VENTILATION STRATEGIES TO PROMOTE GOOD INTERNAL AIR QUALITY

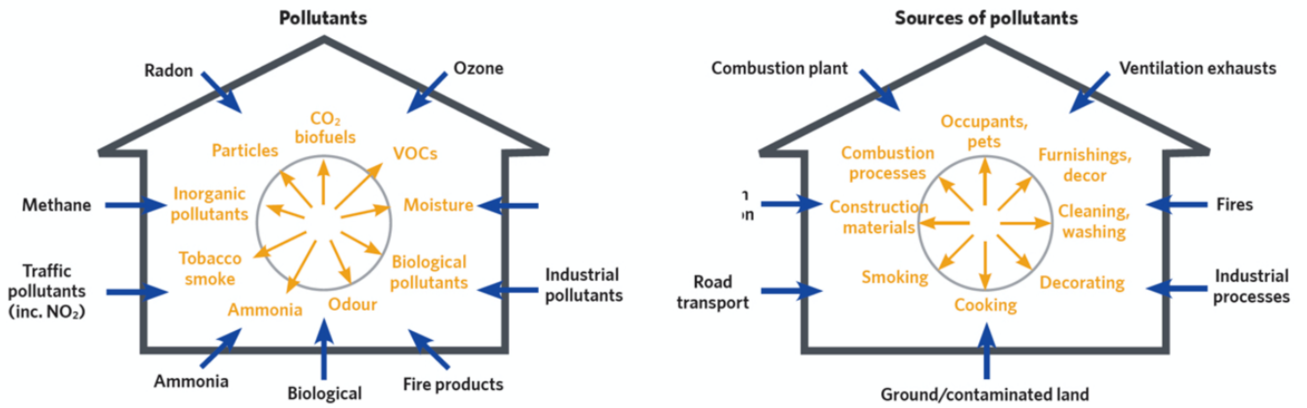
Toolbox Talk

Background

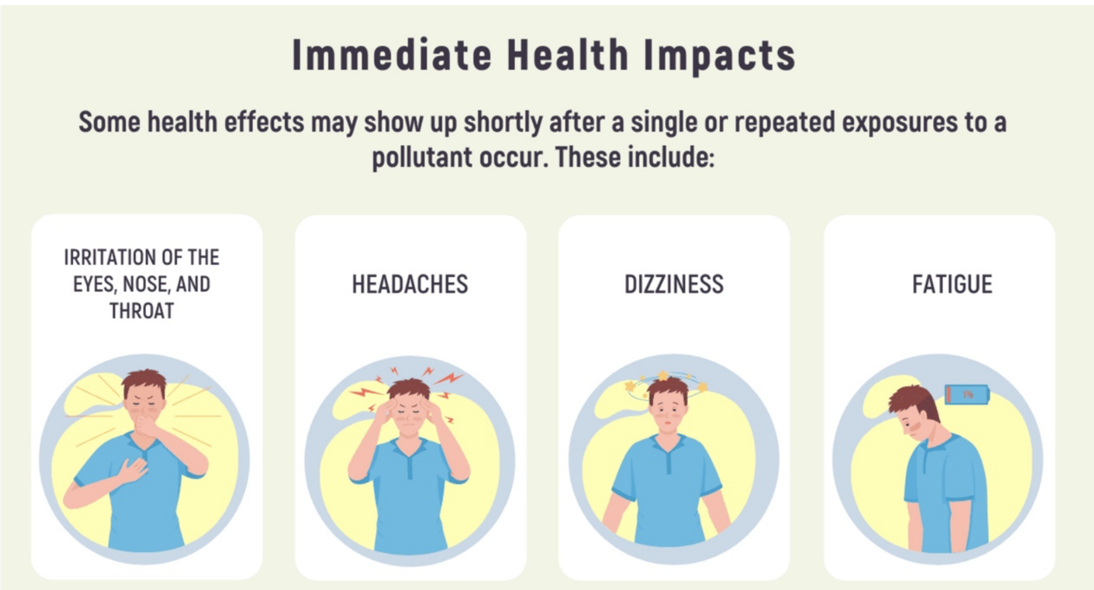
Air of good quality is air in which there are no known contaminants at harmful concentrations.

The quality of indoor air is affected not only by outdoor pollution, but also by indoor sources and inadequate ventilation. Tobacco smoke, mould, and chemicals released from synthetic fabrics, paints, furnishings and household products are some of the sources of contaminants that make indoor air worse than outside air.

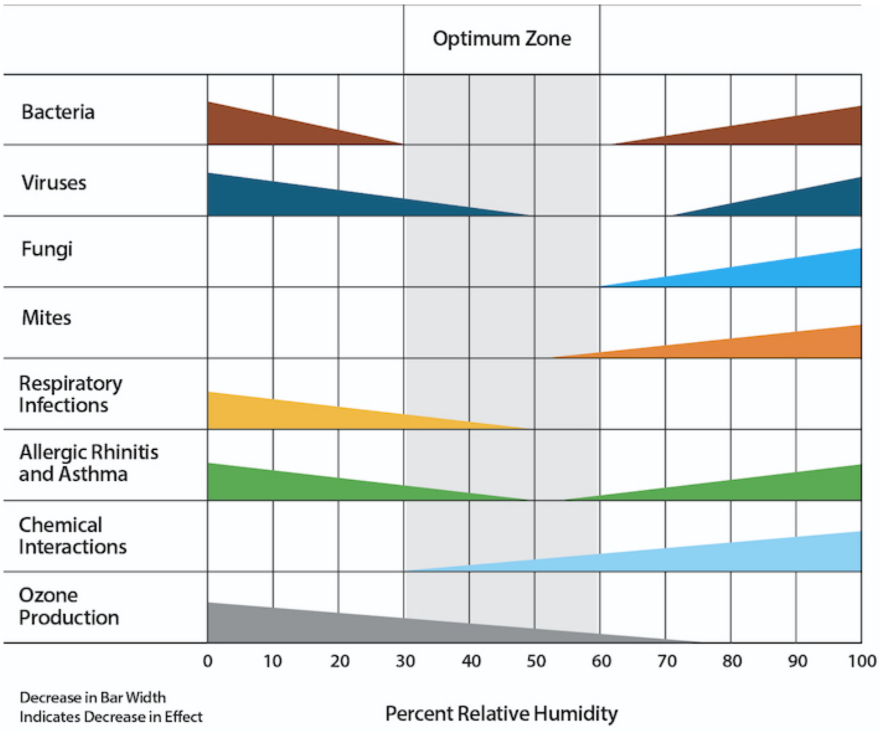
The diagram below from the 2022 Chief Medical Officer's Annual Report shows some of the most common pollutants and their sources:



In the UK, we spend approximately 90% of our time indoors, with much of that time spent within our own homes; this makes Internal Air Quality (IAQ) incredibly important for our health and well-being. Poor internal air quality can quite quickly lead to some of the below symptoms with prolonged exposure leading to serious health consequences and in extreme cases, death.



The level of relative humidity within a dwelling is one of the key indicators for IAQ, the Sterling Chart below gives a good representation of how relative humidity can translate to poor IAQ.



Outdoor Air Quality

Natural and man-made pollution is around us all the time and can come from a variety of sources as identified in the table from the Chief Medical Officer's Report. Most of the sources of outdoor air pollution are well beyond the control of individuals to control, but this doesn't mean that consideration should not be given when developing a ventilation strategy. Radon and locality to busy roads are two of the most common issues which can be addressed on a house-by-house basis if required.

Damp, Condensation and Mould

There are more than 100,000 types of mould types with some being more problematic than others. They fall under three categories: allergenic, pathogenic and toxigenic. All types can have detrimental affects on the health of residents within a building.

Mould is more likely to form in specific areas internally dues to the interactions between various factors including:

- High relative humidity
- Low ambient temperature
- Low surface temperature
- Low surface temperature due to thermal bridges
- Moisture ingress through defects or capillary action
- Trapped moisture or water vapour

Ventilation Strategy

The key tool at our disposal when looking to promote good IAQ, and avoid damp and mould risk, is ventilation.

PAS2035, Approved Document F of the Building Regulations, BS5250 and the BSRIA Guide to Domestic Ventilation Systems are all key documents to understand when tackling the challenging subject of promoting good Internal Air Quality (IAQ). The guidance within these documents should be understood by any retrofit professional working on any stage of the ventilation strategy; from design through to install and commissioning. A standard ventilation strategy will be made up of four main components:

- Ensuring adequate purge ventilation is available
- Ensuring adequate background ventilation
- Maintaining airflow pathways through a property
- Extraction from 'wet' rooms

Draught proofing and airtightness measures may also be considered a key element however these are often not within the scope of a retrofit project for various reasons.

While providing purge ventilation, adequate background ventilation and maintaining the airflow are all relatively straight forward, there are a number of different methods available for extraction:

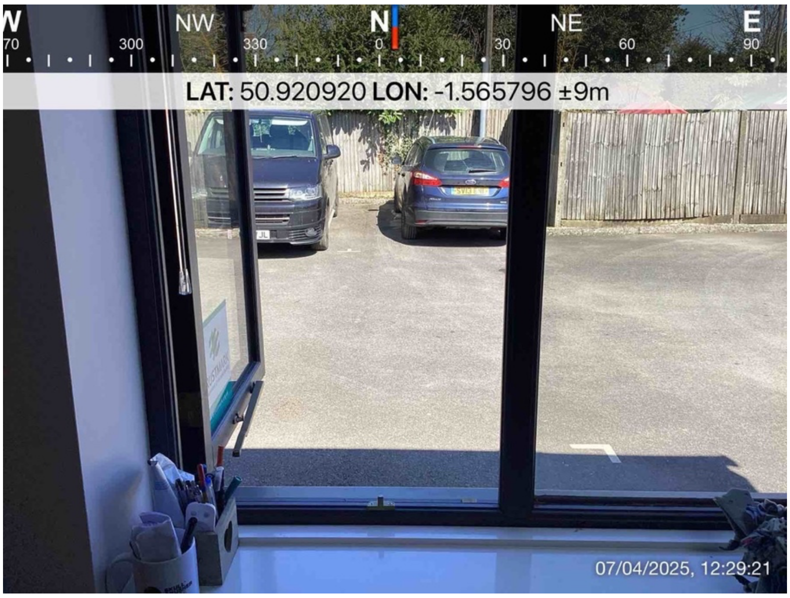
- Intermittent Extraction
- Centralised Mechanical Ventilation
- Decentralised Mechanical Ventilation
- Mechanical Ventilation with Heat Recovery
- Positive Input Ventilation

While these methods may all have a place, we will focus on the requirements of Decentralised Mechanical Ventilation which is usually the most appropriate system to use when retrofitting a property.

The below guidance is for reference and information in order to provide a broader explanation of the key requiremens; each property will have a specific ventilation strategy written and this should be referred to at all times.. Ventilation strategies are written in accordance with the requirements of Part F of the Building Regulations.

Purge Ventilation

Part F sets out specific requirements for achieving the minimum of 4 air changes per hour per room and how this can be achieved in various situations however in almost all properties this will be achieved simply by the presence of windows and doors which open greater than 30 degrees. Evidence of this should be taken by the Retrofit Assessor and should be checked by the installer.



Background Ventilation

Part F succinctly sets out the background ventilation requirements:

Background ventilators for continuous mechanical extract ventilation

1.64 Where continuous mechanical extract ventilation is used, background ventilators should satisfy all of the following conditions.

a. Not be in wet rooms.

b. Provide a minimum equivalent area of $4000mm^2$ for each habitable room in the dwelling.

c. Provide a minimum total number of ventilators that is the same as the number of bedrooms plus two ventilators (i.e. a one-bedroom dwelling should have three background ventilators, a two-bedroom dwelling should have four background ventilators, etc.).

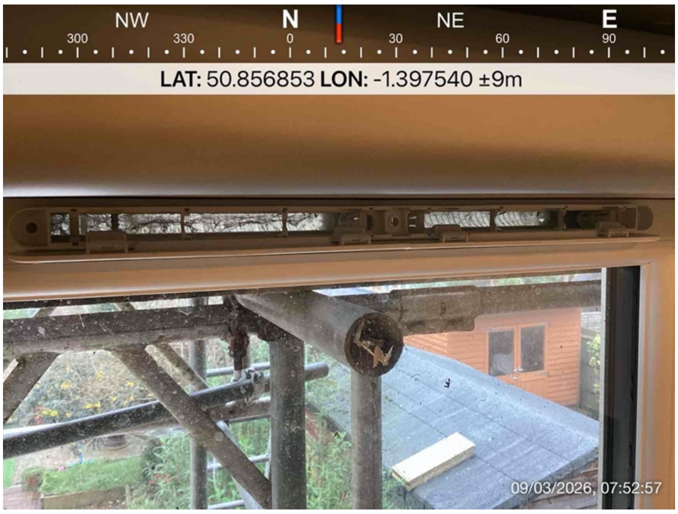
Achieving these requirements when installing new windows is simple however when working with existing windows it can be slightly more complicated. Retrofit Assessors must measure the size of the existing trickle vent however it will be almost impossible to measure either the free area or the equivalent area of this vent. In this instance, the retrofit coordinator or designer will use the information available to best determine whether the background ventilation in a specific room is adequate. Where damp and mould issues are evident, a background ventilation assessment using the Pulse system may be specified and new background ventilation may be installed.

Any new trickle vents installed should identify their equivalent area and evidence of this should be provided:

Assessors, installers and site managers should pay particular attention to ensuring that the trickle vent is routered out properly so that the equivalent area is achieved. A common non-compliance seen is where installers cut corners by simply drilling a few holes as below:

Non-compliant

Compliant



Existing trickle vents in wet rooms are sealed to ensure that the process of drawing fresh air into the property through the habitable rooms is not shortcut. They can be sealed through various means including sealant, airtightness tape or installation of blanks. The most appropriate method will be determined by the design, quality and condition of the existing vents.

Maintaining airflow through the dwelling

This is achieved by ensuring that door undercuts meet the below requirements**:**

1.25 Internal doors should allow air to flow through the dwelling by providing a minimum free area equivalent to a 10mm undercut in a 760mm wide door. Doors should be undercut to achieve one of the following.

a. If the floor finish is fitted: 10mm above the floor finish.

b. If the floor finish is not fitted: 20mm above the floor surface.

Extraction from wet rooms

Simply installing dMEV units and presuming that they will hit both the whole dwelling ventilation rate and the required high rates, does not constitute a compliant install, all fans must be commissioned to the requirements of Part F. The exact fan to use will be specified by the retrofit designer, this will ensure that it is compliant with PAS2035 requirements. The designer will also specify the type of external vent to use, this is mainly to ensure that dMEV are not affected adversely by wind conditions where they are located on walls which are subject to prevailing winds. It also ensures that gravity vents aren't used: in most cases these are not suitable for use with dMEV due to the low pressure of the trickle rate.

Each ventilation strategy will specify which rooms require dMEV to be installed as well as the rates they must achieve on each of their settings. The whole dwelling ventilation rate is usually determined by the number of bedrooms within a property as below:

Table 1.3 Minimum whole dwelling ventilation rates determined by the number of bedrooms

Number of bedrooms[1][2]	Minimum ventilation rate by number of bedrooms (l/s)
1	19
2	25
3	31
4	37
5	43

NOTES:

1. If the dwelling only has one habitable room, a minimum ventilation rate of 13l/s should be used.
2. For each additional bedroom, add 6l/s to the values in Table 1.3.

The total rate, in L/S, of all dMEV on trickle rate must meet the whole dwelling ventilation rate (this will be clarified in the section below regarding commissioning).

The high rates of each individual dMEV must meet the below requirements:

Table 1.2 Minimum extract ventilation rates for continuous extract systems[1]

Room	High rate (l/s)	Continuous rate
Kitchen	13	The sum of all extract ventilation in the dwelling on its continuous rate should be at least the whole dwelling ventilation rate given in Table 1.3
Utility room	8	
Bathroom	8	
Sanitary accommodation	6	

NOTE:

1. If the continuous rate of ventilation provided in a room is equal to or higher than the minimum high rate specified in the table, no extra ventilation is needed.

Common Issues

Common issues with ventilation systems are usually a result of poor installation practices, these issues can result in extraction rates not being hit and therefore puts the success of the strategy at risk, this in turn may increase the risk of poor IAQ including damp, mould and condensation issues. Part F provides useful information on how to avoid these issues:

Installation of ventilation systems

1.74 Ventilation systems should be installed to meet both of the following conditions.

a. Comply with the guidance in this approved document.

b. Not compromise the performance of the system.

1.75 Adequate space should be available for access to maintain ventilation equipment.

1.76 Rigid ducts should be used wherever possible.

1.77 Flexible ductwork, where installed, should meet all of the following conditions.

a. Only used for final connections.

b. Lengths should be a maximum of 1.5m.

c. Meet the standards of BSRIA's BG 43/2013.

1.78 Any flexible ducts should be installed so that the full internal diameter is maintained and flow resistance is minimised. This is achieved by taking both of the following actions.

a. Pulling the duct taut.

b. Ensuring that ductwork does not pass through orifices with a smaller diameter than the duct itself.

1.79 Ductwork installations should be designed and installed to minimise the overall pressure losses within the system by taking all of the following steps.

a. Minimising the overall length of duct.

b. Minimising the number of bends required.

c. Installing appropriately sized ducts for the air flow rate.

1.80 Each air terminal should have a free area of at least 90% of the free area of its associated duct.

1.81 Duct connections should be both mechanically secured and adequately sealed to prevent leaks. Rigid connectors and jubilee clips should be used for flexible ducting to ensure a good seal.

1.82 The installer should make a visual inspection to confirm both of the following.

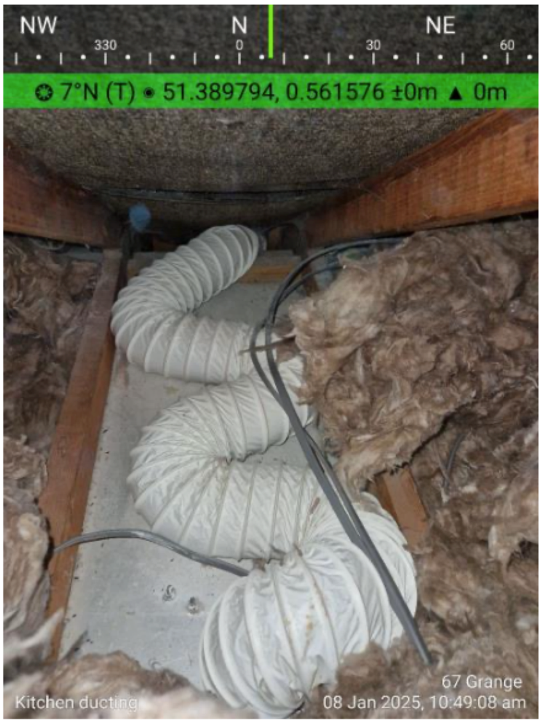
a. There are no obvious defects.

b. All packaging has been removed.

Examples of some common issues are below:

Excessive flexi ducting, no fixings, no support, incorrect ducting type, internal diameter not maintained

Ducting not extended to full length.



Kitchen ducting

Incorrect vent type with poor external finish

Fans installed in poor location – cleaning, maintenance and measurement impossible! Flow rates compromised. If replacing a fan that is in a bad position then we should relocate it to a better position and not just leave it in a bad position

No ducting and installed to an airbrick will reduce efficiency, reduce airflow and increase noise.

No ducting resulting in insulation bead filling the air pathway

Commissioning

The BSRIA Guide to Domestic Ventilation Systems sets out three methods for accurately measuring the extraction rates achieved by ventilation systems, these are detailed in the table below:

	Natural ventilation with background ventilators and Intermittent extract fans	Mechanical extract ventilation		Mechanical ventilation with heat recovery (MVHR)
	Decentralised	Decentralised (dMEV)	Centralised (MEV)	Centralised
Method A Unconditional measurement method	Yes	Yes	Yes	Yes
Method B Conditional measurement method	Only with specific correction factors for both the instrument and the fan	Only with specific correction factors for both the instrument and the fan	Not preferred	Not preferred
Method C Minimum Benchmark method	Yes	No	No	No
Fan Rating	Minimum benchmark performance	**Method C Minimum Benchmark method** Note: This method has been established to allow the testing of axial type fans in intermittent fan type systems, where correction factors for the test equipment and fan combination have not been generated. Vane anemometers cannot provide an accurate measurement of airflow rates but they may be used to provide an indication of compliance. These minimum benchmark values have been set to allow for the back pressure that vane anemometers impose on the ventilation system.		
15l/s	12l/s			
30l/s	24l/s			
60l/s	35l/s			

There are issues with all of these methods when installing dMEV:

- Method A requires a very expensive piece of equipment which most assessors and installers do not have so using this method at scale is currently impractical
- Method B requires correction factors which are often very difficult to acquire from manufacturers
- Method C – there are no benchmark figures currently available for dMEV

Due to these restrictions, the current strategy is to use method C and have the flow rates reviewed by a competent person to ensure they are close to what can reasonably expected. This is not 100% accurate but does give the best possible approach at this time and will certainly be indicative that the fans are working to a level close to where they should be; combined with a competent installer ensuring that the system has been installed following the Part F guidance, this will be the approach until a better alternative can be agreed upon.