

VENTILATION IN NEW AND EXISTING HOMES

Guide to Building Regulations requirements



INTRODUCTION

This guide supports the 2021 edition of *Approved Document F, Volume 1: Dwellings for England*, which relates to work carried out from the 15th June 2022. While this guidance should help users to understand the requirements, it should not be used as a substitute for the full detail of the approved document. It should be noted there may be other ways to comply with the requirements than those described in an approved document and any proposed variation should be agreed with the relevant building control body.

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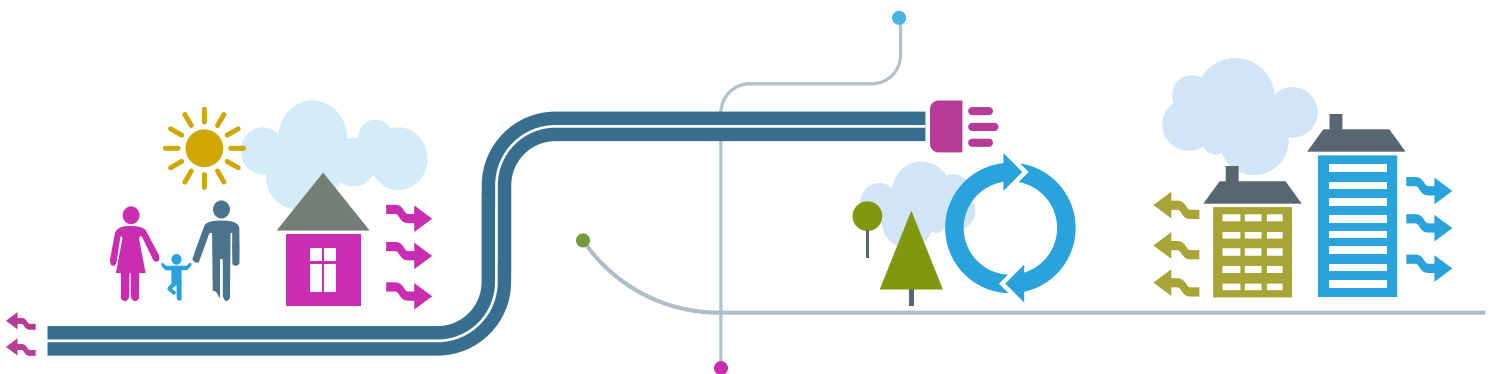
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1. VENTILATION IN NEW HOMES

GUIDE TO BUILDING REGULATIONS REQUIREMENTS

It is a **legal requirement** that new dwellings must have 'adequate means of ventilation' for the occupants. As buildings have to be built to high standards of airtightness this means that the ventilation strategy has to be carefully considered.

New guidance for ventilation has been published by Government and comes into force in England on the 15th June 2022. This guidance is therefore based on the new regulations for dwellings in England only.

Revisions to Part F of the Building Regulations for Wales, will come into force in November 2022, and the domestic Building Standards Technical Handbook in Scotland have also been consulted on. A detailed review of ventilation regulations in Northern Ireland is also due to take place in 2022.

Selecting a Ventilation System

There are two approaches to selecting a suitable ventilation system to meet the requirements of the regulations:

1. Follow the guidance set out in the Part F Approved Document by choosing one of three specified systems, depending on the design airtightness of the dwelling, and following the design guidance.
2. Use an alternative ventilation system. As stated in the Government response to the consultation on the new regulations "*other less commonly used ventilation systems such as Positive Input Ventilation and Passive Stack Ventilation, which will not be covered in the approved documents, can still be used to achieve regulatory compliance.*" It must be shown to the building control body that any alternative solution meets the legal requirement to provide adequate ventilation for people in the building. In practice, this means that you need to obtain 'expert advice' (e.g., a building services specialist or ventilation manufacturer) on the design, sizing, positioning, and commissioning of the ventilation system you choose to use.

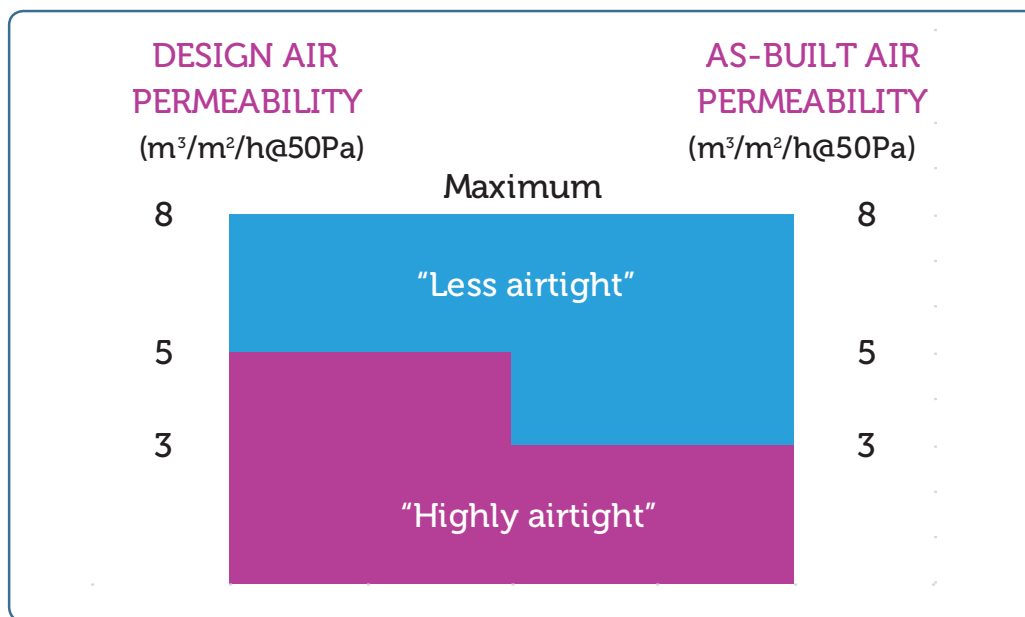


Ventilation Systems for which Guidance is Provided in the Approved Document

Part F of the Building Regulations (England) sets out guidance on three suitable ventilation systems to meet the regulations. The names of the systems for which guidance is provided have been changed from the previous version of the regulations, although the technology described is the same. These changes are explained below:

Name in 2013 version of Part F	Name in 2022 version of Part F	Notes
System 1 – Background ventilators and intermittent extract fans	Natural ventilation	Despite the new name, intermittent mechanical extract fans are still required
System 2 – Passive stack ventilation	N/A	Guidance no longer provided on this system
System 3 – Continuous mechanical extract (MEV)	Continuous mechanical extract ventilation	
System 4 – Continuous mechanical supply and extract with heat recovery	Mechanical ventilation with heat recovery	

A further change is that guidance for systems is dependent on the airtightness of the dwelling. New homes must have an air permeability of at most 8 m³/m²/h at 50 Pa (tested by a pressure test) but can be much less than this to achieve energy efficiency benefits. This is shown below:



Newly built homes are defined as “less airtight” if they have a design air permeability of 5 or higher, or they have an ‘as built’ air permeability of 3 or higher. (The reason for the difference is that it makes allowance for the fact that a building designed for one level of airtightness may be slightly more airtight when tested.) Homes more airtight than this are classed as “highly airtight.”



Using these definitions, the new version of Part F sets out the following:

- **Natural ventilation** systems should only be used in “less airtight” buildings. If using in “highly airtight buildings” then expert advice must be used for the system design to ensure that adequate ventilation is provided. In practice this is likely to mean that larger background ventilators, or a greater number of them, are needed.
- **Continuous mechanical extract ventilation** and **mechanical ventilation with heat recovery** systems can be used in dwellings of any airtightness.

A description of the systems and their design standards is covered below:

Natural ventilation systems

The requirements are as below:

1. Intermittent extract fans in all wet rooms, with either manual or automatic control, and providing a minimum extract rate as stated below:
 - **Kitchens** – 60 l/s (or 30 l/s if the extract is a cooker hood)
 - **Utility rooms** – 30 l/s
 - **Bathrooms** – 15 l/s
 - **Sanitary accommodation (toilets)** – 6 l/s

Where any wet room has no external walls the minimum extract rate should be four air changes per hour.

NOTE: The minimum extract rate is for the fan when installed. Some fans may not achieve their stated extract rate in-situ due to resistance from ductwork, grilles etc¹.

2. Background ventilators should be fitted in the outside wall of all rooms. The minimum equivalent area of those background ventilators should be as below:

Room	Minimum equivalent area (mm ²)	
	Dwellings with 2 or more floors	Single storey dwellings
Habitable rooms	8,000	10,000
Kitchen	8,000	10,000
Bathroom	4,000	4,000
Utility room	Not required	Not required
Sanitary accommodation (toilets)	Not required	Not required

NOTE: Requirements for dwellings where there are not separate rooms, each with an outside wall, are covered in Part F Volume 1.

3. All internal doors should be adapted to allow the flow of air when the door is closed. This should provide a free area of a 10mm undercut in a 760mm wide door, or the equivalent. Where the door is undercut, the gap must allow for 10mm above the final floor covering.
4. The specific fan power for the system should not exceed 0.5W/l/s. (Covered under Part L.)

Continuous mechanical extract ventilation systems

The requirements are as below:

1. Continuous extract ventilation from kitchens, bathrooms, utility rooms and sanitary accommodation.

¹ The Green Homes Compliance Scheme lists fans that have been tested to deliver required extract rates for specific applications when exposed to expected resistance: <https://www.beama.org.uk/portfolios/ventilation-and-indoor-air-quality/product-lists-ventilation.html>

This should be provided by either:

- a) A centralised extract fan connected to each room by ductwork.
- b) Individual extract fans in each room, operating continuously.
- c) A combination of (a) and (b).

The minimum total continuous extract rate from the dwelling should be as below:

Number of bedrooms	Total extract rate (l/s)
1	19
2	25
3	31
4	37
5	43

In addition, the extract ventilation should have a 'high rate' setting that provides the following extract rate for the type of room it is extracting from:

Room type	High rate (l/s)
Kitchen	13
Bathroom	8
Utility room	8
Sanitary accommodation (toilets)	6

If, in order to meet the continuous extract rate, the extract rate in each room is already at or above the defined 'high rate' levels there is no need to provide an additional high rate.

Manual or automatic controls must be provided to select the 'high rate' setting. Manual controls must be positioned near to or in the rooms being served.

2. Background ventilators should be provided as below:

- a) No background ventilators in rooms with extract ventilation.
- b) A background ventilator in each habitable room with a minimum equivalent area of 4,000 mm².
- c) A total number of background ventilators that is at least the number of bedrooms in the dwelling plus two.

Where the number of background ventilators calculated in (c) above is greater than the number of habitable rooms, the minimum equivalent area required for each room does not increase. For example, one room could have two background ventilators, each with an equivalent area of 2,000 mm².

3. All internal doors should be adapted to allow the flow of air when the door is closed. This should provide a free area of a 10mm undercut in a 760mm wide door, or the equivalent. Where the door is undercut, the gap must allow for 10mm above the final floor covering.

4. The specific fan power for the system should not exceed 0.7W/l/s. (Covered under Part L.)



Mechanical ventilation with heat recovery systems

The requirements are as below:

1. A central unit should provide both continuous supply and continuous extract. It should also incorporate a heat exchanger to transfer energy from the extract air into the supply air.

The heat recovery system must have a minimum efficiency of 73%, a summer bypass facility and a variable speed controller. The specific fan power for the system should not exceed 1.5W/l/s. (Covered under Part L.)

2. Ductwork from the central unit will provide supply air to each habitable room. This excludes rooms that are solely a kitchen, utility room, bathroom, or sanitary accommodation (toilet.) The minimum total continuous supply rate to the dwelling should be 0.3 litres per second per m³ of internal floor area, or the rate determined by number of bedrooms as below, whichever is the higher.

Number of bedrooms	Total supply rate (l/s)
1	19
2	25
3	31
4	37
5	43

The total supply flow rate should be distributed proportionally to each habitable room based on the volume of each room.

3. Ductwork from the central unit will also provide extract ventilation from kitchens, bathrooms, utility rooms and sanitary accommodation. The minimum total continuous extract rate from the dwelling should be at least the same as the supply rate above.

In addition, the extract ventilation should have a 'high rate' setting that provides the following extract rate for the type of room it is extracting from:

Room type	High rate (l/s)
Kitchen	13
Bathroom	8
Utility room	8
Sanitary accommodation (toilets)	6

If, in order to meet the continuous extract rate, the continuous extract rate in each room is already at or above these levels there is no need to provide an additional high rate.

Manual or automatic controls must be provided to select the 'high rate' setting. Manual controls must be positioned near to or in the rooms being served.



4. All internal doors should be adapted to allow the flow of air when the door is closed. This should provide a free area of a 10mm undercut in a 760mm wide door, or the equivalent. Where the door is undercut, the gap must allow for 10mm above the final floor covering.
5. Background ventilators must **not** be installed with this system.

Purge ventilation

In addition to the ventilation provision described above, habitable rooms must be provided with purge ventilation. This needs to be available for occasional rapid dilution of pollutants and water vapour, and also to remove excess heat that can result in summer overheating as set out in Part O of the Building Regulations.

To provide purge ventilation, one of the following is required in each habitable room:

- Mechanical extract ventilation capable of extracting four air changes per hour per room.
- Hinged or pivot window(s) with a 15-30° opening angle and a total opening area at least 1/10th of the floor area.
- Hinged or pivot window(s) with a minimum 30° opening angle and a total opening area at least 1/20th of the floor area.
- Opening sash windows.
- An external door.

It should also be noted that compliance with Part O may require higher levels of purge ventilation.

Additional requirements

Part F includes additional requirements for ventilation systems. These should be checked in detail but are summarised below:

Installation

- Rigid ductwork should be used wherever possible. Flexible ductwork should only be used for end connections, never exceed 1.5m, and be pulled taut.
- Reasonable access should be provided for maintenance, such as replacing filters.
- Length of ductwork and the number of bends should be minimised.
- Duct connections should be both mechanically secured and sealed to prevent leaks.
- Ventilation intakes should be located away from sources or outdoor air pollution.
- Exhaust outlets should be located so that re-entry of exhaust air into the building is minimised, and so that it will not cause any harm.

Noise

- Both intermittent and continuous mechanical ventilation should be designed and installed to minimise noise.
- Fans should be sized so that they do not operate near maximum capacity under normal operating conditions.
- It is considered good practice for ventilation systems under normal operating conditions not to exceed an average A-weighted sound pressure level of 30dB $L_{Aeq,T}$ in bedrooms and living rooms and 45dB $L_{Aeq,T}$ elsewhere.



Filtration

- Measures to minimise the intake of pollution within external air, such as filtration, will be needed if outside pollution levels are exceeded, or if the dwelling is close to sources of significant pollution. These are defined in Table 2.1 of Approved Document F: Volume 1.

Compliance and Commissioning

Having selected, designed and installed a suitable ventilation system, this will not be deemed compliant until the commissioning requirements have been met.

It is a legal requirement that, when a ventilation system has been installed, it should be commissioned and notice of the commissioning given to the local authority. The process set out below should be followed for every dwelling in which a new ventilation system is installed:

1	The commissioning sheet in Appendix C of Part F Volume 1 must be completed as evidence that the system has been correctly installed, inspected and commissioned.
2	Before commissioning, Part 1 and Part 2a must be completed by the installer, who must also sign the declaration in 2a.2.
3	Part 2b and Part 3 must be completed by the person carrying out the commissioning, who must also sign the declaration in 3.5. The person carrying out the commissioning must either: a. Be a member of a registered Competent Persons Scheme for ventilation, or: b. Provide suitable evidence to the building control body (with the commissioning sheet) to demonstrate their competence.
4	If it proves to be impossible to commission the system to meet the design standards, or if any of the items in part 2b of the checklist result in a 'no' response, then all issues must be rectified by the installer before the declaration in 3.5 is signed off.
5	The completed copy of the commissioning sheet should be submitted to the building control body within 5 days for new dwellings, or within 30 days in all other cases.
6	A copy of the completed commissioning sheet should be given to the building owner, along with operating and maintenance instructions for the ventilation system.
	NOTE: <i>If ventilation systems are installed outside of those for which guidance is provided in Part F, the system designer should provide details of the installation checks and commissioning procedures that are applicable for that system. This guidance and the relevant inspection and commissioning details must be provided alongside the commissioning sheet to both the building control body and the building owner.</i>



Commissioning of ventilation systems must include the following:

- The air flow rate of all mechanical ventilation fans must be tested, either directly at the fan or at ducted terminals as appropriate.
- Air flow measurements must be carried out using an air flow device with a proprietary hood, an accuracy of +/- 5%, and UKAS accredited calibration within the last 12 months.
- Commissioning must show that the air flow rates required for the dwelling are being achieved.
- Continuous systems must be balanced to achieve design air flow rates at each terminal.
- Controls must be checked to show that they are operating as required.
- The actual equivalent area and location of background ventilators should be recorded, and these should meet the Part F requirements for the system installed.
- For ducted systems the installation should be checked, including that the location of the terminals will provide effective air distribution and that supply and extract terminals have air flow in the right direction.

Provision of information

Once ventilation work is complete, the building owner must be provided with the following information:

- Operating and maintenance instructions that are clear and non-technical and allow the ventilation system to be operated effectively and provides information on how it should be maintained to ensure optimal performance. Details of necessary information are listed in section 4.16 and 4.17 of the Approved Document.
- A copy of the completed commissioning sheet in Appendix C of Part F Volume 1.

For new dwellings, in addition to the above, a Home User Guide should be provided with a section on ventilation. This is a non-technical overview of the systems installed for the occupiers and full details are provided in Section 9 of Approved Document L, Volume 1: Dwellings.



2. VENTILATION IN EXISTING HOMES

GUIDE TO BUILDING REGULATIONS REQUIREMENTS

When energy efficiency measures are added to an existing dwelling, those measures are likely to make it more airtight and increase the risk that there is insufficient ventilation to maintain adequate indoor air quality. This contravenes the building regulations requirement that building work should not reduce the ventilation provision below the standards set out in Part F.

One of the following actions is therefore needed whenever energy efficiency measures are added to a building to assess whether ventilation is needed:

1. Get an air permeability test carried out before and after the energy efficiency measures are added. To demonstrate that the building's natural infiltration rate has not been reduced by the work being carried out, and therefore its ventilation cannot be defined as being "less satisfactory". If the infiltration rate after the energy efficiency measures have been added has been reduced, then one of the actions below must also be carried out.
2. Engage an expert to demonstrate that the building provides adequate ventilation for the occupants after the energy efficiency measures have been added. If the dwelling solely relies on natural infiltration to provide adequate ventilation this approach may be difficult as Part F doesn't define what a suitable rate of natural infiltration would need to be for it to constitute adequate ventilation.
3. Follow the procedure set out in BSI PAS 2035 Appendix C.
4. Follow the 'simplified method' set out in Part F (see below.)

NOTE: In any situation where there is evidence of condensation and/or mould growth in the dwelling it would be good practice to improve the ventilation.

The simplified method

This is the most straightforward approach to follow and likely to be used in most cases when adding energy efficiency measures. Table 3.1 in the Part F Approved Document Volume 1 classifies energy efficiency measures by whether they are 'minor' or 'major' in respect of their likely impact on the airtightness of the building. A matrix then sets out what action is required depending on the number of minor or major measures added.

Broadly speaking these actions are as below:

- Up to two minor measures (e.g., loft insulation, cavity wall insulation) mean that no further ventilation provision is necessary.
- More than two minor measures or a single major measure (e.g., external wall insulation, full double glazing) mean that any Part F compliant ventilation system must be installed.



- More than three major measures, or one or two major measures together with a number of minor measures, mean that either a continuous mechanical extract ventilation system or a MVHR system should be installed in the dwelling.

When carrying out this assessment it is important to note that all energy efficiency measures added to the dwelling since it was built must be included in the assessment. It is not enough to only consider the energy efficiency measures being added at this time.

If this process indicates that a ventilation system is required, it may be possible to use an existing system in the building. Appendix D in Part F provides a checklist that should be used to work out the suitability of any existing system in relation to what is needed.

Other ventilation requirements for existing dwellings

The ventilation standards in Part F of the Building Regulations also apply to existing dwellings in the following situations:

- **Building change of use.**
 - When a building is converted to a dwelling, or converted into flats, the requirements in Part F Volume 1 apply in full.
- **Wet rooms.**
 - When a wet room (kitchen, bathroom, utility room, or toilet) is added to a building, extract ventilation should be provided, and suitable additional supply air provided to the building. This can be done in isolation or by extending the existing ventilation system.
 - Refurbishment of an existing kitchen or bathroom does not specifically require that extract ventilation is provided, but this should be considered good practice.
- **Rooms other than wet rooms.**
 - Where a habitable room, excluding a conservatory, is added to a building it should be provided with a source of ventilation, for example by a suitably sized background ventilator or by extending an existing ducted system.
 - If the room is a conservatory over 30m², suitably sized background ventilators should be provided.
- **Replacing windows**
 - When replacing windows that have background ventilators, the replacement windows should have background ventilators of at least the same size.
 - When replacing windows that don't have background ventilators, and in a dwelling that doesn't have a fully ducted supply and extract ventilation system the replacement windows should have background ventilators of minimum equivalent area 8,000mm² in habitable rooms and kitchens and 4,000mm² in bathrooms. (If there is a continuous mechanical extract ventilation system then background ventilators are only required in habitable rooms and should have a minimum equivalent area of 4,000mm².)





Rotherwick House
3 Thomas More Street
London E1W 1YZ

www.beama.org.uk