



incorporating



Contractors' guide to car park ventilation

*A no-nonsense guide to the safe
ventilation of underground and covered
car parks*

Car park ventilation



What are the regulations?

Ventilation of car parks is important to prevent the build-up of toxic fumes and flammable gases from motor exhausts and also to clear smoke in the event of a fire.

The Building Regulations specify what is required to maintain safe conditions, in particular **Approved Document B** and **Approved Document F**. Guidance is also given in **BS 7346-7:2006**.



Why ventilate?

There are broadly two methods of complying with the Building Regulations regarding ventilation and these are natural or mechanical ventilation.

Whichever method is used, the required results are defined as:



Smoke clearance:

To provide sufficient openings for enclosed car parks to allow any smoke being produced to leave the space naturally, or if this cannot be achieved then to remove smoke via a mechanical extract system.



Fume exhaust:

To provide sufficient openings arranged such that a through draught at low to mid level is created to allow CO to leave the car park naturally, or if this cannot be achieved then to limit the concentration of CO within the space via a mechanical extract system.



Natural ventilation

In an ideal world, this is the preferred method of ventilating car parks as it simply requires openings to fresh air being provided to equal a percentage of the floor area of the car park. The areas to be provided are currently:

5% for ventilation of everyday vehicle pollution and smoke with at least 50% being provided between opposite faces of the building; the openings provided must be sufficient to create a through draught.

2.5% for smoke clearance only with at least 50% being provided in opposite faces of the building. If only 2.5% is provided a supplementary CO ventilation system will be required to limit the concentration of CO within the space.

This method obviously relies on a path to outside being freely available, which is not usually the case in underground car parks - hence the need for mechanical extract systems.

Mechanical extract

These systems use powered fans to control the build-up of CO in the car park. The regulations for fume exhaust state that the system should be capable of limiting the concentration of CO within the car park to below **30 parts per million** (averaged over an eight-hour period). For smoke clearance, **ten air changes per hour** (the number of times the volume within the car park is extracted within

one hour) should be extracted.

The regulations for smoke clearance state that the system should have an extract facility which is split into two parts, each part capable of providing 50% of the required duty and extracting from both high and low level. Extract fans should be fire rated

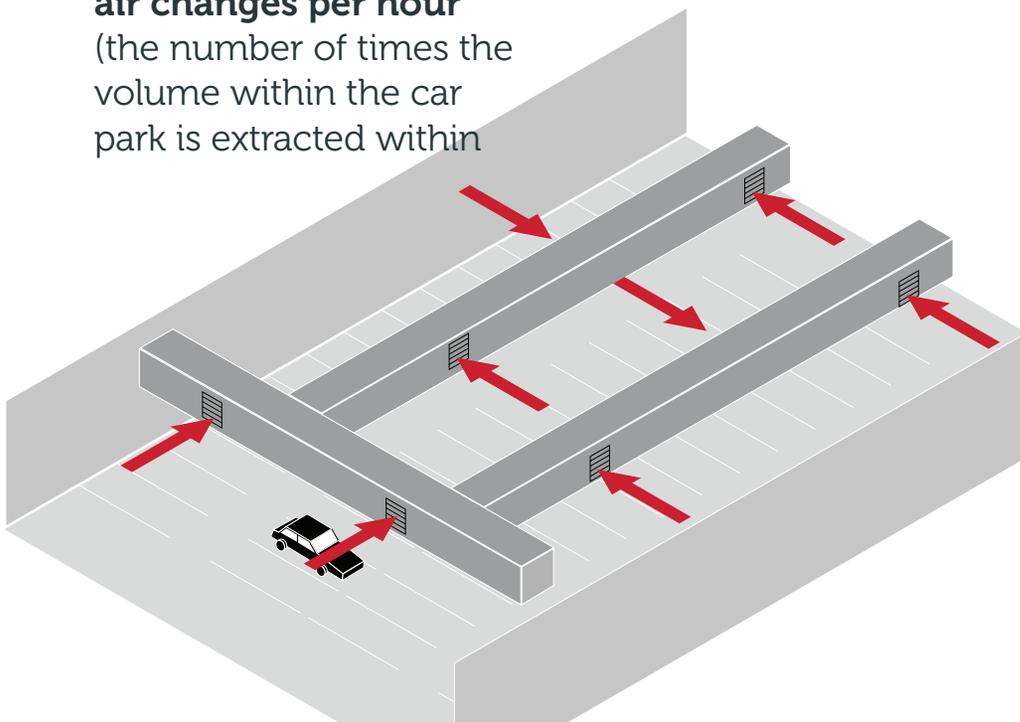
at 300°C for one hour.

A standard 10ach/hr smoke clearance system - as described in this brochure - is not applicable to deep basements (more than 10m or three storeys below ground) or for buildings with two or more basement storeys with a footprint greater than 900m²; in this case the system should be designed to assist firefighters.

Traditional systems

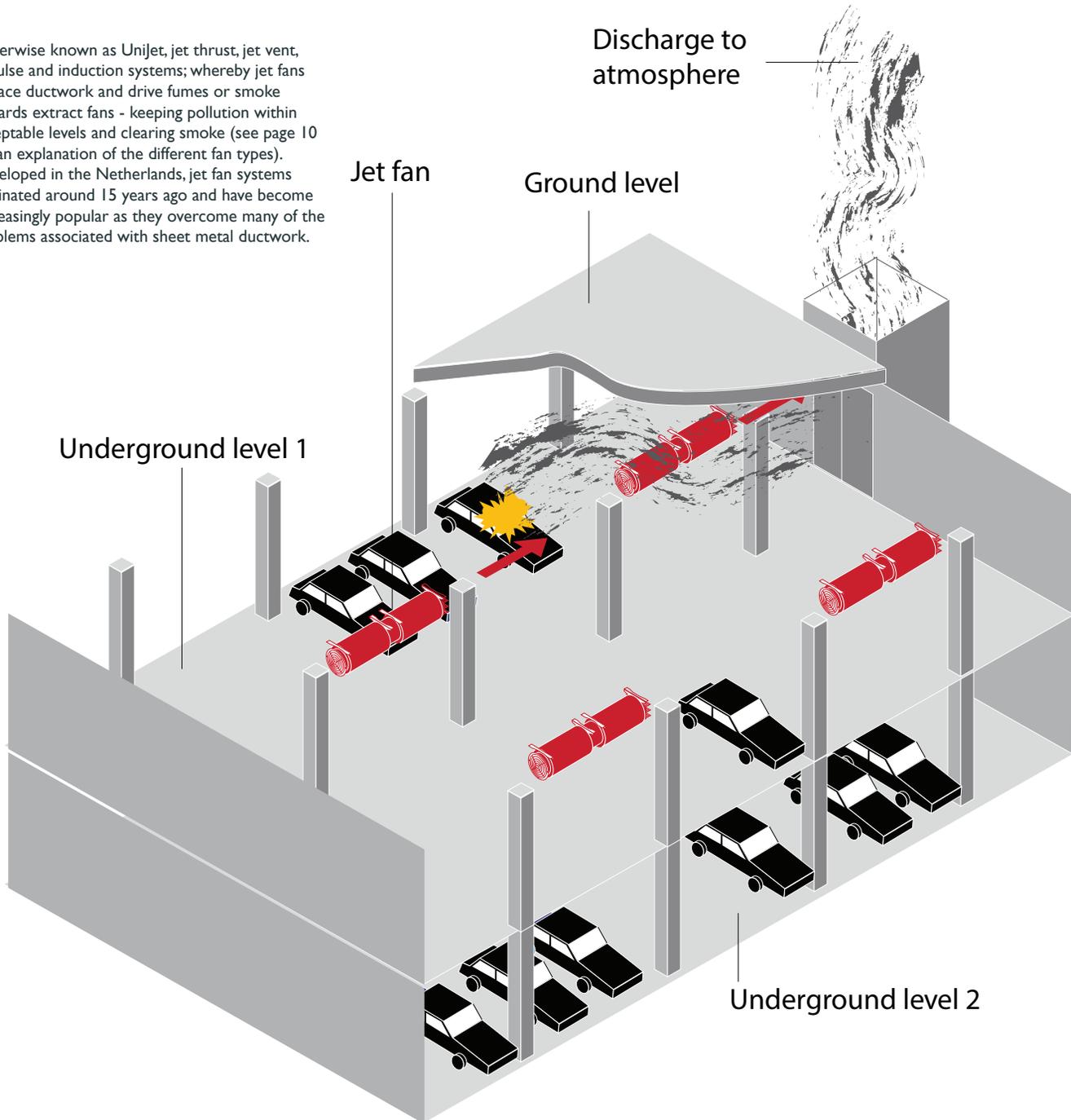
These use sheet metal ductwork to transport the fumes or smoke being extracted to the external atmosphere. The ducts must be evenly distributed around the car park and also drop to low levels to provide the low level extract points.

Accommodating large ducts can be problematic due to the low headroom in most car parks; low level ducts can be subject to damage from vehicles.



Jet fan systems

Otherwise known as Unijet, jet thrust, jet vent, impulse and induction systems; whereby jet fans replace ductwork and drive fumes or smoke towards extract fans - keeping pollution within acceptable levels and clearing smoke (see page 10 for an explanation of the different fan types). Developed in the Netherlands, jet fan systems originated around 15 years ago and have become increasingly popular as they overcome many of the problems associated with sheet metal ductwork.



Benefits of jet fan systems

Space saving – jet fan systems are more discreet and take up considerably less room than ducted ones.

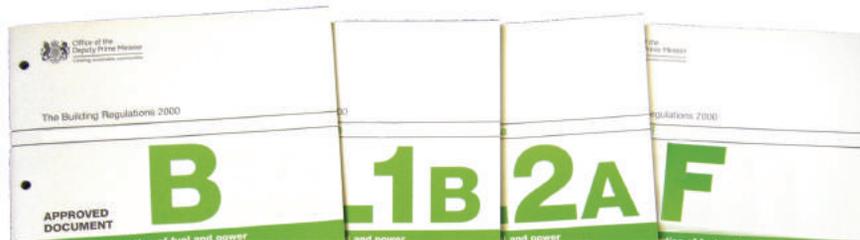
Energy saving – they are often combined with CO detection to initiate CO control; this ensures

that fans are precisely controlled to dilute pollution without running unnecessarily.

Low noise – because the main extract fans are relatively small and (for CO control) run at lower speeds than traditional

systems, the noise generated is considerably lower.

Cost saving – jet fan systems cost less than a comparable ducted system, are quicker to install and easier to maintain.



How they comply with the regulations

In a smoke clearance system the main extract fans are sized to extract a minimum of ten air changes per hour as detailed in the Building Regulations; the jet fans are positioned to ensure that fumes and smoke are transported quickly and efficiently to the main extract points.

For everyday ventilation of pollution either a CO detection system is used to limit the concentration of CO to below 30ppm (over an eight-hour period) or as an alternative the system can operate continuously at six air changes per hour.

How they work

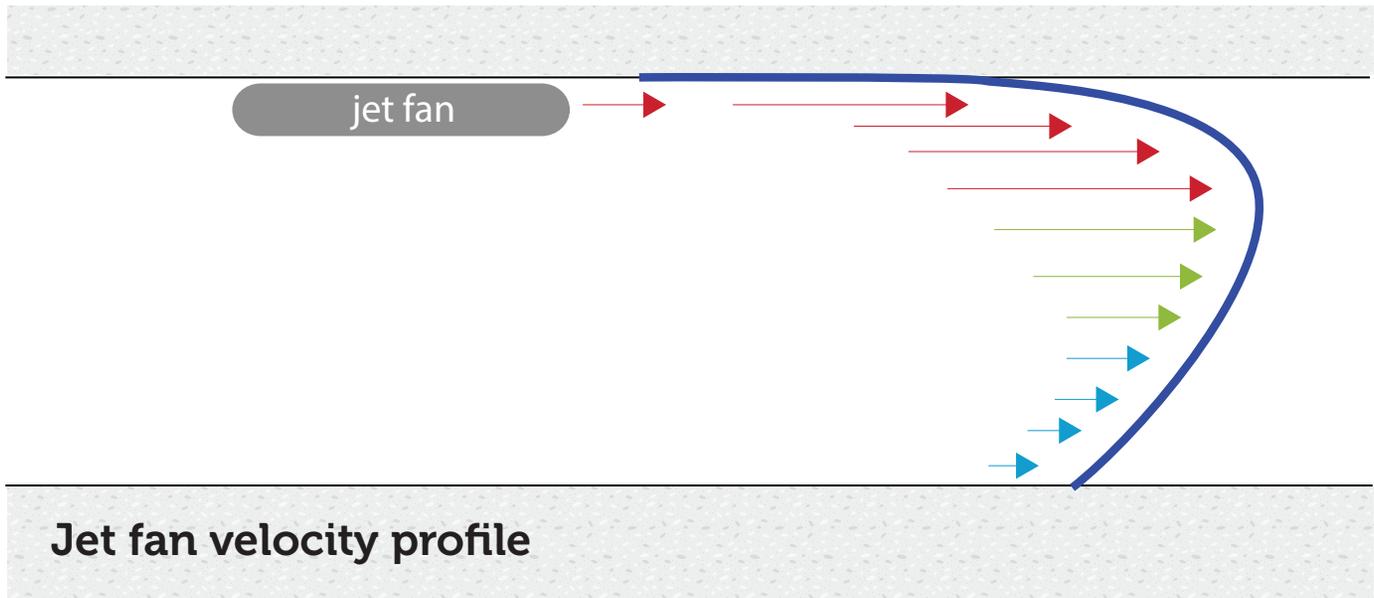
Jet fans were originally developed for ventilating tunnels and work by propelling a small jet of air at extremely high velocity which causes surrounding air to be entrained; in a confined space like a tunnel or enclosed car park they can quickly move a large volume of gas. Each jet, impulse or induction

fan has a characteristic thrust which smoke control engineers and designers use to position fans in an enclosed or underground car park, to ensure relatively even distribution of air.

They are used to control zonal areas of the car park, directing airflow based on the detected

location of fume or smoke build-up.

On activation of the system via smoke detection, the jet fans should shut down for an agreed period of time to let the people escape (the main extract fans should activate immediately to provide 10ach/hr).



Designing a jet fan smoke control system

By using jet fans it is possible to provide a more sophisticated system than 'smoke clearance' which is intended to offer safe conditions for occupants escaping the car park in a fire, and to assist

firefighters in locating and extinguishing the fire. The basic procedure to be followed when designing 'smoke control' systems can be summarised as:

Design for a fire:

The extract rate for a smoke clearance system is relative to the size of the car park, whereas a smoke control system is designed to extract smoke for a given fire (e.g. 4MW for a car park

with sprinklers or 8MW if sprinklers are not provided) and is independent of the overall size of the car park. Guidance for the design fire size is given in BS 7346-7:2006.

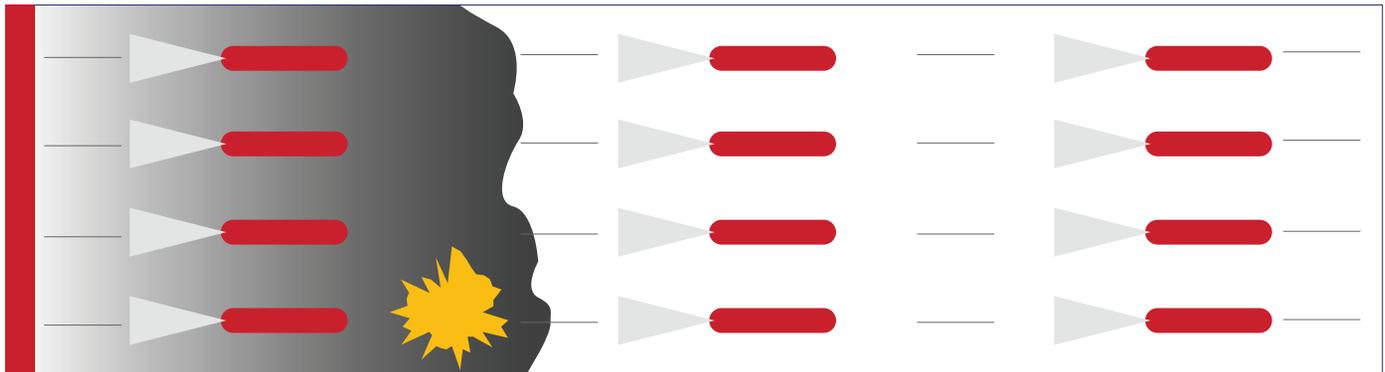
Develop a control philosophy:

Independent control of fans is required to cater for fires occurring in different zones within the car park. Reversible jet fans are available and can be programmed to drive smoke in opposite directions dependent on the fire location.

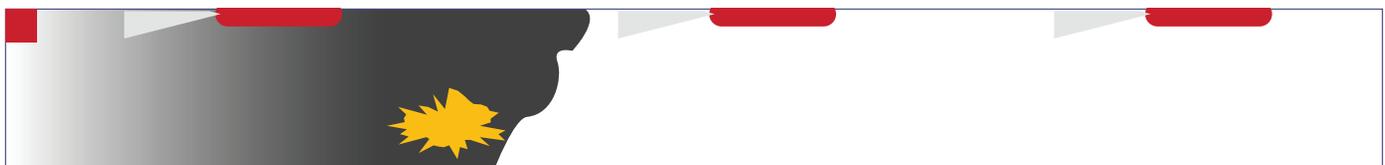
Zone the car park:

The car park is divided into smoke control zones with fire zones being sacrificed in a fire, while safe conditions are maintained in adjacent zones. See diagram below.

Plan view



Profile view



CFD:

Computational Fluid Dynamics (CFD) is often used to help design complex smoke control systems and is a useful tool for predicting their performance.

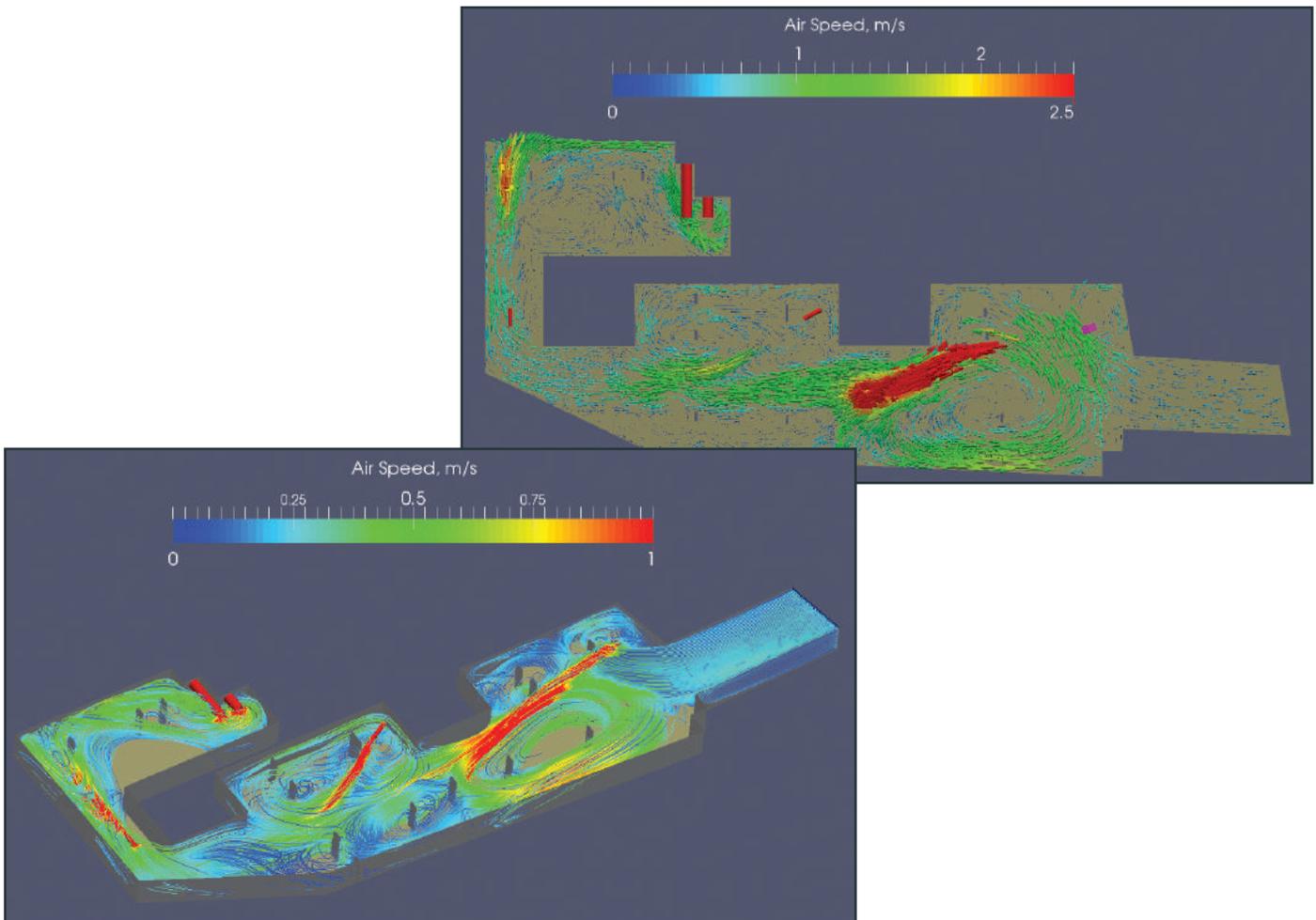
In the early days of jet fan systems CFD was often used as a sales aid by specialists to convince approving authorities that such systems were

effective and it has now become strongly associated with car park ventilation, however for smoke clearance systems it is not usually required.

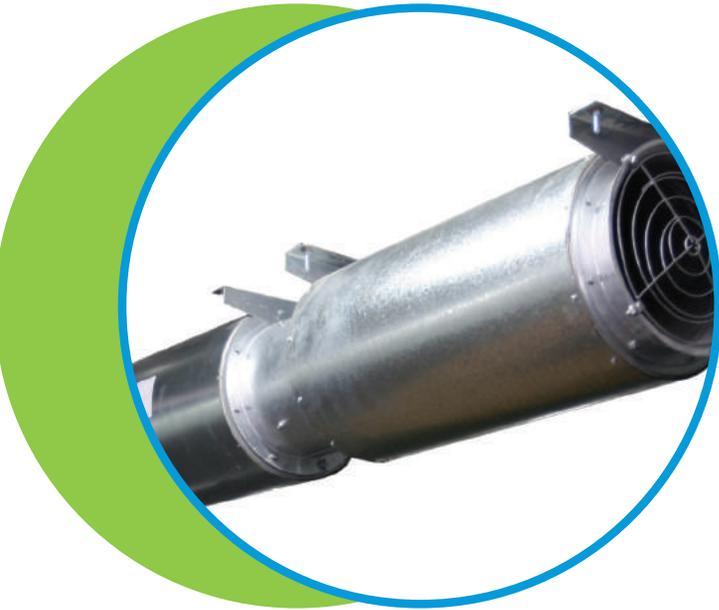
Guidance is given in **BS 7346-7:2006** and this states that as a minimum the report should be prepared stating the CFD software and version used, the boundary conditions, geometry layout and

simplifying assumptions, grid specification, sensitivity analysis, results and the modelling objectives.

The CFD should show temperatures and smoke spread. Results should, as a minimum, show in the horizontal plane smoke spread and temperatures at 1700mm from FFL. Modelling should always be based on the worst case scenarios.



Available fan types

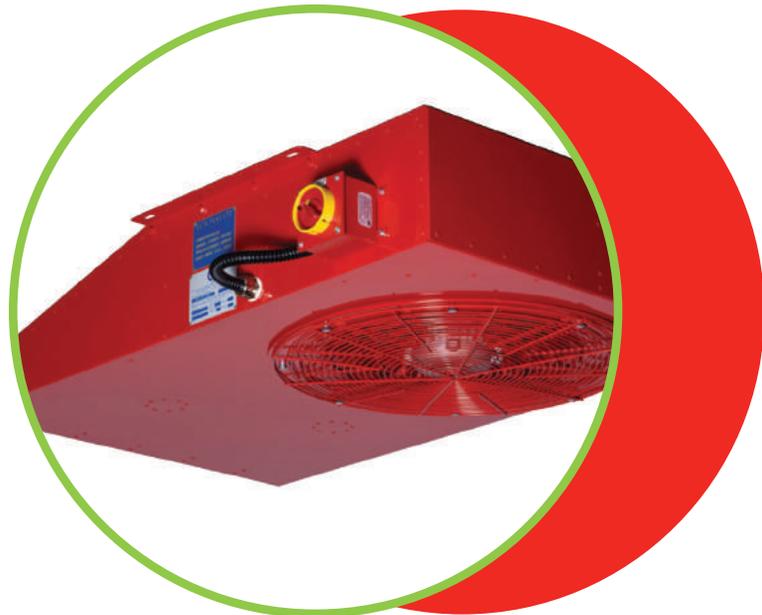


Jet thrust fan, jet fan, jet vent fan or impulse fan:

An axial flow fan mounted within an inlet and outlet cylindrical silencer. Tested as a complete unit, jet fans can provide up to 50N of thrust. Suitable for most small to medium sized car parks.

Induction fan:

A centrifugal fan with an air inlet positioned beneath the body of the fan and discharging through a reduced size opening, induction fans can provide up to 100N of thrust. Careful coordination is required if a sprinkler system is used. Suitable for medium to large car parks, benefit can be achieved from the greater coverage area. Attenuation is not provided on an induction fan.



References

The Building Regulations Approved Document B - Volume 2 - Buildings other than dwelling houses (2006 Edition)

Approved Document F - Ventilation (2006 edition)

BS 7346-7 Components for smoke and heat control systems – Part 7: Code of practice on functional recommendations and calculation methods for smoke and heat control systems for covered car parks



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