

Performance requirements, design and operation of commercial kitchen ventilation systems

Extraction/Ventilation Systems Adequate ventilation/extraction is a necessity in food and drinks premises in order to remove steam, cooking odours and grease-laden air. In the majority of cases, natural ventilation alone is not sufficient and therefore an extract duct with a fan and filters is required to ventilate cooking fumes and remove odours without causing a nuisance to neighboring properties.

Further advice will be sought after from a specialist contractor, who can carry out a ventilation survey and advise on specific aspects required.

Minimum requirements for canopy

Velocity requirements

- Light loading – 0.25 m/s (applies to steaming ovens, boiling pans, bains marie and stock-pot stoves)
- Medium loading – 0.35 m/s (applies to deep fat fryers, bratt pans solid and open top ranges and griddles)
- Heavy loading – 0.5 m/s (applies to chargrills, mesquite and specialist broiler units)

Material of construction and position

- A material that would comply with the food hygiene requirement is stainless steel.
- Extend 250mm beyond the edge of the cooking equipment.

Grease filtration

- Have a minimum performance the same as a baffle filter
- Be easy to clean

Minimum ventilation rates

- An internal ambient air temperature of 28°C maximum.
- Maximum humidity levels of 70%.
- Internal noise level should be between NR40 – NR50.
- Dedicated make up air system to be approximately 85% of the extract flow rate.
- Minimum air change rate of 40 per hour (bases on canopy and general room extraction)
- Extract flow rates should be calculated using the thermal convection method only.

Ducting

Ducting should be as short and straight as possible, to ensure that all fumes are discharged as effectively and efficiently as possible. Careful planning should take place when designing the route of ducting as to avoid proximity to residential or office windows on neighbouring properties, as this could cause complaints that were otherwise avoidable. It is also important to avoid discharge into a semi-enclosed area such as a courtyard or the area between back additions. The prevailing wind direction should also be considered in the ducting positioning.

Ducting systems should extend to at least one metre higher than the eaves of the property and/or above any dormer window. In some cases we may ask for the top of the extract duct to discharge in a certain direction in order to minimise the likelihood of complaints. Ducting should not be routed through residential rooms. The efflux (terminal discharge) velocity should be at least 12 m/s to provide sufficient dispersal and is likely to require the introduction of a venturi system to increase the flow velocity.

Ductwork should be fitted with anti-vibration mountings to minimise the vibration. Vibration from the ductwork inside the building could also cause a nuisance to adjacent domestic or residential properties. Anti-vibration mountings should be used for all ductwork fixings.

Minimum requirements for ductwork

- All ductwork should be Low Pressure Class 'A' and constructed in accordance with HVCA Specification DW/144[1] with a minimum thickness of 0.8mm
- Duct should be as follows:

Supply (m/s)		Extract (m/s)
Mains run	6-8	6-9
Branch runs	4-6	5-7
Spigots	3-5	5-7

- All internal surfaces of the ductwork should be accessible for cleaning and inspection. Access panels should be installed at 3.0m centres and should be grease tight using a heat proof gasket or sealant.
- Duct work should not pass through fire barriers
- Where it is not possible to immediately discharge the captured air, fire rated ductwork may be required.

Minimum requirements for Odour Control

Discharge stack

The discharge stack should:

- Discharge the extracted air not less than 1 m above the roof ridge of any building within 20 m of the building housing the commercial kitchen
- If 1 cannot be complied with for planning reasons, then the extracted air shall be discharged not less than 1 m above the roof eaves or dormer window of the building housing the commercial kitchen. Additional odour control measures may be required
- If 1 or 2 cannot be complied then planning permission is likely to be refused. Where it is accepted exceptional high level of odour control will be required.

Low level discharge should be avoided and the use of Chinaman's hats or other cowls is not recommended

Filters

Various types of filters will usually be required in order to eliminate grease and odours from the cooking fumes. These filters will be talked about below.

Grease filters (C)

The grease filters are generally integral to the cooker hood/canopy. The housing should be arranged for easy exchange of the filters, for routine cleaning and for maintenance according to manufacturer's instructions, so ensuring maximum efficiency. High efficiency grease filters (grease extraction efficiency of at least 90%) should be chosen, such as removable and washable baffle filters. A spare set of filters must also be maintained for replacement purposes. The system should never be run

without the filters in place. Proper maintenance of these filters is essential, as grease accumulates further up the ventilation duct it can be very difficult to remove.

Pre-filters

Coarse Pre-Filters (D)

These should be fitted to stop larger particulates escaping through the system. They are often 25mm synthetic pads.

Fine Pre-Filters (E)

These should be fitted to stop finer particles escaping through the system. They are often 50mm pleated elements. The filters should be in a panel type housing, arranged for easy exchange of the filters, where routine cleaning and maintenance to the manufacturer's instructions can take place, ensuring maximum efficiency. The filters should be fireproofed. Pre-filters should be changed every 2 weeks. If the pre-filters are not changed on a regular basis, the other filters units in the system will need changing more regularly. If particulates are deposited on the carbon filter unit, this will be deactivated very quickly and will soon need replacing. Running costs will be significantly reduced with the proper maintenance and use of the pre-filters.

Carbon Filters (F)

Properly maintained carbon filters can eliminate most odours created. Carbon filters should be fitted internally to the ductwork, after the grease filters, and should be positioned so that they can easily be accessed for cleaning.

The carbon filter unit selected should include pre-filters; this is to ensure that no grease enters the carbon filters themselves. Carbon filters can be ruined by operating the extraction system without effective removal of grease. This can be very expensive, so it is important to ensure that there are grease filters and pre-filters and that they are properly maintained and used at all times when cooking.

Electrostatic precipitation

Electrostatic separators (ESP) are used to separate solid or liquid particles from ventilation air. The particles distributed in the gas are electrostatically charged so that they stick to collection plates. The system replaces the need for Fine Pre-Filters.

The Main components of an ESP are the filter housing, discharge and collecting electrodes, power supply, gas guides or baffles and a rapping system for cleaning the collecting plates.

ESPs can be designed to eliminate extensive quantities of smoke however the effectiveness of an ESP is limited to removing the grease that adheres to smoke and **should not be considered to be a primary source of odour control**. Where installed, coarse pre-filters should be fitted upstream of the ESP to provide some protection from large contaminants that may pass through the grease filters.

Where an ESP is used to treat oily fumes the collecting plates can become fouled, rendering them less effective. Weekly servicing should be the minimum requirement and they should be cleaned immediately as soon as there is any sign of deterioration in fume control.

In-line oxidation systems

Oxidation using ozone and/or activated oxygen ions has been used to treat odour emissions from commercial and industrial kitchen processes. Due consideration needs to be given to the residual ozone that may arise from these systems. Complete degradation of ozone is unlikely to take place within the duct work and therefore the extraction system must discharge at high level. There will need to be restricted application of these systems in areas housing multiple commercial kitchens.

Odour neutralising and counteracting agents

Counteracting agents when added to the air stream claim to result in a reduced response to the odour by humans by reducing the perceived intensity. As this type of system does not actually remove odour, the level of odour removal is likely to be negligible.

With these systems correct chemical dosing is critical as the chemical agent that is injected into the air stream can also give rise to odour annoyance. Such systems should be avoided where the dispersion of the discharging plume is severely impeded, e.g. in courtyard situations.

Risk Assessment for Oil, Grease, Smoke and Odour from Commercial Kitchens

Odour control must be designed to prevent odour nuisance in each situation. The following score methodology is suggested as a means of determining odour control requirements using a simple risk assessment approach.

Impact Risk	Odour Control Requirement	Significance Score*
Low to Medium	Low level of odour control	Less than 20
High	High level of odour control	20 to 35
Very high	Very high level of odour control	more than 35

Criteria	Score	Score	Details
Dispersion	Very poor	20	Low level discharge, discharge into courtyard or restriction on stack.
	Poor	15	Not low level but below eaves, or discharge at below 10m/s
	Moderate	10	Discharging 1m above eaves at 10-15m/s
	Good	5	Discharging 1m above ridge at 15 m/s
Proximity of receptors	Close	10	Closest sensitive receptor less than 20m from kitchen discharge.
	Medium	5	Closest sensitive receptor between 20 and 100m from kitchen discharge.
	Far	1	Closest sensitive receptor more than 100m from kitchen discharge.
Size of kitchen	Large	5	More than 100 covers or large sized take away.
	Medium	3	Between 30 and 100 covers or medium sized take away.
	Small	1	Less than 30 covers or small take away
Cooking type (odour and grease loading)	Very high	10	Pub (high level of fried food), fried chicken, burgers or fish & chips.
	High	7	Kebab, Vietnamese, Thai or Indian.
	Medium	4	Cantonese, Japanese or Chinese.
	Low	1	Most pubs, Italian, French, Pizza or steakhouse.]

Minimum requirements for Odour Control - Odour arrestment plant performance

Low to medium level control may include:

- Fine filtration or ESP followed by carbon filtration (carbon filters rated with a 0.1 second residence time)
- Fine filtration followed by counteractant/neutralising system to achieved the same level of control as 1

High level odour control may include:

- Fine filtration or ESP followed by carbon filtration (carbon filters rated with a 0.2-0.4 second residence time).
- Fine filtration or ESP followed by UV ozone system to achieve the same level of control as 1

Very high-level odour control may include:

- Fine filtration or ESP followed by carbon filtration (carbon filters rated with a 0.4 –0.8 second residence time)
- Fine filtration or ESP followed by carbon filtration and by counteractant/neutralising system to achieve the same level of control as 1.
- Fine filtration or ESP followed by UV ozone system to achieve the same level of control as 1.
- Fine filtration or ESP followed by wet scrubbing to achieve the same level of control as 1.

Maintenance must be carried out to ensure these performance levels are always achieved.

Fans

Fans are required to pull the fumes caused by cooking from the cooker hood to the point of discharge at roof height. The size of the motor on the fan needs to be of adequate size to ensure proper ventilation, taking into account the length and design of the ductwork and filters used.

A ventilation contractor will be able to advise you of the appropriate size of fan motor for your ducting and on the adequacy of air changes. Fans should be located within the building wherever possible as to reduce potential noise and vibration use from occurring. However, where this is not possible details of the fan and the noise levels it produces should be submitted within the application for approval. Even when fans are located within the building, consideration should still be given to ensure that any noise and vibration caused from the fans does not disturb and cause a nuisance to neighbouring properties.

Minimum requirements for fans

- Fans must be capable of dealing with the operating static pressure within the duct work and should be designed with a minimum 10% pressure margin.
- Backward curved centrifugal, mixed flow or axial flow impellers are preferred as they are less prone to imbalance and are more easily maintained/cleaned due to their open construction. Fixed or adjustable metal impellers with a robust and open construction should be used.
- Fan motors should be rated to IP55 with no need to mount the motor outside of the air stream.
- For fans that have motors within the air stream and are ventilating cooking equipment that produce high levels of temperature and humidity the specification for the motor should be upgraded to withstand more onerous conditions.

Minimum requirements for noise control

- For new premises or premises covered by planning conditions restricting the impact of noise the system should be designed to prevent an acoustic impact on the external environment and therefore harm to the amenity, as well as ensuring that noise exposure of kitchen staff does not constitute a hearing hazard.
- For existing premises not covered by planning conditions restricting the impact of noise, the system should be designed to avoid statutory nuisance and should comply with the principles of Best Practicable Means.
- To achieve these objectives the noise control system should include:
 - o control of noise at source to the greatest extent possible
 - o control of noise to the environment by taking acoustic considerations into account within the duct, grille and termination design
- The noise from the system should be calculated to meet the requirements in accordance with the methodologies of BS4142:2014+A1:2019.

Maintenance

Proprietors of commercial kitchens have a duty to ensure that the ventilation system serving the respective premises are maintained and operated effectively. Proper maintenance is a condition for ensuring that the ventilation system complies with Best Practicable Means under statutory nuisance provision and is a key element of any scheme designed to minimise harm to the amenity under planning regulation. Good maintenance is required by the food hygiene regulations and will also minimise the risk of fire. The recommended cleaning period for extract ductwork is:

- Heavy use – 12-16 hrs/day – 3 monthly
- Moderate use – 6-12 hrs/day – 6 monthly
- Light use – 2-6 hrs/day – Annually

Recommendations for maintenance of odour control system include:

- System employing fine filtration and carbon filtration:
 - o Change filters every two weeks
 - o Change carbon filters every 4 to 6 months
- System using ESP and other in line abatement.
 - o ESP systems cleaned, and sump emptied on a four weekly basis
 - o UV-C systems used in line, cleaned on a four weekly basis
 - o Side Stream UV-C systems cleaned every 3 to 6 months.
 - o Carbon filters with ESP pre-treatment change carbon filter every 6 to 12 months

These time frames may increase or reduce for extreme or very light applications.