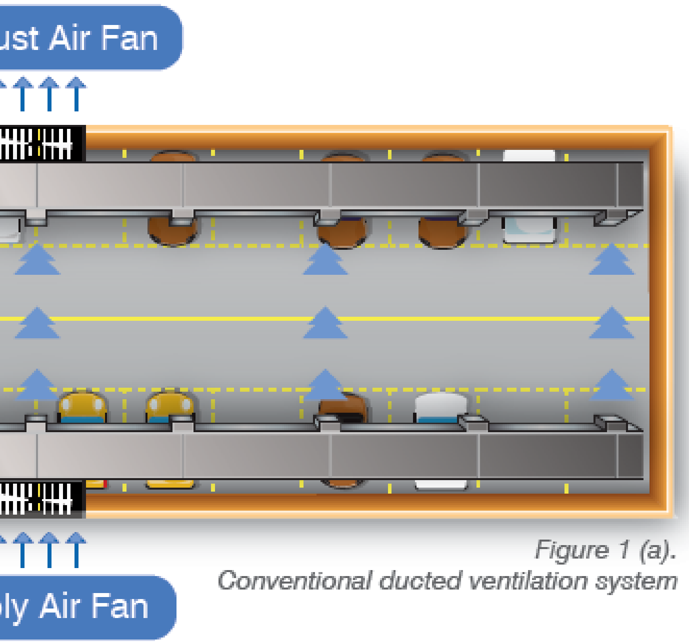


Figure 1 (a).
Conventional ducted ventilation system

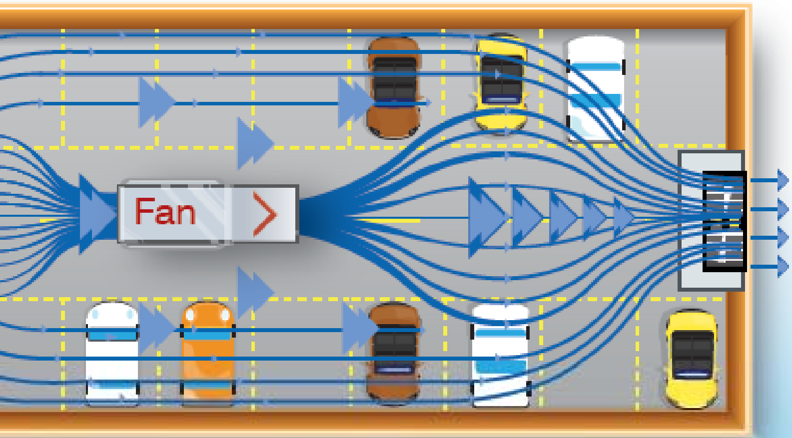
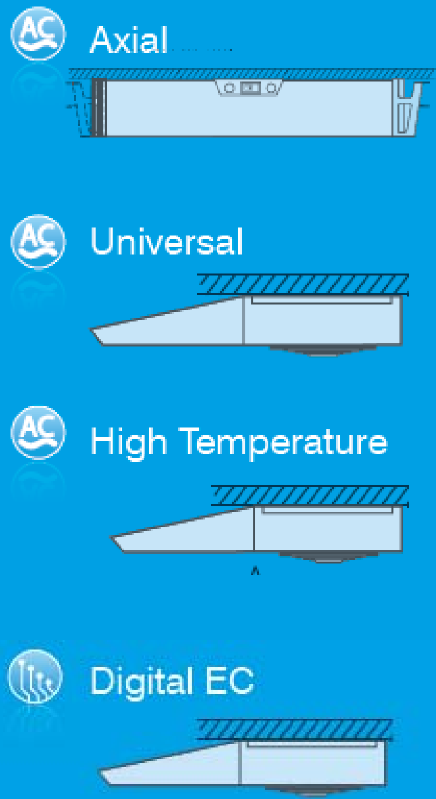


Figure 1 (b).
Impulse ventilation system

Figure 2. Workings of a JetVent or Impulse fan

JetVent fan types



Axial
JV Series - JetVent Fans

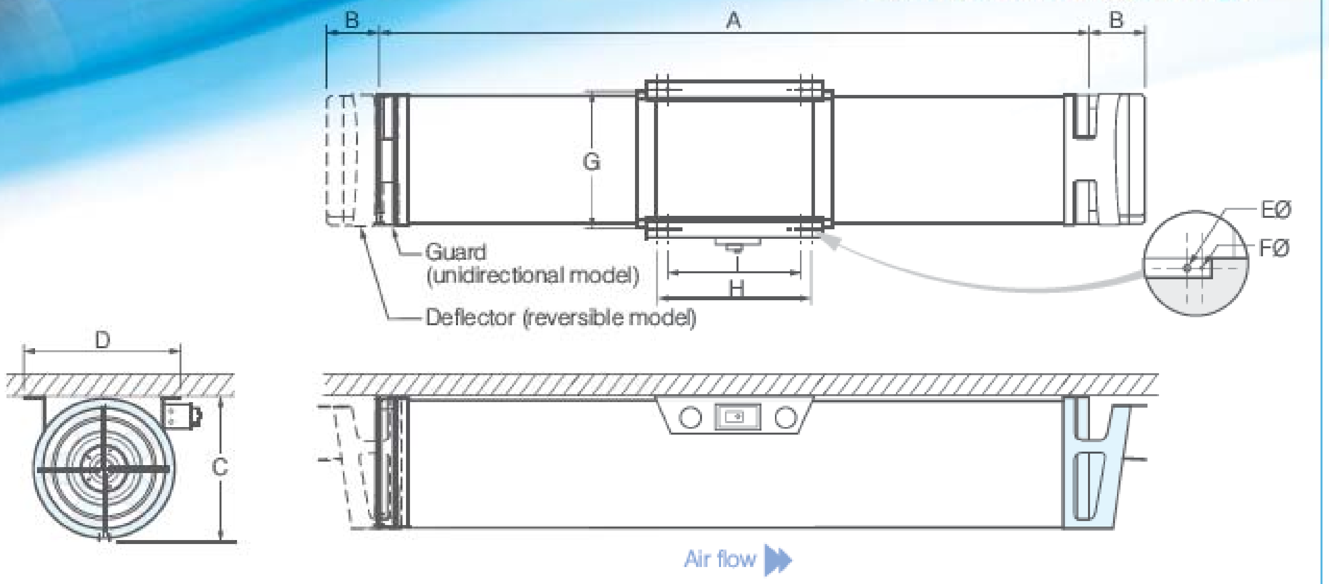
The JV Series of JetVent Fans offer flexibility to satisfy the majority of requirements for car park ventilation. It is available in 2 sizes, 315mm and 400mm diameter and provides options for uni-directional or truly reversible air flow and single or dual speed. Units may also be speed controlled using Variable Speed Drives (VSD). Units approved to AS4429:1999 for smoke exhaust are also available.

Product Series	Fan Speed		Thrust Rating		Car park Installed Noise Levels		Free-field Noise Rating		Power Rating		Control Types	
	r/s		N		dB(A)#		dB(A) @ 3m		kW		2-Speed	Analogue
	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	Relay (See Page 29)	VSD (See Page 30)
JVU-CPA-315	48	24	20	5	71	61	59	49	0.8	0.16	✓	✓
JVU-CPA-400	48	24	50	12	73	63	62	47	1.7	0.34	✓	✓

Car park installed noise levels apply 8m away from the fan with multiple fans operating. Contact your nearest Fantech office to confirm if this is applicable to your installation.

Table 1. JetVent JV series technical data

Dimensional Drawings



Product Series	A	B	Vertical Height C	D	EØ	FØ	G	H	I	Approx. Weight, kg
JVU-CPA-315	1808	142	336	417	25	13	367	420	360	62
JVU-CPA-400	2660	145	423	471	25	13	421	420	360	71

Note

- High/Low speeds selected by 2-speed motor.
- Further fan options available for Truly reversible, smoke exhaust rated and single speed models.
- Electrical supply - 415V, three-phase, 50Hz.
- For the exact product codes of JV series fans, contact your nearest Fantech office.

Universal
JIU Series - JetVent Fans

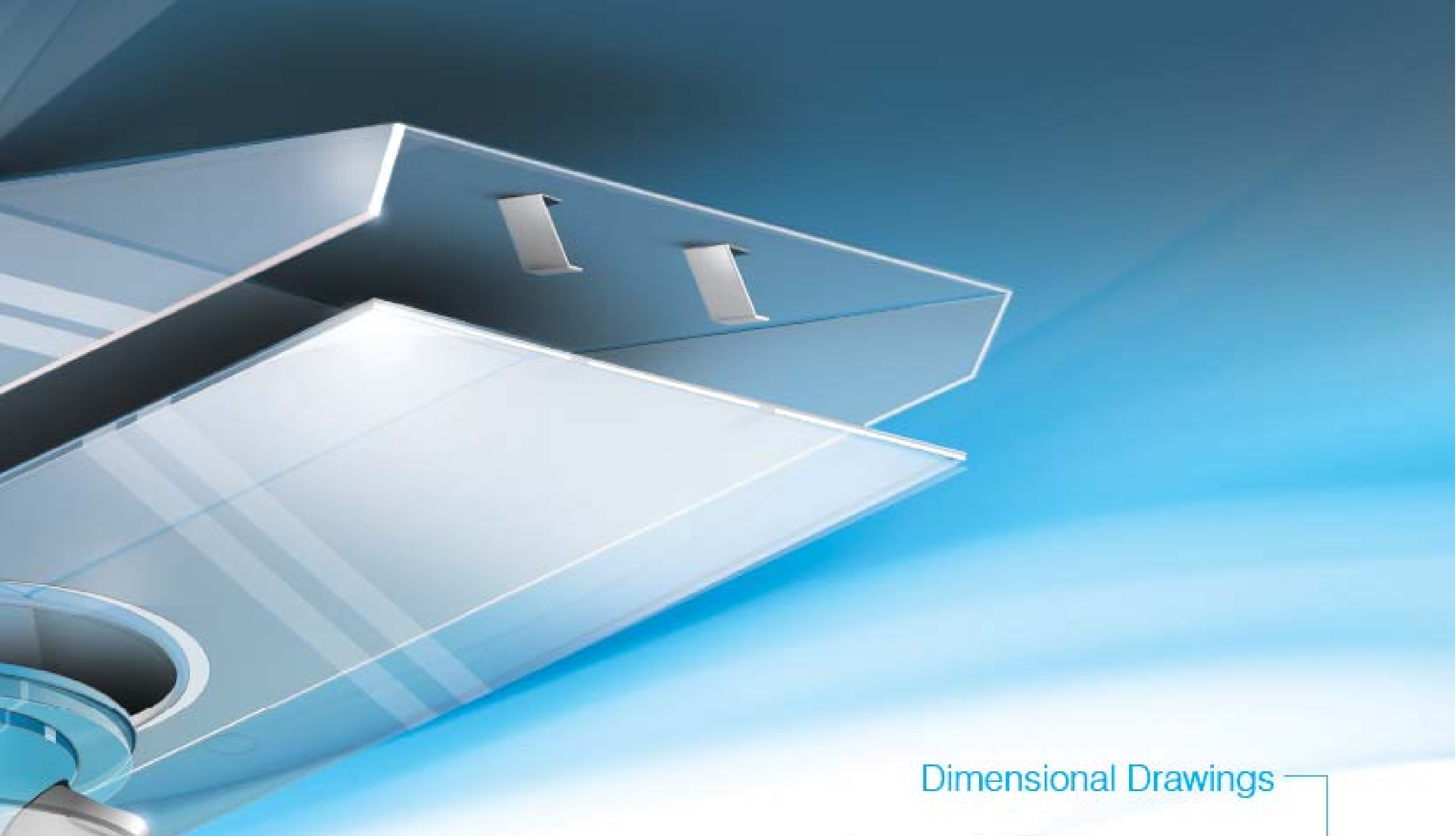
The JIU series JetVent Fans are designed for general car park ventilation requirements. All units in this range are suitable for car park installations where a low ceiling height and tight spaces make fitting the fans particularly challenging. The JIU-CPC2 series can be controlled either by a Variable Speed Drive (VSD) or two-speed switching, while the JIU-CPMF series is suitable for lower cost installations requiring only two-speed control.

Product Code	Fan Speed		Thrust Rating		Car park Installed Noise Levels		Free-field Noise Rating		Power Rating		Control Types	
	r/s		N		dB(A)#		dB(A) @ 3m		kW		2-Speed	Analogue
	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	Relay *(See Page 29)*	VSD *(See Page 30)*
JIU-CPMF-50N	23	16	50	22	76	67	69	60	0.75	0.25*	✓	✗
JIU-CPC2-50N	24	12	50	12	82	66	73	57	1.38	0.35	✓	✓
JIU-CPC2-100N	23	12	100	18	82	66	72	57	2.42	0.61	✓	✓

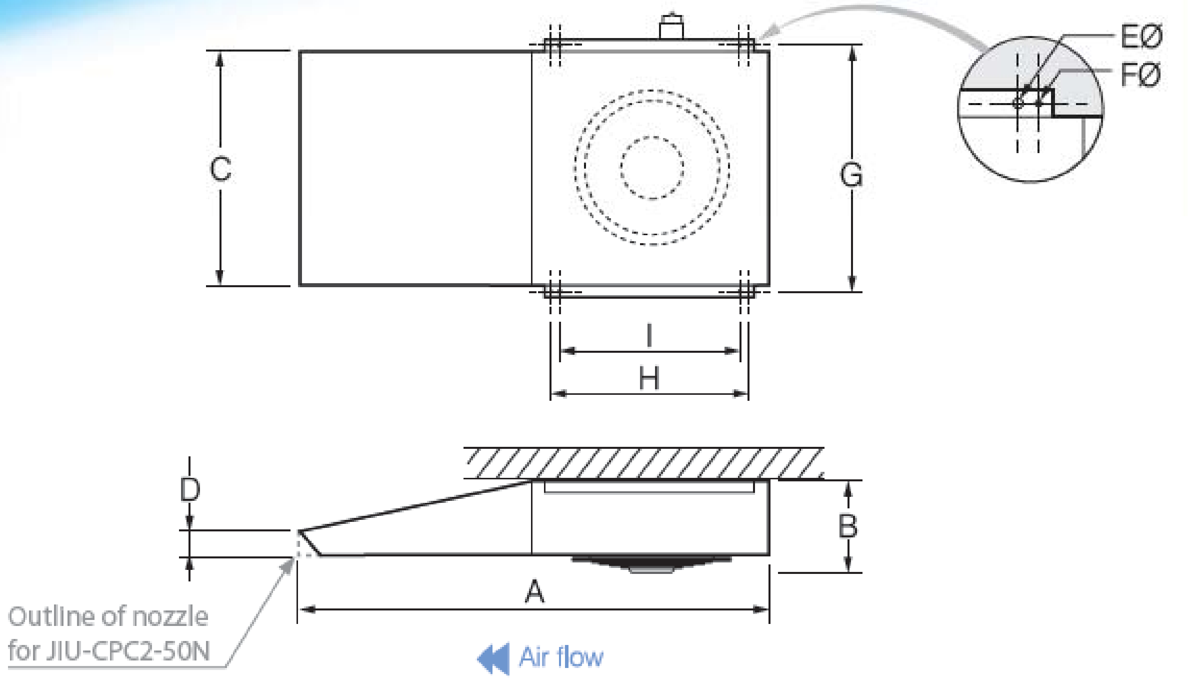
Car park installed noise levels apply 8m away from the fan with multiple fans operating. Contact your nearest Fantech office to confirm if this is applicable to your installation.

* Estimated power consumption.

Table 2. JetVent JIU series technical data



Dimensional Drawings

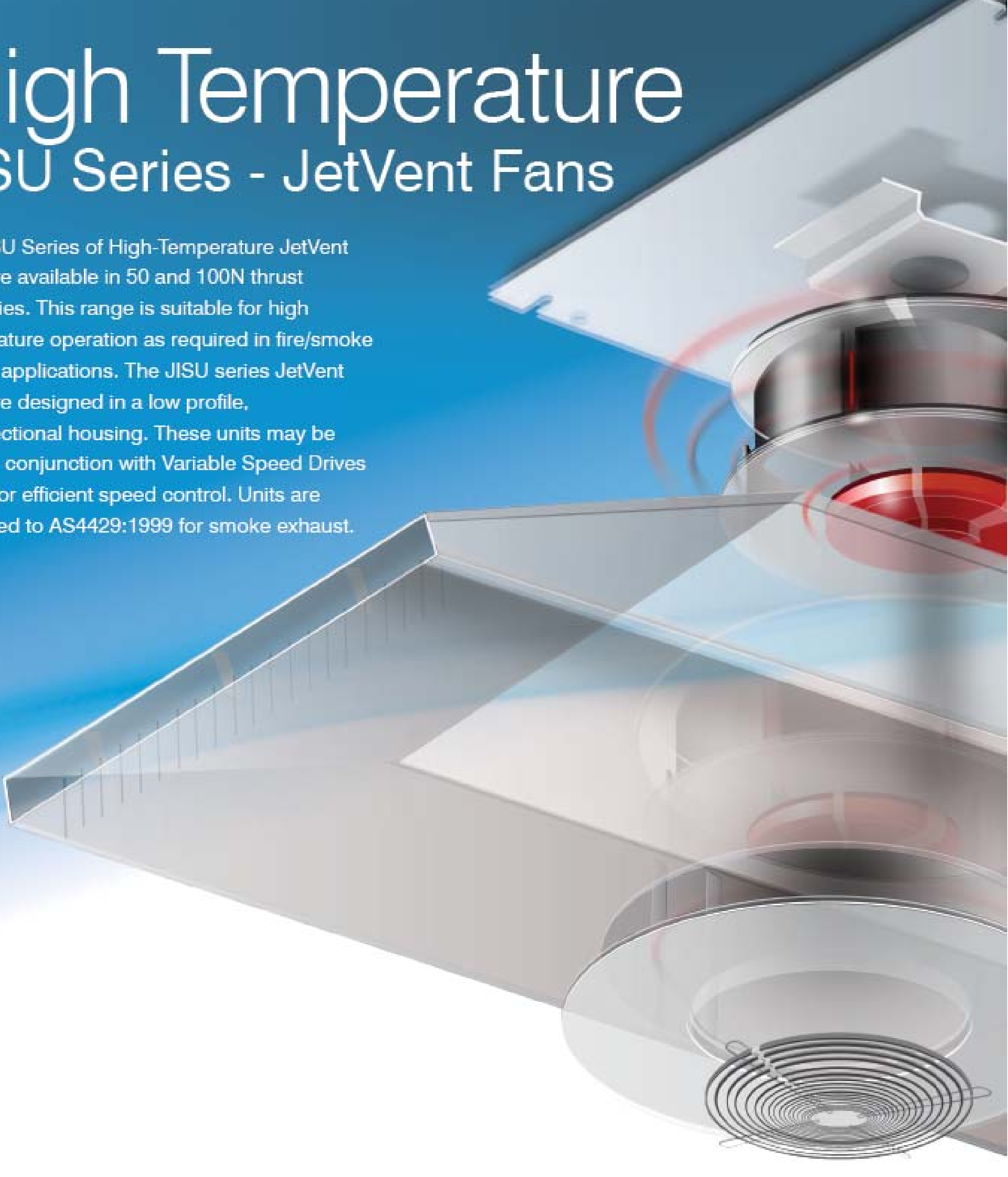


Product Code	A	Vertical Height B	C	D	EØ	FØ	G	H	I	Approx. Weight, kg
JIU-CPMF-50N	1602	313	798	83	25	13	872	675	605	71
JIU-CPC2-50N	1265	268	784	75	25	13	866	395	325	86
JIU-CPC2-100N	1830	330	1144	69	25	13	1233	675	605	160

Note:
- High/Low speeds selected by switching from star to delta electrical connection.
- Further fan options available for low noise/low Speed models.
- Electrical supply - 415V, three-phase, 50Hz.

High Temperature
JISU Series - JetVent Fans

The JISU Series of High-Temperature JetVent Fans are available in 50 and 100N thrust capacities. This range is suitable for high temperature operation as required in fire/smoke control applications. The JISU series JetVent Fans are designed in a low profile, uni-directional housing. These units may be used in conjunction with Variable Speed Drives (VSD) for efficient speed control. Units are approved to AS4429:1999 for smoke exhaust.



Product Code	Fan Speed		Thrust Rating		Car park Installed Noise Levels		Free-field Noise Rating		Power Rating		Control Types	
	r/s		N		dB(A)[#]		dB(A) @ 3m		kW		2-Speed	Analogue
	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	Relay *(See Page 29)*	VSD *(See Page 30)*
JISU-CPC-50N	23	15	50	25	78	69	69	60	1.42	0.45*	✗	✓
JISU-CPC-100N	21	14	100	50	77	68	68	59	2.6	0.75*	✗	✓

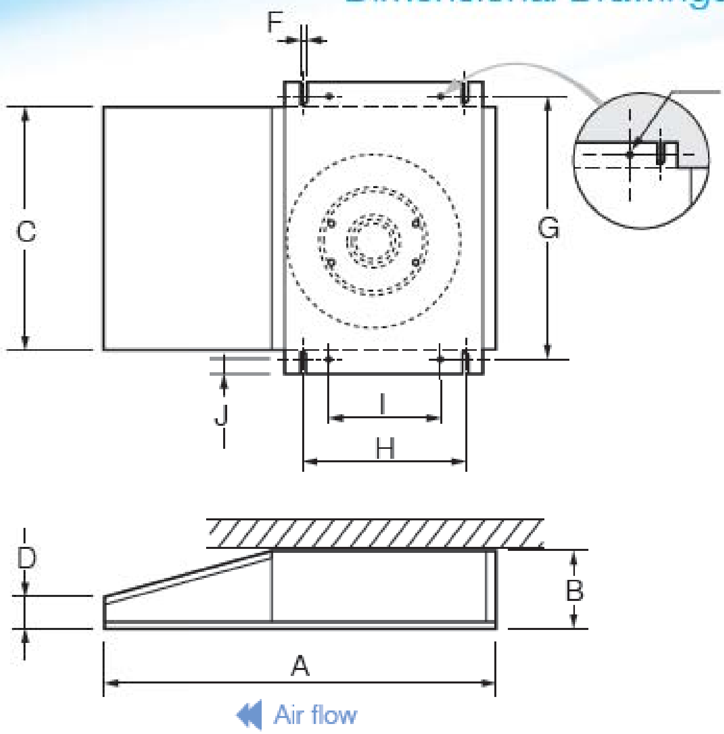
Low

[#] Car park installed noise levels apply 8m away from the fan with multiple fans operating. Contact your nearest Fantech office to confirm if this is applicable to your installation.

* Estimated power consumption.

Table 3. JetVent JISU series technical data

Dimensional Drawings



Product Code	A	Vertical Height B	C	D	EØ	F	G	H	I	J	Approx. Weight kg
JISU-CPC-50N	1262	250	790	102	30	16	890	607	427	60	85
JISU-CPC-100N	1832	320	1150	69	30	16	1240	600	450	50	184

Dimensions in mm

Note:

- High/Low speeds selected through VSD control of fans to listed speed.
- Lower noise levels achievable with further speed reduction.
- When VSDs are used with these models, sinusoidal filters are required in the power supply to these fans.
- Electrical supply - 415V, three-phase, 50Hz.

Digital EC
JIU-CPCEC Series JetVent Fans

The JIU-CPCEC series of JetVent fans represents a new step forward in car park ventilation systems. These energy efficient fans feature advanced digital EC motor technology with integrated speed control, doing away with VSDs, current overloads and motor phase protection. It even simplifies electrical connections between fans in the car park.

However, the truly revolutionary feature of this system is ComLink, the digital communication between JetVent fans, sensors and the pre-configured Digital EcoVent Zone Controller. The result is a very simple control wiring scheme that is easy to install and easy to commission while providing the ultimate in energy efficiency and system monitoring. The JetVent Digital EC system will vary the operating speed of the impulse fan units and therefore the ventilation rate, according to the CO or NO_x pollutant levels in the car park.

Integrated smoke detection

The Digital EC JetVent fans now come with a factory fitted and fully integrated smoke detection kit that ensures a simplified installation and reliable operation. This innovative feature allows the Fantech EcoVent intelligent car park controller or BMS to monitor for smoke and respond accordingly.

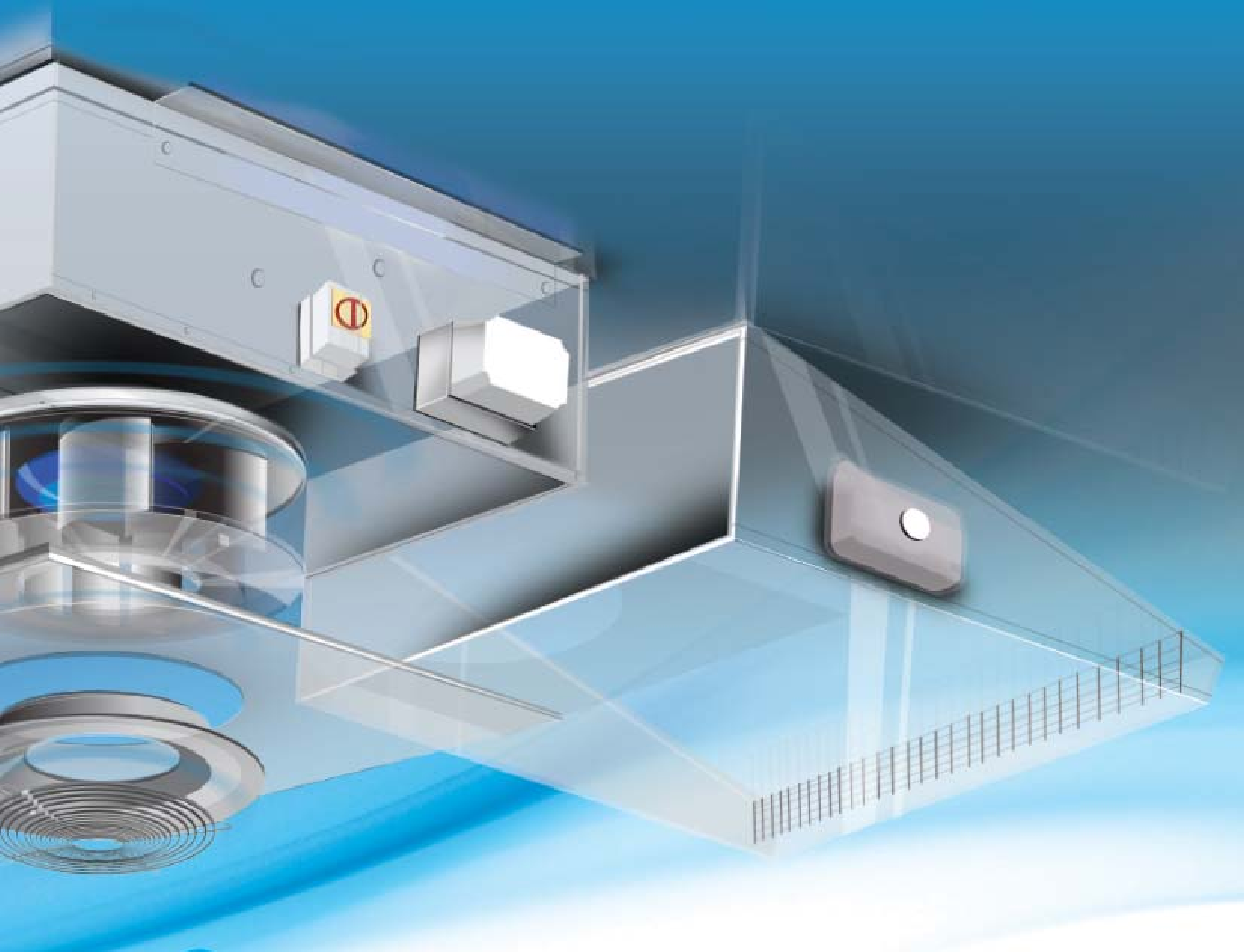
Product Code	Fan Speed		Thrust Rating		Car park Installed Noise Levels		Free-field Noise Rating		Power Consumption		Current	
	rpm		N		dB(A) @ 8m#		dB(A) @ 3m#		kW		A	
	High speed	Pre-set speed*	High speed	Pre-set speed*	High speed	Pre-set speed*	High speed	Pre-set speed*	High speed	Pre-set speed*	High speed	Pre-set speed*
JIU-CPCEC-HP	1230	858	91.8	48.2	75.2	65.0	65.8	56.5	2.9	1.0~	4.2	1.6
JIU-CPCEC-SD	1770	1296	52.2	28.4	72.4	65.0	64.4	56.7	1.7	0.7~	2.5	1.1
JIU-CPCEC-LH	1770	1120	46.8	18.9	76.4	65.0	68.7	56.7	1.7	0.4~	2.6	0.8

Car park installed noise levels apply 8m/3m away from the fan with multiple fans operating. Contact your nearest Fantech office to confirm if this is applicable to your installation.

~ Estimated power consumption.

* Pre-set speed so fan does not operate above the AS2107:2000 recommended noise level of 65dB(A) @ 8m.

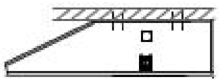
Table 4. JetVent JIU-CPCEC series technical data



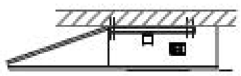
How to Order

Step 1

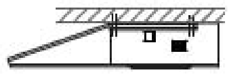
Select the digital EC JetVent fan model



JIU-CPCEC-HP



JIU-CPCEC-SD



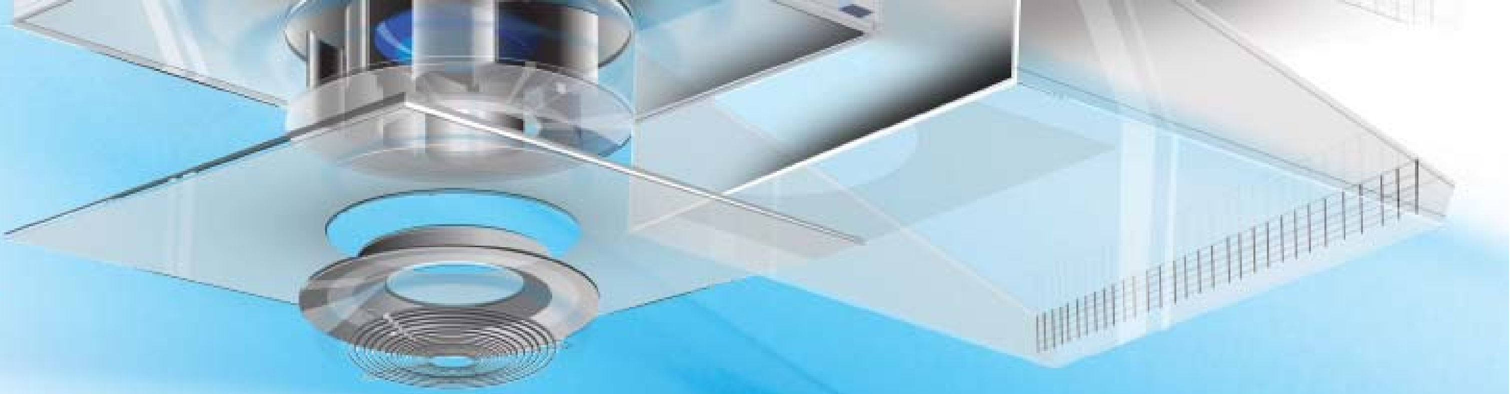
JIU-CPCEC-LH

Step 2

Select Isolator or Smoke Detection Kit

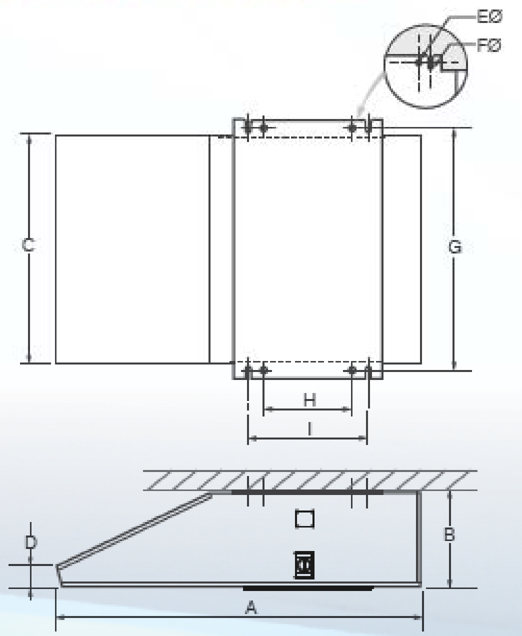
Isolator Kit
(Code: JIU-ISOLATORKIT)

Smoke Detector Kit
(Code: JIU-SMOKEKIT)

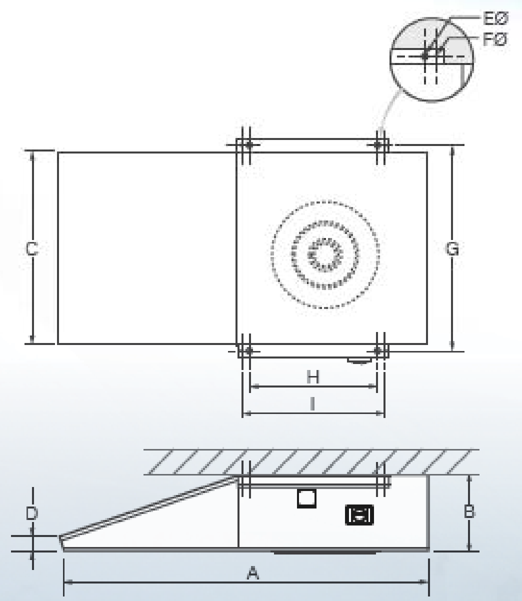


Digital EC
JIU-CPCEC Series
JetVent Fans

Dimensional Drawings



JIU-CPCEC-HP



JIU-CPCEC-LH/SD

Product Code	A	Vertical Height B	C	D	E	F	G	H	I	Approx. Weight kg
JIU-CPCEC-HP	1833	492	1151	110	30	16	1240	450	600	160
JIU-CPCEC-SD	1745	370	906	68	25	13	973	605	675	89
JIU-CPCEC-LH	1745	322	906	68	25	13	973	605	675	89

Dimensions in mm

Note:
- Lower noise levels achievable with further speed reduction.
- Electrical supply - 415V, three-phase, 50Hz.

System Layouts & Applications

Assisted Natural Flow/Augmented Ducted System

Where supply and exhaust air outlets are a large distance apart (more than 40m), there must be provisions to ensure air moves evenly across the width of the carpark.

JetVent Fans can be used to maintain constant air movement in these car parks to remove the effects of air stagnation and the resulting build up of pollutants. In large open car parks, JetVent Fans can be used to create a large pressure difference between supply and exhaust, hence boosting air flow in and out of the car park as shown in Figure 3.

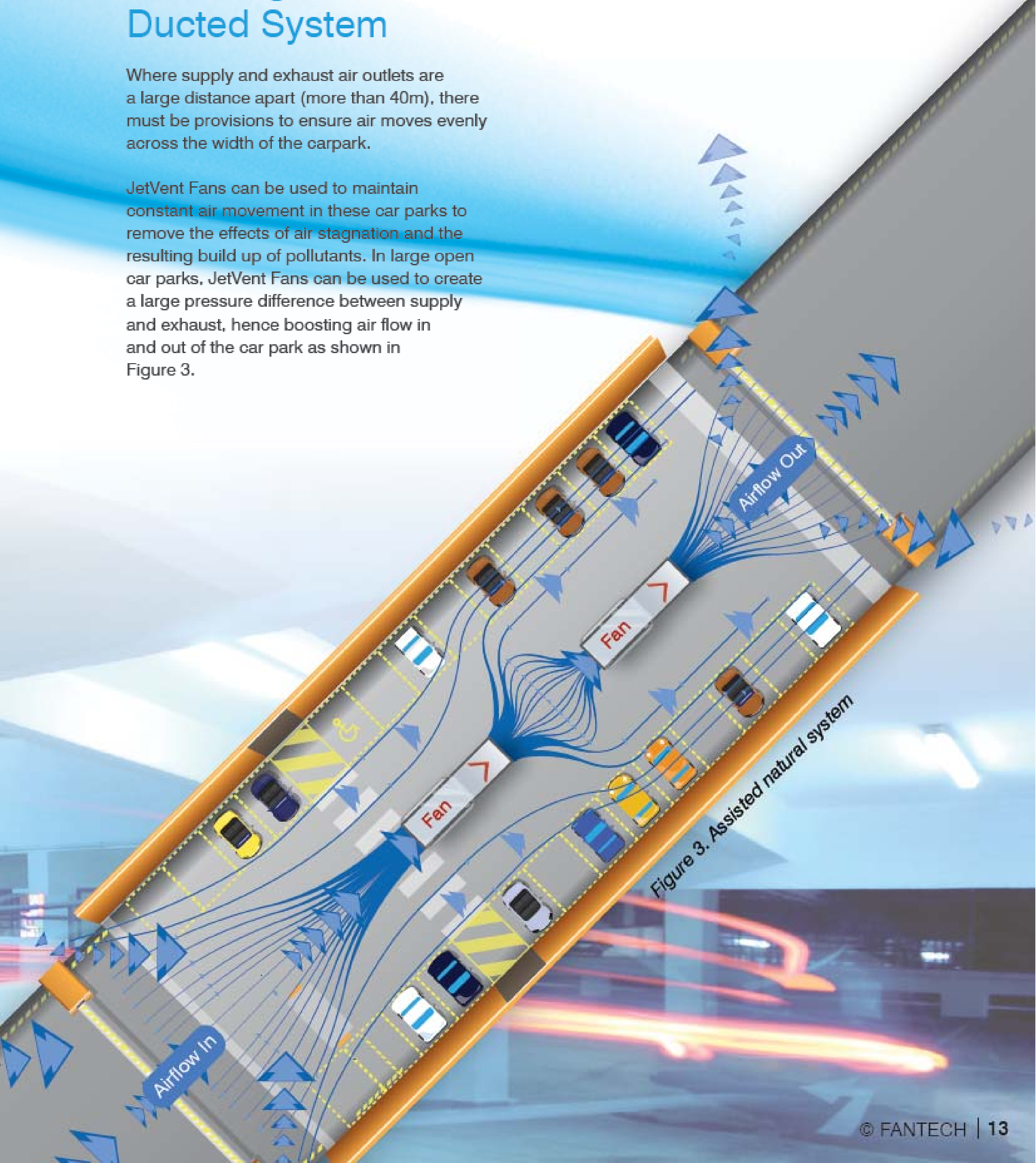


Figure 3. Assisted natural system

System Layouts & Applications

Linear flow

A linear flow system uses JetVent Fans pointing in the same general direction to move air from one end of a car park to the other. This system is similar to a traditional mechanically ducted system, the main difference is that the JetVent Fans direct air flow from a single supply point to a single exhaust point.

For this scheme to work effectively, the exhaust and supply points should be located on opposing ends of the car park across its longest dimensions (refer to Figure 4). If this is not the case, units arranged for circular mixing may be a better solution (refer to following page).

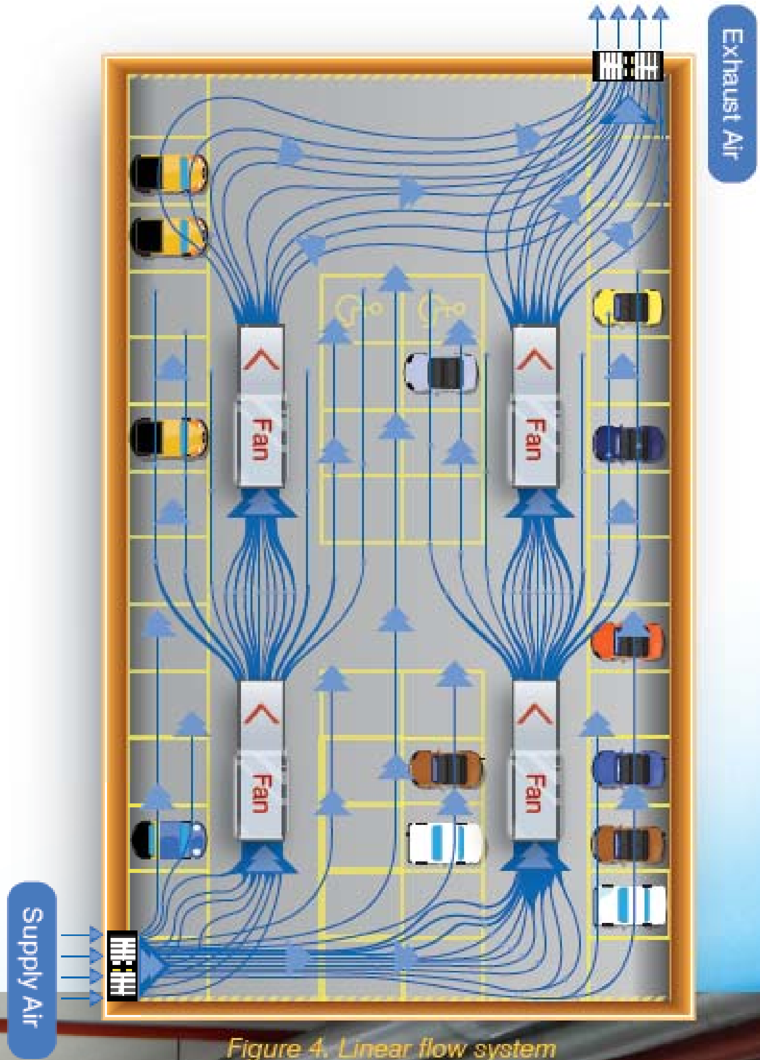


Figure 4. Linear flow system

Circular mixing

JetVent Fans can be positioned around the car park to generate air movement in a circular pattern. The result is that air gets mixed and stirred throughout the entire area, which provides greater dilution of pollutants within the car park. Figure 5 gives an example of this system layout and shows the direction of air flow from supply to exhaust.

Circular mixing is suitable for smaller car parks where the length and width of the car park is less than 50m. This system also provides added flexibility when positioning supply and exhaust points. Unlike a linear flow system, a circular mixing system does not require exhaust and supply points to be on opposite sides of the car park.

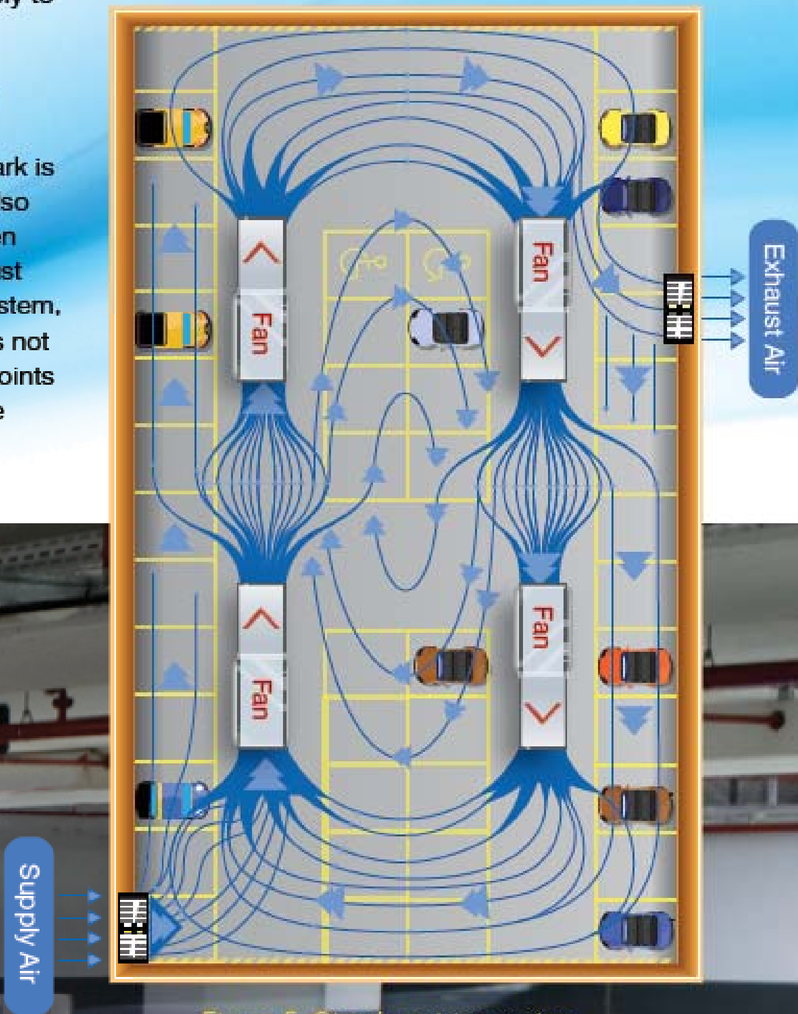
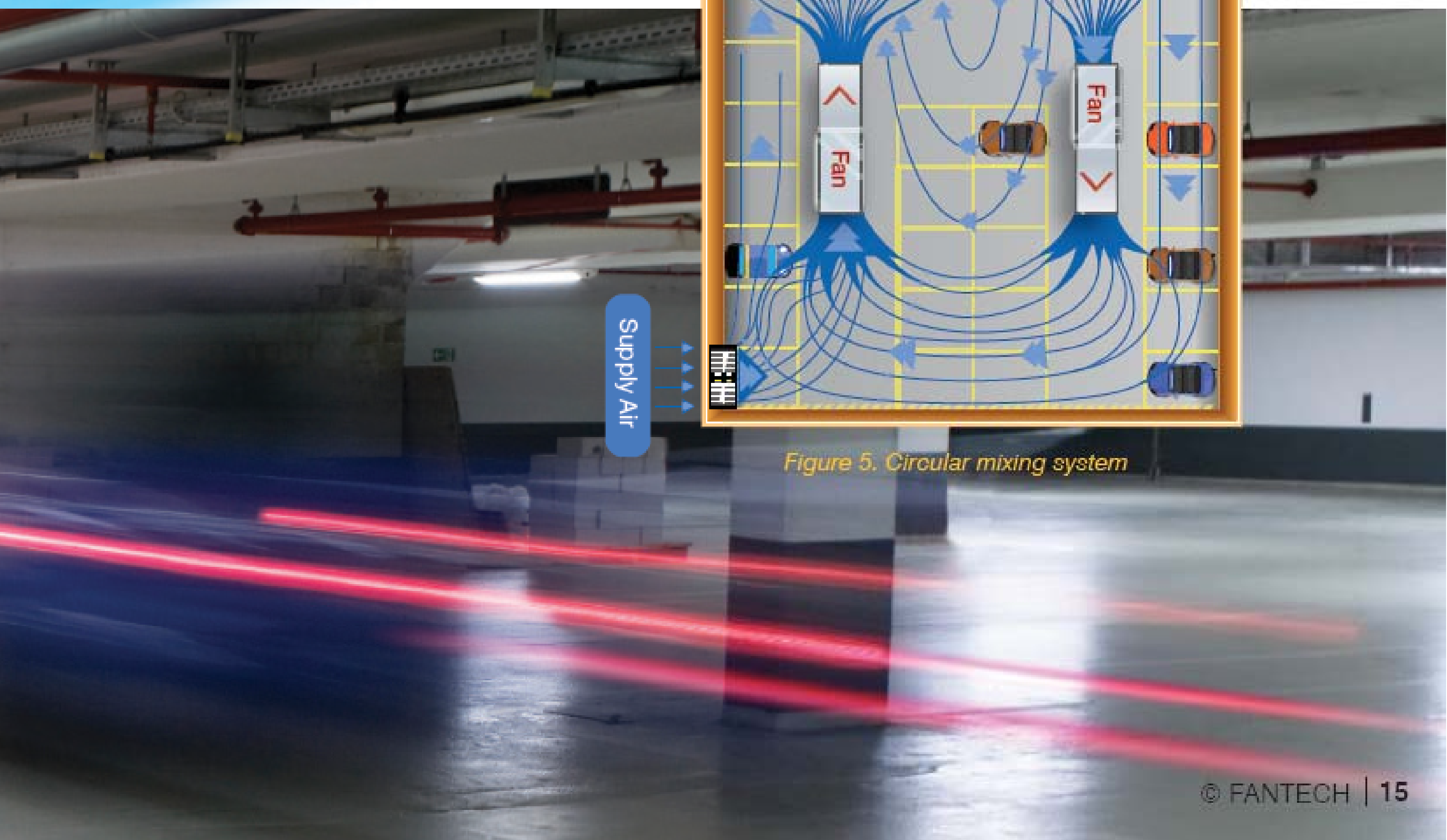


Figure 5. Circular mixing system



Designing & Implementing the System

Estimating fan quantities

For the purpose of estimating costs, the steps on the following pages may be bypassed. Allow 5N of thrust per 100m^2 of car park floor area to approximate the number of fans required.

The following steps are sufficient to create an initial impulse ventilation system design. A Computational Fluid Dynamics (CFD) analysis is often required to prove and further refine the design. Fans may need to be re-orientated, or in some cases, added or removed.

An impulse ventilation system can be tailored to suit virtually any car park. Before considering fan locations, the system layout will need to be identified. Refer to the previous section for information relating to system layouts and their suitability for particular car parks.

Step 1
Assessing Car Park Geometry

First identify the supply and exhaust points in the car park. A system that complements the natural air path and is able to circulate or move air effectively within the car park should be chosen. Certain layout features may assist the effectiveness of a particular layout as shown below:

(a) 'Natural air path'

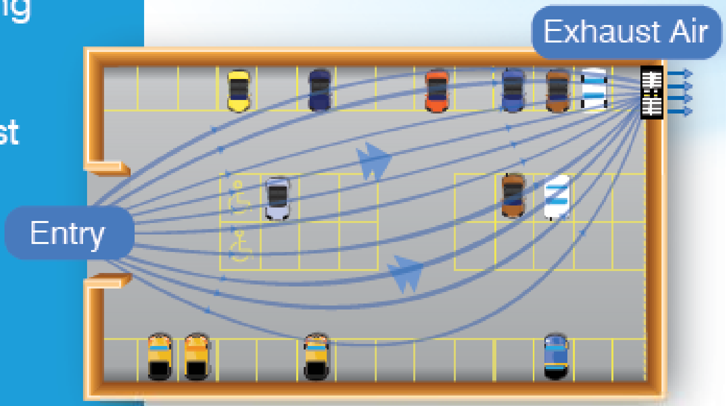


Figure 6(a). Preferred natural air path

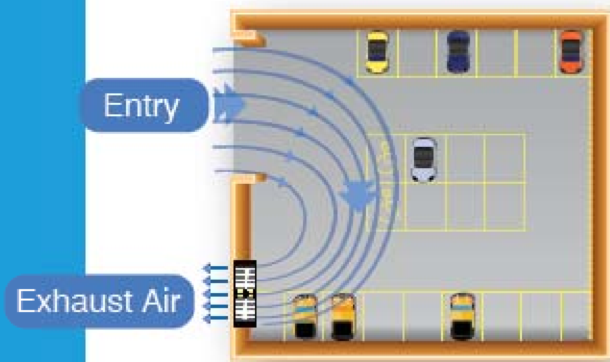


Figure 6(b). Natural air path to be avoided

- For 'Linear Flow Systems', supply and exhaust points should be spaced across the length of a car park.
- 'Circular Mixing Systems' are more tolerant of closely placed supply and exhaust points, but it is advisable to have a good amount of separation.
- Supply air points should include access ramps to outside.
- The impulse ventilation system layout should complement the natural air path from supply to exhaust points.

(b) Ceiling features

To make the system more effective, position JetVent Fans in-line with supporting ceiling beams as illustrated in Figure 7(a). If this is not possible, the system becomes less effective and more fans may be needed.

(c) Vertical clearance

Sufficient vertical clearance ensures maximum flexibility in system design. JetVent Fans may be recessed between ceiling beams to minimise the height of the system.

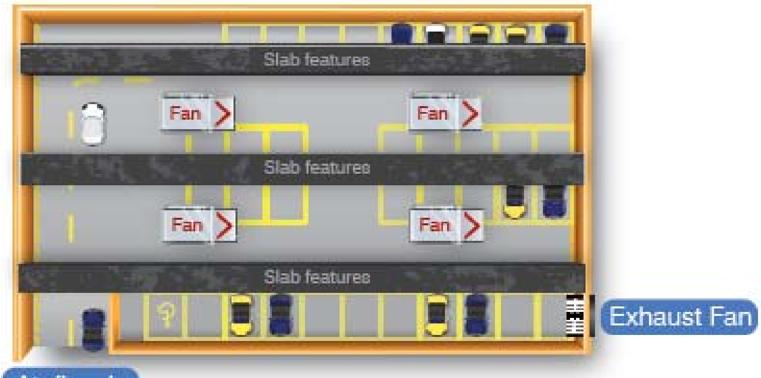


Figure 7(a).
Fan's air movement parallel to beams is most effective

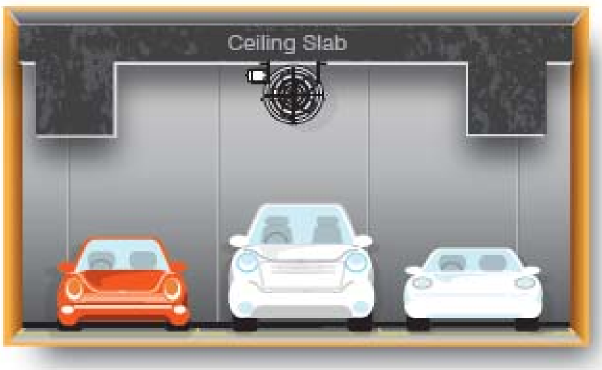


Figure 8(a). Sufficient clearance

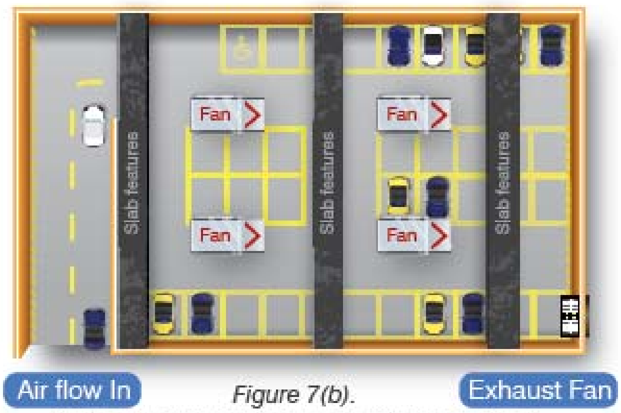


Figure 7(b).
Fan's air movement perpendicular to beams is less effective

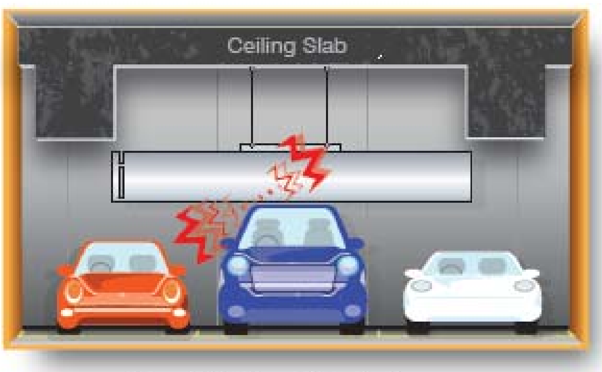


Figure 8(b). Insufficient clearance

(d) Obstructions

If there is no option and the JetVent Fans must blow across ceiling beams, they have to be positioned a sufficient distance away from the obstruction as illustrated in Figure 9(b). A horizontal distance eight times (8x) the height of the obstruction is generally sufficient. Nozzles on the JetVent units are specially designed and angled downwards for this purpose.

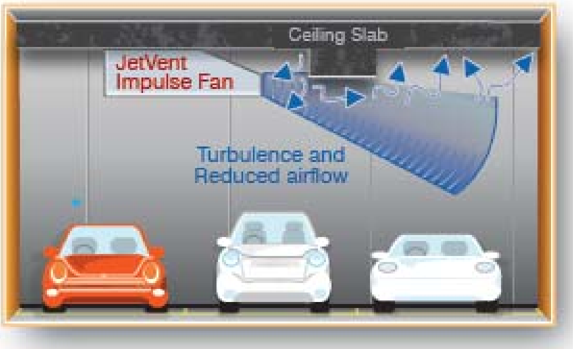


Figure 9(a). Obstruction too close

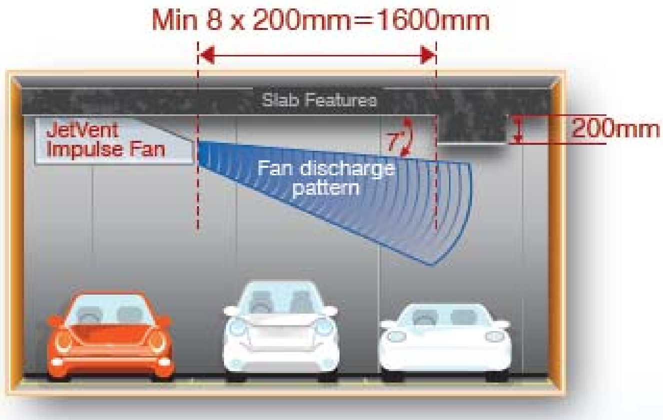


Figure 9(b). Obstruction out of the way

(e) Clashes with other services

Place mechanical service components, such as sprinklers, signs and pipework out of the JetVent's discharge pattern area. Examples of these clashes are shown below.

Figure 10(a). An example of how to avoid clashes with pipe-work

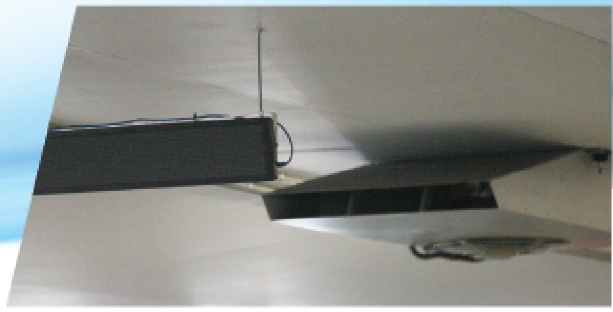


Figure 10(b). Signs can impede fan throw

Figure 10(d). Pipe work can impede fan throw

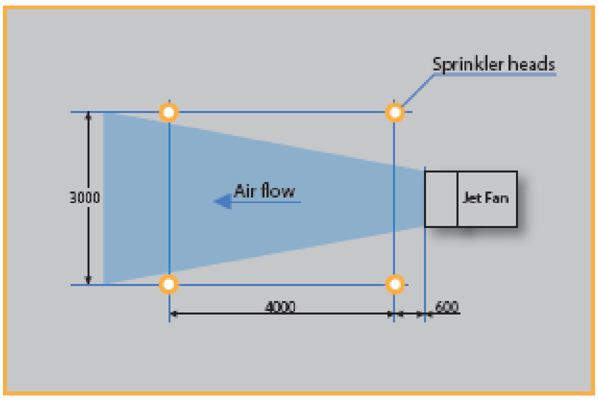
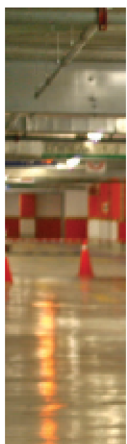


Figure 10(e). Jet fan layout in relation to sprinkler heads.



Step 2
Identify Fan Selection and Spacing

Table 5 shows the maximum and recommended spacings between JetVent Fans for different levels of fan thrust. These spacing distances are guidelines for fans placed in series. When using these spacings, air velocities in most of the ventilated areas should be greater than 1m/s. Analysis will determine whether this is achieved in a particular car park design. In some ideal cases, designs using the maximum distances have been effective.

Fan thrust depends on the operating speed of a particular fan unit and its thrust rating. See tables one to four for the thrust ratings of various fan models at different speeds.

Operating fan thrust	Recommended fan to fan spacing distance	Maximum fan to fan spacing distance	Approximate coverage area
50N	45m	60m	1000m^2
28N	34m	45m	560m^2
25N	30m	40m	500m^2
19N	23m	30m	380m^2
12N	12m	20m	250m^2

Note that using fewer higher rated JetVent fans generally makes the system more cost effective than using more lower rated fans. However, to effectively ventilate car parks with unusual or irregularly shaped geometries, selecting more fans with smaller thrust ratings may be necessary.

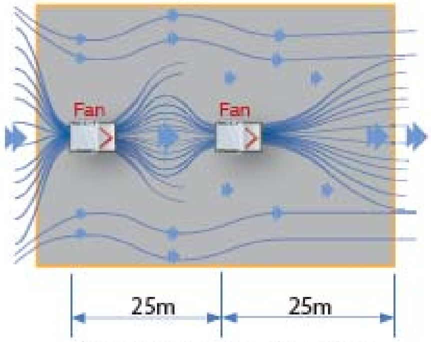


Figure 11(a). Two 25N fans

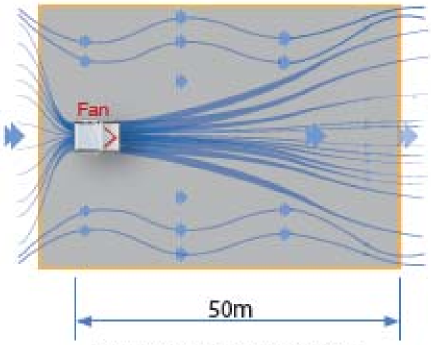


Figure 11(b). One 50N fan

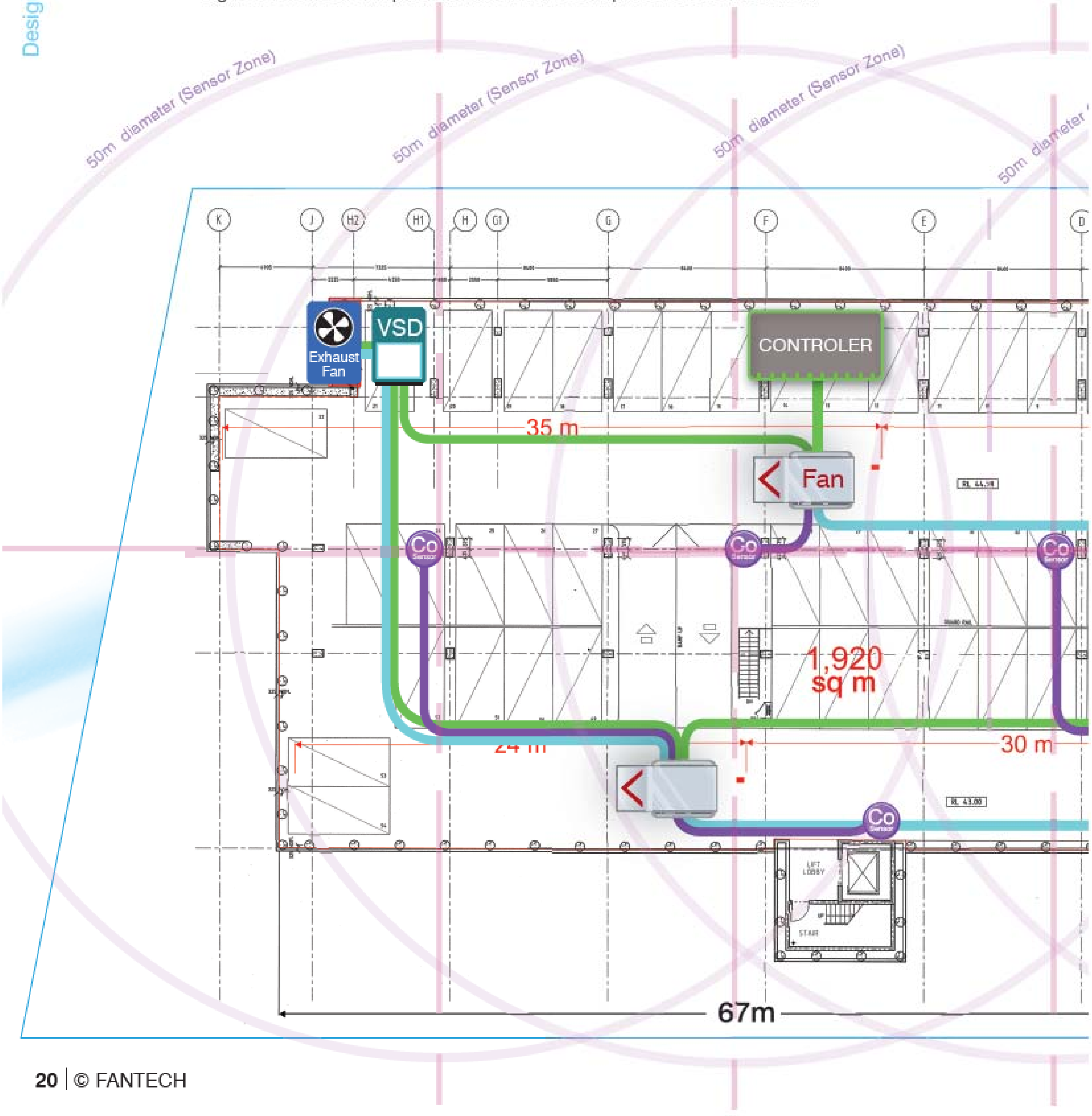
Design and implementation

Step 3 - Design Example

For the purpose of estimating costs, the steps below may be bypassed. Allow 5N of thrust per 100m² of car park floor area to approximate the number of fans required.

Fans should be placed in the laneways with the air blowing along them. This will ensure that the high air velocities close to the outlet nozzle do not significantly disturb pedestrian traffic as velocities will be lower at the lane edges. Also, ensure that the throw pattern of the selected fan is long enough to reach the next impulse fan.

Figure 12 shows an example of how fans are sized and placed based on floor area.



Design parameters;

- Based on 5N per 100m² floor area,

  minimum total fan thrust = car park floor area x 5N/100m²
  = 1920m² x 5N/100m²
  = 96N

- Minimum thrust criteria can be achieved with 4 x JISU-CPC-50N fans on low speed (operating thrust 25N), total fan thrust= 25N x 4= 100N.
- Fans are spaced within the 30m spacing recommendation for 25N thrust.
- Final fan to wall spacing under 40m maximum spacing guide lines for 25N fan thrust. This is because the exhaust point is an area of low pressure, making it likely to enhance the fan throw distance.

Placement of CO sensors:

Because the guidelines for positioning CO sensors in AS/NZS1668.2:2012 is based on a ducted system, we propose that the following guidelines be used as a starting point for their placement in a jet fan system.

1. No part of the enclosure shall be greater than 25 metres from a sampling point. (A 50 metre diameter circle around a CO sensor can show coverage areas).
2. Additional detectors shall be installed in areas where people may congregate within the car park and are not within separately ventilated areas.
3. The most practical mounting position for a CO sensor within a car park is the support columns.
4. CO sensors will be more effective if placed in areas where CO levels are likely to be high. Eg. Placing a CO sensor in front of a fresh air intake is not likely to be effective.

If jet fans are placed in each laneway of a car park and the recommended low speed jetfan spacings are followed, the above guidelines can be achieved by using one CO sensor per jet fan and providing additional CO sensors at congregation points. Therefore, for this car park we would suggest installing 5 (4 + 1) CO sensors for good coverage.

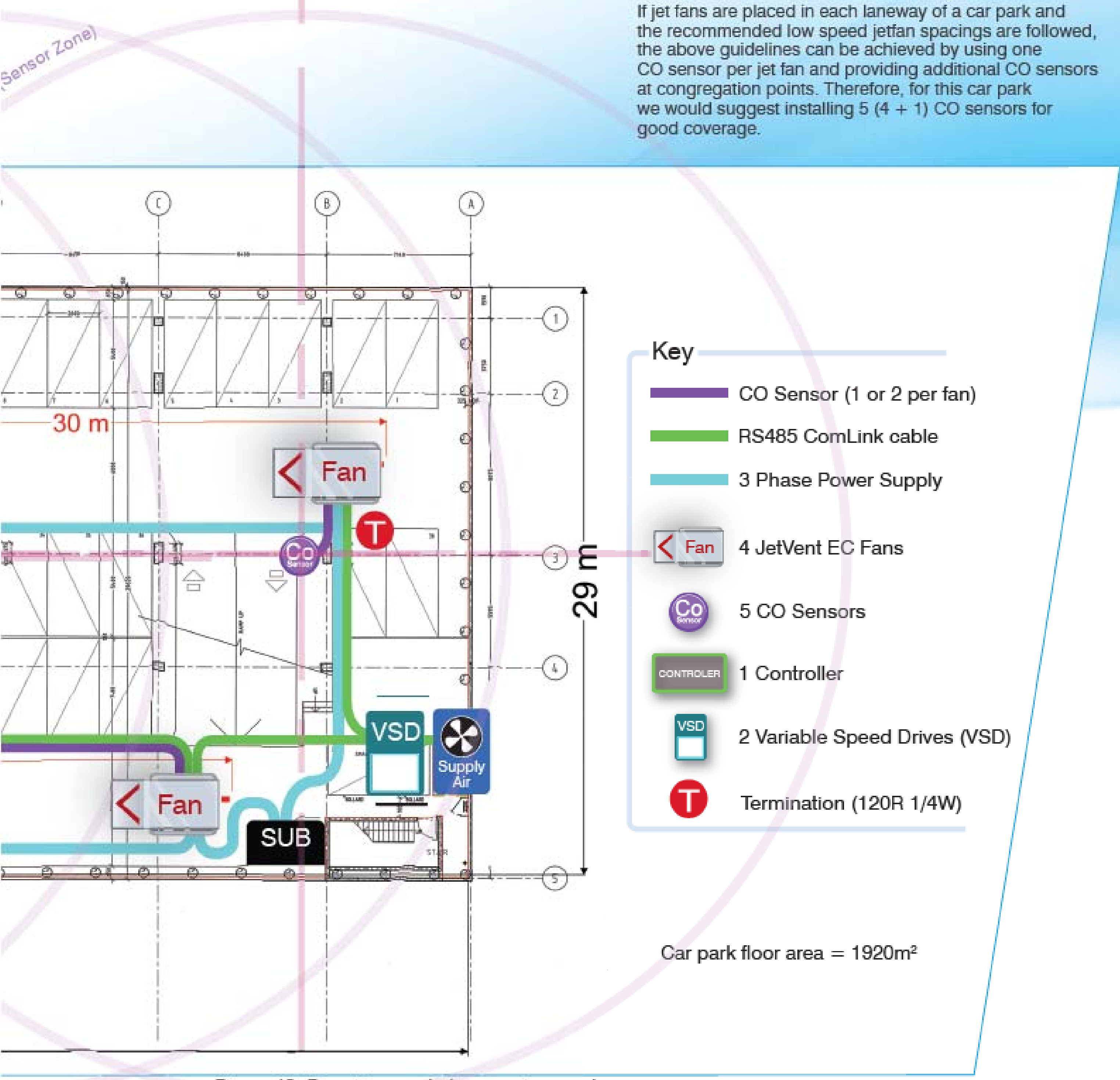


Figure 12. Fan sizing and placement example

Step 4 - Calculate Supply & Exhaust Rates

Section 4 of AS/NZS1668.2:2012 details requirements for ventilating car parks.
In particular, sub-sections 4.4.3 and 4.4.4.2 of the standard outlines calculations of exhaust rates. In any of the two cases below, the exhaust air flow rate for a car park is taken as the greatest of the following calculations:

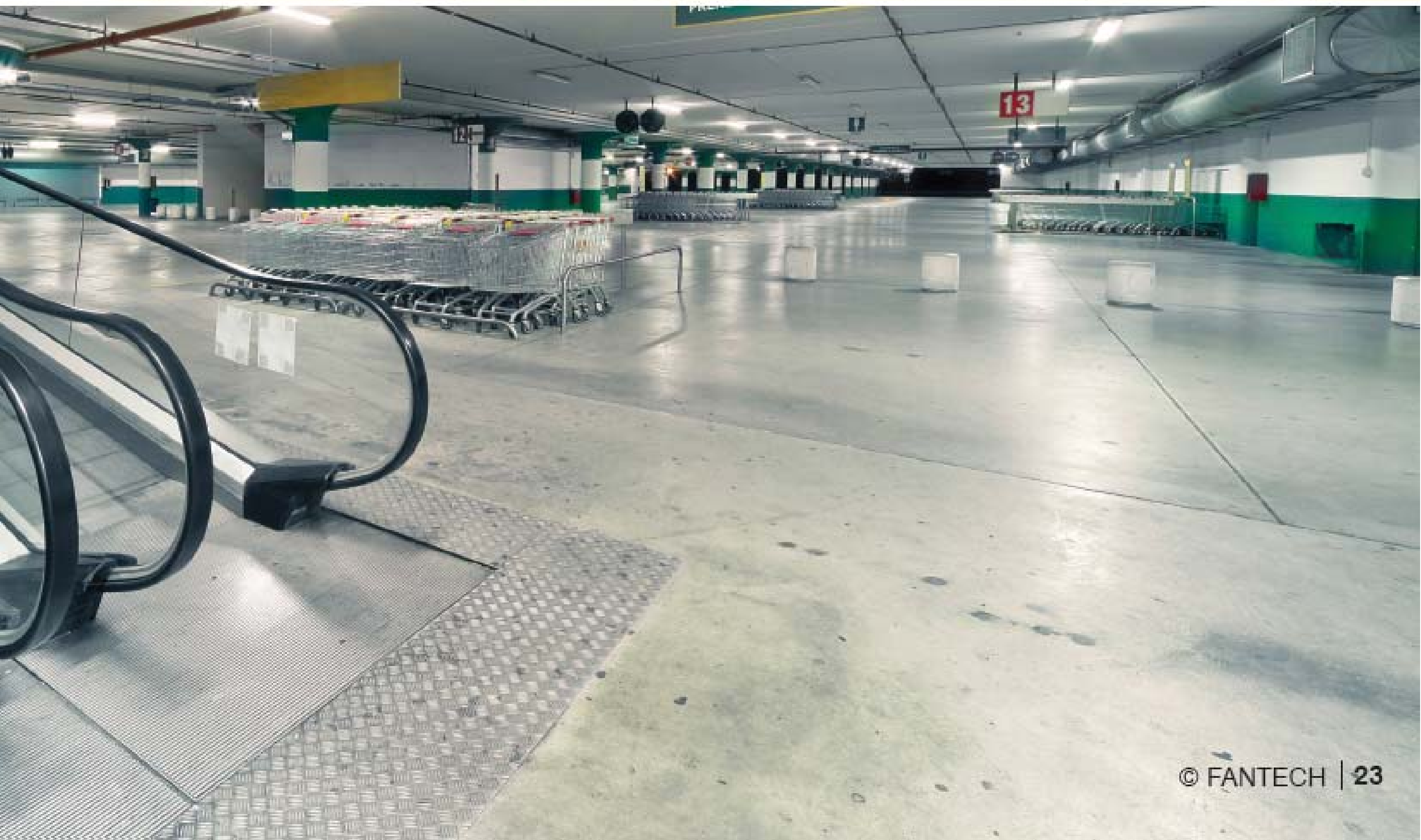
Calculation of exhaust air flow rates	
Car parks with more than 40 spaces	**Car parks with less than or equal to 40 spaces**
a) 2000 x F x T Litres/s (minimum air quantity for one operating car)	a) 2000 Litres/s
b) $0.85 \times P \times (100 \times n_1 + n_1 \times d_1 + n_2 \times d_2) \times E \times T$	b) 2.5 x *A* Litres/s
c) 2.5 x A Litres/s (minimum air quality based on area of car park)	c) 400 n_1 x *P* Litres/s

Supply air flows should range from 75% to 90% of the exhaust air quantity. This is based on the pressurisation of the car park, which should be 12Pa maximum.

Reference information for the calculation of exhaust air flow rates in the table above:

- A = the area of the zone or level, in square metres
- d_1 = the average driving distance, in metres, within the zone or level under consideration for the exit of a car parked there (see Clause 4.4.4.1)
- d_2 = the average driving distance, in metres, within the zone or level under consideration for the exit of a car whose exit route passes through the zone or level under consideration, but excluding any part of the exit route designated as queuing areas and ventilated in accordance with Clause 4.6 (see Clause 4.4.4.1)
- E = the staff exposure factor determined from page 41
- F = the staff usage factor determined from page 41
- n_1 = the number of parking spaces in the zone of level under consideration (see Clause 4.3.2)
- n_2 = the number of parking spaces situated in other parts of the car park, having exit routes passing through the zone or level under consideration
- P = the parking usage factor determined from page 40
- T = the vehicle type factor determined from page 40

If the car park has significant queuing areas for vehicles, refer to section 4.6 in AS1668.2:2012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Step 5 - Select your control strategy

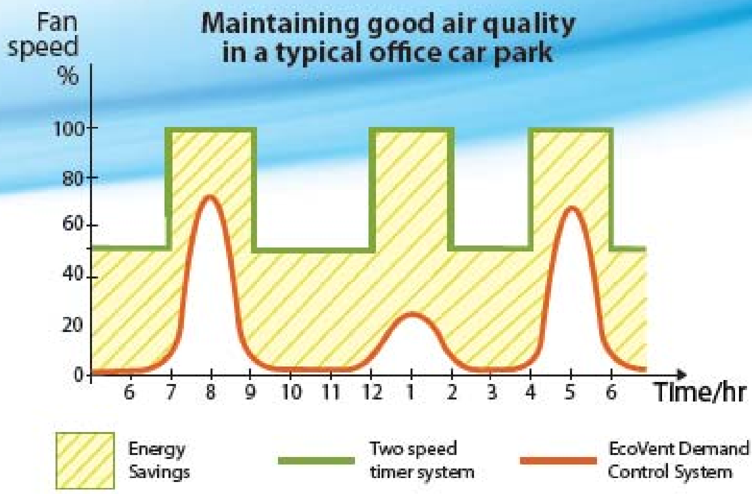
The EcoVent Control System is a tailored solution, designed to efficiently manage the car park ventilation equipment. It helps maintain good air quality when the car park traffic is high and conserve energy when it is low.

Overview

The EcoVent Control System works in conjunction with the JetVent fans, CO and NOx pollutant sensors, variable speed drives, supply and exhaust fans and the BMS. The EcoVent Control System has been developed to help increase the energy efficiency of a car park, while ensuring the ventilation output is optimized. It will vary the operating speed of the car park fans according to when the requirements and demand in the environment develop.

When the CO or NOx pollutant levels within the car park reach a pre-set level, the ventilation fans begin to ramp up in speed. As the levels increase and decrease during the course of the day and night, the speed of the fans and therefore the ventilation rate also increase and decrease.

The EcoVent Control System can also be connected to the fire system in the building to manage the automatic starting/stopping of the fans when a fire is detected (depending on fire/smoke management strategies), and control the fans at the Fire Indicator Panel (FIP) by manual speed control. Some buildings also require links from the Building Management System (BMS) to monitor the operation of the JetVent system in the car park.



Controller

Features

- Quick and easy to install and commission
- Controller's pre-set parameters increase and decrease the fan's speed in proportion to demand
- Will increase the energy efficiency of your car park
- Helps maintain good air quality
- Connects to the FIP
- Full speed override function
- Purge timer function
- Can connect to a BMS for monitoring
- The EcoVent controller can be factory pre-configured to suit specific car park requirements.
- Automatic/off/manual modes of operation
- Integrated smoke detection

Manual and Auto functionality

Step 5 (a) - Digital EC Control Systems

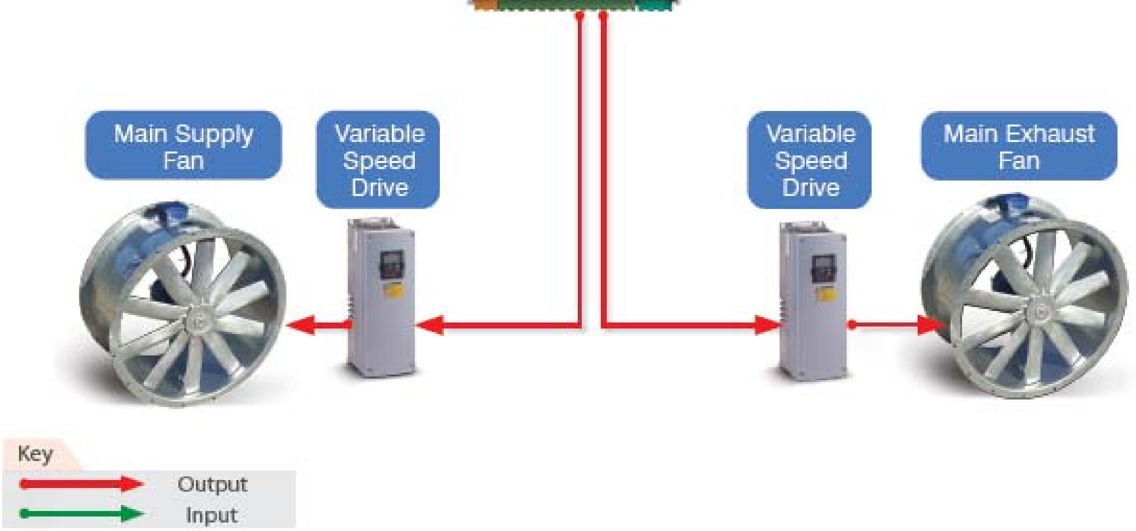
The system comprises of impulse fans that incorporate intelligent, highly efficient Electronically Commutated (EC) motors.

There are two types of Digital EC control systems.

1 Digital EC JetVent fans and analogue VSD control for supply and exhaust fans

Benefits for both control strategies

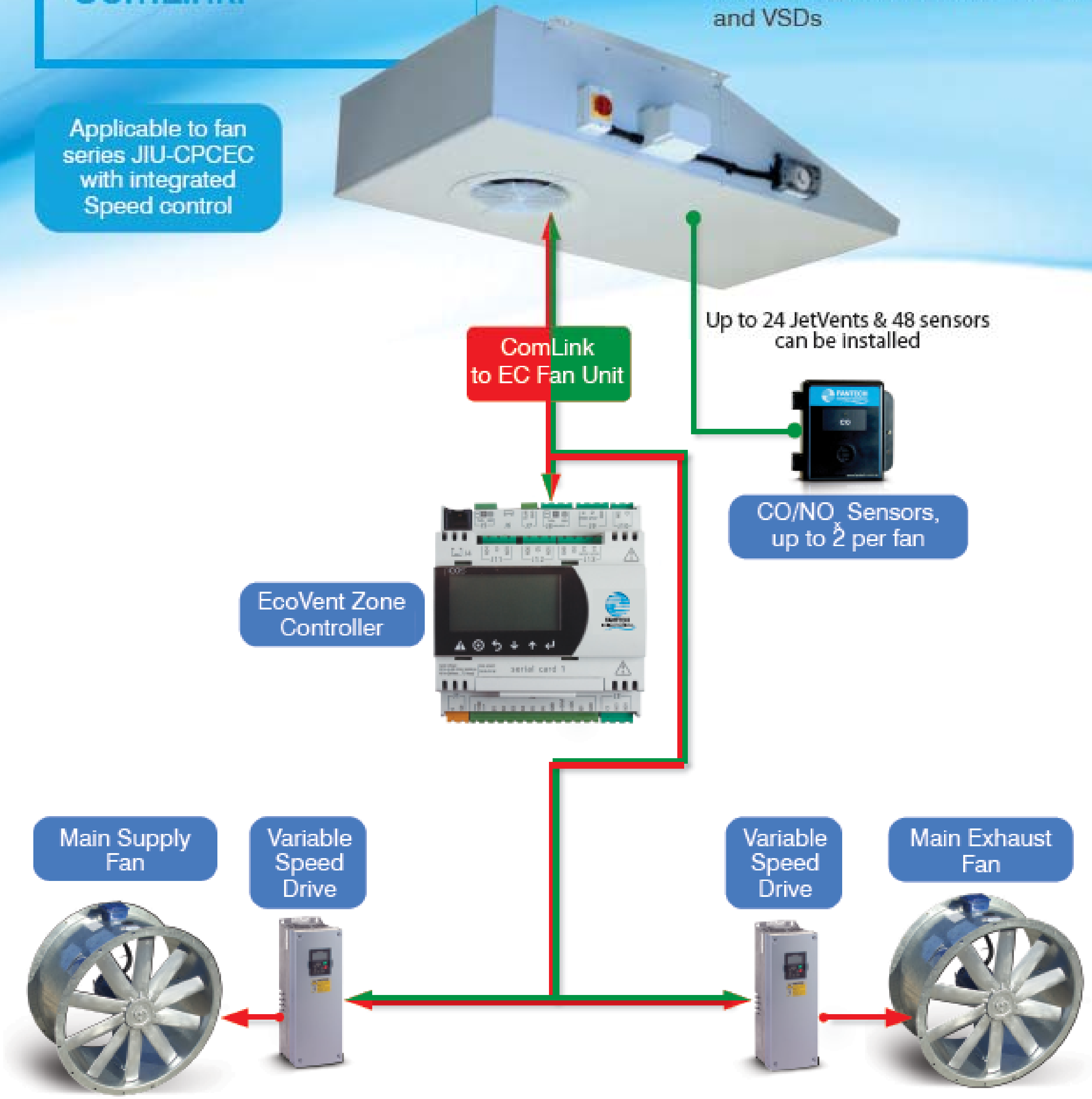
- Most cost effective solution
- Minimal cabling as digital messages are used
- Digital monitoring of Jetvent Fans
- Easy installation
- Easy commissioning
- Lowest running costs
- Excellent noise to airflow ratio
- Soft starting motors
- No VSDs or Sinusoidal filters required for Jetvent fans
- Digital EC Control capability
  - Up to 24 EC JetVent Fans
  - Up to 48 CO/NOx sensors
  - Up to 24 integrated smoke detectors



Additional benefits of control strategy 2

- Controller can monitor the VSDs for actual fan speed and detect any fault conditions that may occur. No additional control equipment is required for this monitoring
- The VSDs can also be daisy chained on the ComLink allowing them to be located up to 1000m from the EcoVent Controller
- Up to 6 VSDs can be connected to the ComLink in supply or exhaust mode.
- Ability to digitally monitor JetVent fans and VSDs

2 Digital EC JetVent fans and digital VSD control utilising ComLink.



Key
Output
Input

Note:

- Fantech sensors included in the Digital EC Control Systems have been designed specifically for this purpose. Please contact Fantech for suitability of any other sensor.
- 120 ohms end of line resister should be used

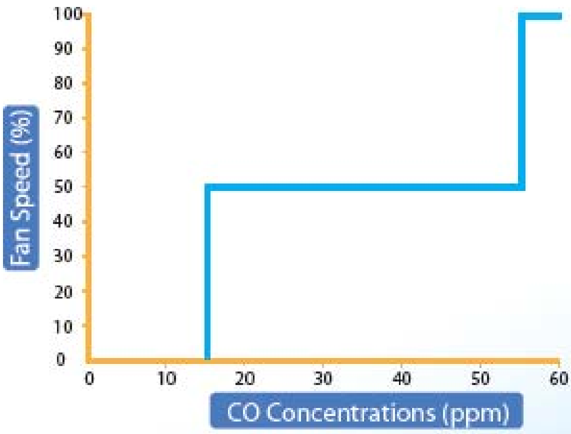
Step 5 (b) - Analogue Systems

An analogue system comprises of impulse fans that incorporate AC motors. There are two ways of controlling these fans and three different control systems.

Methods of controlling an analogue system

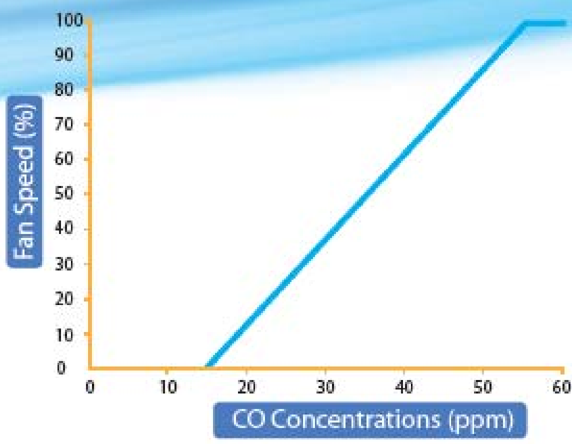
Stepped approach (ie. High/low speed)

Two-speed control involves setting the fans to off, low or high speed with a two-speed motor and relays. The relays are switched by the controller and in turn power contactors to the motor windings. The relays are switched at various set points corresponding to sensor readings in the car park. This is a simple and low cost way of achieving basic speed control of JetVent fans in a car park.



Ramped control of speed (i.e with variable speed control)

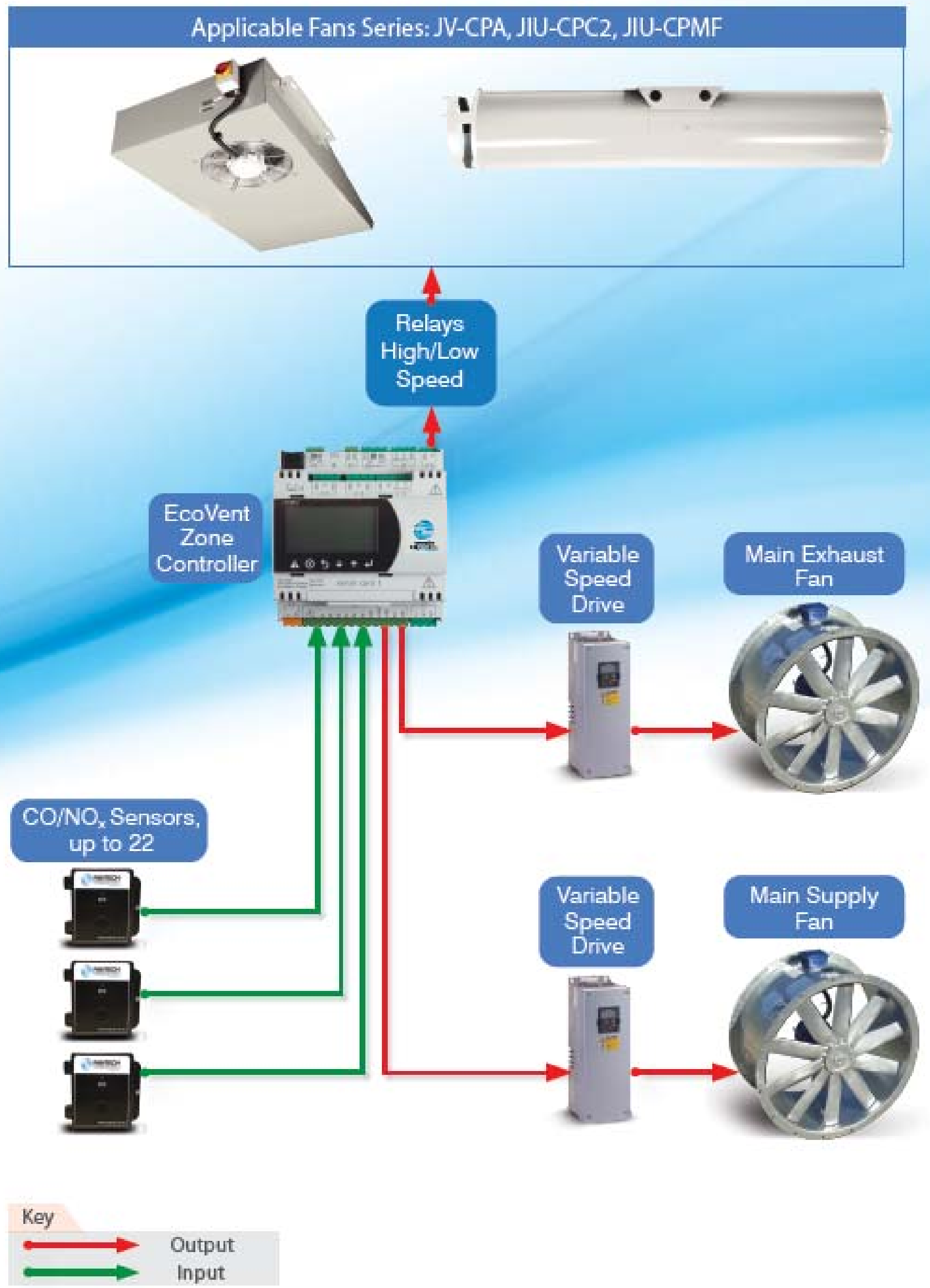
Variable speed control involves controlling the speed of the fans proportionally to pollutant levels in a car park. The EcoVent control system will control a VSD using a 0-10 Vdc analogue signal. This system of speed control is more energy efficient as it provides more precise control of the fan speed against pollution levels.



There are three types of analogue control systems.

1 Two speed JetVent fans

Using relays to drive contactors connected to the fans

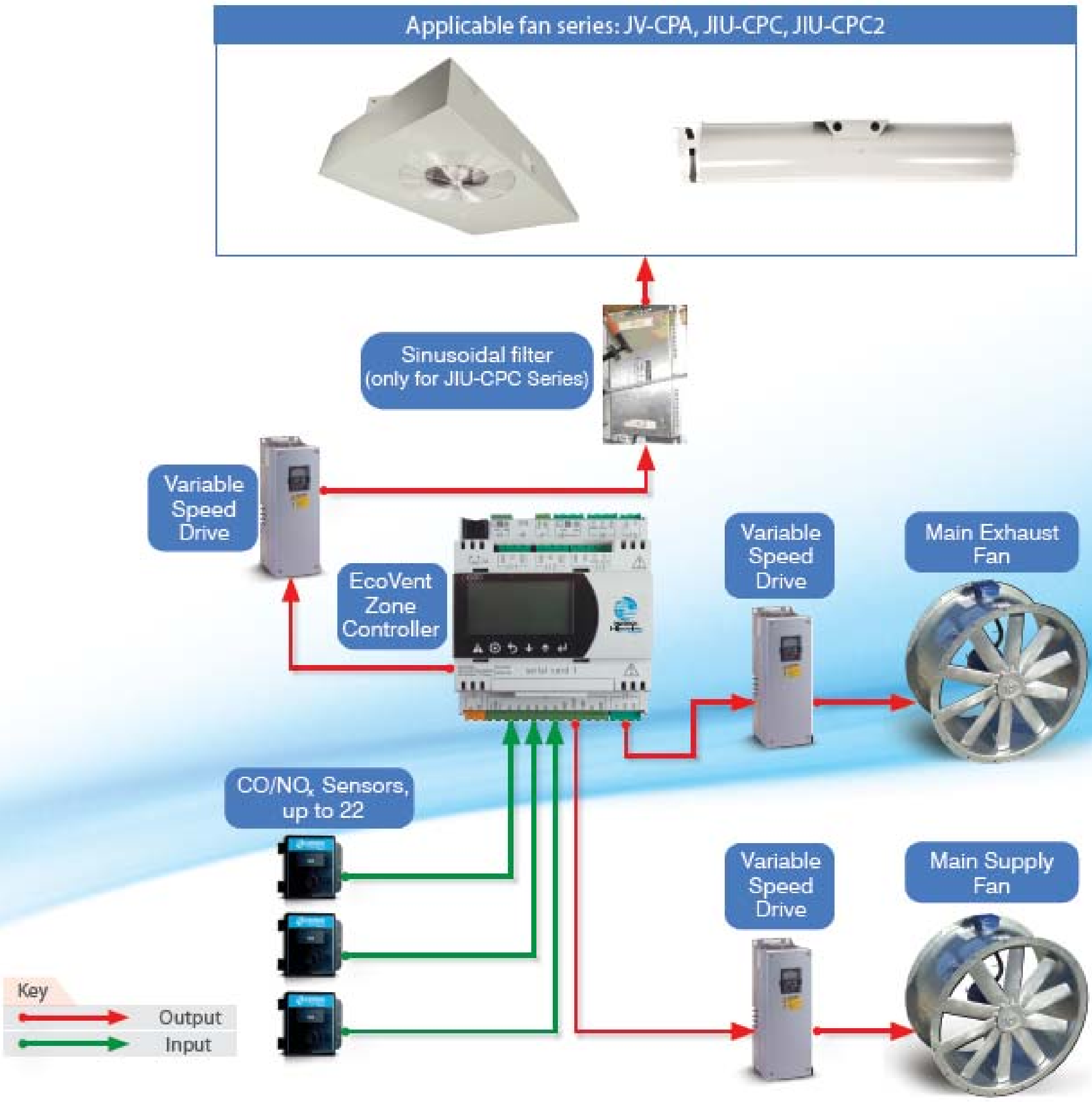


Step 5 (b) - Analogue Systems

Types of control systems

2 Variable Speed JetVent Fans

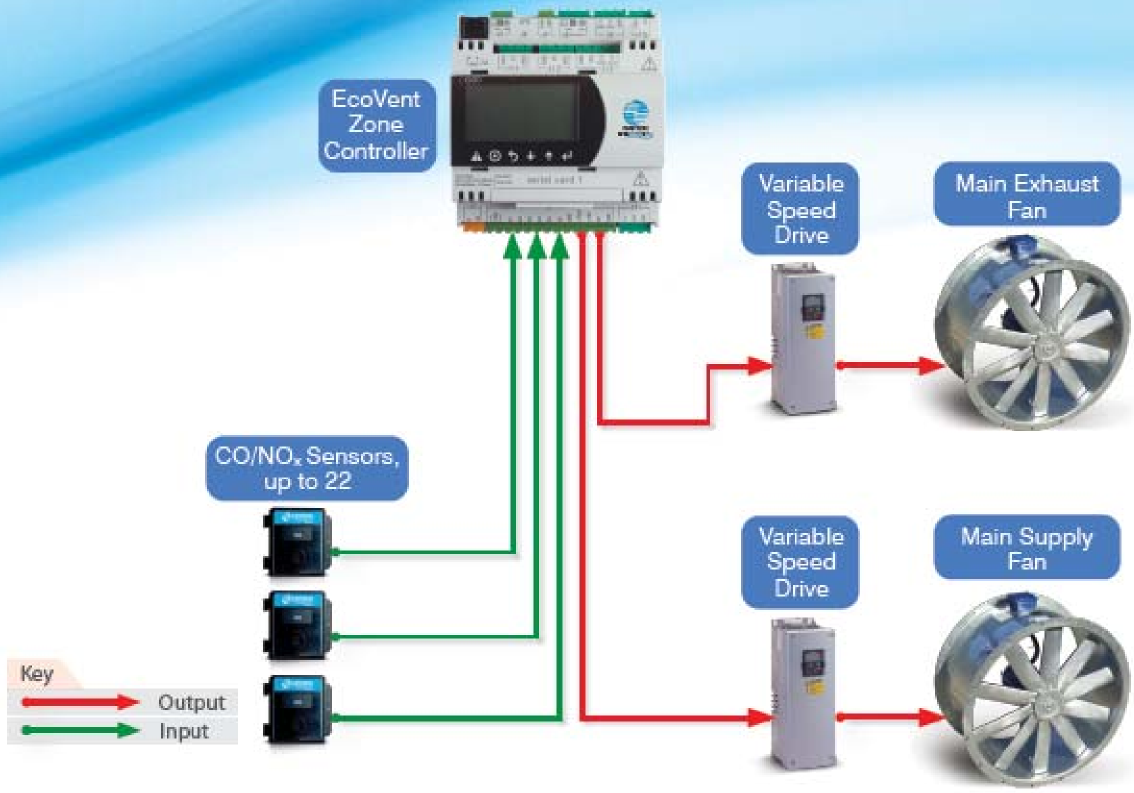
Using 0-10 Vdc outputs to proportionally drive VSDs



3 For car parks with ducted systems

This control system has been primarily designed to improve the energy efficiency of a ducted ventilation system in new and older car parks. It is a packaged and tailored solution that ensures the exhaust and supply fans are working at the speed required to maintain good air quality when the car park traffic is high and conserve energy when it is low.

This type of control system reads the signal from the CO or NOx pollutant sensors and relays these to variable speed drives that modulate the speed of the supply and exhaust fans



Step 6
Installation

JetVent Fans are typically hard mounted to the concrete ceiling of the car park using 8mm fixing bolts. In some cases, fans may be set off the ceiling through the use of brackets and anti-vibration mounts. This may be the case if there are unavoidable obstructions near the discharge air stream. To maintain the building's structural integrity, methods of affixing fans may need to be approved by a structural engineer.

In general, vibration isolation is not required when installing JetVent Fans in retail or commercial office car parks. However, anti-vibration mounts may be required for installations underneath residential buildings or floor structures that are flexible or vibration sensitive. An isolation efficiency of 90%, or as otherwise specified by the design consultant, would be recommended. The images below show typical JetVent fan installations.

Figure 14(a). JetVent installation using anti-vibration mounts

Figures 14(b). Typical JetVent fan installations

Step 7
Commissioning the System

The following points are guidelines given regarding the procedure for commissioning a JetVent Impulse Ventilation system:

1. Check each fan's rotation when the fan is first started. When the direction of rotation is incorrect, immediately advise the electrical contractor so that wiring at the motor terminals can be changed.

2. The following individual elements are then measured:
   - Air flow and running current for each of the JetVent Fans to verify their performance in the field.
   - The running current and fan pressures for all the main exhaust fans should be checked and noted. Main exhaust and supply fan should be commissioned for air flow as usual.
3. Check individual CO/NO_x sensor operation using supplier's recommendations. This may also include sensor calibration.
4. Check CO/NO_x sensor naming/numbering in accordance to the control strategies.
5. Use sensor's in-built test mode to assist with commissioning.

6 Overall performance/clearance may be checked by using cold smoke.
A cold smoke test is considered a practical way of representing the air flow in a fully enclosed car park. The main objective of the cold smoke test is to visually confirm good air distribution in the car park, and ensure that 'dead spots' are not present.

Start, Approx 8.0m visibility

~5 min., 12m visibility

18 min., 40m visibility

32 min., +60m visibility

7 Once the car park is open for public use and sufficient vehicles are present, observe system operation to ensure it is operating as expected. Also make sure that additional signs or other services have not been installed in such a way that they impede with the air movement of the system.

Step 8 Maintenance

1 Due to differing periods of operation, recommended inspection and maintenance periods may vary. It is suggested that inspection and, if necessary, fan cleaning (with non-abrasive cleaner) is carried out at regular intervals of 5000 running hours or 12 months, whichever comes first.

2 All mounting fasteners, should be checked for tightness within 4-6 weeks of commissioning and periodically thereafter.

3 Bearings are a 'sealed-for-life' type and hence will not need re-greasing. The motor's cleanliness must be checked to ensure overheating from dirt and dust buildup does not occur.

4 If possible visually check to make sure that the fans rotating components are not touching any other parts of the fan.

System Compliance

BCA Framework

In order to comply with the Building Codes of Australia (BCA), a building solution must satisfy the performance requirements as outlined in Section A.05.

This can be achieved by:

a) Complying with the "Deemed-to-Satisfy" provisions in the BCA.

b) Formulating an alternative solution that complies with performance requirements or is shown to be equivalent to the Deemed-to-Satisfy provisions in the BCA.

For car park ventilation, the "Deemed-to-Satisfy" requirements as outlined in the BCA requires a ventilation system complying with AS1668.2:2012 and AS/NZS1668.1:1998 or an adequate system of permanent natural ventilation (Section F4.11).

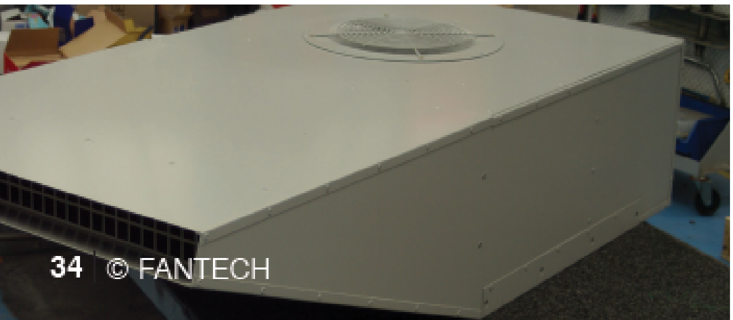
Australian Standard Requirements (AS/NZS1668.1 & 2)

AS/NZS1668.2:2012 is the current Standard relevant to ventilation of buildings as referenced in the BCA. As per this standard, the target of a car park ventilation system is to limit Carbon Monoxide (CO) concentrations to levels specified in Worksafe and National Health and Medical Research Criteria (NHMRC).

Under AS/NZS1668.2:2012 jet fans can be used to meet the Deemed-to-Satisfy provisions of the BCA.

Clause 4.4.2(c) of AS1668.2 2012 is intended to apply to situations where 1 or 2 jet fans are serving a dead spot in a car park. Where the installation falls outside of these guidelines, the system is no longer considered Deemed-to-Satisfy and it is recommended that an alternative solution should be performed.

As only supply and exhaust fans are specifically mentioned in AS1668.1:1998 Section 5.5, jet fans should be treated as an alternative solution to the BCA from a fire and smoke control perspective (in addition to the ventilation requirements). Therefore the fire engineer on the project would need to add jet fans into their fire engineering report for the project and ensure that they meet the relevant BCA performance clauses.




CPIF 45


P
Disabled
parking

System Compliance

BCA
Performance clauses

An Independent Statutory Body has agreed that the relevant performance requirements applicable to jet fans are EP1.4, EP2.2 and FP4.4 of BCA2013 (where jet fans are outside of the Deemed-to-Satisfy requirements). The most common method of proving compliance is by performing an alternative solution.

If an alternative solution is required, a report will need to be submitted to the relevant approval authority to show that compliance with Performance Requirements EP1.4, EP2.2 and FP4.4 are achieved. These performance requirements are shown below.

BCA2013 EP1.4

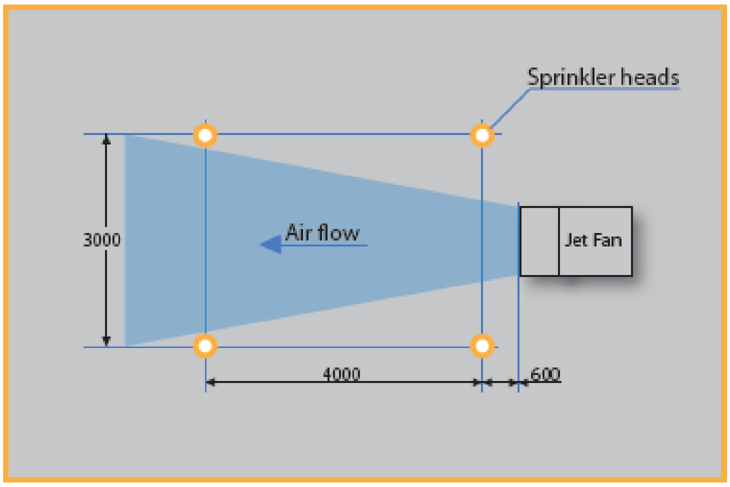
An automatic fire suppression system must be installed to the degree necessary to facilitate to control the development and spread of fire appropriate to –

a) The size of the fire compartment; and
b) The function or use of the building; and
c) The fire hazard; and
d) The height of the building.

Guidance: In practical terms, the impact on sprinkler activation times should be minimised. This can be achieved with careful placement of jet fans in relation to sprinkler heads and by ensuring that jet fans are shut down prior to predicted sprinkler activation for the specific car park.

Sprinklers must be installed as per the BCA and AS 2118.1:1999. Fast response sprinkler heads may be an option to ensure activation times are minimised.

Note: If jet fans are shut down by smoke detection prior to sprinkler activation, activation times due to jet fans interaction become largely irrelevant. However, rapid sprinkler activation times with jet fans operating are still desirable as they may be considered a redundancy in the event that the smoke detection system fails.



Example of Jet fan layout in relation to sprinkler heads.

BCA2013 EP2.2

(a) In the event of a fire in a building the conditions in any evacuation route must be maintained for the period of time occupants take to evacuate the part of the building so that-

- *(i) the temperature will not endanger human life: and*
- *(ii) the level of visibility will enable the evacuation route to be determined; and*
- *(iii) the level of toxicity will not endanger human life*

(b) The period of time occupants take to evacuate referred to in (a) must be appropriate to-

- *(i) The number, mobility and other characteristics of the occupants; and*
- *(ii) The function or use of the building; and*
- *(iii) The travel distance and other characteristics of the building; and*
- *(iv) The fire load; and*
- *(v) The potential fire intensity; and*
- *(vi) The fire hazard; and*
- *(vii) Any active fire safety systems installed in the building; and*
- *(viii) Fire brigade intervention*

BCA2013 FP4.4

A mechanical air-handling system installed in a building must control

a) the circulation of objectionable odours; and

b) the accumulation of harmful contamination by micro-organisms, pathogens and toxins.

The most comprehensive way of demonstrating this is by building a Computation Fluid Dynamics (CFD) Model of the car park. The model has to simulate pollution and air flow movement within the car park to ensure that Carbon Monoxide levels meet the requirements outlined above. While this approach is precise and ensures that the designed system works throughout the car park, it may be unnecessary for smaller car parks and those partially served by natural ventilation.

In these cases, 'expert judgement' or knowledge gained from projects completed previously may indicate that a proposed car park ventilation design using JetVent Fans will be adequate.

Having defined the scenario for assessing the performance of the car park system, there are a number of ways of proving that the ventilation design performs adequately.

This standard contains information that will assist in the formulation of an alternative design.. In order for the impulse ventilation system to be approved as an alternative design solution under AS1668.2:2012, it will need to be demonstrated that CO concentration levels between 900mm and 2500mm above the floor are limited to:

- (i) 60ppm 1hr maximum average
- (ii) 100ppm peak value; and
- (iii) 30ppm Time-Weighted Average (TWA) over 8hrs

These guidelines are derived from Appendix N of AS1668.2:2012. The 60ppm 1hr maximum average is taken to be the significant design criteria. This is because guidelines in AS1668.2:2012 regarding the pollution levels of cars and maximum traffic scenarios work on the basis of a 'worst case condition' of one hour in duration. Also, if this is met, it is safe to say that CO levels will be well under the 100ppm peak values allowed in the standard.

The 30ppm time weighted average appears to apply to car parks where people work within the confines of the car park without having separate ventilation systems for their work area. Examples of this include car parks with a car wash inside or parking attendant booths with no other sources of ventilation. In most cases, the third CO concentration criteria will not apply to the car park due to the lack of these features.

Computational Fluid Dynamics
(CFD) Analysis

Computational Fluid Dynamics (CFD) is the use of computer-generated models to simulate the aerodynamic behavior around objects within a space. When alternative systems are proposed, as outlined on page 34 of this guide, a CFD analysis is a good method to demonstrate to approving authorities that the system is likely to perform satisfactorily. In order to successfully perform a CFD analysis, the following information is required:

1. Mechanical and architectural drawings are required in AutoCAD format with the locations of any obstructions to air flow, such as support columns, included. These drawings must also display plan views and elevations with detailed cross-sections to illustrate floor and ceiling heights.
2. Exhaust and supply air flow rate calculations provided by the consulting engineer.
3. Exhaust and supply air outlets/inlets are clearly marked on the drawings with all relevant dimensions and details shown.
4. Parameters for CO calculation are to be supplied correctly as per Clause 4.4.4.1 of AS/NZS1668.2:2012. This includes the number of cars, traffic paths and relevant parameters as per the standard (see pages 40 and 41 for reference). Another option is for the consulting engineer to clearly state an alternative international standard to be used for calculation purposes.
5. The JetVent Fan type, model and control method is clearly stated and indicated.
6. The target criteria for the CFD model is to be confirmed, e.g. 60ppm 1hr maximum average as per Australian Standards, along with the steps in the methodology.
7. Any additional views or plots required by the analysis are noted for inclusion in the CFD report.

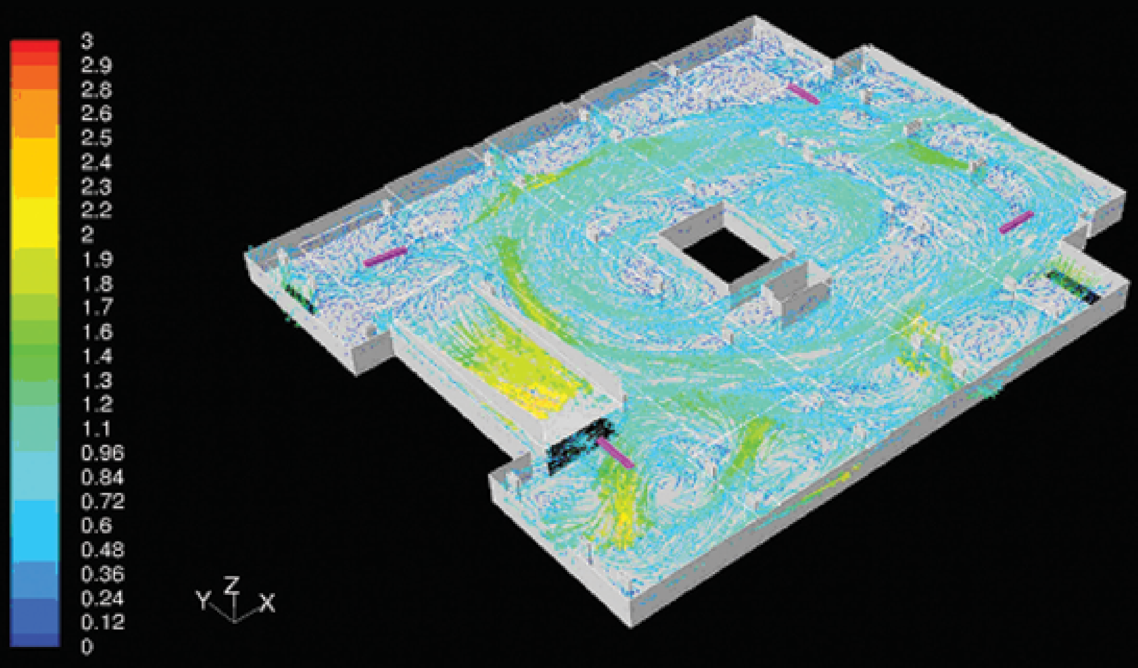


Figure 15. CFD plot with velocity vectors, scale in m/s

The final CFD report should include a detailed description of the ventilation system with placements of JetVent fans illustrated on the drawings. The design criteria and objectives of the analysis need to be clearly detailed at the beginning of the report.

The report should also include the scenarios investigated along with air velocity and CO plots. These results closely reflect what would occur in the car park during real life situations. Figures 15 and 16 provide examples of typical CFD plots for air velocities and CO concentration levels respectively.

Fantech are able to facilitate a CFD analysis for you.

The cost of a CFD analysis is generally expected to be minimal in comparison with the potential cost savings associated with implementing the Impulse Ventilation system. The time required to perform the analysis and supply the report varies greatly but is usually between 2-6 weeks.

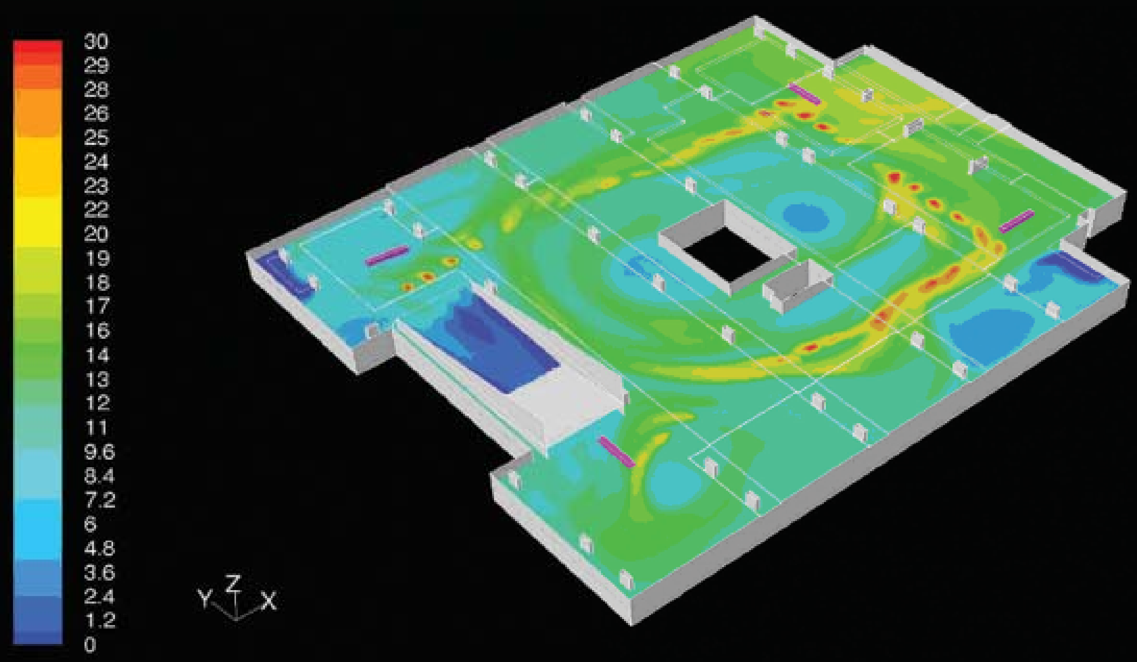


Figure 16. CFD plot of CO concentration levels, scale in ppm

References

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Appendix

AS/NZS1668.2 - 2012 Calculation Factors

1 Parking Usage Factor (P)

Use of car park	Parking usage factor (P)
Residential	0.3
Commercial	0.5
Retail/food and drink services	0.7
Entertainment/sports centres	1.0
Vehicle Depots	2.4

2 Vehicle Type Factor (T)

Use of car park	Vehicle type factor (T)
No special vehicle population	1.0
Diesel vehicles	2.4
LPG vehicles	1.0
CNG vehicles	1.0
Electric powered vehicles	0.1
Motorcycles	0.25

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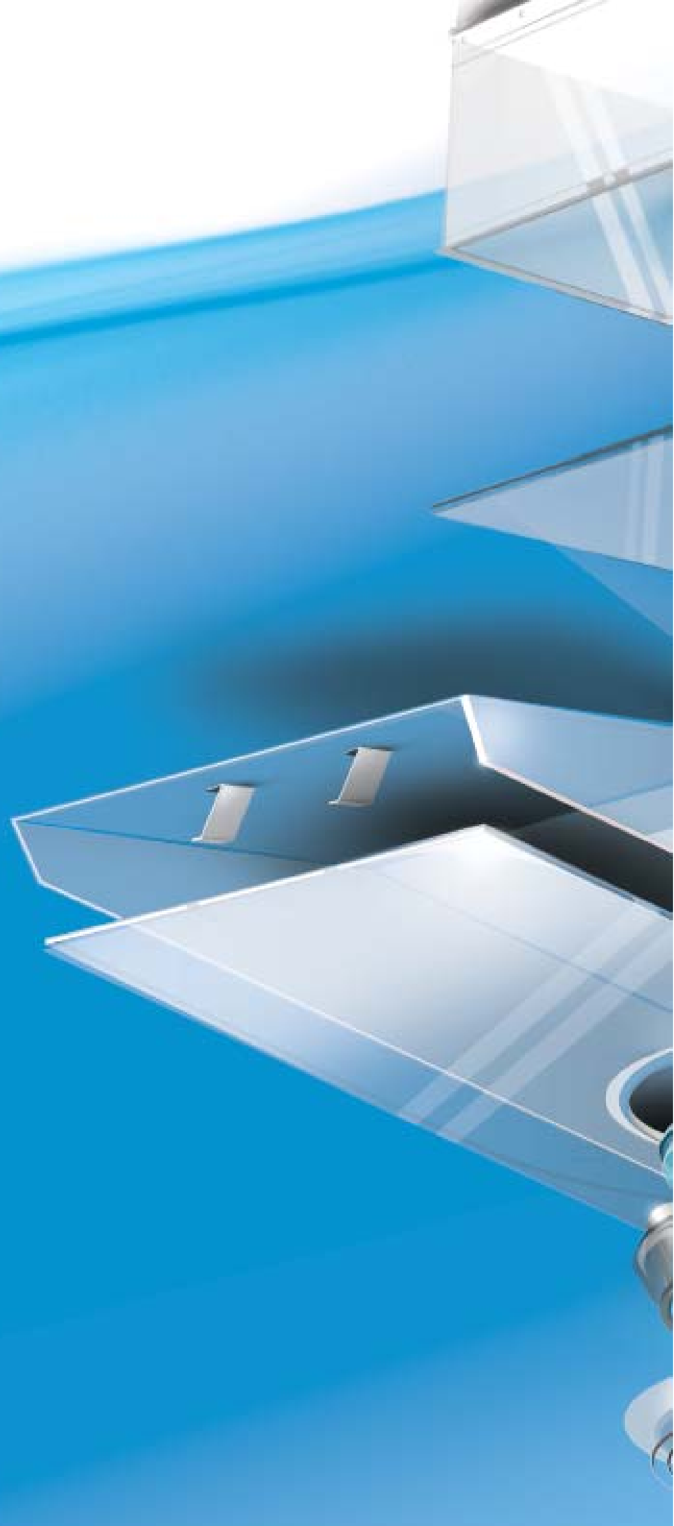

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