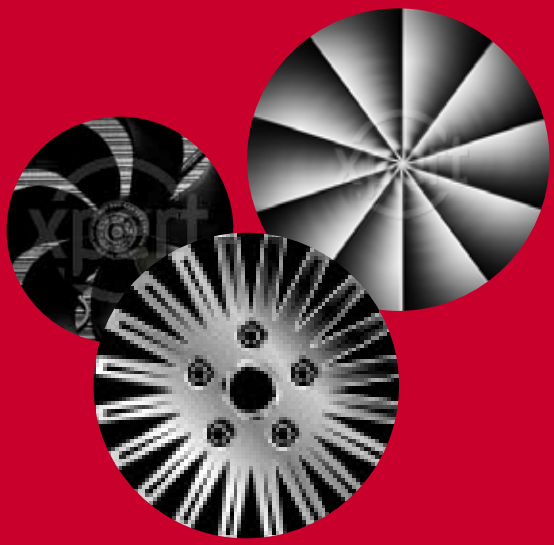
information guide

SCS group

Car Park Ventilation Demystified

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



Introduction

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

What are the regulations?

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

What is required?

There are broadly two methods of complying with the Building Regulations regarding ventilation and these are by 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

This is the preferred method of ventilating car parks and 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

The rules for mechanical extract state that for control of fumes a system which is capable of limiting the concentration of CO within the car park to below 30 parts per million averaged over an eight hour period should be provided. For smoke clearance 10 air changes per hour should be extracted.

Floor Area x Height = Volume

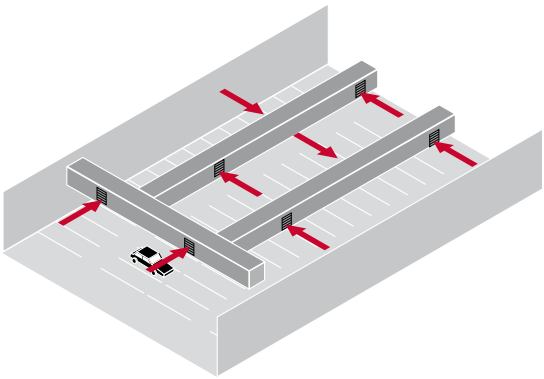
Air change per hour = the number of times the volume within the car park is extracted within 1 hour

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 rated at 300°C for one hour.

Traditional Systems

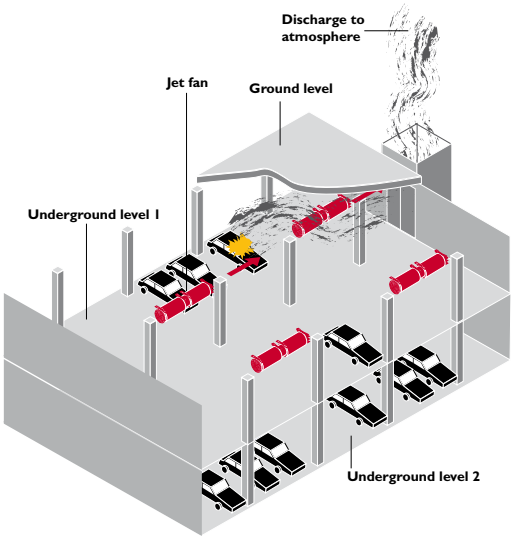
Traditional mechanical extract systems use sheet metal ductwork to transport the fumes or smoke being extracted to the external atmosphere. The ducts must be evenly distributed around the car park and also drop to low level to provide the low level extract points.

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



Jet fan, jet thrust, jet vent, impulse or induction systems

All the above are different names for the same basic system (see page 6 for an explanation of the different fan types). Developed in the Netherlands, jet fan systems originated around 10 years ago and have become increasingly popular as they can overcome many of the problems associated with sheet metal ductwork.



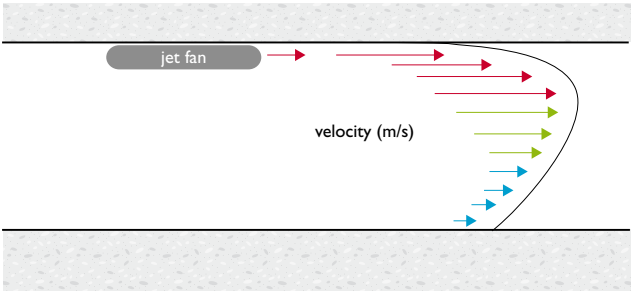
How they work

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

In car parks jet fans are used to replace the ductwork and to drive the fumes or smoke towards the extract fans to keep pollution within acceptable levels and to clear smoke.

Each jet, impulse or induction fan has a characteristic thrust which designers use to position fans in a car park to ensure relatively even distribution of air.

Velocity profile of Jet Fan



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 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 6 air changes per hour

Additional benefits of jet fan systems

In addition to the space saving benefits jet fans have other advantages over traditional ducted systems.

Energy saving

Jet fan systems are often combined with CO detection to initiate them for CO control and these can ensure that fans are precisely controlled to dilute pollution without fans running unnecessarily with large potential energy savings.

Low noise

Because the main extract fans are relatively smaller and for CO control run at lower speeds than a traditional system the noise generated is considerably lower.

Low cost

Jet fan systems cost less than a comparable ducted system.

Smoke control systems

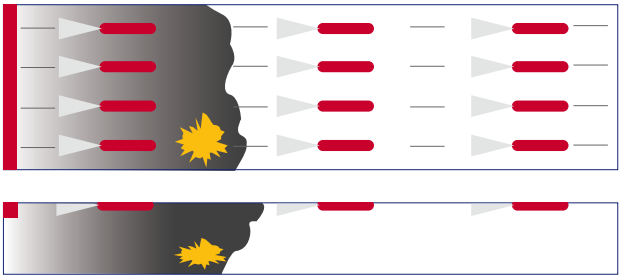
Using jet fans it is possible to provide a more sophisticated system than smoke clearance which is intended to offer safe conditions for occupants escaping the building in a fire and to assist fire fighters in locating and extinguishing the fire. The basic procedure to be followed when designing smoke control systems can be summarised as follows.

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 size of the car park. Guidance for the design fire size is given in BS 7346-7:2006

Zone the car park

The car park is divided into smoke control zones with fire zones being sacrificed in a fire with safe conditions being maintained in adjacent zones.

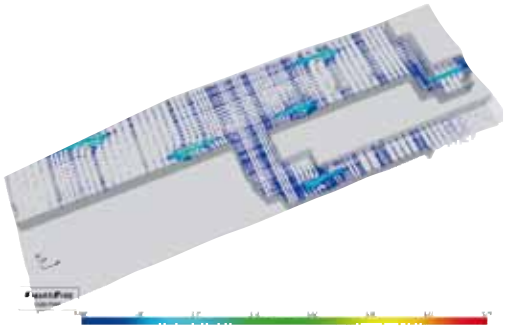


Develop a control philosophy

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 dependant on the fire location.

Computational Fluid Dynamics modelling and car park ventilation

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



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.

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.

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

Jet Fan or Impulse Fan

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.

Cyclone Fan, 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

SCS Group provides innovative engineering solutions for buildings, industry and the environment including:

- Control and automation systems
- Smoke Control
- Passive ventilation
- Energy saving products

Contact
P 0870 2406460
F 01443 819 119
@ enquiry@groupscs.co.uk

www.groupscs.co.uk

The Innovation Centre
Tredomen Business Park
Caerphilly CF82 7FQ