



Proposals for amending Part L and Part F of the Building Regulations – *Consultation*

Volume 3: Proposed technical guidance for Part F



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Volume 3, Chapter 1

Proposed Approved Document F 2010 Edition

Approved Document F (2010)

Introduction

1. This document contains the proposed text of the 2010 Approved Document F: *Ventilation*. The style is based on the style of Approved Documents L issued for consultation in 2008, which was strongly supported by consultees.
2. The [key proposed technical amendments to the 2006 Approved Document F are shown in this new version in blue](#) but readers are advised to review the whole document.
3. Text extracted from the Building Regulations 2000 is shown against a green background. **Key terms are in bold italic text.** *Additional commentary in italics appears after some numbered paragraphs to help understanding, but is not part of the technical guidance itself. Text added to assist with the consultation process is shown in plum italics.*
4. The intent of proposed changes to the Building Regulations 2000 is given under the Part F Requirement. The proposed changes to the legal text have not been drafted.

Main changes in the 2010 edition

5. This edition of Approved Document F: *Ventilation* replaces the 2006 edition.
6. The proposed main changes to the Building Regulations 2000 are:
 - all ventilation systems (both natural and mechanical) shall be inspected and commissioned.
 - for mechanical ventilation systems installed in new dwellings, air flow rates shall be measured on-site as part of the commissioning process. This shall apply to intermittently-used extract fans and cooker hoods, as well as continuously running systems;
 - where continuously running ventilation systems for dwellings are specified, these shall have been type tested and shown to meet specified noise limits;
 - the owner/occupier shall be given sufficient information about the ventilation system and its maintenance requirements so that the ventilation system can be operated to provide adequate air flow. This should apply to natural and mechanical systems in new dwellings;
 - a check list shall be completed and given to the building control body as evidence that all the above have been done for new dwellings;
 - domestic ventilation systems will become a controlled service for ventilation as well as energy performance, which means that all work on domestic ventilation systems will be building work that must meet Requirement F1. However, only the provision (which includes replacement) or alteration of continuously running mechanical systems will be notifiable building work.

7. Guidance has now been included for airtight homes. In all cases, this results in greater ventilation provisions for dwellings with design air permeability tighter than or equal to $5 \text{ m}^3/(\text{h.m}^2)$ at 50 Pa.
8. The infiltration allowance for leakier homes is now the same for single-storey and multi-storey dwellings, resulting in increased ventilation provisions for single-storey dwellings up to four storeys above the ground.
9. For passive stack ventilators (PSV), the stack diameter has been increased to 125 mm for all room types. Use of PSV in inner wet rooms has been clarified.
10. The guidance for ventilation has been clarified when windows are replaced in an existing dwelling.
11. The guidance for ventilation has been clarified when a kitchen or bathroom in an existing dwelling is refurbished.
12. A new Appendix has been included which gives guidance on specifying and assessing noise levels from continuously running mechanical ventilation systems.
13. A separate guidance document has been produced covering installation and commissioning of domestic ventilation systems (and the 2006 Appendices D and E have therefore been removed).

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Section 1: Introduction

What is an Approved Document?

- 1.1 This document has been approved by the Secretary of State to provide practical guidance on ways of complying with the ventilation requirements (see Section 2) and regulation 7 of the Building Regulations 2000 (SI 2000/2531) for England and Wales, as amended. The Building Regulations 2000 are referred to throughout the remainder of this Document as “the Building Regulations”.
- 1.2 The intention of issuing Approved Documents is to provide guidance about compliance with specific aspects of building regulations in some of the more common building situations. They set out what, in ordinary circumstances, would be reasonable provision for compliance with the relevant requirement(s) of building regulations to which they refer.
- 1.3 If guidance in an Approved Document is followed there will be a presumption of compliance with the requirement(s) covered by the guidance. However, this presumption can be overturned, so simply following guidance does not guarantee compliance; for example, if the particular case is unusual in some way, then “normal” guidance may not be applicable. It is also important to note that there may well be other ways of achieving compliance with the requirements. There is therefore no obligation to adopt any particular solution contained in this Approved Document if you would prefer to meet the relevant requirement in some other way. Persons intending to carry out building work should always check with their **building control body**, either the local authority or an approved inspector, that their proposals comply with building regulations.
- 1.4 The guidance contained in this Approved Document relates only to the particular requirements of building regulations that the document addresses (set out in Section 2). However, building work may be subject to more than one requirement of building regulations. In such cases the work will also have to comply with any other applicable requirements of building regulations.
- 1.5 There are Approved Documents that give guidance on each of the Parts of Schedule 1 and on regulation 7. A full list of these is provided at the back of this document.

Consideration of technical risk

- 1.6 The construction of new buildings, and building work to existing buildings, must satisfy all the technical requirements set out in the Building Regulations. When considering the incorporation of ventilation measures in dwellings, attention should be paid in particular to the need to comply with Part B (fire safety), Part C (site preparation and resistance to contaminants and moisture), Part E (resistance to the passage of sound), Part L (conservation of fuel and power), Part J (combustion appliances and fuel storage systems) and Part P (electrical safety), as well as Part F. The adoption of any particular ventilation measure should not involve unacceptable technical risk of, for instance, creating a cold bridge. Designers and builders should refer to the relevant Approved Documents and to other generally available good practice guidance to help minimise these risks.

How to use this Approved Document

- 1.7 This Approved Document is subdivided into eight sections as detailed below. These main sections are followed by a glossary of key terms and five supporting appendices.

This **introductory** Section sets out the general context in which the guidance in the Approved Document must be considered.

Section 2 sets out the relevant legal requirements as published in the Building Regulations.

Section 3 contains general guidance on the types of building work covered by Approved Documents, how to deal with “special” areas of buildings that contain dwellings, procedures for notifying work, materials and workmanship, certification and standards, and health and safety issues.

Section 4 details the principles of ventilation and its control.

Section 5 details the guidance for ventilation of dwellings.

Section 6 details the guidance for ventilation of buildings other than dwellings.

Section 7 details the guidance for ventilation of existing buildings.

Section 8 lists Standards and other publications referred to in the text. A reference to a publication is likely to be made for one of two main reasons. The publication may contain additional or more comprehensive technical detail, which it would be impractical to include in full in the Approved Document but which is needed to fully explain ways of meeting the requirements; or it is a source of more general information. The reference will be to a specified edition of the document. The Approved Document may be amended from time to time to include new references or to refer to revised editions where this aids compliance.

Where you can get further help

1.8 If you do not understand the technical guidance or other information set out in this Approved Document and the additional detailed technical references to which it directs you, there are a number of routes through which you can seek further assistance:

- the CLG website: www.communities.gov.uk;
- the Planning Portal website: www.planningportal.gov.uk;
- if you are the person undertaking the building work you can seek assistance either from your local authority building control service or from your approved inspector (depending on which building control service you are using, or intend to use, to certify compliance of your work with the requirements of the Building Regulations);
- businesses registered with a competent person self-certification scheme may be able to get technical advice from their scheme operator;
- if your query is of a highly technical nature you may wish to seek the advice of a specialist, or industry technical body, in the area of concern.

Responsibility for compliance

1.9 It is important to remember that if you are the person (e.g. designer, builder, installer) carrying out building work to which any requirement of building regulations applies you have a responsibility to ensure that the work complies with any such requirement. The building owner may also have a responsibility for ensuring compliance with building regulation requirements and could be served with an enforcement notice in cases of non-compliance.

Section 2: The Requirement

- 2.1 This Approved Document, which takes effect on dd mm 2010, deals with the requirement of Part F: *Ventilation* of Schedule 1 to the Building Regulations 2000 as amended.

Requirement	Limits on application
<p>Means of ventilation</p> <p>F1. There shall be adequate means of ventilation provided for people in the building.</p>	<p>Requirement F1 does not apply to a building or space within a building:</p> <p>a. into which people do not normally go; or</p> <p>b. which is used solely for storage; or</p> <p>c. which is a garage used solely in connection with a single dwelling.</p>

Proposed amendments

We intend to amend the Regulations and/or requirement F1 so that:

1. *All ventilation systems (both natural and mechanical) shall be inspected and commissioned.*
2. *For mechanical ventilation systems installed in new dwellings, air flow rates shall be measured on-site as part of the commissioning process. This shall apply to intermittently-used extract fans and cooker hoods, as well as continuously running systems.*
3. *Where continuously running ventilation systems for dwellings are specified, these shall have been type tested and shown to meet specified noise limits.*
4. *The owner/occupier shall be given sufficient information about the ventilation system and its maintenance requirements so that the ventilation system can be operated to provide adequate air flow. This should apply to natural and mechanical systems in new dwellings.*
5. *A check list shall be completed and given to the building control body as evidence that all the above have been done for new dwellings.*
6. *Domestic ventilation systems will become a controlled service for ventilation as well as energy performance, which means that all work on domestic ventilation systems must meet Requirement F1. However, only the provision (which includes replacement) or alteration of continuously running mechanical systems will be notifiable building work.*

Section 3: General guidance

Types of work covered by this Approved Document

- 3.1 This Approved Document is intended to give guidance on what, in ordinary circumstances, would be reasonable provision for compliance with the requirements of Part F of Schedule 1 to the Building Regulations for those creating new dwellings and buildings other than dwellings and also carrying out work on existing buildings.

Live-work units

- 3.2 If a unit contains both living accommodation and space to be used for commercial purposes (e.g. workshop or office), the whole unit should be treated as a dwelling as long as the commercial part could revert to domestic use. This could be the case if, for example:
- a. there is direct access between the commercial space and the living accommodation; and
 - b. both are contained within the same thermal envelope; and
 - c. the living accommodation occupies a substantial proportion of the total area of the unit.

*Sub paragraph c. means the presence of (e.g.) a small manager's flat in a large non-domestic building would not result in the whole building being treated as a **dwelling**. Similarly, the existence of a room used as an office or utility space within a **dwelling** would not mean that the building should not be treated as a **dwelling**.*

Mixed use developments

- 3.3 When constructing a **dwelling** as part of a larger building that contains other types of accommodation, sometimes called a mixed use development, Section 5 of this Approved Document should be used for guidance in relation to each individual **dwelling**. Section 6 gives guidance relating to the non-dwelling parts of such buildings.

Competent person self-certification schemes

- 3.4 It is not necessary to notify a **building control body (BCB)** (i.e. a local authority or an approved inspector) in advance of carrying out work which is to be carried out by a person registered with a competent person self-certification scheme for that type of work. In order to join such a scheme a person must demonstrate competence to carry out the type of work the scheme covers, and also the ability to comply with all relevant requirements in the Building Regulations.
- 3.5 Where work is carried out by a person registered with a competent person scheme, regulation 16A of the Building Regulations and regulation 11A of the Building (Approved Inspectors etc) Regulations 2000 require that the occupier of the building be given, within 30 days of the completion of the work, a certificate confirming that the work complies fully with all applicable building regulation requirements. There is also a requirement that the **BCB** should be given a notice of the work carried out, again within 30 days of the completion of the work. These certificates and notices are usually made available through the scheme operator.
- 3.6 **BCBs** are authorised to accept these certificates and notices as evidence of compliance with the requirements of the Building Regulations. Local authority inspection and enforcement powers remain unaffected, but they are normally used only in response to a complaint that work does not comply.
- 3.7 From time to time self certification schemes may change name or new schemes may be authorised; an up to date list can be found at www.communities.gov.uk

Materials and workmanship

- 3.8 Any building work which is subject to the requirements imposed by Schedule 1 to the Building Regulations should, in accordance with regulation 7, be carried out with proper materials and in a workmanlike manner.
- 3.9 You may show that you have complied with regulation 7 in a number of ways. These include demonstrating the appropriate use of:
- a product bearing CE marking in accordance with the Construction Products Directive (89/106/EEC), as amended by the CE Marking Directive (93/68/EEC), the Low Voltage Directive (2006/95/EC) and the EMC Directive (2004/108/EC); or
 - a product complying with an appropriate technical specification (as defined in those Directives mentioned above), a British Standard, or an alternative national technical specification of a Member State of the European Union or Turkey, or of another State signatory to the Agreement on the European Economic Area (EEA) that provides an equivalent level of safety and protection; or

- a product covered by a national or European certificate issued by a European Technical Approval issuing body, provided the conditions of use are in accordance with the terms of the certificate.

3.10 You will find further guidance in the Approved Document which specifically supports regulation 7 on materials and workmanship.

Independent certification schemes

3.11 There are many UK product certification schemes. Such schemes certify compliance with the requirements of a recognised standard that is appropriate to the purpose for which the material is to be used. Materials which are not so certified may still conform to a relevant standard.

3.12 Many certification bodies that approve products under such schemes are accredited by the United Kingdom Accreditation Service (UKAS). Such bodies can only issue certificates for the categories of product covered under the terms of their accreditation.

3.13 **BCBs** may accept the certification of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Similarly, **BCBs** may accept the certification of the installation or maintenance of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Nonetheless, before accepting that certification constitutes compliance with building regulations, a **BCB** should establish in advance that the relevant scheme is adequate for that purpose.

Standards and technical specifications

3.14 Building regulations are made for specific purposes, including securing the health, safety, welfare and convenience of people in or about buildings; furthering the conservation of fuel and power; furthering the protection or enhancement of the environment; and facilitating sustainable development. Guidance contained in standards and technical approvals is relevant to the extent that it relates to those purposes. However, the guidance may also address other aspects of performance such as serviceability, or aspects which, although they relate to health and safety, are not covered by building regulations.

- 3.15 When an Approved Document makes reference to a named standard or document, the relevant version of the standard or document is the one listed at the end of the Approved Document. If this version has been revised or updated by the issuing body, the latest version may be used as a source of guidance provided it continues to address the relevant requirements of the Building Regulations. However, until the reference in the Approved Document is revised, the standard or document listed remains the approved source.
- 3.16 The appropriate use of a product in compliance with a European Technical Approval as defined in the Construction Products Directive will meet the relevant requirements.
- 3.17 The Department intends to issue periodic amendments to its Approved Documents to reflect emerging harmonised European Standards. Where a national standard is to be replaced by a European harmonised standard, there will be a co-existence period during which either standard may be referred to. At the end of the coexistence period the national standard will be withdrawn.

The Workplace (Health, Safety and Welfare) Regulations 1992

- 3.18 The Workplace (Health, Safety and Welfare) Regulations 1992, as amended, apply to the common parts of flats and similar buildings if people such as cleaners, wardens and caretakers are employed to work in these common parts. These Regulations contain some requirements which affect building design. The main requirements are now covered by the Building Regulations, but for further information see *Workplace health, safety and welfare, Workplace (Health, Safety and Welfare) Regulations 1992, Approved Code of Practice and guidance*, HSE publication L24, 1996.
- 3.19 Where the requirements of the Building Regulations that are covered by this Approved Document do not apply to dwellings, the provisions may still be required in the situations described above in order to satisfy the Workplace Regulations.

Section 4: Introduction to the provisions

Performance

- 4.1 The purpose of this section is to outline briefly what ventilation in buildings is for and the philosophy behind the guidance for ventilation given in Approved Document F. More detail is given in some of the informative Appendices at the end of this Approved Document.
- 4.2 In the Secretary of State's view the Requirement of Part F will be met where a ventilation system is provided that, under normal conditions, is capable of limiting the accumulation of moisture, which could lead to mould growth, and pollutants originating within a building which would otherwise become a hazard to the health of the people in the building.
- 4.3 In general terms, the requirement may be achieved by providing a ventilation system which:
 - a. extracts, before it is generally widespread, water vapour from areas where it is produced in significant quantities (e.g. kitchens, **utility rooms** and **bathrooms**);
 - b. extracts, before they are generally widespread, pollutants which are a hazard to health from areas where they are produced in significant quantities (e.g. rooms containing processes or activities which generate harmful contaminants);
 - c. rapidly dilutes, when necessary, pollutants and water vapour produced in **habitable rooms, occupiable rooms** and **sanitary accommodation**;
 - d. makes available over long periods a minimum supply of outdoor air for occupants and to disperse, where necessary, residual pollutants and water vapour. Such ventilation should minimise draughts and, where necessary, should be reasonably secure and provide protection against rain penetration;
 - e. is designed, installed and commissioned to perform in a way which is not detrimental to the health of the people in the building; and
 - f. is installed to facilitate maintenance where necessary.
- 4.4 The guidance in this Approved Document has not been formulated to deal with the products of tobacco smoking.

4.5 Ventilation systems in buildings result in energy being used to heat fresh air taken in from outside and, in mechanical **ventilation** systems, to move air into, out of and/or around the building. Energy efficiency is dealt with under Part L of the Building Regulations but consideration should be given to mitigation of **ventilation** energy use, where applicable, by employing heat recovery devices, efficient types of fan motor and/or energy-saving control devices in the **ventilation** system.

The purpose of ventilation

4.6 **Ventilation** is simply the removal of “stale” indoor air from a building and its replacement with “fresh” outside air. It is assumed within the Approved Document that the outside air is of reasonable quality.

4.7 **Ventilation** is required for one or more of the following purposes:

- a. provision of outside air for breathing;
- b. dilution and removal of airborne pollutants, including odours;
- c. control of excess humidity (arising from water vapour in the indoor air);
- d. provision of air for fuel-burning appliances (which is covered under Part J of the Building Regulations).

4.8 **Ventilation** also provides a means to control thermal comfort but this is not controlled under the Building Regulations, although Part L addresses minimising energy use due to summer overheating.

4.9 The airborne pollutants and water vapour mentioned in 4.7(b) and (c) above include those that are released from materials and products used in the construction, decoration and furnishing of a building, and as a result of the activities of the building’s occupants.

4.10 The pollutant(s) of most importance will vary between building types (e.g. dwelling, office, factory), building uses (e.g. industrial process, shop, commercial kitchen), and even from room to room within a building (e.g. kitchen, shower room, conference room, photocopier room). Common pollutants in a dwelling are moisture and combustion products from unflued appliances (e.g. gas, oil or solid fuel cookers) and chemical emissions from construction and consumer products. In an office building, body odour is often the key pollutant, but there are a number of other pollutant sources including the building itself, furnishings, printers and photocopiers.

Types of ventilation

- 4.11 Buildings are ventilated through a combination of **infiltration** and **purpose-provided ventilation**:
- **Infiltration** is the uncontrollable air exchange between the inside and outside of a building through a wide range of air leakage paths in the building structure.
 - **Purpose-provided ventilation** is the controllable air exchange between the inside and outside of a building by means of a range of natural and/or mechanical devices.
- 4.12 It is important to minimise the uncontrollable **infiltration** and supply sufficient **purpose-provided ventilation**. **Air tightness** measures to limit **infiltration** are covered in Part L of the Building Regulations and its supporting Approved Documents. Approved Document F recommends methods of achieving sufficient **purpose-provided ventilation**, allowing for a reasonably high level of **air tightness**.
- 4.13 For the purposes of Part F, a reasonably high level of **air tightness** means a level which is significantly tighter than the minimum target value recommended under Part L, because all new buildings are expected to better the target value to some degree. Research suggests that the most airtight domestic and non-domestic buildings, using normal (but carefully executed) construction methods, can have an **air permeability** down to around 3–4 m³/(h.m²) of envelope area at 50 Pascal (Pa) pressure difference. Some examples will be tighter than this. **The ventilation provisions recommended in this Approved Document have been specified to cope with two design standards of air permeability: (a) leakier than 5 m³/(h.m²) at 50 Pa; and (b) tighter than or equal to 5 m³/(h.m²) at 50 Pa.** See paragraph 5.8 for more information.

The ventilation strategy adopted in Approved Document F

- 4.14 Approved Document F adopts the following strategy (systems which comply with the strategy are described in Sections 5 and 6).
- **Extract ventilation** from rooms where most water vapour and/or pollutants are released, e.g. due to activities such as cooking, bathing or photocopying. This is to minimise their spread to the rest of the building. This extract may be either **intermittent** or **continuous**.

- **Whole building ventilation** to provide fresh air to the building and to dilute and disperse residual water vapour and pollutants not dealt with by **extract ventilation** as well as removing water vapour and other pollutants which are released throughout the building (e.g. by building materials, furnishings, activities and the presence of occupants). **Whole building ventilation** provides nominally continuous air exchange. The **ventilation** rate may be reduced or ceased when the building is not occupied. It may be necessary to purge the air when the building is re-occupied.
- **Purge ventilation** throughout the building to aid removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating or accidental releases such as smoke from burnt food or spillage of water. **Purge ventilation** is **intermittent**, i.e. only required when such occasional activities occur. **Purge ventilation** provisions may also be used to improve thermal comfort, although this is not controlled under the Building Regulations.

- 4.15 This **ventilation** strategy can be delivered by a natural ventilation system or a mechanical ventilation system or a combination of both (i.e. “mixed-mode” or “hybrid” ventilation system). For mainly naturally ventilated buildings, it is common to use a combination of ventilators to achieve this strategy (e.g. for dwellings it is common to use **intermittent** extract fans for **extract ventilation**, trickle ventilators for **whole building ventilation** and windows for **purge ventilation**). For mechanically ventilated or air-conditioned buildings, it is common for the same ventilators to provide both local extract and **whole building ventilation** and, for buildings other than dwellings, to provide **purge ventilation** as well.
- 4.16 The ventilation systems and devices mentioned in the preceding paragraph are examples of those commonly in use at the time of writing. Other ventilation systems and devices, perhaps following a different strategy (e.g. positive input ventilation), may provide acceptable solutions, provided it can be demonstrated to the **building control body** (e.g. by use of a product or system covered by a national or European certificate issued by a European Technical Approval issuing body, provided the conditions of use are in accordance with the terms of the certificate) that they meet Requirement F1. The assessment of the suitability of a ventilation system should take account of the design air permeability of the building, and the fact that the completed building may be “tighter” than the design value because of variability in construction quality.

Control of ventilation

- 4.17 It is important that ventilation is controllable so that it can maintain reasonable indoor air quality and avoid waste of energy. These controls can be either **manual** (i.e. operated by the occupant) or **automatic**. Demand-controlled ventilation systems employ sensors to detect the level of occupancy and adjust the ventilation rate accordingly in order to avoid over-ventilation and so reduce energy consumption.
- 4.18 Manually controlled trickle ventilators (the most common type of **background ventilators**) can be located over the window frames, in window frames, just above the glass or directly through the wall (see Diagram 5 in Key terms). They are positioned typically 1.7 m above floor level to avoid discomfort due to cold draughts. These ventilators often incorporate a simple flap that allows users to shut off the ventilation – depending on external weather conditions. Trickle ventilators are normally left open in occupied rooms in dwellings. A window with a night latch position is not recommended because of the difficulty of measuring the **equivalent area**, the greater likelihood of draughts and the potential increased security risk in some locations.
- 4.19 In dwellings, humidity-controlled devices are available to regulate the humidity of the indoor air and, hence, minimise the risk of condensation and mould growth. These are best installed as part of an extract ventilator in moisture-generating rooms (e.g. kitchen or **bathroom**). Humidity control is not appropriate for **sanitary accommodation** where the dominant pollutant is normally odour. Trickle ventilators are available which “throttle down” the ventilation flow passage(s) according to the pressure difference across the ventilator to reduce draught risks during windy weather. Manufacturers should be consulted when selecting the correct type of pressure-controlled trickle ventilator.
- 4.20 Other types of **automatic control** may be suitable for regulating ventilation devices (e.g. trickle ventilators, ventilation fans, dampers and air terminal devices) in dwellings. In such cases, it is important that the device controls the ventilation air supply and/or extract according to the need for ventilation in the space to remove or dilute indoor pollutants and water vapour. Trickle ventilators with **automatic controls** should also have manual override, so that the occupant can close the ventilator to avoid draughts and fully open the ventilator to provide maximum airflow when required. For pressure-controlled trickle ventilators that are fully open at typical conditions (e.g. 1 Pa pressure difference), only a manual close option is recommended.

4.21 In buildings other than dwellings, various more sophisticated **automatic control** systems are available. These may be based on sensors located within the building, e.g. occupancy sensors (using local passive infra-red detectors) or indoor carbon dioxide concentration sensors (using electronic carbon dioxide detectors) as an indicator of occupancy level and, therefore, body odour.

Performance-based guidance

4.22 This Approved Document focuses on performance-based guidance which suggests to the designer what level of ventilation should be sufficient, rather than how it should be achieved. Therefore, the designer has the freedom to use whatever ventilation provisions suit a particular building, including the use of innovative products and solutions, if it can be demonstrated that they meet the performance standard recommended in this Approved Document.

4.23 The actual performance criteria for acceptable levels of moisture and pollutants are given in Appendix A. The airflow rates necessary to meet the performance criteria are given in the main guidance.

4.24 Simple guidance in the form of ventilator sizes for the whole dwelling is also provided to make it easier for designers to meet building regulations requirements in common situations.

Equivalent area and free area of ventilators

4.25 **Equivalent area** is used in the Approved Document instead of **free area** for the sizing of **background ventilators** (including trickle ventilators) because it is a better measure of the airflow performance of a ventilator. **Free area** is simply the physical size of the aperture of the ventilator but may not accurately reflect the airflow performance which the ventilator will achieve. The more complicated and/or contorted the air flow passages in a ventilator, the less air will flow through it. So, two different ventilators with the same **free area** will not necessarily have the same airflow performance. A European Standard, BS EN 13141-1:2004 (Clause 4), includes a method of measuring the **equivalent area** of **background ventilator** openings. As an approximation, the **free area** of a trickle ventilator is typically 25% greater than its **equivalent area**.

4.26 As **equivalent area** cannot be verified with a ruler, it will be difficult to demonstrate to **building control bodies** that trickle ventilators and similar products have the correct **equivalent area** unless it is clearly marked on the product. For this reason, it is preferable to use ventilators which have the **equivalent area** (in mm² at 1 Pa pressure difference), or **equivalent area** per metre (where the **equivalent area**

of the product varies according to length) marked on the product in an easily visible location. Where it is not practical for the manufacturer to mark the ventilator because it can be used in conjunction with a range of other components, some form of temporary marking for the installed system should be acceptable to the **building control body**.

Ventilation effectiveness

4.27 Ventilation effectiveness is a measure of how well a ventilation system works in terms of delivering the supply air to the occupants of a building. If the supply air is mixed fully with the room air before it is breathed by the occupants, the ventilation effectiveness is 1. If the supply air is extracted from the room before it mixes with any room air, the ventilation effectiveness is 0. If the supply air reaches the occupant without mixing with any room air, the ventilation effectiveness tends towards infinity.

4.28 This is important as a system with a higher ventilation effectiveness achieves acceptable pollutant levels at the occupant's breathing zone for a lower air supply rate, and offers potentially significant energy savings. However, it has been decided not to make an allowance for any reduction of fresh air supply rates based on ventilation effectiveness in Approved Document F at this time. This is because ventilation effectiveness is dependent on the ventilation system design, its installation and the way in which occupants use the space. Whilst it is possible to predict what the ventilation effectiveness of a system should be, there is currently insufficient knowledge of the actual ventilation effectiveness achieved in buildings to allow designers to guarantee performance and so avoid significant under-ventilation by reducing air supply rates. This is because ventilation effectiveness may be influenced by factors beyond the designer's control such as occupant usage (e.g. seating plan and use of computers within a space and whether the space is being heated or cooled by the ventilation air). In the designs shown in this Approved Document, it has been assumed that the ventilation effectiveness is 1.0. See CIBSE Guide A for further information on ventilation effectiveness.

Source control

4.29 A complementary strategy for achieving good indoor air quality is to reduce the release of water vapour and/or air pollutants into the indoor air, i.e. source control. Source control is not considered within the main guidance of the Approved Document owing to limited knowledge about the emission of pollutants from construction and consumer products used in buildings and the lack of suitable labelling schemes for England and Wales. Some construction products such as glass, stone and ceramics are by their nature low emitters of air pollutants. Currently, some paints are labelled for their volatile organic compound (VOC) content, and

some wood-based boards (class E1, BS EN 13986:2004) are available with low formaldehyde emission. This allows suitable products to be chosen when good indoor air quality is a priority, but at the present time it is not practical to make an allowance for use of these products in the ventilation requirements. Further information about control of emissions from construction products is available in BRE Digest 464.

- 4.30 Exposure to house dust mite (HDM) allergens can lead to allergic sensitisation and to exacerbation of allergic conditions. The moisture criteria needed to avoid HDM are more complex and demanding than those needed to avoid mould. The reduction of mite growth may be feasible in UK dwellings via appropriate ventilation, heating and moisture control as part of an integrated approach that involves the removal of existing mite allergens.
- 4.31 Useful information may be found in the following World Health Organisation (WHO) publication *House dust mites*, Crowther D and Wilkinson T (2008), which is included in *Public health significance of urban pests*, Bonnefoy X, Kampen H and Sweeney K, WHO Regional Office for Europe, available at : www.euro.who.int/document/e91435.pdf
- 4.32 Further information and suggested measures for source control are given in *Review of Health and Safety Risk Drivers* (BD 2518), available at: www.communities.gov.uk/documents/planningandbuilding/pdf/reviewhealthsafety.pdf

Environmental noise

- 4.33 In noisy areas it may be appropriate to use sound-attenuating ventilation products depending on the noise level and any planning conditions.
- 4.34 Noise from the ventilation system may also disturb people who are outside the building, so externally emitted noise should also be considered, although it is not controlled under the Building Regulations.

Noise from ventilation systems

- 4.35 Noise generated by ventilation fans (which may propagate through ducts) and noise from the fan unit may disturb the occupants of the building and so discourage their use. Therefore, the designer should consider minimising noise by careful design and the specification of quieter products.

Assessing noise from domestic ventilation systems

4.36 Appendix E gives guidance on measuring noise from continuously running domestic ventilation systems under laboratory conditions. Appendix E also gives guidance to the dwelling designer on how to specify reasonably quiet systems. Following this guidance is the normal way of satisfying Requirement F1 (see point 3 in Section 2).

Fire precautions

4.37 Where ducting passes through a fire-resisting wall/floor or fire compartment, the required measures to ensure compliance with Part B of the Building Regulations must be taken.

Historic buildings

4.38 The inclusion of any particular ventilation measure in existing buildings should not introduce new or increased technical risk, or otherwise prejudice the use or character of the building. In particular, consideration should be given to the special needs of **historic buildings**. Such buildings include:

- a. listed buildings;
- b. buildings situated in a conservation area;
- c. buildings of local architectural and historical interest and which are referred to as a material consideration in a local authority's development plan;
- d. buildings within national parks, areas of outstanding natural beauty and world heritage sites.

4.39 Advice on the factors determining the character of **historic buildings** is set out in PPG15 *Planning and the historic environment*. Specific guidance on meeting the requirements of Part F when undertaking work in **historic buildings** is given in Section 7 of this Approved Document.

Modular and portable buildings

4.40 Buildings constructed from sub-assemblies that are delivered newly made or selected from stock are no different from any other new building and must comply with all requirements in Schedule 1 of the Building Regulations 2000. In some applications, such as buildings that are constructed to be temporary (in the normal sense of the word), the provision of adequate ventilation may vary depending upon the circumstances in the particular case. For example, (a) a building created by dismantling, transporting and re-erecting the sub-assemblies on the same premises would normally be considered to meet the requirements; and (b) a building constructed from sub-assemblies obtained from other premises or from stock manufactured before this Approved Document came into force would normally be considered to meet the requirements if it satisfies the relevant requirements of Part F that were applicable in 2006.

Section 5: Dwellings

Introduction to provisions

- 5.1 This Approved Document shows three main ways of complying with the Requirement by:
- a. providing the ventilation rates set out in paragraphs 5.4 to 5.7; or
 - b. following the system guidance set out:
 - for dwellings without **basements** in paragraphs 5.8 to 5.10. [This guidance covers dwellings with design air permeability \(a\) leakier than \(\$>\$ \) \$5 \text{ m}^3/\(\text{h.m}^2\)\$ at 50 Pa; and \(b\) tighter than or equal to \(\$\leq\$ \) \$5 \text{ m}^3/\(\text{h.m}^2\)\$ at 50 Pa; or](#)
 - for dwellings with **basements** in paragraphs 5.11 to 5.13; or
 - c. using other ventilation systems provided it can be demonstrated to the **building control body** that they satisfy the Requirement, e.g. by showing that they meet the moisture and air quality criteria set out in Appendix A.
- 5.2 There should be reasonable access for maintenance. This should include access for the purpose of changing filters, replacing defective components and cleaning ductwork.
- 5.3 Note that extract fans lower the pressure in a building, which can cause the spillage of combustion products from open-flued appliances (i.e. the combustion gases may fill the room instead of going up the flue or chimney). This can occur even if the appliance and the fan are in different rooms. Ceiling sweep fans produce air currents and hence local depressurisation which can also cause the spillage of flue gases from open-flued gas appliances or from solid fuel open fires. In buildings where it is intended to install open-flued combustion appliances and extract fans, the combustion appliance should be able to operate safely whether or not the fans are running. A way of showing compliance in these circumstances would be to follow the guidance given in Approved Document J on both the installation of the appliances and tests to show that combustion appliances operate safely whether or not fans are running.

Ventilation rates

- 5.4 The performance will be achieved by providing the airflow rates set out in paragraphs 5.5 to 5.7. The airflow rates specified are for the performance of the complete installation. The performance of the ventilation devices (and associated components such as ducting for fans) should be tested according to the Standards listed under “Performance test methods” in Table 5.3. All natural and mechanical systems should be fully commissioned, and guidance is given in *Domestic ventilation: Installation and commissioning compliance guide*, which is available at www.communities.gov.uk/... (see *Volume 3, Chapter 2 of this consultation document*).
- 5.5 **Extract ventilation** to outside is required in each kitchen, **utility room** and **bathroom** and for **sanitary accommodation**. The extract can be either **intermittent** or continuously operating. The **intermittent** rate, and for **continuous** systems the minimum extract airflow rates at the highest and lowest settings, should be no less than specified in Table 5.1 a.
- 5.6 The **whole building ventilation** rate for the supply of air to the **habitable rooms** in a dwelling should be no less than specified in Table 5.1 b.
- 5.7 **Purge ventilation** provision is required in each **habitable room** and should be capable of extracting a minimum of four air changes per hour (ach) per room directly to outside. Normally, openable windows or doors can provide this function (see Appendix B), otherwise a mechanical extract system should be provided. In other rooms (e.g. kitchens and **bathrooms**) the mechanical or passive stack extract provisions should be sufficient, although **passive stack ventilation** will take longer to purge the room.

Table 5.1a: Extract ventilation rates

Room	Intermittent extract	Continuous extract	
	Minimum rate	Minimum high rate	Minimum low rate
Kitchen	30 l/s adjacent to hob; or 60 l/s elsewhere	13 l/s	Total extract rate should be at least the whole building ventilation rate given in Table 5.1b
Utility room	30 l/s	8 l/s	
Bathroom	15 l/s	8 l/s	
Sanitary accommodation	6 l/s	6 l/s	

Table 5.1b: Whole building ventilation rates

	Number of bedrooms in dwelling				
	1	2	3	4	5
Whole building ventilation rate ^{a,b} (l/s)	13	17	21	25	29

Notes:

a. In addition, the minimum ventilation rate should not be less than 0.3 l/s per m² of internal floor area. (This includes all floors, e.g. for a two-storey building add the ground and first floor areas.)

b. This is based on two occupants in the main bedroom and a single occupant in all other bedrooms. This should be used as the default value. If a greater level of occupancy is expected add 4 l/s per occupant.

Ventilation systems for dwellings without basements

5.8 The performance required for dwellings without basements could be achieved by following Steps 1 and 2 below. Worked examples for each system are given in Appendix C.

5.9 For each system, guidance is given for dwellings designed to have air permeability

a. leakier than ($>$) 5 m³/(h.m²) @ 50 Pa, and

b. tighter than or equal to (\leq) 5 m³/(h.m²) @ 50 Pa.

This is to ensure that additional ventilation is provided for more airtight dwellings.

5.10 It is important to note that dwellings designed to an air permeability leakier than $5 \text{ m}^3/(\text{h.m}^2)$ may be under-ventilated if the measured as-built air permeability is tighter than this. There is a margin of safety such that there should be sufficient ventilation provision for dwellings with an as-built air permeability of $4 \text{ m}^3/(\text{h.m}^2)$. Therefore, enforcement action will not be necessary providing the as-built value is not tighter than $4 \text{ m}^3/(\text{h.m}^2)$. If at the design stage it is considered that the as-built air permeability could be tighter than $4 \text{ m}^3/(\text{h.m}^2)$, it would be prudent to adopt the ventilation provisions for those dwellings designed to an air permeability of tighter than or equal to $5 \text{ m}^3/(\text{h.m}^2)$.

Step 1: Select **one** of the following four ventilation systems (illustrated in Diagram 1a).

System 1: Background ventilators and intermittent extract fans. Guidance on minimum provisions for **extract** and **whole building ventilation** is set out in Table 5.2a. Note that it includes separate guidance for dwellings with only a single exposed façade.

System 2: Passive stack ventilation (PSV). Guidance on minimum provisions for **extract** and **whole building ventilation** is set out in Table 5.2b.

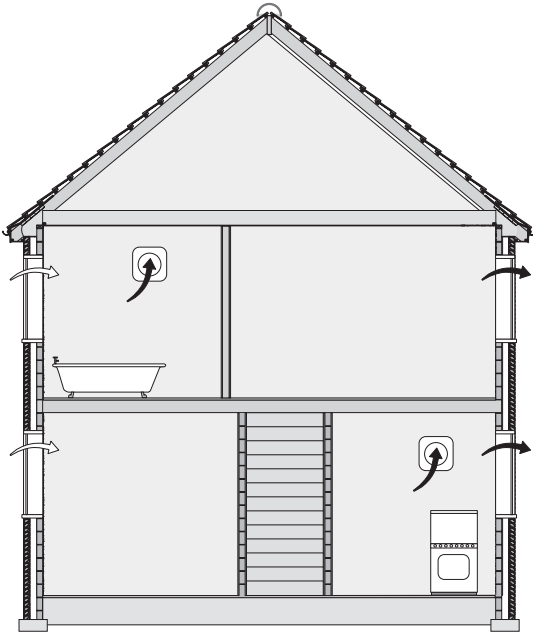
System 3: Continuous mechanical extract (MEV). Guidance on minimum provisions for **extract** and **whole building ventilation** is set out in Table 5.2c.

System 4: Continuous mechanical supply and extract with heat recovery (MVHR). Guidance on minimum provisions for **extract** and **whole building ventilation** is set out in Table 5.2d.

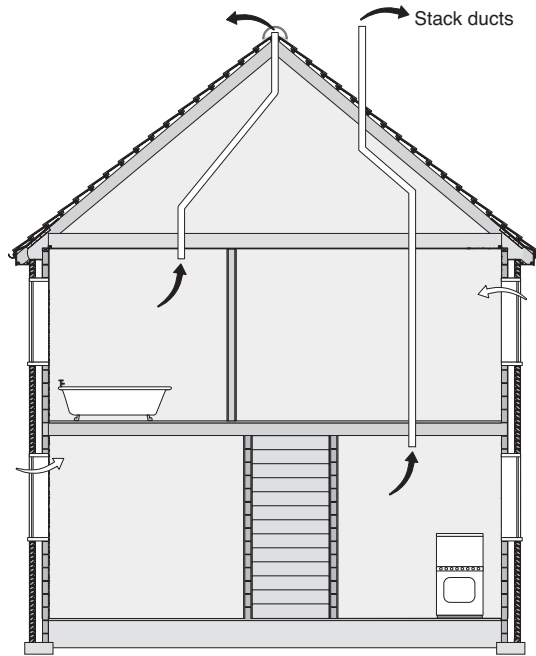
Step 2: See Table 5.3 for guidance on performance test methods for the products chosen.

Diagram 1a: Ventilation systems

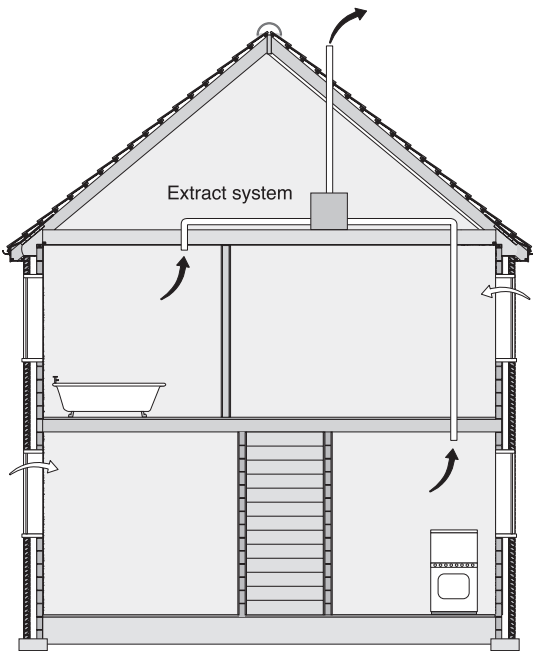
Background ventilators and intermittent extract fans



Passive stack ventilation



Continuous mechanical extract



Continuous mechanical supply and extract with heat recovery

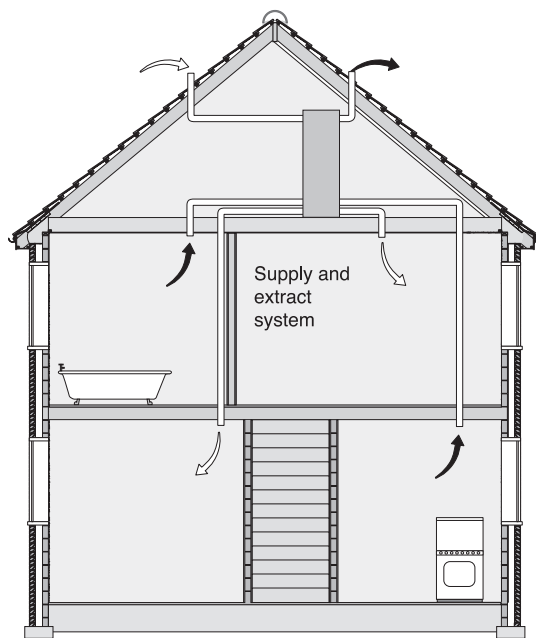


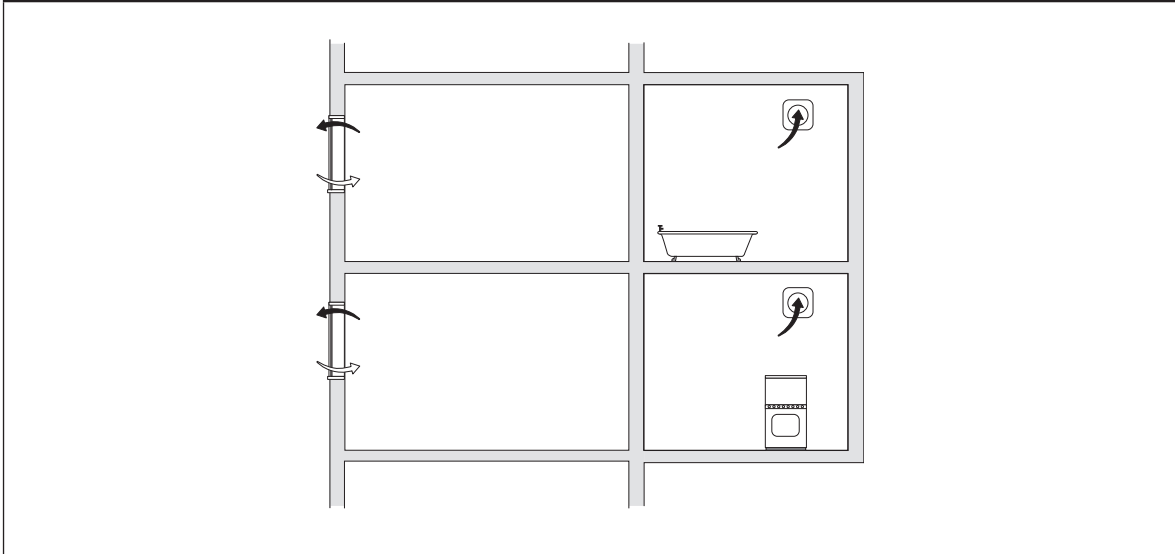
Diagram 1b: Single-sided ventilation

Table 5.2a System 1 – Background ventilators and intermittent extract fans (for additional information see Table 5.3 and worked examples C1 and C5 in Appendix C)

Design of system 1

The **background ventilators** have been sized for the winter period. Additional ventilation may be required during warmer months and it has been assumed that the provisions for **purge ventilation** (e.g. openable windows) could be used.

Intermittent extract

- **Intermittent** extract rates are given in Table 5.1a. For **sanitary accommodation** only, as an alternative, the **purge ventilation** provisions (windows) given in Appendix B can be used where security is not an issue.
- Instead of a conventional **intermittent** fan, a continuously running single room heat recovery ventilator could be used in **wet rooms**. It should use the minimum high rate given in Table 5.1a and 50% of this value as the minimum low rate. No **background ventilator** is required in the same room as the single room heat recovery ventilator. Furthermore, the total equivalent **background ventilator** area described below can be reduced by 2500 mm² for each room containing a single room heat recovery ventilator.

Location of intermittent extract fans

- **Intermittent** extract fans should be installed in each **wet room**.
- Cooker hoods should be 650 mm to 750 mm above the hob surface (or follow manufacturer instructions).
- Mechanical extract fans should be installed as high as is practical and preferably less than 400 mm below the ceiling.
- Where fans and **background ventilators** are fitted in the same room they should be a minimum of 0.5 m apart.

Table 5.2a: System 1 – Background ventilators and intermittent extract fans (for additional information see Table 5.3 and worked examples C1 and C5 in Appendix C) *continued*

Background ventilators

A. For dwellings with more than one exposed façade:

Step 1. Select the appropriate Table below for the dwelling design permeability either leakier than (>) 5 m³/(h.m²) at 50 Pa or tighter than or equal to (≤) 5 m³/(h.m²) at 50 Pa.

Step 2. For multi-storey dwellings, and single storey dwellings more than four storeys above ground level, use the total **equivalent area** for the dwelling given in the Table; or

Step 3. For single storey dwellings up to and including the fourth storey above ground level, add a further 10000 mm² to the value given in the Table, preferably shared between several rooms.

B. For a dwelling with only a single exposed façade, cross ventilation is not possible with this system and an alternative is required. In this case, **background ventilators** should be located at both high and low positions in the façade to provide enhanced single-sided ventilation. The total **equivalent area** should be determined as described in Steps 1 and 2 above, and should be provided at the high position (typically 1.7 m above floor level) for all dwelling types and all storey heights. In addition, ventilators having the same total **equivalent area** should be provided at least 1.0 m below the high ventilators as shown in Diagram 1b. Single-sided ventilation is most effective if the dwelling is designed so that the **habitable rooms** are on the exposed façade, and these rooms are no greater than 6 m in depth.

Total equivalent ventilator area^a (mm²) for dwellings with design air permeability leakier than (>) 5 m³/(h.m²)@ 50 Pa.					
Total floor area (m²)	Number of bedrooms^b				
	1	2	3	4	5
≤50	25000	35000	45000	45000	55000
51-60	25000	30000	40000	45000	55000
61-70	30000	30000	30000	45000	55000
71-80	35000	35000	35000	45000	55000
81-90	40000	40000	40000	45000	55000
91-100	45000	45000	45000	45000	55000
> 100	Add 5000 mm ² for every additional 10 m ² floor area				

Table 5.2a: System 1 – Background ventilators and intermittent extract fans (for additional information see Table 5.3 and worked examples C1 and C5 in Appendix C) *continued*

Total equivalent ventilator area ^a (mm ²) for dwellings with design air permeability tighter than or equal to (\leq) 5 m ³ /(h.m ²)@ 50 Pa.					
Total floor area (m ²)	Number of bedrooms ^b				
	1	2	3	4	5
≤ 50	35000	40000	50000	60000	65000
51-60	35000	40000	50000	60000	65000
61-70	45000	45000	50000	60000	65000
71-80	50000	50000	50000	60000	65000
81-90	55000	60000	60000	60000	65000
91-100	65000	65000	65000	65000	65000
> 100	Add 7000 mm ² for every additional 10 m ² floor area				

Notes:

- The **equivalent area** of a **background ventilator** should be determined at 1 Pa pressure difference, using the appropriate test method given in Table 5.3.
- This is based on two occupants in the main bedroom and a single occupant in all other bedrooms. For a greater level of occupancy, assume a greater number of bedrooms (i.e. assume an extra bedroom per additional person). For more than five bedrooms, add an additional 10000 mm² per bedroom.

Location of background ventilators

- Background ventilators** should be located to avoid draughts, e.g. typically 1.7 m above floor level (except in the single sided case described above).
- Background ventilators** should be located in all rooms with external walls. If a **habitable room** has no external walls follow the guidance in paragraphs 5.14 to 5.16. If a **wet room** has no external walls follow the guidance for **intermittent** extract given for Purge ventilation and Controls below.

Table 5.2a: System 1 – Background ventilators and intermittent extract fans (for additional information see Table 5.3 and worked examples C1 and C5 in Appendix C) *continued*

Purge ventilation

For each **habitable room** with:

- external walls, see Appendix B for window or external door (including patio door) sizing;
- no external walls, see paragraphs 5.14 to 5.16.

There may be practical difficulties in achieving this (e.g. if unable to open a window due to excessive noise from outside).

For each **wet room** with:

- external walls, install an openable window (no minimum size);
- no external walls, the normal extract provisions will suffice, although it will take longer to purge the room.

As an alternative to the provisions given above for **habitable** and **wet rooms**, a mechanical fan extracting at 4 ach to outside could be used.

Devices used for **purge ventilation** should be manually controlled. The location of the devices is not critical for ventilation.

Air transfer

- To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600 mm² in all internal doors above the floor finish. This is equivalent to an undercut of 10 mm for a standard 760 mm width door. [This should be achieved by making an undercut of 10 mm above the floor finish if the floor finish is fitted, or by a 20 mm undercut above the floorboards, or other surface, if the finish has not been fitted.](#)

Table 5.2a: System 1 – Background ventilators and intermittent extract fans (for additional information see Table 5.3 and worked examples C1 and C5 in Appendix C) *continued*

Controls

Intermittent extract

- May be operated manually and/or automatically by a sensor (e.g. humidity, occupancy/usage, pollutant release). Humidity controls should not be used for **sanitary accommodation** as odour is the main pollutant.
- In kitchens, any **automatic control** must provide sufficient flow during cooking with fossil fuel (e.g. gas) to avoid build-up of combustion products.
- Any **automatic control** should have a manual override to allow the occupant to turn the extract on.
- In a room with no openable window (i.e. an internal room) an **intermittent** extract fan should have a 15 minute overrun. In rooms with no natural light, the fans could be controlled by the operation of the main room light switch.

Background ventilators

- May be either manually adjustable or automatically controlled (see paragraphs 4.18 to 4.20).

Manual controls

Where **manual controls** are provided, they should be within reasonable reach of the occupants. It is recommended that they are located in accordance with the guidance for Requirement N3 *Safe opening and closing of windows etc.*, which is given in Approved Document N. Where reasonable, pull cords, operating rods or similar devices should be provided. Although Requirement N3 only applies to workplaces, for the purpose of this Approved Document it should also apply to dwellings.

Noise

Any continuously running fans should be quiet so as not to discourage their use by occupants. Guidance on noise is given in Appendix E.

Table 5.2b: System 2 – Passive stack ventilation (PSV)
(for additional information see Table 5.3 and worked examples C2 and C6 in Appendix C)

Design of system 2

The **background ventilators** have been sized for the winter period. Additional ventilation may be required during warmer months and it has been assumed that the provisions for **purge ventilation** (e.g. openable windows) could be used.

Ceiling extract grilles should have a **free area** of not less than the duct cross-sectional area (when in the fully open position if adjustable).

If a dwelling in which **PSV** is proposed is situated near a significantly taller building (i.e. more than 50% taller), it should be at least five times the difference in height away from the taller building (e.g. if the difference in height is 10 m, **PSV** should not be installed in a dwelling within 50 m of the taller building).

The roof terminal design should be as specified by the **PSV** manufacturer.

Size of passive stack ventilators

Room	Internal duct diameter (mm)	Internal cross sectional area (mm ²)
Kitchen	125	12000
Utility room	125	12000
Bathroom	125	12000
Sanitary accommodation*	125	12000

*For **sanitary accommodation** only, as an alternative, the **purge ventilation** provisions (windows/doors) given in Appendix B can be used where security is not an issue.

Location of PSV

- For a dwelling with only a single exposed façade, the dwelling should be designed such that the **habitable rooms** are on the exposed façade so as to achieve cross ventilation.
- **PSV** extract terminals should be located in the ceiling or on a wall less than 400 mm below the ceiling.

Instead of **PSV**, an open-flued appliance may provide sufficient **extract ventilation** for the room in which it is located when in operation, and can be arranged to provide sufficient ventilation when not firing. For instance, the provisions would be adequate if: (a) the solid fuel open-flued appliance is a primary source of heating, cooking or hot water production; or (b) the open-flued appliance has a flue of **free area** at least equivalent to a 125 mm diameter duct and the appliance's combustion air inlet and dilution inlet are permanently open, i.e. there is a path with no control dampers which could block the flow, or the ventilation path can be left open when the appliance is not in use (see also paragraph 5.3).

Table 5.2b: System 2 – Passive stack ventilation (PSV)

(for additional information see Table 5.3 and worked examples C2 and C6 in Appendix C) *continued*

Background ventilators (follow steps 1 to 3 below)

Separate guidance on **background ventilator** sizes has been given in the tables below for dwellings having air permeability designed to be leakier than ($>$) $5 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ at 50 Pa or tighter than or equal to (\leq) $5 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ at 50 Pa.

Total equivalent ventilator area^a (mm²) for dwellings with design air permeability leakier than ($>$) $5 \text{ m}^3/(\text{h}\cdot\text{m}^2)$@ 50 Pa.					
Total floor area (m²)	Number of bedrooms^b				
	1	2	3	4	5
≤ 50	25000	35000	45000	45000	55000
51-60	25000	30000	40000	45000	55000
61-70	30000	30000	30000	45000	55000
71-80	35000	35000	35000	45000	55000
81-90	40000	40000	40000	45000	55000
91-100	45000	45000	45000	45000	55000
> 100	Add 5000 mm ² for every additional 10 m ² floor area				

Total equivalent ventilator area^a (mm²) for dwellings with design air permeability tighter than or equal to (\leq) $5 \text{ m}^3/(\text{h}\cdot\text{m}^2)$@ 50 Pa.					
Total floor area (m²)	Number of bedrooms^b				
	1	2	3	4	5
≤ 50	35000	40000	50000	60000	65000
51-60	35000	40000	50000	60000	65000
61-70	45000	45000	50000	60000	65000
71-80	50000	50000	50000	60000	65000
81-90	55000	60000	60000	60000	65000
91-100	65000	65000	65000	65000	65000
> 100	Add 7000 mm ² for every additional 10 m ² floor area				

Notes:

- The **equivalent area** of a **background ventilator** should be determined at 1 Pa pressure difference, using the appropriate test method given in Table 5.3.
- This is based on two occupants in the main bedroom and a single occupant in all other bedrooms. For a greater level of occupancy, assume a greater number of bedrooms (i.e. assume an extra bedroom per additional person). For more than five bedrooms, add an additional 10000 mm² per bedroom.

Table 5.2b: System 2 – Passive stack ventilation (PSV)

(for additional information see Table 5.3 and worked examples C2 and C6 in Appendix C) *continued*

Step 1: Determine the equivalent ventilator area for the dwelling from the appropriate table above.

Step 2: Make an allowance for the total air flow through all **PSV** units. As an approximation assume each **PSV** unit provides an **equivalent area** of 2500 mm².

Step 3: The actual equivalent ventilator area required for the dwelling is the value found in Step 1- Step 2.

In addition to this, the total **equivalent area** of the **background ventilators** must be at least equal to the total cross-sectional area of all the **PSV** ducts.

Location of background ventilators

- **Background ventilators** should be located in all rooms with external walls except the rooms where a **PSV** is located, but open-flued combustion appliances will still require an air supply as given in Approved Document J.
- If a **habitable room** has no external walls, follow the guidance in paragraphs 5.14 to 5.16.
- Background ventilators should be located to avoid draughts, e.g. typically 1.7 m above floor level.

Purge ventilation

For each **habitable room** with:

- external walls, see Appendix B for window or external door (including patio door) sizing;
- no external walls, see paragraphs 5.14 to 5.16.

There may be practical difficulties in achieving this (e.g. if unable to open a window due to excessive noise from outside).

For each **wet room** with:

- external walls, install an openable window (no minimum size);
- no external walls – the **PSV** systems will be adequate, although it may take longer to purge the room.

As an alternative to the provisions given above for **habitable** and **wet rooms**, a mechanical fan extracting at 4 ach to outside could be used.

Devices used for **purge ventilation** should be manually controlled. The location of the devices is not critical for ventilation.

Table 5.2b: System 2 – Passive stack ventilation (PSV)
 (for additional information see Table 5.3 and worked examples C2 and C6 in Appendix C) *continued*

Air transfer

- To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600 mm² in all internal doors above the floor finish. This is equivalent to an undercut of 10 mm for a standard 760 mm width door. **This should be achieved by making an undercut of 10 mm above the floor finish if the floor finish is fitted, or by a 20 mm undercut above the floorboards, or other surface, if the finish has not been fitted.**

Controls

- Should be set up to operate without occupant intervention. May have **automatic controls** (e.g. sensors for humidity, occupancy/usage, pollutant release). Humidity controls should not be used for **sanitary accommodation** as odour is the main pollutant.
- In kitchens, any **automatic control** must provide sufficient flow during cooking with fossil fuel (e.g. gas) to avoid build-up of combustion products.
- Ensure the system always provides the minimum **whole building ventilation** rate specified in Table 5.1b in the heating season.

Background ventilators

- May be either manually adjustable or automatically controlled (see paragraphs 4.18 to 4.20).

Manual controls

Where **manual controls** are provided, they should be within reasonable reach of the occupants. It is recommended that they are located in accordance with the guidance for Requirement N3 *Safe opening and closing of windows etc.*, which is given in Approved Document N. Where reasonable, pull cords, operating rods or similar devices should be provided. Although Requirement N3 only applies to workplaces, for the purpose of this Approved Document it should also apply to dwellings.

Table 5.2c: System 3 – Continuous mechanical extract (MEV)
(for additional information see Table 5.3 and worked examples C3 and C7 in Appendix C)

Design of continuous mechanical extract systems

System 3 has been sized for the winter period. Additional ventilation may be required during warmer months and it has been assumed that the provisions for **purge ventilation** (e.g. openable windows) could be used.

Step 1: Determine the whole dwelling air supply rate from Table 5.1b.

(Note: no allowance is made for **infiltration** as the extract system lowers the pressure in the dwelling and all airflow through **infiltration** paths does not increase the overall ventilation rate.)

Step 2: Calculate the whole dwelling air extract rate at maximum operation by summing the individual room rates for “minimum high rate” from Table 5.1a.

(For **sanitary accommodation** only, as an alternative, the **purge ventilation** provisions given in Appendix B can be used where security is not an issue. In this case the “minimum high extract rate” for the **sanitary accommodation** should be omitted from the Step 2 calculation.)

Step 3: The required extract rates are as follows:

The **maximum rate** (i.e. “**boost**”) should be at least the greater of Step 1 and Step 2. Note that the maximum individual room extract rates should be at least those given in Table 5.1a for minimum high rate.

The **minimum rate** should be at least the whole building rate in Step 1.

Note: This system could comprise either a central extract system or individual room fans (or a combination of both). To ensure that the system provides the intended ventilation rate, measures should be taken to minimise likely wind effects when any extract terminal is located on the prevailing windward façade. Possible solutions include ducting to another façade, use of constant volume flow rate units or, for central extract systems, follow more detailed guidance which has been prepared by the Energy Saving Trust (EST) and the Building Research Establishment (BRE) in conjunction with The Electric Heating and Ventilation Association (TEHVA) and the Residential Ventilation Association (RVA). This guidance, entitled *Performance testing of products for residential ventilation* should be read in conjunction with the appropriate parts of BS EN 13141 and is available at the SAP Appendix Q website www.sap-appendixq.org.uk/page.jsp?id=5

Note: if a single room heat recovery ventilator (SRHRV) is used to ventilate a **habitable room**, with the rest of the dwelling provided by **continuous** mechanical extract, the air flow rates are determined as follows:

- determine the **whole building ventilation** rate from Table 5.1b;
- calculate the room supply rate required for the SRHRV from:
 - $(\text{Whole building ventilation rate} \times \text{Room volume}) / (\text{Total volume of all habitable rooms})$;
- undertake Steps 1 to 3 above for sizing the **continuous** mechanical extract for the rest of the dwelling. However, when performing Step 1, the supply rate specified for the SRHRV should be subtracted from the value given in Table 5.1b.

Table 5.2c: System 3 – Continuous mechanical extract (MEV)
 (for additional information see Table 5.3 and worked examples C3 and C7 in Appendix C) *continued*

Background ventilators

The need for **background ventilators** will depend on the air permeability of the dwelling. Where the design air permeability is leakier than ($>$) $5 \text{ m}^3/(\text{h} \cdot \text{m}^2)$ at 50 Pa **background ventilators** are not necessary. Where the design air permeability is tighter than or equal to (\leq) $5 \text{ m}^3/(\text{h} \cdot \text{m}^2)$ at 50 Pa, controllable **background ventilators** having a minimum **equivalent area** of 2500 mm^2 should be fitted in each room, except **wet rooms** from which air is extracted. Where this approach causes difficulties (e.g. on a noisy site) seek expert advice.

Where **background ventilators** are fitted:

- they should be located to avoid draughts, e.g. typically 1.7 m above floor level;
- fans and **background ventilators** fitted in the same room should be a minimum of 0.5 m apart;
- **background ventilators** may be either manually adjustable or automatically controlled (see paragraphs 4.18 to 4.20).

Purge ventilation

For each **habitable room** with:

- external walls, see Appendix B for window or external door (including patio door) sizing;
- no external walls, see paragraphs 5.14 to 5.16.

There may be practical difficulties in achieving this (e.g. if unable to open a window due to excessive noise from outside). In such situations, seek expert advice.

For each **wet room** with:

- external walls, install an openable window (no minimum size);
- no external walls, the normal extract provisions will suffice, although it will take longer to purge the room.

As an alternative to the provisions given above for habitable and **wet rooms**, a mechanical fan extracting at 4 ach to outside could be used.

Devices used for **purge ventilation** should be manually controlled. The location of the devices is not critical for **purge ventilation**.

Table 5.2c: System 3 – Continuous mechanical extract (MEV)
 (for additional information see Table 5.3 and worked examples C3 and C7 in Appendix C) *continued*

Location of ventilation devices

- Extract should be from each **wet room**.
- Cooker hoods should be 650 mm to 750 mm above the hob surface (or follow manufacturer instructions).
- Mechanical extract terminals and fans should be installed as high as is practical and preferably less than 400 mm below the ceiling.
- Where ducts etc. are provided in a dwelling with a protected stairway, precautions may be necessary to avoid the possibility of the system allowing smoke or fire to spread into the stairway. See Approved Document B.

Air transfer

- To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600 mm² in all internal doors above the floor finish. This is equivalent to an undercut of 10 mm for a standard 760 mm width door. **This should be achieved by making an undercut of 10 mm above the floor finish if the floor finish is fitted, or by a 20 mm undercut above the floorboards, or other surface, if the finish has not been fitted.**

Controls

- Should be set up to operate without occupant intervention, but may have **manual** or **automatic controls** to select the boost rate. **Any manual boost controls should be provided locally to the spaces being served, e.g. bathrooms and kitchen, as provision of a single centrally located switch may result in fans being left in an inappropriate mode of operation. Automatic controls** could include sensors for humidity, occupancy/usage, pollutant release. Humidity controls should not be used for **sanitary accommodation** as odour is the main pollutant.
- In kitchens, any **automatic control** must provide sufficient flow during cooking with fossil fuel (e.g. gas) to avoid build-up of combustion products.
- Ensure the system always provides the minimum **whole building ventilation** rate specified in Table 5.1b.

Where **manual controls** are provided, they should be within reasonable reach of the occupants. It is recommended that they are located in accordance with the guidance for Requirement N3 *Safe opening and closing of windows etc.*, which is given in Approved Document N. Where reasonable, pull cords, operating rods or similar devices should be provided. Although Requirement N3 only applies to workplaces, for the purpose of this Approved Document it should also apply to dwellings.

Noise

All continuously running fans used should be quiet so as not to discourage their use by occupants. Guidance on noise is given in Appendix E.

Table 5.2d: System 4 – Continuous mechanical supply and extract with heat recovery (MVHR) (for additional information see Table 5.3 and worked examples C4 and C8 in Appendix C)

Design of MVHR systems

System 4 has been sized for the winter period. Additional ventilation may be required during warmer months and it has been assumed that the provisions for **purge ventilation** (e.g. openable windows) could be used.

Step 1: Determine the whole dwelling air supply rate from Table 5.1b.

Where the design air permeability is leakier than ($>$) $5 \text{ m}^3/(\text{h} \cdot \text{m}^2)$ at 50 Pa allow for infiltration for all dwelling types by subtracting from this value:

$0.04 \times$ **gross internal volume** of the dwelling heated space (m^3).

Step 2: Calculate the whole dwelling air extract rate at maximum operation by summing the individual room rates for “minimum high rate” from Table 5.1a.

(For **sanitary accommodation** only, as an alternative, the **purge ventilation** provisions given in Appendix B can be used where security is not an issue. In this case the “minimum high extract rate” for **sanitary accommodation** should be omitted from the Step 2 calculation.)

Step 3: The required air flow rates are as follows:

- The maximum extract rate (e.g. “boost”) should be at least the greater of Step 1 and Step 2. Note that the individual room extract rates should be at least those given in Table 5.1a for “minimum high rate”.
- The minimum air supply rate should be at least the whole dwelling ventilation rate in Step 1.

Purge ventilation

For each **habitable room**:

- with external walls, see Appendix B for window or external door (including patio door) sizing;
- without external walls, see paragraphs 5.14 to 5.16.

There may be practical difficulties in achieving this (e.g. if unable to open a window due to excessive noise from outside). In such situations, seek expert advice.

For each **wet room**:

- with external walls, install an openable window (no minimum size);
- without external walls, the normal extract provisions will suffice, although it will take longer to purge the room.

As an alternative to the provisions given above for habitable and **wet rooms**, a mechanical fan extracting at 4 ach to outside could be used.

Devices used for **purge ventilation** should be manually controlled. The location of the purge devices is not critical for ventilation.

Table 5.2d: System 4 – Continuous mechanical supply and extract with heat recovery (MVHR) (for additional information see Table 5.3 and worked examples C4 and C8 in Appendix C) *continued*

Location of ventilation devices

- Extract should be from each **wet room**. Air should normally be supplied to each **habitable room**. The total supply airflow should usually be distributed in proportion to the **habitable room** volumes. Recirculation by the system of moist air from the **wet rooms** to the **habitable rooms** should be avoided.
- Cooker hoods should be 650 mm to 750 mm above the hob surface (or follow the manufacturer's instructions).
- Mechanical extract terminals and fans should be installed as high as is practical and preferably less than 400 mm below the ceiling.
- Mechanical supply terminals should be located and directed to avoid draughts.
- Where ducts etc. are provided in a dwelling with a protected stairway, precautions may be necessary to avoid the possibility of the system allowing smoke or fire to spread into the stairway. See Approved Document B.
- **Background ventilators** are not required with System 4.

Air transfer

- To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600 mm² in all internal doors above the floor finish. This is equivalent to an undercut of 10 mm for a standard 760 mm width door. [This should be achieved by making an undercut of 10 mm above the floor finish if the floor finish is fitted, or by a 20 mm undercut above the floorboards, or other surface, if the finish has not been fitted.](#)

Table 5.2d: System 4 – Continuous mechanical supply and extract with heat recovery (MVHR) (for additional information see Table 5.3 and worked examples C4 and C8 in Appendix C) *continued*

Controls

- Should be set up to operate without occupant intervention, but may have **manual or automatic controls** to select the boost rate. Any **manual** boost controls should be provided locally to the spaces being served, e.g. **bathrooms** and kitchen, as provision of a single centrally located switch may result in fans being left in an inappropriate mode of operation. **Automatic controls** could include sensors for humidity, occupancy/usage, pollutant release. Humidity controls should not be used for **sanitary accommodation** as odour is the main pollutant.
- In kitchens, any **automatic control** must provide sufficient flow during cooking with fossil fuel (e.g. gas) to avoid build-up of combustion products.
- Ensure the system always provides the minimum **whole building ventilation** rate specified in Table 5.1b.

Where **manual controls** are provided, they should be within reasonable reach of the occupants. It is recommended that they are located in accordance with the guidance for Requirement N3 Safe opening and closing of windows etc., which is given in Approved Document N. Where reasonable, pull cords, operating rods or similar devices should be provided. Although Requirement N3 only applies to workplaces, for the purpose of this Approved Document it should also apply to dwellings.

Noise

All continuously running fans used should be quiet so as not to discourage their use by occupants. Guidance on noise is given in Appendix E.

Table 5.3: Performance test methods

The minimum performance requirements specified within Tables 5.2 a-d should be assessed using the test methods contained in relevant clauses of the following documents.

Intermittent extract fans

- BS EN 13141-4 clause 4 *Performance testing of aerodynamic characteristics*. All sub-clauses are relevant.

Range hoods

- BS EN 13141-3 clause 4 *Performance testing of aerodynamic characteristics*. All sub-clauses are relevant.

Background ventilators (non-RH controlled)

- BS EN 13141-4 clause 4 *Performance testing of aerodynamic characteristics*. Only the following sub-clauses are relevant:
 - a. 4.1 *Flow rate/pressure*; and
 - b. 4.2 *Non-reverse flow ability*.

The performance requirements should normally be met for both airflow from outside to inside the dwelling and for inside to outside. To ensure the installed performance of **background ventilators** is similar to the results achieved when they are tested to this Standard, **background ventilators** and associated components should be installed according to manufacturers' instructions. This also applies to non-RH controlled sound attenuating **background ventilators**.

Passive stack ventilators

For the commissioning of passive stack systems follow the guidance in *Domestic ventilation: Installation and commissioning compliance guide*, which is available at www.communities.gov.uk/... (see *Volume 3, Chapter 2 of this consultation document*).

Continuous mechanical extract (MEV) systems

BS EN 13141-6 clause 4 *Performance testing of aerodynamic characteristics*. Also see Note 2 below.

Continuous supply and extract ventilation MVHR units

BS EN 13141-7 clause 6 *Test methods*. Also see Note 2 below.

Single room heat recovery ventilators

BS EN 13141-8 clause 6 *Test methods*. Only the following sub-clauses are relevant: 6.1 *General*; and 6.2 *Performance testing of aerodynamic characteristics* sub-clauses 6.2.1 *Leakage and mixing* and 6.2.2 *Airflow*. For internal and external leakage and for mixing, the unit should meet at least Class U4 as given in clause 3.2 *Classification*.

Table 5.3: Performance test methods *continued*

Note 1. For all ventilation devices (e.g. extract fan, cooker hood), fitting ducting, intake/exhaust terminals, filters etc. will impose an additional resistance to the airflow. Where appropriate this should be allowed for when specifying ventilation system components because, for example, a fan that meets the appropriate requirements when tested on its own may fail to meet the requirement when it is installed and fitted with ducting etc. In such cases, the performance of the separate components should be assessed according to the relevant parts of BS EN 13141 and other relevant standards. The complete assembly, as installed, should be designed to meet the performance requirement by following good practice such as is given in *Domestic ventilation: Installation and commissioning compliance guide*, which is available at [www.communities.gov.uk/...](http://www.communities.gov.uk/) (see Volume 3, Chapter 2 of this consultation document).

Note 2. Detailed guidance on the tests to be undertaken has been prepared by the Energy Saving Trust (EST) and the Building Research Establishment (BRE) in conjunction with The Electric Heating and Ventilation Association (TEHVA) and the Residential Ventilation Association (RVA). This guidance, entitled *Performance testing of products for residential ventilation* should be read in conjunction with the appropriate parts of BS EN 13141 and is available at the SAP Appendix Q website www.sap-appendixq.org.uk/page.jsp?id=5

Ventilation systems for basements

- 5.11 For a dwelling which includes a **basement** that is connected to the rest of the dwelling above ground by a large **permanent opening** (e.g. an open stairway), the whole dwelling including the **basement** should be ventilated in accordance with paragraph 5.8 (for dwellings without **basements**) and treated as a multi-storey dwelling. If the **basement** has only a single exposed façade, while the rest of the dwelling above ground has more than one exposed façade, ventilation systems 3 and 4 are preferred, following the guidance in paragraph 5.8. If systems 1 or 2 are to be used, seek expert advice.
- 5.12 For a dwelling which includes a **basement** that is not connected to the rest of the dwelling above ground by a large **permanent opening**:
- a. the part of the dwelling above ground should be considered separately and ventilated in accordance with paragraph 5.8. If the part of the dwelling above ground has no bedrooms, assume it has one bedroom for the purpose of determining ventilation provisions; and

- b. the **basement** should be treated separately as a single-storey dwelling above ground level in accordance with paragraph 5.8. If the **basement** has no bedrooms, assume it has one bedroom for the purpose of determining ventilation provisions. The guidance on natural ventilation given in the Approved Document may not be appropriate for this situation and expert advice should be sought.

5.13 For a dwelling which comprises only a **basement** it should be treated as a single-storey dwelling above ground level in accordance with paragraph 5.8. The guidance on natural ventilation given in the Approved Document may not be appropriate for this situation and expert advice should be sought.

Ventilation of a habitable room through another room or a conservatory

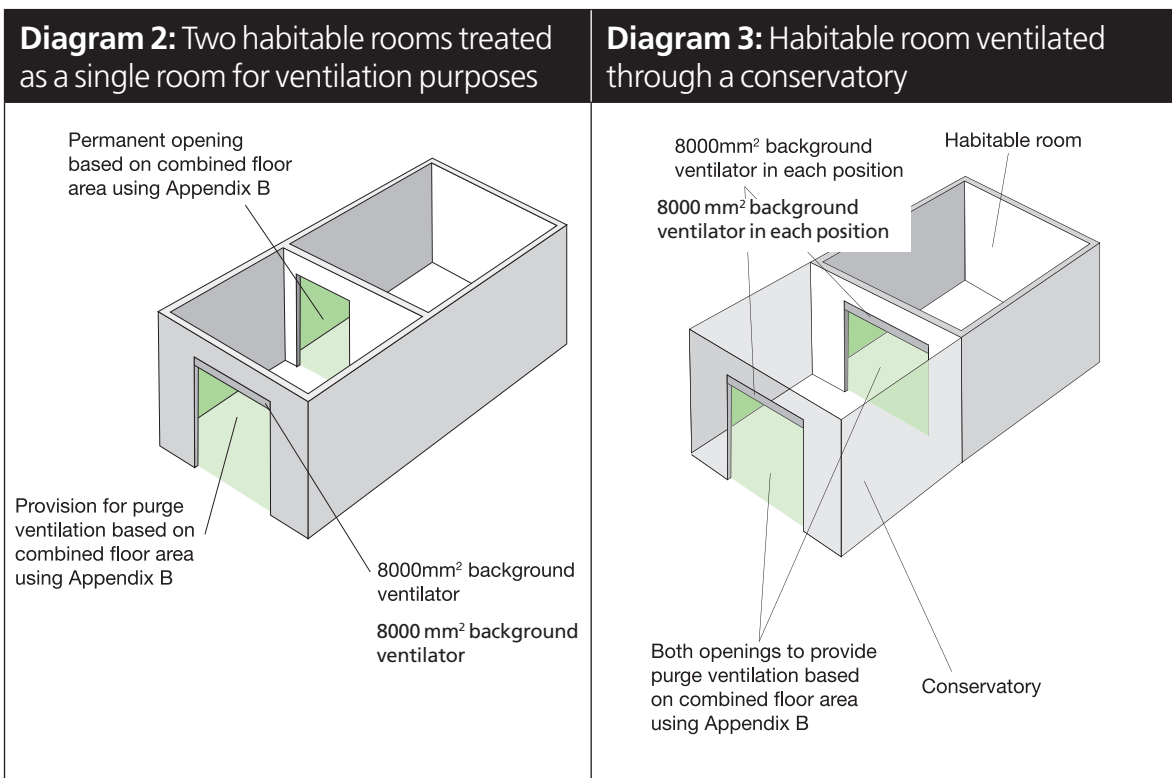
5.14 In a **habitable room** not containing openable windows (i.e. an internal room) the requirement will be met if the room is either ventilated through another **habitable room** (see paragraph 5.15) or through a conservatory (see paragraph 5.16).

5.15 A **habitable room** not containing openable windows may be ventilated through another **habitable room** (see Diagram 2) if:

- a. there is, from the **habitable rooms** to outside, provision for both:
 - i. **purge ventilation**, one or more **ventilation openings**, with a total area given in Diagram 2 based on at least the combined floor area of the **habitable rooms**; and
 - ii. **background ventilation** of at least 8000 mm² **equivalent area**; and
- b. there is an area of **permanent opening** between the two rooms as given in Diagram 2 based on at least the combined floor area of the **habitable rooms**.

5.16 A **habitable room** not containing openable windows may be ventilated through a conservatory (see Diagram 3) if:

- a. there is, from the conservatory to outside, provisions for both:
 - i. **purge ventilation**, one or more **ventilation openings**, with a total area given in Diagram 3 based on at least the combined floor area of the **habitable room** and conservatory; and
 - ii. **background ventilation**, a **ventilation opening** (or openings) of at least 8000 mm² **equivalent area**; and
- b. there are openings (which must be **closable**) between the **habitable room** and the conservatory for:
 - i. **purge ventilation** equivalent to 5.15a(i) above; and
 - ii. **background ventilation** equivalent to 5.15a(ii) above which should be located typically at least 1.7 m above floor level and need not be within the door frame.



Section 6: Buildings other than dwellings

General

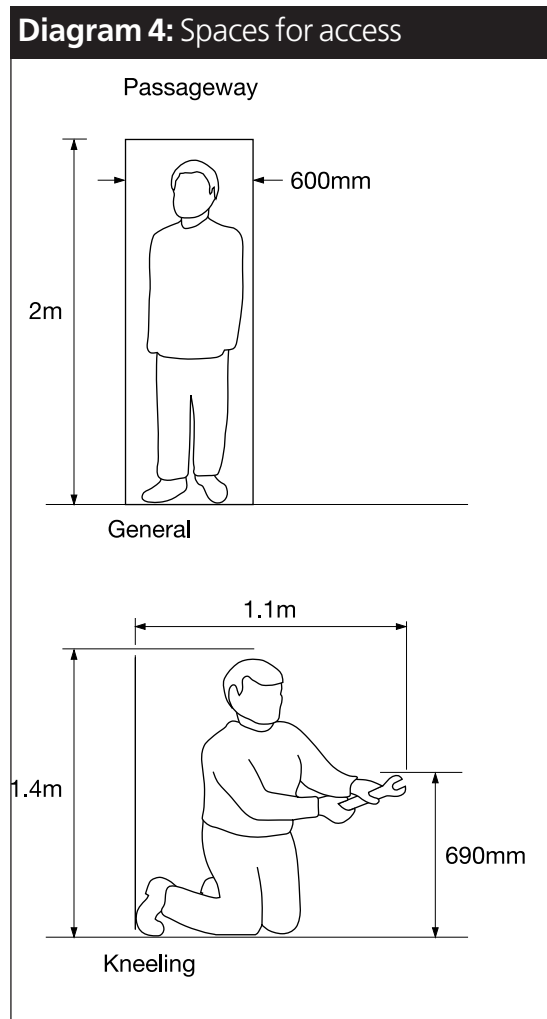
- 6.1 This Approved Document sets out guidance for the following range of building types and uses:
 - a. offices – paragraphs 6.9 to 6.17;
 - b. car parks – paragraphs 6.19 to 6.22;
 - c. other building types – paragraph 6.18.
- 6.2 The ventilation provisions will not necessarily meet cooling needs. Guidance on the control of overheating is considered in Approved Document L2A *Conservation of fuel and power in new buildings other than dwellings*.
- 6.3 Provision should be made to protect the fresh air supplies from contaminants injurious to health. Guidance on the siting of air inlets is provided in Appendix D.
- 6.4 Guidance on design measures to avoid legionella contamination, including design features not related to the ventilation of the building, is given in the HSE document *Legionnaires' disease: the control of legionella bacteria in water systems* (see paragraphs 79 to 144). Further guidance may be found in CIBSE TM13 *Minimising the risk of Legionnaires' disease* and in BSRIA Application Guides AG19/2000, AG20/2000, AG21/2000.
- 6.5 Guidance on recirculated air in air conditioning and mechanical ventilation systems is given in HSE document L24 *Workplace health, safety and welfare, Workplace (Health, Safety and Welfare) Regulations 1992, Approved Code of Practice and guidance* (paragraph 32).

Access for maintenance

- 6.6 Reasonable provision would be to include:
- access for the purpose of replacing filters, fans and coils; and
 - provision of access points for cleaning duct work.

- 6.7 In a central plant room adequate space should be provided as necessary for the maintenance of the plant. Where no special provision is required, the requirement could be satisfied if 600 mm space is provided where access is required between plant and 1 100 mm where space for routine cleaning is required (see Diagram 4). These figures are the minimum necessary and additional space may be needed for opening of access doors, withdrawal of filters, etc. Further guidance for more complex situations can be found in Defence Works Functional Standard, Design & Maintenance Guide

08: *Space requirements for plant access operation and maintenance*. Further guidance for the cleaning of ducts is provided by CIBSE *Ventilation hygiene toolkit* and HVCA TR19 – *Guide to good practice – Internal cleanliness of ventilations systems*.



Commissioning

- 6.8 See Approved Document L2A *Conservation of fuel and power in new buildings other than dwellings* for information on commissioning to conserve energy. For information on commissioning for ventilation performance (and other aspects) see CIBSE Commissioning Codes available from www.cibse.org/index.cfm?go=publications.view&item=266, and the following HVCA guidance documents: DW144 *Specification for sheet metal ductwork: low, medium and high pressure/velocity air systems*, DW154 *Specification for plastics ductwork* and DW143 *Practical guide to ductwork leakage testing*.

Offices

Introduction to provisions

- 6.9 This Approved Document shows four ways of complying with the requirement by:
- a. providing a ventilation system which meets the airflow rates set out in paragraphs 6.10 to 6.14; or
 - b. following the system guidance set out in paragraphs 6.15 to 6.16; or
 - c. using the alternative approaches set out in paragraph 6.17; or
 - d. using other ventilation systems provided it can be demonstrated to the **building control body** that they satisfy the Requirement, e.g. by showing that they meet the moisture and air quality criteria set out in Appendix A.

Ventilation rates

- 6.10 The performance will be achieved by ventilation which provides the airflow rates set out in paragraphs 6.11 to 6.14. The airflow rates specified are for the installed performance.
- 6.11 Extract to outside is required in all office **sanitary accommodation**, washrooms and food and beverage preparation areas. In addition, printers and photocopiers in substantial use (greater than 30 minutes per hour) should be located in a separate room (to avoid any pollutants entering the occupied space) and extract provision installed. The extract flow rates should be no less than those specified in Table 6.1a.
- 6.12 The **whole building ventilation** rate for the supply of air to the offices should be no less than that specified in Table 6.1b.
- 6.13 **Purge ventilation** provision is required in each office. The total ventilation should be sufficient to reduce pollutants to an acceptable level before the space is occupied. The purged air should be taken directly to outside and should not be recirculated to any other part of the building.
- 6.14 The outdoor air supply rates in Table 6.1b for offices are based on controlling body odours with low levels of other pollutants. Where there are significant levels of other pollutants, adequate outdoor air supply can be achieved by following the calculation method provided in CIBSE Guide A.

Table 6.1a: Extract ventilation rates

Room	Extract rate
Rooms containing printers and photocopiers in substantial use (greater than 30 minutes per hour)	Air extract rate of 20 l/s per machine during use. Note that, if the operators are in the room continuously, use the greater of the extract and whole building ventilation rates
Office sanitary accommodation and washrooms	Intermittent air extract rate of: 15 l/s per shower/bath 6 l/s per WC/urinal
Food and beverage preparation areas (not commercial kitchens)	Intermittent air extract rate of: 15 l/s with microwave and beverages only 30 l/s adjacent to the hob with cooker(s) 60 l/s elsewhere with cooker(s) All to operate while food and beverage preparation is in progress
Specialist buildings/spaces (e.g. commercial kitchens, sports centres)	See Table 2.3

Table 6.1b: Whole building ventilation rate for air supply to offices

	Air supply rate
Total outdoor air supply rate for offices (no smoking and no significant pollutant sources)	10 l/s per person

Natural ventilation of rooms

6.15 The airflow rates specified in Tables 6.1a and 6.1b can be provided by a mainly natural ventilation system by following the guidance in Tables 6.2a, 6.2b and 6.2c. A wide range of natural ventilation systems for providing **whole building ventilation** is given in CIBSE Application Manual AM 10: *Natural ventilation in non-domestic buildings*.

Mechanical ventilation of rooms

6.16 The requirement will be satisfied by following:

- the airflow rates set out in paragraphs 6.10 to 6.14; and
- the location guidance in Table 6.2b for **extract ventilation**; and
- the control guidance in Table 6.2c for **extract ventilation**.

Alternative approaches

6.17 As an alternative to paragraphs 6.10 to 6.14 the requirement will be satisfied by following the relevant recommendations of:

- a. CIBSE Application Manual AM 13: 2000: *Mixed mode ventilation*;
- b. CIBSE Guide A and CIBSE Guide B2.

Table 6.2: Ventilation for offices with natural air supply

a. Ventilation provisions

Extract

Extract rates as per paragraph 6.11^(1,2)

Whole building ventilation

See CIBSE Application Manual AM 10: *Natural ventilation in non-domestic buildings*.

Purge ventilation

See CIBSE Application Manual AM 10: *Natural ventilation in non-domestic buildings*.

Notes:

1. **PSV** can be used as an alternative to a mechanical extract fan for office sanitary, washroom and food preparation areas.
2. When an open-flued appliance is provided in a building with mechanical extract, the spillage of flue gases could occur. The open-flued appliance needs to operate safely whether or not the fan is running, and further guidance is provided in BS 5440-1 which applies for up to 70 kW appliance input.

b. Location of ventilators in rooms

Extract

- Extract ventilators should be located as high as practicable and preferably less than 400 mm below the ceiling. This will tend to remove pollutants from the breathing zone of the occupants as well as increase the effectiveness of extracting buoyant pollutants and water vapour.
- For **PSV**, extract terminals should be located in the ceiling of the room.

Whole building ventilation

- See CIBSE Application Manual AM 10: *Natural ventilation in non-domestic buildings*.

Purge ventilation

- See CIBSE Application Manual AM 10: *Natural ventilation in non-domestic buildings*.

Table 6.2: Ventilation for offices with natural air supply *continued***c. Controls for ventilators in rooms****Extract**

- Extract fans can be controlled either manually or automatically. For a room with no openable window (i.e. an internal room), the extract should have a 15 minute overrun.
- For **PSV**, either operated manually and/or automatically by a sensor or controller.

Whole building ventilation

- See CIBSE Application Manual AM 10: *Natural ventilation in non-domestic buildings*.

Purge ventilation

- See CIBSE Application Manual AM 10: *Natural ventilation in non-domestic buildings*.

Accessible controls

- Readily accessible override controls should be provided for the occupants.

Ventilation of other types of building

6.18 The requirement will be satisfied by following the appropriate design guidance for the other buildings given in Table 6.3. In addition to the guidance documents listed, it should be noted that the Workplace (Health, Safety and Welfare) Regulations 1992 apply to most places where people work. A short guide, INDG244, is available from the HSE and at: www.hse.gov.uk/pubns/indg244.pdf

Table 6.3: Ventilation of other buildings and spaces

Building/space/activity	Regulations and guidance (also see Section 8)
Animal husbandry	The Welfare of Farm Animals (England) Regulations SI 2000 No. 1870 London: The Stationery Office 2000. The Welfare of Farm Animals (England) (Amendment) Regulations SI 2002 No.1646 The Welfare of Farm Animals (England) (Amendment) Regulations SI 2003 No. 299 BS 5502:2003 <i>Buildings and Structures for Agriculture</i> See also CIBSE Guide B2:2001, Section 3.24.1
Assembly halls	CIBSE Guide B2:2001, Section 3.3
Atria	CIBSE Guide B2:2001, Section 3.4
Broadcasting studios	CIBSE Guide B2:2001, Section 3.5
Building services plant rooms	Provision for emergency ventilation to control dispersal of contaminating gas releases (e.g. refrigerant leak) is given in paragraphs 23–25 of HSE Guidance Note 202 <i>General Ventilation in the Workplace – Guidance for Employers</i> . Other guidance is in BS 4434:1989 <i>Specification for safety aspects in the design, construction and installation of refrigeration appliances and systems</i>
Call centres	CIBSE Guide B2:2001, Section 3.24.2
Catering (inc. commercial kitchens)	HSE Catering Information Sheet No. 10, 2000: <i>Ventilation of kitchens in catering establishments</i> HSE Information Sheet No. 11, 2000: <i>The main health and safety law applicable to catering</i> See also CIBSE Guide B2:2001, Section 3.6
Cleanrooms	CIBSE Guide B2:2001, Section 3.7
Common spaces	The following provisions apply to common spaces where large numbers of people are expected to gather, such as shopping malls and foyers. They do not apply to common spaces used solely or principally for circulation. Either: a. natural ventilation by appropriately located ventilation opening(s) with a total opening area of at least 1/50th of the floor area of the common space ; or b. mechanical ventilation installed to provide a supply of fresh air of 1 l/s per m ² of floor area

Table 6.3: Ventilation of other buildings and spaces *continued*

Building/space/activity	Regulations and guidance (also see Section 8)
Communal residential buildings	EST, Energy Efficiency Best Practice in Housing, Good Practice Guide GPG 192: <i>Designing energy efficient multi-residential buildings</i> See also CIBSE Guide B2:2001, Section 3.8
Computer rooms	CIBSE Guide B2:2001, Section 3.9
Court rooms	Department for Constitutional Affairs <i>Court standards and design guide</i> , 2004
Darkrooms (photographic)	CIBSE Guide B2:2001, Section 3.24.4
Dealing rooms	CIBSE Guide B2:2001, Section 3.24.5
Factories and warehouses	Factories Act Health and Safety at Work etc. Act See also CIBSE B2:2001, Section 3.11 Requirements are often exceeded by other criteria such as the ventilation requirements of the particular manufacturing process
High-rise (non-domestic buildings)	CIBSE Guide B2:2001, Section 3.12
Horticulture	CIBSE Guide B2:2001, Section 2.42.6
Hospitals and healthcare buildings	NHS Activity database Health Technical Memorandum (HTM) 03 Health Building Notes (HBN) – various CIBSE Guide B2:2001, Section 3.13
Hotels	CIBSE Guide B2:2001, Section 3.14
Industrial ventilation	<i>Industrial ventilation</i> , 24th Edition, <i>Manual of recommended practice</i> , American Conference of Government Industrial Hygienists HS(G) 37 <i>An introduction to local exhaust ventilation</i> HS(G) 54 <i>Maintenance, examination and testing of local exhaust ventilation</i> HS(G) 193 <i>COSHH essentials</i>
Laboratories	CIBSE Guide B2:2001, Section 3.16
Museums, libraries and art galleries	BS 5454:2000. CIBSE Guide B2: 2001, Section 3.17
Plant rooms	CIBSE Guide B2: 2001, Section 3.18

Table 6.3: Ventilation of other buildings and spaces *continued*

Building/space/activity	Regulations and guidance (also see Section 8)
Prison cells	Refer to National Offender Management Service (NOMS). Home Office, NOMS Property, Technical Services, Room 401, Abell House, John Islip St., London SW1P 4LH
Schools and educational buildings	Ventilation provisions in schools can be made in accordance with the guidance in Building Bulletin 101, <i>Ventilation of School Buildings</i> (see www.teachernet.gov.uk/iaq) and in the Education (School Premises) Regulations. Building Bulletin 101 can also be used as a guide to the ventilation required in other educational buildings such as further education establishments where the accommodation is similar to that found in schools, e.g. sixth form accommodation. However, the standards may not be appropriate for particular areas where more hazardous activities take place than are normally found in schools, e.g. some practical and vocational activities requiring containment or fume extraction. The Building Bulletin can also be used for children's centres and other early years settings, including day nurseries, playgroups, etc.
Shops and retail premises	CIBSE Guide B2:2001, Section 3.20
Sports centres (inc. swimming pools)	CIBSE Guide B2:2001, Section 3.21
Standards rooms	CIBSE Guide B2:2001, Section 3.24.7
Sanitary accommodation	Same as for offices in Table 2.1a
Transportation buildings and facilities	CIBSE Guide B2:2001, Section 3.23

Ventilation of car parks

6.19 The requirement will be satisfied for car parks below ground level, for enclosed-type car parks and for multi-storey car parks if the mean predicted pollutant levels are calculated, the ventilation rate is designed and equipment is installed to limit the carbon monoxide to:

- a. an average concentration of not more than 30 parts per million over an eight hour period; and
- b. peak concentrations, such as by ramps and exits, of not more than 90 parts per million for periods not exceeding 15 minutes.

6.20 Note that Approved Document B also includes provisions for the ventilation of car parks for the purpose of fire risk management.

Alternative approaches for ventilation of car parks

6.21 As an alternative to paragraph 6.19, the following guidance would satisfy the requirement:

a. Naturally ventilated car parks. The provision of well distributed permanent natural ventilation, e.g. openings at each car parking level with an aggregate **equivalent area** equal to at least 1/20th of the floor area at that level, of which at least 25% should be on each of two opposing walls.

b. Mechanically ventilated car parks

Either:

- i. the provision of both permanent natural **ventilation openings** of **equivalent area** not less than 1/40th of the floor area and a mechanical ventilation system capable of at least three air changes per hour (ach); or
- ii. for basement car parks, the provision of a mechanical ventilation system capable of at least six air changes per hour (ach).

And:

- iii. for exits and ramps, where cars queue inside the building with engines running, provisions should be made to ensure a local ventilation rate of at least 10 air changes per hour (ach).

6.22 Further guidance can be found in *Code of practice for ground floor, multi-storey and underground car parks* published by the Association for Petroleum and Explosives Administration (www.apea.org.uk); CIBSE Guide B2, Section 3.23.3; and Health and Safety Publication EH40: *Occupational exposure limits for limiting concentration of exhaust pollutants*. Fire safety issues are considered in Approved Document B.

Section 7: Work on existing buildings

General

- 7.1 When building work is carried out on an existing building the work should comply with the applicable requirements of Schedule 1 to the Building Regulations 2000, and the rest of the building should not be made less satisfactory in relation to the requirements than before the work was carried out (see regulations 3 and 4 of the Building Regulations). Further, when a building undergoes a material change of use, as defined in regulation 5 of the Building Regulations, Part F applies to the building or that part of the building which has been subject to the change of use, in accordance with regulation 6. Therefore, the guidance in other sections of this Approved Document may be applicable.
- 7.2 Windows are a controlled fitting. Regulation 4(1) of the Building Regulations requires that, when windows in an existing building are replaced, the replacement work should comply with the applicable requirements of Schedule 1, i.e. Parts L and N. In addition, the building work once completed should not have a worse level of compliance with other applicable requirements of Schedule 1 than before commencement of the work. Other applicable requirements of Schedule 1 may include Parts B, F and J.
- 7.3 Where the original windows were fitted with trickle ventilators the replacement windows should include them and they should be sized as set out in paragraph 7.6.
- 7.4 Where the original windows were not fitted with trickle ventilators and the room is not ventilated adequately by other installed provisions, it would be good practice to fit trickle ventilators (or an equivalent means of ventilation) to help with control of condensation and improve indoor air quality. Ventilation devices should be fitted with accessible controls.
- Note: Paragraph 7.4 may be amended in the light of a cost-benefit analysis evaluating the need for trickle ventilators. If the cost-benefit analysis finds the benefits of fitting trickle ventilators exceed the costs, the underlined text will be changed to: “trickle ventilators (or an equivalent means of ventilation) should be fitted”.*
- 7.5 When windows are replaced as part of the work connected with a material change of use, sections 5 and 6 of this Approved Document apply.

7.6 In all cases where trickle ventilators (or an equivalent means of ventilation) are to be fitted, the new **ventilation opening** should not be smaller than was originally provided, and it should be controllable. Where there was no **ventilation opening**, or where the size of the original **ventilation opening** is not known, the following minimum sizes should be adopted.

Dwellings:

- **habitable rooms** – 5000 mm² **equivalent area**;
- kitchen, **utility room** and **bathroom** (with or without WC) – 2500 mm² **equivalent area**.

Buildings other than dwellings:

- **occupiable rooms**: for floor areas up to 10 m² – 2500 mm² **equivalent area**; greater than 10 m² at the rate of 250 mm² **equivalent area** per m² of floor area;
- kitchens (domestic type) – 2500 mm² **equivalent area**;
- **bathrooms** and shower rooms – 2500 mm² **equivalent area** per bath or shower;
- **sanitary accommodation** (and/or washing facilities) – 2500 mm² **equivalent area** per WC.

Addition of a habitable room (not including a conservatory) to an existing dwelling

7.7 The requirements will be met by following the guidance in paragraphs 7.8 to 7.10.

7.8 The general ventilation rate for the additional room and, if necessary, adjoining rooms could be achieved by one of the following options.

- a. **background ventilators** could be used as follows:
 - i. if the additional room is connected to an existing **habitable room** which now has no windows opening to outside, the guidance in paragraph 5.15 should be followed; or
 - ii. if the additional room is connected to an existing **habitable room** which still has windows opening to outside but with a total **background ventilator equivalent area** less than 5000 mm², the guidance in paragraph 5.15 should be followed; or

- iii. if the additional room is connected to an existing **habitable room** which still has windows opening to outside and with a total **background ventilator equivalent area** of at least 5000 mm², there should be **background ventilators** of at least 8000 mm² **equivalent area** between the two rooms and **background ventilators** of at least 8000 mm² **equivalent area** between the additional room and outside.
- b. a single room heat recovery ventilator could be used to ventilate the additional **habitable room**. The supply rate to that room should be determined as follows. First, determine the **whole building ventilation** rate from Table 5.1b. Second, calculate the room supply rate required from:

(Whole building ventilation rate x Room volume)/(Total volume of all habitable rooms)

- 7.9 For **purge ventilation**, follow the guidance given in Table 5.2a.
- 7.10 Guidance on location and controls is also given in Tables 5.2a and guidance on performance testing standards is given in Table 5.3.

Addition of a wet room to an existing dwelling

- 7.11 The requirements for the additional wet room will be met by following the guidance in paragraphs 7.12 to 7.15.
- 7.12 Whole building and **extract ventilation** can be provided by:
 - a. intermittent extract, as given in Table 5.2a, and a background ventilator of at least 2500 mm² equivalent area; or
 - b. single room heat recovery ventilator, as given in Table 5.2a; or
 - c. passive stack ventilator, as given in Table 5.2b; or
 - d. continuous extract fan, as given in Table 5.2c.
- 7.13 To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600 mm² in the internal door between the **wet room** and the existing dwelling. This is equivalent to an undercut of 10 mm for a standard 760 mm width door. **This should be achieved by making an undercut of 10 mm above the floor finish if the floor finish is fitted, or by a 20 mm undercut above the floorboards, or other surface, if the finish has not been fitted.**
- 7.14 For **purge ventilation**, follow the guidance for the appropriate system given in Tables 5.2a to 5.2c.

7.15 Guidance on location and controls is given in Tables 5.2a to 5.2c and guidance on performance standards is given in Table 5.3.

Addition of a conservatory to an existing building

7.16 The guidance applies to conservatories with a floor area over 30m².

7.17 The requirements will be met by following the guidance in paragraphs 7.18 to 7.20.

7.18 The general ventilation rate for the conservatory and, if necessary, adjoining rooms could be achieved by the use of **background ventilators**. Follow the guidance in paragraph 5.16 whatever the ventilation provisions in the existing room adjacent to the conservatory.

7.19 For **purge ventilation**, follow the guidance given in Table 5.2a.

7.20 Guidance on location and controls is also given in Tables 5.2a and guidance on performance standards is given in Table 5.3.

Historic buildings

7.21 Conserving the special characteristics of **historic buildings** needs to be recognised: see BS 7913. In such work, the aim should be to improve ventilation to the extent that is necessary, taking into account the need not to prejudice the character of the **historic building** nor to increase the risk of long-term deterioration to the building fabric or fittings. It may be that the fabric of the **historic building** is more leaky than a modern building, and this can be established by pressure testing. In arriving at a balance between **historic building** conservation and ventilation, it would be appropriate to take into account the advice of the local planning authority's conservation officer.

7.22 Particular issues relating to work in **historic buildings** that warrant sympathetic treatment and where advice from others could therefore be beneficial include:

- a. restoring the historic character of a building that had been subject to previous inappropriate alteration, e.g. replacement windows, doors and roof-lights;
- b. rebuilding a former **historic building** (e.g. following a fire or filling in a gap site in a terrace);
- c. making provisions enabling the fabric to "breathe" to control moisture and potential long term decay problems: see SPAB Information Sheet No. 4, *The need for old buildings to breathe*, 1986.

Refurbishing a kitchen or bathroom in an existing dwelling

7.23 If any of the work being carried out in the kitchen or **bathroom** of an existing building is “building work”, as defined in regulation 3 of the Building Regulations, the Regulations require that you do not make compliance with other requirements of the Regulations, including ventilation, worse than before. The Regulations also require that the work is reported to a **building control body**. This may be the local authority building control department or you can use an “Approved Inspector” or you can have the work carried out by a contractor/installer who is registered with a CLG authorised Competent Person Scheme (CPS). Registered installers are required to certificate and report all the notifiable work that they carry out to their scheme operator, who passes this information on to the relevant **building control body**.

7.24 The definition of “building work” in regulation 3 of the Building Regulations includes a range of building activities in existing buildings and includes all work on controlled services (for more information you can read the Building Regulations 2000 (consolidated version) at:
www.planningportal.gov.uk/england/professionals/en/1115314808708.html

7.25 If you carry out any “building work”, and there is an existing extract fan or passive stack ventilator (or cooker hood extracting to outside in the kitchen), you should retain or replace it. However, if there is no existing ventilation system you need not provide one. Replacing an extract fan or cooker hood with a similar type, and using the existing cabling, need not be notified to a **building control body**.

7.26 If a combustion appliance is installed, Approved Document J – *Heat producing appliances* should be consulted. It is available at:
www.planningportal.gov.uk/england/professionals/en/4000000000502.html

Section 8: Standards and other publications

Standards

BS EN 378-3:2008 *Refrigerating systems and heat pumps – Safety and environmental requirements. Installation site and personal protection.*

BSI PD CR 1752:1999 *Ventilation for buildings – design criteria for the indoor environment.*

BS 5502:2003 *Buildings and structures for agriculture. Various relevant parts including: Part 33:1991 Guide to the control of odour pollution, AMD 10014 1998. Part 52:1991 Code of practice for design of alarm systems, emergency ventilation and smoke ventilation for livestock housing, AMD 10014 1998.*

BS 5454: 2000 *Recommendations for the storage and exhibition of archival documents.*

BS 5925: 1991 *Code of practice for ventilation principles and designing for natural ventilation. AMD 8930 1995.*

BS 7913: 1998 *Principles of the conservation of historic buildings.*

BS EN 13141-1: 2004 *Ventilation for buildings. Performance testing of components/products for residential ventilation. Externally and internally mounted air transfer devices.*

BS EN 13141-3: 2004 *Ventilation for buildings. Performance testing of components/products for residential ventilation. Range hoods for residential use.*

BS EN 13141-4: 2004 *Ventilation for buildings. Performance testing of components/products for residential ventilation. Fans used in residential ventilation systems.*

BS EN 13141-6: 2004 *Ventilation for buildings. Performance testing of components/products for residential ventilation. Exhaust ventilation system packages used in a single dwelling.*

BS EN 13141-7: 2004 *Ventilation for buildings. Performance testing of components/products for residential ventilation. Performance testing of a mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for single family dwellings.*

BS EN 13141-8: 2006 *Ventilation for buildings. Performance testing of components/products for residential ventilation. Performance testing of unducted mechanical supply and exhaust ventilation units [including heat recovery] for mechanical ventilation systems intended for a single room.*

BS EN 13986: 2004 *Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking.*

Other publications

American Conference of Government industrial hygienists (ACGIH)

Industrial ventilation 26th Edition, *Manual of recommended practice.*

Available from: www.acgih.org/store

Building Research Establishment (BRE)

BRE Digest 464, Part 1: *VOC emissions from building products. Sources, testing and emission data*, 2002. ISBN 1 86081 546 4.

BRE Digest 464, Part 2: *VOC emissions from building products. Control, evaluation and labelling schemes*, 2002. ISBN 1 86081 547 2.

Chartered Institution of Building Services Engineers (CIBSE)

Applications Manual AM10: *Natural ventilation in non-domestic buildings*, 2005. ISBN 1 80328 756 1.

Applications Manual AM13: *Mixed mode ventilation*, 2000. ISBN 1 90328 701 4.

CIBSE Guide A: *Environmental design*, 2006. ISBN-13: 978-1-903287-66-8.

CIBSE Guide B2: *Ventilation and air conditioning*, 2001. ISBN 1 90327 816 2.

TM13: *Minimising the risk of Legionnaires' disease*, 2002. ISBN 1 90328 723 5.

CIBSE Commissioning Codes, available from:

www.cibse.org/index.cfm?go=publications.view&item=266.

Ventilation hygiene toolkit:

BSRIA Facilities Management Specification 1 *Guidance to the standard specification for ventilation hygiene*, 2002. ISBN 0 86022 454 6.

CIBSE TM26 *Hygienic maintenance of office ventilation ductwork*, 2000.

ISBN1 90328 711 1.

HSE HSG 202 *General ventilation in the workplace. Guidance for employers*, 2002.

ISBN 0 71761 793 9.

HVCA TR/19 *Guide to good practice. Internal cleanliness of ventilation systems*, 2005.

ISBN 0 90378 335 5.

Defence Estates

Defence Works Functional Standard, Design and Maintenance Guide 08: *Space requirements for plant access operation and maintenance*, 1996. ISBN 0 11772 785 7.
Available from: www.defence-estates.mod.uk/publications/dmg/dmg_08.pdf

Department for Constitutional Affairs (DCA)

Court standards and design guide, 2004. CD available from the DCA.

Department for Children, Schools and Families (DCSF);

Building Bulletin 101, *Ventilation of school buildings*, 2006. ISBN 0 11271 164 2.
See: www.teachernet.gov.uk/iaq

Department of Health Estates and Facilities Division

HTM 03; Part A – *Ventilation in healthcare premises: Design and validation*, 2007.
HTM 03; Part B – *Ventilation in healthcare premises: Verification and operational Management*, 2007.
HBN (various).

Energy Saving Trust

Good Practice Guide 192. *Designing energy efficient multi-residential buildings*, 1997.
Available from: www.est.org.uk/bestpractice/index.cfm (archived).

Health and Safety Executive (HSE)

HSE Catering Information Sheet No 10, *Ventilation of kitchens in catering establishments*, 2007. Available from: www.hsebooks.com
HSE Catering Information Sheet No 11, *The main health and safety law applicable to catering*, 2000. Available from: www.hsebooks.com
HSG 258 *Controlling airborne contaminants at work. A guide to local exhaust ventilation (LEV)*, 2008. ISBN 978 0 71 76 6298 2, (Supersedes HSG 54 and HSG 37).
HSG 193. *COSHH Essentials*. Accessed on: www.coshh-essentials.org.uk
HSG 202 *General ventilation in the workplace – Guidance for employers*, 2000. ISBN 0 71761 793 9.
L8 *Legionnaires Disease: The control of legionella bacteria in water systems*. Approved code of practice and guidance, 2000. ISBN 0 71761 772 6.
L24 Workplace (Health, Safety and Welfare) Regulations 1992. *Approved code of practice and guidance*, 2001. ISBN 0 71760 413 6.

Legislation

Factories Act 1961, Chapter 34.
Welfare of Farm Animals (England) Regulations 2000, SI 2000/1870.
Welfare of Farm Animals (England) (Amendment) Regulations 2002, SI 2002/1646.
Welfare of Farm Animals (England) (Amendment) Regulations 2003, SI 2003/299.

Department for Communities and Local Government

Planning Policy Guidance (PPG) 15: *Planning and the historic environment*; DoE, 1994.

Paragraphs 6.1 to 6.40 have been superseded by Circular 01/2007, *Revisions to principles of selection for listing buildings*. Both available at:

www.communities.gov.uk/planningandbuilding/planning/planningpolicyguidance/historicenvironment/ppg15/

Review of Health and Safety Risk Drivers (BD 2518); available at:

www.communities.gov.uk/documents/planningandbuilding/pdf/reviewhealthsafety.pdf

Society for the Protection of Ancient Buildings (SPAB)

Information Sheet No. 4, *The need for old buildings to “breathe”*, 1987.

Key terms

For the purposes of this Approved Document the following definitions apply:

Air permeability: the physical property used to measure the airtightness of the building fabric. It is defined as air leakage rate per hour per square metre of envelope area at a test reference pressure differential across the building envelope of 50 Pascal (50 N/m²). The design **air permeability** is the target value set at the design stage. The envelope area of the building, or measured part of the building, is the total area of all floors, walls and ceilings bordering the internal volume subject to the test. This includes walls and floors below external ground level. Overall internal dimensions are used to calculate this area and no subtractions are made for the area of the junctions of internal walls, floors and ceilings with exterior walls, floors and ceilings. The envelope area of a terraced house includes the party wall(s). The envelope area of a flat in a multi-storey building includes the floors, walls and ceilings which are shared with adjacent flats.

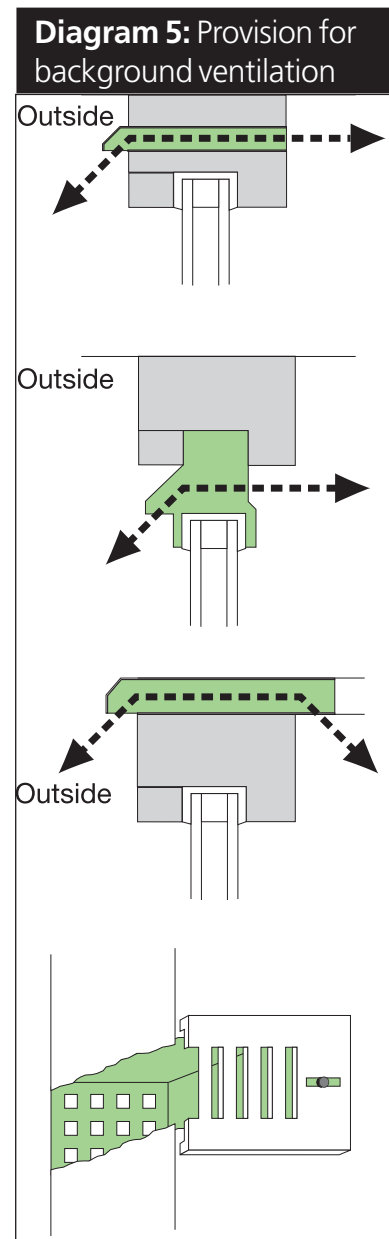
Air tightness: a general descriptive term for the resistance of the building envelope to **infiltration** with ventilators closed. The greater the **air tightness** at a given pressure difference across the envelope, the lower the **infiltration**.

Automatic control: where a ventilation device is opened and closed or switched on and off or its performance is adjusted by a mechanical or electronic controller which responds to a relevant stimulus. That stimulus is usually related to the humidity of the air in a room, pollutant levels (e.g. carbon dioxide concentration in a room), occupancy of the space (e.g. using a passive infra-red motion detector) or pressure difference across the device (e.g. due to the wind outside).

Background ventilator: a small **ventilation opening** designed to provide controllable **whole building ventilation**. See Diagram 5.

Basement for dwellings: a dwelling, or a usable part of a dwelling (i.e. a **habitable room**), that is situated partly or entirely below ground level. Note that a **cellar** is distinct from a basement in that it is used only for storage, heating plant or purposes other than habitation.

Bathroom: a room containing a bath or shower and, in addition, can also include **sanitary accommodation**.



BCB or building control body: a local authority or an approved inspector.

Cellar: see **basement for dwellings**.

Closable opening: a **ventilation opening** which may be opened and closed under either **manual** or **automatic control**.

Common spaces: those spaces where large numbers of people are expected to gather, such as shopping malls or cinema/theatre foyers. For the purposes of this Approved Document, spaces used solely or principally for circulation (e.g. corridors and lift lobbies in office buildings and blocks of flats) are not **common spaces**.

Continuous operation: where a mechanical ventilation device runs all the time, e.g. mechanical **extract ventilation** (MEV) and mechanical ventilation with heat recovery (MVHR). The airflow rate provided by the mechanical ventilation need not be constant but may be varied, under either **manual** or **automatic control**, in response to the demand for pollutant or water vapour removal.

Equivalent area: a measure of the aerodynamic performance of a ventilator. It is the area of a sharp-edged orifice which air would pass through at the same volume flow rate, under an identical applied pressure difference, as the opening under consideration.

Extract ventilation: the removal of air directly from a space or spaces to outside.

Extract ventilation may be by natural means (e.g. by **passive stack ventilation**) or by mechanical means (e.g. by an extract fan or central system).

Free area: the geometric open area of a ventilator.

Gross internal volume: the total internal volume of the heated space, including the volume of all furniture, internal walls, internal floors, etc.

Habitable room: a room used for dwelling purposes but which is not solely a kitchen, utility room, **bathroom**, **cellar** or **sanitary accommodation**.

Historic buildings: these include (a) listed buildings; (b) buildings situated in conservation areas; (c) buildings which are of architectural and historical interest and which are referred to as a material consideration in a local authority's development plan; (d) buildings of architectural and historical interest within national parks, areas of outstanding natural beauty and world heritage sites; and (e) vernacular buildings of traditional form and construction.

Infiltration: the uncontrolled exchange of air between inside a building and outside through cracks, porosity and other unintentional openings in a building, caused by pressure difference effects of the wind and/or **stack effect**.

Intermittent operation: where a mechanical ventilator does not run all the time, usually only running when there is a particular need to remove pollutants or water vapour (e.g. during cooking or bathing). **Intermittent operation** may be under either **manual control** or **automatic control**.

Manual control: where a ventilation device is opened and closed or switched on and off or its performance is adjusted by the occupants of a room or building (c.f. **automatic control**).

Occupiable room: a room in a building other than a dwelling that is occupied by people, such as an office, workroom, classroom, hotel bedroom, but not a **bathroom, sanitary accommodation, utility room** or rooms or spaces used solely or principally for circulation, building services plant or storage purposes.

Passive stack ventilation (PSV): a ventilation device using ducts from terminals in the ceiling of rooms to terminals on the roof that extract air to outside by a combination of the natural **stack effect** and the pressure effects of wind passing over the roof of the building.

Permanent opening: a **ventilation opening** which is permanently fixed in the open position.

Purge ventilation: manually controlled ventilation of rooms or spaces at a relatively high rate to rapidly dilute pollutants and/or water vapour. **Purge ventilation** may be provided by natural means (e.g. an openable window) or by mechanical means (e.g. a fan).

Purpose-provided ventilation: that part of the ventilation of a building provided by ventilation devices designed into the building (e.g. via **background ventilators, PSV, extract fans, mechanical ventilation** or air conditioning systems).

Sanitary accommodation: a space containing one or more water closets or urinals.

Sanitary accommodation containing one or more cubicles counts as a single space if there is free circulation of air throughout the space.

Stack effect: the pressure differential between inside and outside a building caused by differences in the density of the air due to an indoor/outdoor temperature difference.

Surface water activity: a measure of the availability of water to micro-organisms and is determined from the ratio of the vapour pressure of the water in the substrate to that of pure water at the same temperature and pressure. This ratio is in steady-state conditions numerically equal to the equilibrium relative humidity of the air except that the latter is commonly expressed as a percentage (from IEA Annex 14 source book (IEA Annex 41, 1991)).

Utility room: a room containing a sink or other feature or equipment which may reasonably be expected to produce water vapour in significant quantities.

Ventilation: the supply and removal of air (by natural and/or mechanical means) to and from a space or spaces in a building. It normally comprises a combination of **purpose-provided ventilation** and **infiltration**.

Ventilation opening: any means of **purpose-provided ventilation** (whether it is permanent or closable) which opens directly to external air, such as the openable parts of a window, a louvre or a **background ventilator**. It also includes any door which opens directly to external air.

Wet room: a room used for domestic activities (such as cooking, clothes washing and bathing) which give rise to significant production of airborne moisture, e.g. a kitchen, utility room or **bathroom**. For the purposes of Part F, **sanitary accommodation** is also regarded as a **wet room**.

Whole building ventilation (general ventilation): nominally **continuous** ventilation of rooms or spaces at a relatively low rate to dilute and remove pollutants and water vapour not removed by operation of **extract ventilation**, **purge ventilation** or **infiltration**, as well as supplying outdoor air into the building.

Appendix A: Performance-based ventilation

Introduction

As specified in the section on Performance, this Approved Document recommends ventilation provisions to control both moisture and pollutants in buildings. In order to do this, acceptable levels of moisture and other pollutants need to be defined. This Appendix sets out the levels of moisture and other pollutants that the provisions in this Approved Document are designed to control.

Note that the guidance within this Approved Document may not be adequate to address pollutants from flueless combustion space heaters or from occasional, occupant-controlled events such as painting, smoking, cleaning or other high-polluting events. It does not address the airborne spread of infection or contamination from outdoor sources. While many of these considerations could be important factors in achieving acceptable indoor air quality, solutions are not ready for inclusion in this guidance, and indeed indoor air quality may be better controlled at source (e.g. avoidance, isolation or use of lower emitting products).

Performance criteria for dwellings

The performance criterion for moisture is as follows:

- there should be no visible mould on external walls in a properly heated dwelling with typical moisture generation.

The principal performance criteria used for other indoor air pollutants are as follows.

Exposure to the following levels of nitrogen dioxide (NO₂) should not be exceeded:

- 288 µg/m³ (150 ppb) – 1 hour average (DOH, 2004);
- 40 µg/m³ (20 ppb) – long-term average (DOH, 2004).

Exposure to the following levels of carbon monoxide should not be exceeded:

- 100 mg/m³ (90 ppm) – 15 minute averaging time (DOH, 2004);
- 60 mg/m³ (50 ppm) – 30 minute averaging time (DOH, 2004);

- 30 mg/m³ (25 ppm) – 1 hour averaging time (DOH, 2004);
- 10 mg/m³ (10 ppm) – 8 hours averaging time (DOH, 2004).

Exposure to total volatile organic compound (TVOC) levels should not exceed 300 µg/m³ averaged over 8 hours (ECA, 1992).

Control of bio-effluents (body odours) for adapted individuals (reduction in perception due to being exposed to the environment for a period of time) will be achieved by an air supply rate of 3.5 l/s/person (ASHRAE, 2003).

Mould growth can occur whether the dwelling is occupied or unoccupied, so the performance criteria for moisture (as set out in Table A2) should be met at all times, regardless of occupancy. The other pollutants listed above are only harmful to the occupants when the dwelling is occupied.

Assumptions used in applying performance criteria for dwellings in Section 5

General

- Dwellings with a design air permeability >5 m³/(h.m²) at 50 Pa are assumed to have an **infiltration** of 0.15 ach. This has been applied to the Systems 1, 2 and 4. For System 3 **infiltration** is assumed to be negligible, as discussed in Table 5.2c.
- Dwellings with a design **air permeability** ≤5 m³/(h.m²) at 50 Pa are assumed to have an **infiltration** of 0.05 ach for Systems 1 and 2, and no **infiltration** for Systems 3 and 4.
- The ventilation effectiveness is 1.0.
- For the purpose of this Approved Document, for all dwellings (new, and existing where Part F applies), the moisture criterion is likely to be met if the average **surface water activity** (see Key terms for an explanation) of the internal surfaces of external walls is less than the values noted in Table A1 during the heating season. Table A1 is the primary basis for demonstrating compliance with the moisture criterion.

Table A1: Surface water activity

Period	Surface water activity
1 month	0.75
1 week	0.85
1 day	0.95

As a guide, for new dwellings, for the purpose of this Approved Document, the moisture criteria in Table A1 are likely to be met if the average relative humidity (RH) in a room is less than the values given in Table A2 during the heating season.

Table A2: Indoor air relative humidity	
Period	Room air relative humidity
1 month	65%
1 week	75%
1 day	85%

The performance criterion for moisture (given above) is the same as that used in the 2006 edition of Approved Document F. However, research carried out since 2006 has indicated that the values of relative humidity needed to satisfy the criterion could be expressed in a different and more practical way as shown in Table A2. These RH values may, in general, be slightly less onerous than those used in the 2006 edition. This may not be true in all cases and so the ventilation rates necessary to satisfy the criterion have not been changed.

Extract ventilation

- The principal pollutant to be removed by **extract ventilation** is moisture. The source rates were taken from BS 5250: 2002 Table B.1.
- For **intermittent** extract:
 - Historically, a ventilation rate of 60 l/s has been specified in the kitchen for the removal of moisture and there is no strong justification to amend it. The ventilation rate removes moisture generated at a production rate of 2000 g/h. A reduced ventilation rate of 30 l/s is used for a cooker hood, owing to the greater ventilation effectiveness.
 - Historically, a ventilation rate of 15 l/s has been specified in the **bathroom** for the removal of moisture and there is no strong justification to amend it. The ventilation rate removes moisture generated at a production rate of 400 g/h.
 - In the **utility room**, it is assumed that the ventilation rate required is 50% of that in the kitchen.
 - In WCs, the main pollutant is odour. Historically, a ventilation rate of 6 l/s has been specified and there is no strong justification to amend it.
- For **continuous** extract:
 - No reason has been found to change the extract rates, so the rates used in Table 5.1a are the same as used in the 2006 edition of AD F.

Whole building ventilation

- The principal pollutant to be removed by **whole building ventilation** is moisture. The source rates were taken from BS 5250: 2002 Table B.1.
- It was assumed that local extract removes 100% of the moisture generated in the **bathroom** and 50% of the moisture generated in the kitchen.
- The rates given in Table 5.1b are the same as in the 2006 edition.
- The calculations were based on winter weather conditions. During warmer spring and autumn periods, the moisture removal capacity of the outdoor air will be less (i.e. the outdoor air on being heated to the internal temperature within the dwelling will have a higher relative humidity in the spring and autumn periods) and additional ventilation may be required. The provisions for **purge ventilation** (e.g. windows) may be used for this purpose.
- There are other pollutants which must also be adequately controlled. These are particularly important in homes of low occupant density where moisture production is low for the size of the property. Levels of volatile organic compounds were monitored in a BRE study of UK homes (Dimitroulopoulou et al, 2005). From these data, the total source production rate of volatile organic compounds was determined to be 300 µg/h per m² of floor area. To meet the performance criterion of 300 µg/m³, it requires a minimum **whole building ventilation** rate of 0.3 l/s per m² of internal floor area.

Purge ventilation

- A value of 4 ach has been selected as:
 - it provides a **purge ventilation** rate an order of magnitude above **whole building ventilation**;
 - it is similar to the ventilation rate provided by windows in the 1995 edition of Approved Document F. The calculation assumes single-sided ventilation for a dwelling in an urban environment and an internal/external temperature difference of 3°C.

Basis of Table 5.2 – Whole building ventilation rates

- In determining the ventilation rates, the air supply rates in Table 5.1b have been used.
- For dwellings having an **air permeability** of > 5 m³/(h.m²) @50 Pa, the air supply rate has been reduced by 0.15 ach to allow for **infiltration**.
- To determine the **equivalent areas**, the standard airflow equation has been used as below:

$$A = 1000 \cdot (Q/C_d) \cdot (\rho/2 \cdot \Delta P)^{0.5}$$

Where:

A = the **background ventilator equivalent area** (mm^2)

Q = the air supply rate (l/s)

C_d = the discharge coefficient, taken as 0.61

ρ = the air density (kg/m^3), taken as 1.2

ΔP = the pressure across the vent, which has been taken as 0.6 Pa for single-storey dwellings and 1.0 Pa for multi-storey dwellings.

Note that the total actual **equivalent area** required (A_r) is double that derived from the equation above, which only provides the **equivalent area** for air supplied to the dwelling. A similar **equivalent area** is required for air to exit the dwelling. The total **equivalent area** determined in this way is given in the guidance for Systems 1 and 2. Note that in determining these pressure differences, a meteorological wind speed of 4 m/s at 10 m height was taken (based on BS 5925:1991) and an internal/external temperature difference of 15°C.

Performance criteria for buildings other than dwellings

The main guidance within this document has focused on offices. For this, the main criteria have been:

- A supply rate, in the absence of tobacco smoking or other excessive pollutants, of 10 l/s/person, based upon surveys which indicate that below this level the incidence of health effects becomes increasingly significant. This will also satisfy the requirement of 8 l/s/person needed to control bioeffluents for unadapted individuals.
- There should be no visible mould on external walls in a properly heated building with typical moisture generation.
- Exposure to the following levels of nitrogen dioxide (NO_2) should not be exceeded:
 - 288 $\mu\text{g/m}^3$ (150 ppb) – 1 hour average (Department of the Environment, 1996);
 - 40 $\mu\text{g/m}^3$ (21 ppb) – long-term average (WHO, 2003).
- Exposure to the following levels of carbon monoxide should not be exceeded:
 - 100 mg/m^3 (90 ppm) – 15 minute averaging time (WHO, 2000);
 - 60 mg/m^3 (50 ppm) – 30 minute averaging time (WHO, 2000);
 - 30 mg/m^3 (25 ppm) – 1 hour averaging time (WHO, 2000);
 - 10 mg/m^3 (10 ppm) – 8 hours averaging time (Department of the Environment, 1994a).

- Exposure to the following levels of carbon monoxide for occupational exposure should not be exceeded:
 - 35 mg/m³ (30 ppm) – 8 hours averaging time (HSE, 2003).
- Exposure to total volatile organic compound (TVOC) levels should not exceed 300 µg/m³ averaged over 8 hours (ECA, 1992).
- Ozone levels should not exceed 100 µg/m³ (Department of the Environment, 1994b).

Note that the guidance within this Approved Document may not be adequate to address pollutants from occasional, occupant-controlled events such as painting, smoking, cleaning or other high-polluting events. While these could be important factors in achieving acceptable indoor air quality, solutions are not ready for inclusion in this guidance, and indeed they may be better controlled at source (e.g. avoidance, isolation or use of lower emitting products).

Mould growth can occur whether the building is occupied or unoccupied, so the performance criteria for moisture (as set-out in Table A1) should be met at all times, regardless of occupancy. The other pollutants listed above are only harmful to the occupants when the building is occupied.

Where the Health and Safety Executive gives guidance for specific situations, it should be followed in preference to the guidance given here.

Assumptions used in applying performance criteria for offices in Section 2

General

- The office has an **air permeability** of 3 m³/(h.m²) at 50 Pa.
- At this level of **air permeability**, in large buildings (low ratio of surface area to volume contained), **infiltration** can be assumed to be negligible compared with the **purpose-provided ventilation**.
- The ventilation effectiveness is 0.9 (for Table 6.1b).
- For the purposes of this Approved Document, the moisture criterion will be met if the **surface water activity** in a room does not exceed the values given in Table A1 during the heating season.

Extract ventilation

- Office equipment can emit pollutants including ozone and organic compounds. For example, a study by Black and Wortham (1999) suggests the following emission rates for laser printers and dry paper copiers assuming 30 minutes continual use in an hour:
 - 25 mg/h for TVOCs;
 - 3 mg/h for ozone.

To meet the performance criteria for these pollutants requires an extract rate of 20 l/s per machine during use.

- For **sanitary accommodation**, the extract rates used for dwellings have been applied.
- For food and beverage preparation areas, the extract rates used for dwellings have been applied.

Whole building ventilation

- A number of studies have investigated ventilation and health in offices (principally sick building syndrome). Although there is no clear threshold ventilation rate below which health suddenly worsens, a number of sources have identified 10 l/s/p as a significant level. This can probably be traced back to an analysis of experimental studies of office buildings by Mendell (1993). Hence the recommendation within the Approved Document is for 10 l/s/p for buildings with no smoking and no significant pollutant sources.
- Increasing the ventilation rate above 10 l/s/p may improve health (results unclear), but there are diminishing returns (i.e. the improvement in health per l/s/p increase in ventilation rate becomes smaller as the ventilation rate increases). It suggests that there is little advantage in increasing the **whole building ventilation** rate above 10 l/s/p. Increased ventilation has a cost in economic and environmental terms. Having set a ventilation rate of 10 l/s/p, if further improvements in indoor air quality are necessary, alternative approaches should be considered first, e.g. use of low-emission materials.

Purge ventilation

- There are normally more options for the removal of high concentrations of pollutants from office spaces than for dwellings (e.g. leaving rooms unoccupied until acceptable pollutant levels are achieved). Hence, general guidance has been provided rather than specifying any ventilation rate(s).

References

ASHRAE. Handbook 2007: HVAC applications.

Black M S and Wortham A W (1999). *Emissions from office equipment*. Proceedings of the 8th International Conference on Indoor Air Quality and Climate, Indoor Air 99, Edinburgh 8–13 August 1999, Vol. 2, pp455–459.

BS 5250:2002 *Code of practice for the control of condensation in buildings*. BSI.

Department of the Environment (1994a). *Expert panel on air quality standards: Carbon monoxide*. London, HMSO.

www.defra.gov.uk/environment/airquality/panels/aqs/publications/index.htm

Department of the Environment (1994b). *Expert panel on air quality standards: Ozone*. London, HMSO.

www.defra.gov.uk/environment/airquality/panels/aqs/publications/index.htm

Department of the Environment (1996). *Expert panel on air quality standards: Nitrogen dioxide*. London, The Stationery Office.

www.defra.gov.uk/environment/airquality/panels/aqs/publications/index.htm

Department of Health (2004). Committee on the Medical Effects of Air Pollutants. *Guidance on the effects on health of indoor air pollutants*.

www.advisorybodies.doh.gov.uk/comeap/PDFS/guidanceindoorairqualitydec04.pdf

Dimitroulopoulou C, Crump D, Coward S K D, Brown V, Squire R, Mann H, White M, Pierce B and Ross D (2005). *Ventilation, air tightness and indoor air quality in new homes*. Report BR 477. BRE bookshop.

ECA (1992). European Concerted Action on indoor air and its impact on man: *Guidelines for ventilation requirements in buildings*. Working Group Report No. 11. EUR 14449 EN. Commission of the European Communities, Luxembourg.

HSE (2003). Occupational exposure limits 2002, plus supplement 2003. HSE Books.

Mendell M J (1993). *Non-specific symptoms in office workers: a review and summary of the epidemiologic literature*. Indoor air 3, 227–236.

Ross D I and Wilde D (1999). *Continuous monitoring of nitrogen dioxide and carbon monoxide levels in UK homes*. Proceedings of the 8th International Conference on Indoor Air Quality and Climate, Indoor Air 99, Edinburgh 8-13 August 1999, Vol. 3, pp147–152.

WHO (2005). *Guidelines for air quality*. World Health Organization, Geneva.

WHO (2003). WHO working group meeting: *Review of health aspects of air pollution with particulate matter, ozone and nitrogen dioxide*, Bonn, Germany, 13–15 January 2003.

Appendix B: Purge ventilation

Introduction

Adequate **purge ventilation** may be achieved by the use of openable windows and/or external doors. This Appendix provides details of necessary window and door sizes. It is a simplification of guidance in BS 5925:1991 (AMD 8930, 1995) *Code of practice for ventilation principles and designing for natural ventilation*. The diagrams below highlight the window dimensions of importance.

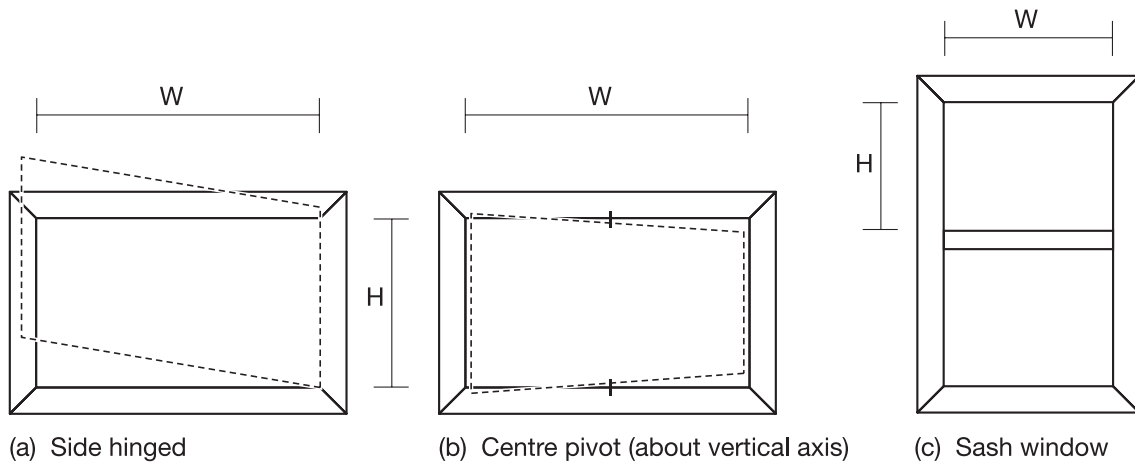
Windows

- For a hinged or pivot window that opens 30° or more, or for sliding sash windows, the height x width of the opening part should be at least 1/20 of the floor area of the room.
- For a hinged or pivot window that opens between 15° and 30°, the height x width of the opening part should be at least 1/10 of the floor area of the room.
- If the window opens less than 15° it is not suitable for providing **purge ventilation** and other arrangements should be made.
- If the room contains more than one openable window, the areas of all the opening parts may be added to achieve the required proportion of the floor area. The required proportion of the floor area is determined by the opening angle of the largest window in the room.
- Note that Approved Document B includes provisions for the size of escape windows. The larger of the provisions in Approved Document B or F should apply in all cases.

Window dimensions

Window opening area = $H \times W$

H and W are dimensions of the open area



External doors (including patio doors)

- For an external door, the height x width of the opening part should be at least 1/20 of the floor area of the room.
- If the room contains more than one external door, the areas of all the opening parts may be added to achieve at least 1/20 of the floor area of the room.
- If the room contains a combination of at least one external door and at least one openable window, the areas of all the opening parts may be added to achieve at least 1/20 of the floor area of the room.

Appendix C: Example calculations for ventilation sizing for dwellings

Introduction

This appendix provides example calculations for each ventilation system set out in paragraph 5.10. A ground-floor flat and a semi-detached house have been considered for each system type. Thus there are eight examples as follows.

Ground-floor flat:

Example C1 – Background ventilators and intermittent extract fans

Example C2 – Passive stack ventilation

Example C3 – Continuous mechanical extract

Example C4 – Continuous mechanical supply and extract

Semi-detached house:

Example C5 – Background ventilators and intermittent extract fans

Example C6 – Passive stack ventilation

Example C7 – Continuous mechanical extract

Example C8 – Continuous mechanical supply and extract

It has been assumed that the design **air permeability** is $> 5 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ in examples C1, C2, C5 and C6, and $\leq 5 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ in the other examples.

Details of ground-floor flat

Description

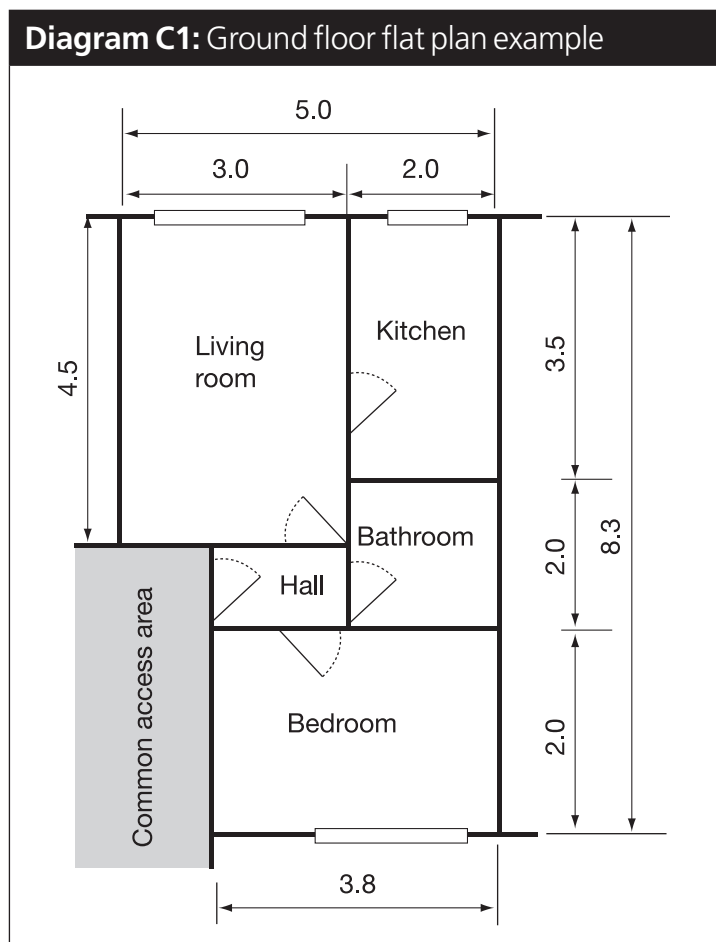
The flat contains the following rooms:

- kitchen;
- combined living/dining room;
- one double bedroom;
- internal **bathroom** containing WC; and in addition
- all rooms have an external wall except for the **bathroom**.

The floor plan is given in Diagram C1.

Assumptions:

- cooker hood adjacent to cooker hob;
- **gross internal volume** of the heated space of 83 m³;
- total floor area of 36 m²;
- two person occupancy; and
- side-hinged windows 1.0 m high and openable to 60°.



Example C1: Background ventilators and intermittent extract fans (this is based on Table 5.2a)

Intermittent extract	
Room	Intermittent extract rate
Kitchen	30 l/s (adjacent to hob)
Bathroom	15 l/s

Background ventilators

- For a single-storey ground-floor dwelling of 36 m² floor area, Table 5.2a shows that the equivalent **background ventilator** area is 35000 mm² (this includes the additional 10000 mm² as we are considering a single-storey building).

- To maximise the airflow through the dwelling by encouraging cross ventilation, it is best to locate similar **equivalent areas of background ventilators** on opposite sides of the dwelling.

Purge ventilation

- Calculate the percentage window opening area (percentage of floor area) for each room having an external wall.
- Using Appendix B with an opening angle of 60° gives: 1/20 of the floor area.
- Therefore, for a living room of 13.5 m² floor area there should be a window opening area of at least 0.68 m². This calculation should be carried out for all **habitable rooms**.

Example C2: Passive stack ventilation (this is based on Table 5.2b)

Choose appropriate passive stack ventilation provision		
Room	Internal duct diameter (mm)	Internal cross-sectional area (mm ²)
Kitchen	125	12000
Bathroom	125	12000

Background ventilators

Calculate the total **equivalent area** of ventilators required for a dwelling as follows:

Step 1: for a single-storey ground-floor dwelling of 36 m² floor area, Table 5.2b shows that the equivalent **background ventilator** area is 35000 mm² (this includes the additional 10000 mm² as we are considering a single-storey building).

Step 2: for a **PSV** in both the kitchen and **bathroom**, an allowance of 5000 mm² can be made.

Step 3: 35000 – 5000 = 30000 mm².

- In addition, the **equivalent area** must be at least the total cross-sectional area of the ducts (24000 mm²), which it is. It should be distributed with similar areas on opposite sides of the dwelling (but not in the kitchen and **bathroom**).

Purge ventilation

- Calculate the percentage window opening area (percentage of floor area) for each room having an external wall.
- Using Appendix B with an opening angle of 60° gives: 1/20 of the floor area.
- Therefore, for a living room of 13.5 m² floor area there should be a window opening area of at least 0.68 m². This calculation should be carried out for all **habitable rooms**.

Example C3: Continuous mechanical extract (this is based on Table 5.2c)

Continuous extract

Step 1: **Whole building ventilation** rate is 13 l/s from Table 5.1b.

Step 2: Whole dwelling extract rate is 21 l/s (from Table 5.1a assuming extract in kitchen and **bathroom**).

Step 3: Maximum rate (e.g. boost) is at least 21 l/s (with a minimum of 13 l/s in the kitchen and 8 l/s in the **bathroom**).

- The minimum rate is at least 13 l/s (spread between the kitchen and **bathroom**).

Background ventilators

As the **air permeability** is $\leq 5 \text{ m}^3/(\text{h} \cdot \text{m}^2)$ **background ventilators** of at least 2500 mm² **equivalent area** should be located in the living room and bedroom.

Purge ventilation

- Calculate the percentage window opening area (percentage of floor area) for each room having an external wall.
- Using Appendix B with an opening angle of 60° gives: 1/20 of the floor area.
- Therefore, for a living room of 13.5 m² floor area there should be a window opening area of at least 0.68 m². This calculation should be carried out for all **habitable rooms**.

Example C4: Continuous mechanical supply and extract with heat recovery (this is based on Table 5.2d)

Continuous supply and extract

Step 1: Calculate the **whole building ventilation** supply rate:

- from Table 5.1b the air supply rate = 13 l/s;

Step 2: Calculate the whole dwelling air extract rate at maximum operation:

- whole dwelling extract rate for the dwelling is 21 l/s (from Table 5.1a assuming extract in kitchen and **bathroom**).

Step 3: Maximum rate (e.g. boost) is at least 21 l/s (with 13 l/s extract in the kitchen and 8 l/s extract in the **bathroom**).

- The minimum rate is at least 13 l/s.

Purge ventilation

- Calculate the percentage window opening area (percentage of floor area) for each room having an external wall.
- Using Appendix B with an opening angle of 60° gives: 1/20 of the floor area.
- Therefore, for a living room of 13.5 m² floor area there should be a window opening area of at least 0.68 m². This calculation should be carried out for all **habitable rooms**.

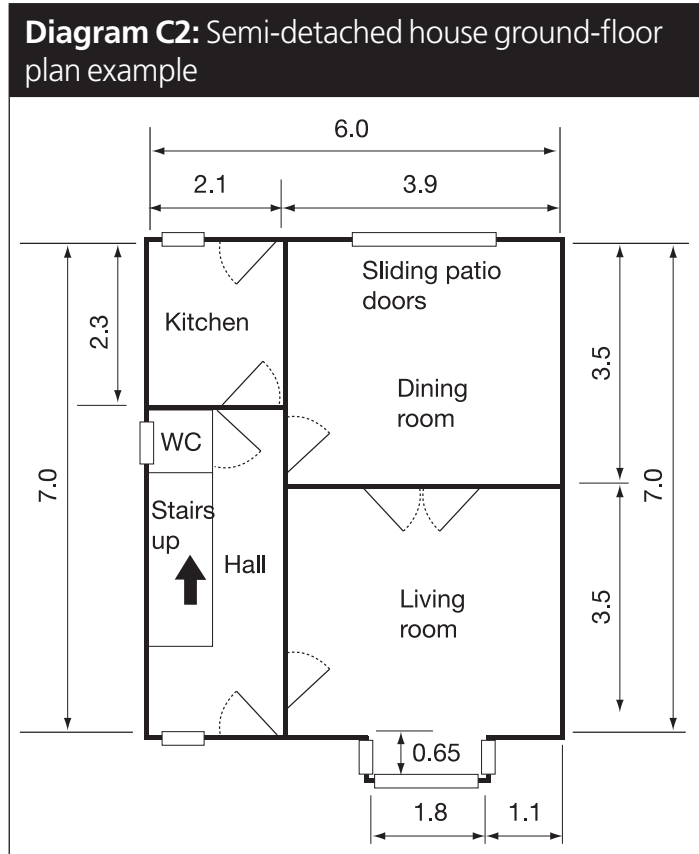
Details of semi-detached house

Description

The semi-detached house contains the following rooms:

- entrance hall/stairway;
- kitchen;
- dining room;
- living room;
- three bedrooms;
- **bathroom** containing WC; and in addition
- all rooms have an external wall.

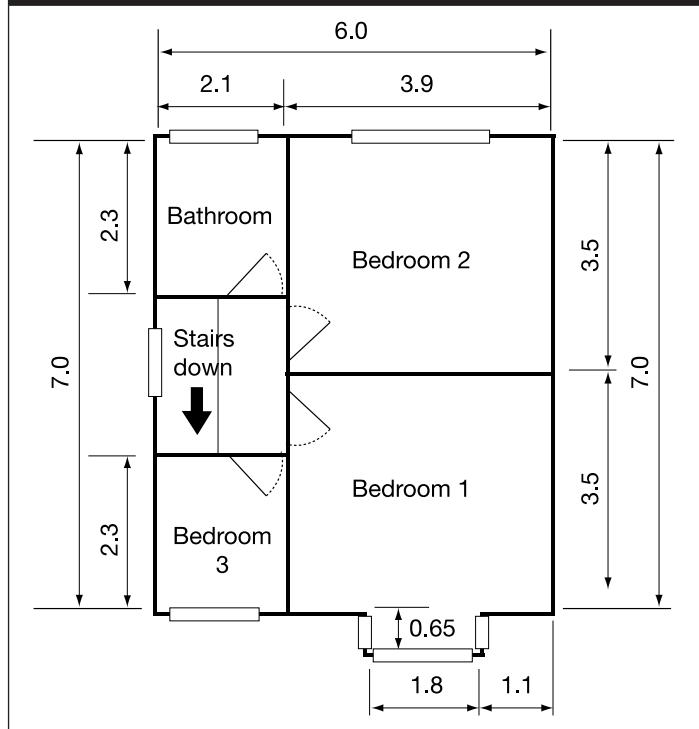
The floor plans are given in Diagrams C2 and C3.



Assumptions:

- cooker hood adjacent to cooker hob;
- **gross internal volume** of the heated space of 210 m³;
- total floor area of 84 m²;
- four person occupancy;
- side-hinged windows 1.0 m high and openable to a fixed position of 20°.

Diagram C3: Semi-detached house first-floor plan



Example C5: Background ventilators and intermittent extract fans (this is based on Table 5.2a)

Intermittent extract	
Room	Intermittent extract rate
Kitchen	30 l/s (adjacent to hob)
Bathroom	15 l/s

Background ventilators

- For a two-storey semi-detached house of 84 m² floor area, Table 5.2a shows that the equivalent **background ventilator** area is 40000 mm².
- To maximise the airflow through the dwelling by encouraging cross ventilation, it is best to locate similar **equivalent areas** of **background ventilators** on opposite sides of the dwelling.

Purge ventilation

- Calculate the percentage window opening area (percentage of floor area) for each room having an external wall.
- Using Appendix B with an opening angle of 20° gives: 1/10 of the floor area.
- Therefore, for a living room of 14.8 m² floor area there should be a window opening area of at least 1.48 m². This calculation should be carried out for all **habitable rooms**.

Example C6: Passive stack ventilation (this is based on Table 5.2b)

Choose appropriate passive stack ventilation provision		
Room	Internal duct diameter (mm)	Internal cross-sectional area (mm²)
Kitchen	125	12000
Bathroom	125	12000

Background ventilators

Calculate the total **equivalent area** of ventilators required for a dwelling as follows:

Step 1: for a two-storey semi-detached house of 84 m² floor area, Table 5.2a shows that the equivalent **background ventilator** area is 40000 mm².

Step 2: for a **PSV** in both the kitchen and **bathroom**, an allowance of 5000 mm² can be made.

Step 3: 40000 – 5000 = 35000 mm².

- In addition, the **equivalent area** must be at least the total cross-sectional area of the ducts (24000 mm²), which it is. It should be distributed with similar areas on opposite sides of the dwelling (but not in the kitchen and **bathroom**).

Purge ventilation

- Calculate the percentage window opening area (percentage of floor area) for each room having an external wall.
- Using Appendix B with an opening angle of 20° gives: 1/10 of the floor area.
- Therefore, for a living room of 14.8 m² floor area there should be a window opening area of at least 1.48 m². This calculation should be carried out for all **habitable rooms**.

Example C7: Continuous mechanical extract (this is based on Table 5.2c)

Continuous extract

Step 1: **Whole building ventilation** rate from the list in Table 5.1b is 21 l/s.

- However, minimum air supply rate = 0.3 x floor area = 0.3 x 84 = 25 l/s.
- Hence, whole house air supply rate is 25 l/s.

Step 2: Whole dwelling extract rate is 21 l/s (from Table 5.1a assuming extract in kitchen and **bathroom**).

Step 3: In this case the required whole house supply rate is greater than the whole house extract rate, and only a minimum extract rate of 25 l/s is required (with at least 13 l/s in the kitchen and 8 l/s in the **bathroom**).

Background ventilators

- As the **air permeability** is $\leq 5 \text{ m}^3/(\text{h} \cdot \text{m}^2)$ **background ventilators** of at least 2500 mm² **equivalent area** should be located in the living room, dining room and each bedroom.

Purge ventilation

- Calculate the percentage window opening area (percentage of floor area) for each room having an external wall.
- Using Appendix B with an opening angle of 15° gives: 1/10 of the floor area.
- Therefore, for a living room of 14.8 m² floor area there should be a window opening area of at least 1.48 m². This calculation should be carried out for all **habitable rooms**.

Example C8: Continuous mechanical supply and extract with heat recovery (this is based on Table 5.2d)**Continuous supply and extract**

Step 1: Calculate the whole dwelling air supply rate:

- **Whole building ventilation** rate for the dwelling from the list in Table 5.1b is 21 l/s.
- However, minimum air supply rate = 0.3 x floor area = 0.3 x 84 = 25 l/s.
- Hence, whole dwelling air supply rate is 25 l/s.

Step 2: Calculate the whole dwelling air extract rate at maximum operation:

- Whole dwelling extract rate is 21 l/s (from Table 5.1a assuming extract in kitchen and **bathroom**).

Step 3: Maximum rate (e.g. boost) is at least 25 l/s (with 13 l/s extract in the kitchen and 8 l/s extract in the **bathroom**).

- The minimum rate is at least 25 l/s.

Purge ventilation

- Calculate the percentage window opening area (percentage of floor area) for each room having an external wall.
- Using Appendix B with an opening angle of 20° gives: 1/10 of the floor area.
- Therefore, for a living room of 14.8 m² floor area there should be a window opening area of at least 1.48 m². This calculation should be carried out for all **habitable rooms**.

Appendix D: Minimising ingress of external pollution into buildings in urban areas

Typical urban pollutants that need to be considered include those covered by the UK Air Quality Strategy (www.defra.gov.uk/environment/airquality/strategy/index.htm (2007)). These are:

- carbon monoxide, CO;
- nitrogen dioxide, NO₂;
- sulphur dioxide, SO₂;
- ozone, O₃;
- particles (PM₁₀);
- benzene;
- 1,3-butadiene;
- polycyclic aromatic hydrocarbons (PAHs);
- ammonia;
- lead.

Although nitrogen oxide, NO, is not included in the UK Air Quality Strategy, it is a normal constituent of combustion discharges and in many cases (for example, from gas-fired plant) the largest polluting emitter; therefore, it also needs to be taken into account.

Typical pollution emission sources that need to be considered include:

- road traffic, including traffic junctions and underground car parks;
- combustion plant (such as heating appliances) running on conventional fuels, most commonly natural gas;
- other combustion processes (for example, waste incineration, thermal oxidation abatement systems);
- discharges from industrial processes;
- fugitive (i.e. adventitious/ not effectively controlled) discharges from industrial processes and other sources;
- building ventilation system exhaust discharges;
- construction and demolition sites which are source of particles and vapourous discharges.

In urban areas, buildings are exposed simultaneously to a large number of individual pollution sources from varying upwind distances (long range, intermediate range and short range) and heights and also over different timescales. The relationship between these and their proportionate contribution under different circumstances governs pollutant concentrations over the building shell and also internally.

Internal contamination of buildings from outdoor pollution sources therefore depends upon the pollutant sources, the physical characteristics of the building and its relation to its surroundings, the ventilation strategy employed and the location of the air intake. Whatever type of ventilation system is used, it is important to ensure that the intake air is not contaminated. This is especially important in air quality management areas where, by definition, pollution levels of at least one pollutant are already close to the air quality standards. Simplified guidance on ventilation intake placement for minimising ingress of pollutants may be summarised, as in Table D1.

Table D1: Guidance on ventilation intake placement fore minimising ingress of pollutants	
Pollutant source	Recommendation
<p>Local static sources</p> <ul style="list-style-type: none"> • Parking areas • Welding areas • Loading bays • Adjacent building exhausts • Stack discharges 	<ul style="list-style-type: none"> • Ventilation intakes need to be placed away from the direct impact of short-range pollution sources especially if the sources are within a few metres of the building. Some guidance is given in CIBSE TM21
<p>Urban traffic</p>	<ul style="list-style-type: none"> • Air intakes for buildings positioned directly adjacent to urban roads should be as high as possible and away from the direct influence of the source so as to minimise the ingress of traffic pollutants. There will be exceptions to this simple guide and these risks may need to be assessed by modelling. In such cases, it is recommended that expert advice is sought • For buildings located one or two streets away, the placement of intakes is less critical

Table D1: Guidance on ventilation intake placement for minimising ingress of pollutants (*continued*)

Pollutant source	Recommendation
Building Features/Layout: <ul style="list-style-type: none"> • Courtyards • Street Canyons (i.e. a canyon formed in a street between two rows of tall buildings) 	<ul style="list-style-type: none"> • Intakes should not be located in these spaces where there are air pollutant discharges. This includes emission discharges from building ventilation system exhausts • If air intakes are to be located in these spaces, they should be positioned as far as possible from the source in an open or well-ventilated area. In addition, steps should be taken to reduce the polluted source, e.g. parking and loading should be avoided as pollutants can accumulate in enclosed regions such as courtyards
Multiple sources	<ul style="list-style-type: none"> • Where there are a large number of local sources, the combined effect of these around the façade of the building should be assessed. The façade experiencing the lowest concentration of the pollutants would be an obvious choice for locating ventilation intakes but this will require expert assistance such as numerical and wind tunnel modelling. In general, however, it is recommended that the air intakes be positioned as far from the source at a location where air is free to move around the intake
Weather factors	<ul style="list-style-type: none"> • In areas where predominant wind comes from opposing directions (e.g. a valley location) the air intakes and outlets should point in opposite directions • In complex urban layouts, complex wind flows are likely to occur. In these cases, expert advice should be sought

Control of ventilation intakes

For pollutant sources such as urban road traffic, whose concentration fluctuates with the time of day, reducing the flow of external air or closing ventilation intakes during peak periods of high external pollutant concentrations, for example during rush hours, for up to an hour may be an option.

Air intakes located on a less polluted side of the building may then be used for fresh air, or air may be fully re-circulated within the building. Alternatively, the building may be used as a “fresh air” reservoir to supply air during these short periods. The use of atria as a source of “fresh air” for this purpose may be an option.

However, care must be taken since, for example, reducing the inflow of external air will also reduce the outflow of internal air, resulting in a build-up of internally generated pollutants that need to be removed. Most modern buildings have low ceiling heights and therefore the concept of a substantial “fresh air” reservoir available within the building may not apply. Further details of this principle with examples may be found in Liddament (2000).

Location of exhaust outlets

The location of exhausts is as important as the location of air intakes. These should be located such that re-entry to a building, or ingestion into other nearby buildings, is minimised (for both natural and mechanical intakes) and such that there is no adverse effect to the surrounding area. Guidance on outlet placement may be summarised as follows.

- exhausts should be located downstream of intakes where there is a prevailing wind direction;
- exhausts should not discharge into courtyards, enclosures or architectural screens as pollutants tend to build up in such spaces and do not disperse very readily;
- it is recommended that stacks should discharge vertically upwards and at high level to clear surrounding buildings and so that downwash does not occur;
- where possible, pollutants from stacks should be grouped together and discharged vertically upwards. The increased volume will provide greater momentum and increased plume height. This is common practice where there are a number of fume cupboard discharges; greater plume height dispersion can be achieved by adding the general ventilation exhaust.

References

CIBSE (1999). CIBSE Technical Memorandum TM21. *Minimising pollution at air intakes*. ISBN 0-90-095391.

Liddament MW (2000) Chapter 13: *Ventilation strategies*. Indoor Air Quality Handbook. McGraw-Hill.

Appendix E: Specifying and assessing noise from continuously running domestic mechanical ventilation systems

Introduction

1. The purpose of a ventilation system is to maintain good indoor air quality which is necessary to protect the health of the building occupants. The system should not produce excessive noise that could discourage the occupants from using it.
2. Noise can be radiated from the ducts supplying or extracting air to or from rooms and from the casing of the ducts and fan units. The grill (or terminal) on the end of a duct may also contribute to the noise. The BS EN 13141 series of Standards include test methods for measuring the noise from each type of system. These tests measure the sound power level (L_w) of the device. This is a measure of the total noise energy radiated by the device in all directions and it is a property of the device itself and is essentially independent of the measuring environment. This makes type testing possible.
3. Manufacturers should have their continuously running domestic ventilation systems tested, and should declare the results as specified in Table E1 this Appendix. Dwelling designers should specify products that meet the performance standards given in this Appendix.

Guidance for specifying a continuously running ventilation system

4. Dwelling designers should specify ventilation systems that meet the performance standards given in Table E1 of this Approved Document under the given conditions. The standards should be met at each outlet and inlet.

Guidance on testing for manufacturers

5. A typical example of a continuously running domestic ventilation system should be tested. Tests should be carried out by a laboratory with UKAS accreditation for such tests, or in-house according to an industry agreed protocol.
6. Tests of sound power levels should be carried out in accordance with the appropriate part of BS EN 13141:

BS EN 13141-2: 2004 Ventilation in Buildings. Performance testing of components/products for residential ventilation. *Exhaust and supply terminal units.*

BS EN 13141-4: 2004 Ventilation in Buildings. Performance testing of components/products for residential ventilation. *Fans used in residential ventilation systems.*

BS EN 13141-6: 2004 Ventilation in Buildings. Performance testing of components/products for residential ventilation. *Exhaust ventilation system packages used in a single dwelling.*

BS EN 13141-7: 2004 Ventilation in Buildings. Performance testing of components/products for residential ventilation. *Performance testing of a mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for single family dwellings.*

BS EN 13141-8: 2006 Ventilation in Buildings. Performance testing of components/products for residential ventilation. *Performance testing of unducted mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for a single room.*
7. The preferred method of testing is by measurement in a reverberant room according to the recommendations of BS EN ISO 5135 and BS EN ISO 3741.
8. Measurements of fan noise and radiation from the casing should include the sound power level L_w and the A-weighted sound power level L_{wA} .
9. The A-weighted level should be measured, or calculated over the frequency range 100 Hz to 10000 Hz.
10. For units with multiple inlets/outlets one test should be made for each type of inlet/outlet.
11. Where air terminal devices are an integral part of the unit, tests should be made with the air terminal devices in place. Where they are not, each type of terminal device should be tested separately at the ventilation rates given below. In either case, any air volume control devices should be set to give the highest noise level while achieving the required air flow.

- 12. Where necessary sound attenuators can be incorporated in the system to be tested and these should be treated as an essential part of the system.
- 13. The performance standards should be achieved with the unit providing the following extract ventilation rates:
 - Kitchens 13 l/s
 - Wet rooms 8 l/s
- 14. For mechanical supply and exhaust ventilation units (including heat recovery) the total supply ventilation rate should be equal to the total extract ventilation rate. If the system is not configured to self regulate air flow rates by the manufacturer, the total supply and exhaust air volume flow rates should be balanced to within 3%.

Performance standards

- 15. To meet the requirements of this Approved Document, the ventilation system should achieve all the relevant performance standards set out in Table E1 under the conditions given in the text.

Table E1: Performance standards		
Room type	Maximum A-weighted level L_{wA} dB	Maximum 125 Hz Octave band level L_w dB
Kitchens and other wet rooms	Outlet/inlet level 38 ¹	Outlet/inlet level 48 ¹
Bedrooms and living rooms	Outlet/inlet level 30 ¹	Outlet/inlet level 40 ¹
Air terminal devices if tested separately ²	20	30
Casing level if not to be exposed in room ³	40	45
Casing level if to be exposed in room	25	35
For all tests, no prominent acoustic tones should be present.	The sound power level in any 1/3 octave band should not exceed the sound power levels in the two bands adjacent to it by more than 5 dB over the frequency range 100 Hz to 10 kHz.	
¹ If there is an inlet and an outlet serving the same room these values should be reduced by 3 dB. ² Any air volume control devices should be set to give the highest noise level while achieving the required volume flow. ³ The unit is assumed to be above the ceiling or in a cupboard well sealed to the room.		

Volume 3, Chapter 2

**Proposed Domestic Ventilation
Installation and Commissioning
Compliance Guide**

2010 Edition

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Residential Ventilation Association

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Section 1: Introduction

This guide provides detailed guidance for persons installing fixed ventilation systems in new and existing dwellings to help them comply with installation and commissioning requirements in Part F, *Ventilation*, and Part L, *Conservation of fuel and power*, of the Building Regulations for England and Wales.

The guide includes an installation and commissioning checklist that should be completed as part of the installation handover and signed and approved by a person “qualified” to do so. “Qualified” in this context means having the appropriate qualifications, knowledge and experience to carry out the inspection and commissioning procedures. The checklist does not need to be completed for replacement installations covered under Section 2 of this guide.

The consultation questionnaire asks consultees for their views on what might be appropriate qualifications, knowledge and experience, and to identify associations whose members would be considered to be “qualified”.

This guide is referenced in Approved Document F (ADF), Approved Document L1A (ADL1A) and Approved Document L1B (ADL1B). It covers ventilation systems as defined by Approved Document F.

It is important to note that the guide covers a range of frequently occurring situations but that alternative means of achieving compliance with the functional requirements in the Building Regulations may be possible.

1.1 Status of guide

Building regulations contain functional requirements, such as requirements that buildings must be structurally stable, must be constructed and fitted out to ensure reasonable levels of fire protection, and must be reasonably energy efficient. These functional requirements are often drafted in broad terms, and so it may not always be immediately clear to a person carrying out building work how to comply with the relevant requirements. Consequently, documents are often issued which provide practical guidance on ways of complying with specific aspects of building regulations in some of the more common building situations. In England and Wales, these documents are called Approved Documents.

Approved Documents are intended to provide practical guidance but they are not intended to be comprehensive. Consequently there may be references in Approved Documents to other documents which will provide more detailed information and assistance on parts of the guidance. This guide is one of those documents. It provides more detailed information on the guidance about compliance with the installation and commissioning requirements in Approved Documents F, L1A and L1B which apply when installing fixed ventilation systems in new and existing dwellings.

Please note: following the guidance in an Approved Document does not guarantee compliance with building regulations. If you follow the guidance in an Approved Document and in any document referred to which provides additional information to help you follow that guidance (such as this guide), there is a legal presumption that you have complied with building regulations. However, in every case it is for the building control body, whether a private sector approved inspector or the local authority, to decide whether work complies with building regulations. So, you should always check with the building control body before you start work what they consider it is necessary for you to do to comply with building regulations.

1.2 How to use this guide

Section 2 and **Section 3** of the guide provide guidance on installation and commissioning of natural ventilation systems and continuous mechanical ventilation systems respectively. The purpose of the guide is to ensure that installations satisfactorily meet the design standards specified in ADF, ADL1A and ADL1B. This is to ensure adequate ventilation whilst minimising energy use and environmental problems such as noise and thermal discomfort.

The commissioning procedures define the method by which a system is checked and assessed before handover to the end user. Commissioning of natural ventilation openings is based on visual checks. For mechanical ventilation (both intermittent and continuous), air flow measurements are included as part of the commissioning process.

Supplementary information that may help with interpreting the minimum installation and commissioning provisions needed to comply with the Building Regulations is in *italic font with a yellow background*. In some cases there are links to best practice guidance that goes beyond the minimum requirements. *Text added to assist with the consultation process is shown in plum italics.*

BS EN 14134: 2004: *Ventilation for buildings – Performance testing and installation checks of residential ventilation systems* may be referred to for further guidance on installation and commissioning procedures.

The guide refers to Systems 1 to 4 as specified in Approved Document F. For the purpose of this guide, “natural ventilation systems” include those that employ intermittently used mechanical extract fans installed in wet rooms.

Section 4 details the information that should be left with the building owner on completion of the installation of the system. This information is to aid the user to correctly operate and maintain the system.

Section 5 contains an installation and commissioning checklist that should be completed for all systems. It requires specific visual and performance checks on the installation, and includes a section for commissioning and recording the airflow measurements for intermittent and continuous mechanical ventilation.

1.3 Key terms

Background Ventilator	A small ventilation opening designed to provide controllable whole building ventilation.
Continuous Mechanical Extract (MEV)	A ventilation system that comprises a central ducted continuously running extract fan (or a set of local continuously running extract fans in the wet rooms for de-centralised systems) with air being supplied via background ventilators into the habitable rooms.
Continuous Mechanical Balanced System with Heat Recovery (MVHR)	A ventilation system that comprises central ducted supply and extract fans with air being supplied into the habitable rooms via a heat recovery unit.
Equivalent Area	A measure of the aerodynamic performance of a ventilator. It is the area of a sharp-edged orifice which air would pass through at the same volume flow rate, under an identical applied pressure difference, as the opening under consideration.
Free Area	The geometric open area of a ventilator or terminal.
Intermittent Extract Fan	A mechanical ventilator that does not run all the time, usually only running when there is a particular need to remove pollutants or water vapour (e.g. during cooking or bathing). Intermittent operation may be under either manual control or automatic control.
Passive Stack Ventilation (PSV)	A ventilation device using ducts from terminals in the ceiling of rooms to terminals on the roof that extract air to outside by a combination of the natural stack effect and the pressure effects of wind passing over the roof of the building.
Single Room Heat Recovery Ventilators (SRHRV)	Comprise local continuously running balanced supply and extract fans in a single room.

For other terms used throughout this guide, reference should be made to the glossary section in Approved Document F.

Section 2: Natural ventilation systems

2.1 System 1 – Background ventilators and intermittent extract fans

The information provided in Tables 1 and 2 gives guidance on the installation and commissioning of systems comprising background ventilators and intermittent extract fans for dwellings. The relevant design guidance is given in ADF, in particular, Table 5.2a.

2.2 System 2 – Passive stack ventilation

The information provided in Tables 3 and 4 gives guidance on the installation and commissioning of passive stack systems for dwellings. The relevant design guidance is given in ADF, in particular, Table 5.2b.

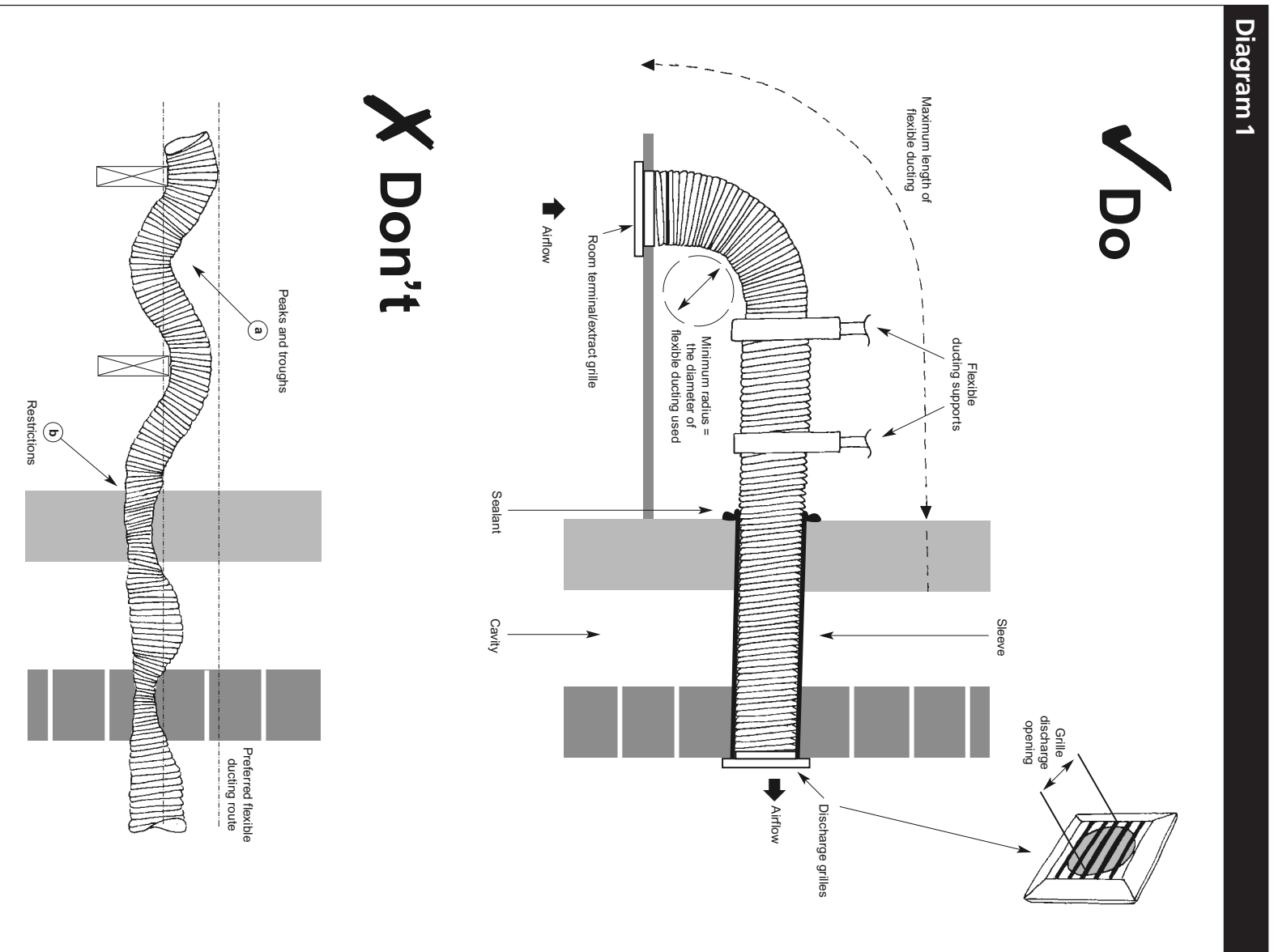
Table 1: System 1 installation requirements		
	Installation clauses	Supplementary information
1.0 Intermittent extract fans (including cooker hoods)	<p>Manufacturer’s details and specific instructions</p> <ul style="list-style-type: none"> a. The information provided in this Table sets out the minimum recommended procedures for typical System 1 installations. b. For further product-specific information, refer to the manufacturer’s installation instructions. 	
	<p>Preparation</p> <ul style="list-style-type: none"> a. Ensure final location of equipment offers sufficient space to allow access for maintenance. b. For through-wall units, core a hole of a suitable dimension through the fabric of the building for the installation of the duct. The hole should have a slight downward angle towards the outside to prevent water ingress. c. For ceiling mounted fans/terminals, the holes should be cut to the minimum required size such that the fan/grille spigot fits snug into the hole. d. Where ductwork penetrates building’s air barrier, the continuity of barrier must be maintained. The nature of the barrier and ease of achieving an effective seal should be considered before holes are drilled. e. It is important to consider the planning and installation of ductwork in co-ordination with other trade activities and installations, such that routes are designed without compromise to the required ventilation air flow rates. 	
	<p>Installation – through wall</p> <ul style="list-style-type: none"> a. The duct sleeve connecting the fan outlet to the terminal/grille should be at least the same diameter as the fan outlet. b. The duct sleeve should be rigid. In situations where this is not possible, flexible ductwork may be used providing extract ventilation rates are not compromised. Flexible ductwork should be pulled taut. c. The installed duct sleeve should be sealed to the external and internal wall to maintain air tightness. This is of particular importance for cavity walls. d. Ensure that there are no obstructions in the duct prior to fitting the fan. 	

Table 1: System 1 installation requirements (*continued*)

	Installation clauses	Supplementary information
1.0 Intermittent extract fans (including cooker hoods) (continued)	<p>Installation – through window</p> <p>a. Check suitability of window and obtain suitable window mounting kit from manufacturer for proposed fan unit.</p>	<p><i>For window mounted fans: do not plan to install in opening lights.</i></p> <p><i>4 mm minimum advisable glass thickness, but seek specialist advice from glazier for mounting suitability.</i></p>
	<p>Installation – ducted</p> <p>a. Rigid ducts, rectangular or circular, should be used wherever possible. Where necessary, flexible ducts may be used, but their lengths should be kept to a minimum, connecting to rigid ductwork at the earliest opportunity.</p> <p>b. For flexible duct connected to axial fans the length is limited to 1.5 metres; for centrifugal fans the length limit is 6 metres (for extract rates 6 to 30 l/s), and 3 metres (for extract rates 31 to 60 l/s).</p> <p>c. The number of bends is limited to two for up to 30 l/s, and reduces to one bend for higher extract rates.</p> <p>d. Flexible duct should be pulled taught to ensure that the full internal diameter is obtained and flow resistance minimised. This is considered to have been achieved if the duct is extended to 90% of its maximum length.</p> <p>e. Ducting should be insulated where it passes through unheated areas and voids (e.g. loft spaces) with the equivalent of at least 25 mm of a material having a thermal conductivity of ≤ 0.04 W/m.K to reduce the possibility of condensation forming.</p> <p>f. Horizontal ducting, including ducting in walls, should be arranged to slope slightly downwards away from the fan to prevent backflow of any moisture into the product.</p> <p>g. Vertical ducting will require a condensate trap in order to prevent backflow of any moisture into the product. Follow manufacturer's recommendations in these instances.</p> <p>h. Where ducting passes through a fire-stopping wall or fire compartment, the required measures to ensure compliance with Part B of the Building Regulations should be taken.</p>	<p><i>Exceptions to duct limits will be accepted providing evidence from the manufacturer is available that confirms that the specified performance will not be affected.</i></p> <p><i>For in-line fans, refer to manufacturer's data.</i></p> <p><i>For duct installations, see Diagram 1.</i></p> <p><i>Where possible, connect straight lengths of ductwork to fan spigot.</i></p>
	<p>Cooker hoods</p> <p>a. Cooker hoods should be installed so that access is easy for changing and cleaning of the filter/filters.</p>	<p><i>It should be noted that re-circulating cooker hoods do not provide extract ventilation and therefore do not provide extract ventilation in a kitchen for the purposes of Part F. In these situations, an extract fan to outside should be provided with an installed capacity of at least 60 l/s.</i></p>

Table 1: System 1 installation requirements (continued)		
	Installation clauses	Supplementary information
2.0 Ventilation air inlets and discharge terminals/ grilles	<p>Background ventilators</p> <ul style="list-style-type: none"> a. Background ventilators should be provided to meet the minimum required equivalent area of ventilation specified by Table 5.2a of ADF. b. For wall mounted background ventilators make an opening in wall in accordance with manufacturer's instructions for the size required. Ensure that there are no obstructions in the opening. c. Install the wall or window ventilator product in accordance with manufacturer's instructions. d. Ensure that wall or window ventilator products are sealed to their surrounds using a proprietary sealant as recommended by the manufacturer. 	<p><i>Background ventilators fitted in windows are usually installed during manufacture. Close co-ordination between supplier and installer is recommended to ensure correct location of ventilators.</i></p> <p><i>Background ventilators installed in walls may require a proprietary wind cowl to reduce wind noise and prevent over ventilation.</i></p>
	<p>Discharge terminals/grilles – roof and wall mounted</p> <ul style="list-style-type: none"> a. Only proprietary terminals should be used. b. Ensure that the free area of the terminal/grille opening is a minimum of 90% of the free area of the ducting being used. 	
3.0 Miscellaneous	<p>Air transfer</p> <ul style="list-style-type: none"> a. To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600 mm² in all internal doors above the floor finish. This is equivalent to an undercut of 10 mm for a standard 760 mm width door. b. Ensure that the air transfer provision is unrestricted after floor finishes have been laid (e.g. carpets should not encroach). This should be achieved by making an undercut of 10 mm above the floor finish if the floor finish is fitted, or by a 20 mm undercut above the floorboards, or other surface, if the finish has not been fitted. 	
4.0 Controls	<p>General</p> <ul style="list-style-type: none"> a. Refer to Table 5.2a of ADF. b. Ensure that a local manual override control is provided for any extract fan operated by automatic controls. 	<p><i>Humidity controls should not be used for sanitary accommodation where odour is the main pollutant.</i></p>

Diagram 1



The inner radius of any bend should be greater or equal to the diameter of the ducting being used. If the radius is reduced, the resistance of the bend will increase and the volume of air being extracted will decrease (see “Do” Diagram).

Ensure flexible ducting is installed without peaks or troughs (see “Don’t” Diagram).

Table 2: System 1 commissioning		
	Minimum commissioning requirements	Supplementary information
1.0 Intermittent extract fans (including cooker hoods)	<p>Visual inspections</p> <p>The following points should be observed and recorded in Section 5:</p> <ol style="list-style-type: none"> System installation complies with the installation clauses given in Table 1. Number of extract points and terminals satisfy Table 5.2a in ADF. All equipment is in good condition with no obvious defects that will be hazardous or affect the system performance. 	
	<p>Functional checks</p> <ol style="list-style-type: none"> Temporary protection and packaging should be removed from all products. Check fan operates correctly when activated by manual control (e.g. light switch), or automatic control (e.g. PIR). Ensure fan switches off after controls are de-activated and, in the case of run-on timers, that these are set to a minimum of 15 minutes. 	<i>Unless timer control is graduated in minutes, run-on timers should be checked against a timed test and adjusted if run time is less than 15 minutes.</i>
	<p>Airflow measurements</p> <ol style="list-style-type: none"> Ensure that all intended background ventilators or other air transfer devices are open. Ensure all internal and external doors and windows are closed, including room in which measurement is being carried out. Airflow measurements should be performed using a calibrated airflow device with proprietary hood attachment and results recorded in litres per second (l/s). Reference should be made to Table 5.1a of ADF for design airflow rates. Record the extract airflow for each extract fan onto commissioning sheet (see Section 5). The instrument should be calibrated annually and be capable of achieving an accuracy of $\pm 5\%$. 	<i>The most common method is the use of a vane anemometer, or similar, placed in a hood which covers the terminal to measure the extract airflow rate. Calibration of measurement equipment should be undertaken annually by returning the instrument to a UKAS accredited calibration centre.</i>
2.0 Background ventilators	<p>Visual inspections</p> <p>The following points should be observed and recorded in Section 5:</p> <ol style="list-style-type: none"> Correct equivalent area and location of air inlets satisfy Table 5.2a in ADF. Remove any temporary protection and packaging from all background ventilators, and check functionality (i.e. do shutters open/close correctly). Ensure that an adequate seal has been provided between ventilator product and wall/window frame. 	<i>The equivalent area should be displayed on the air inlet product.</i>

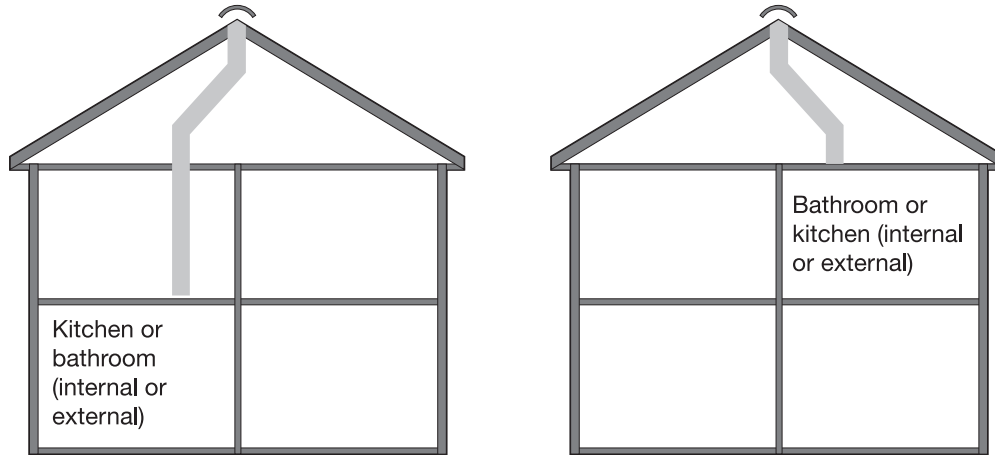
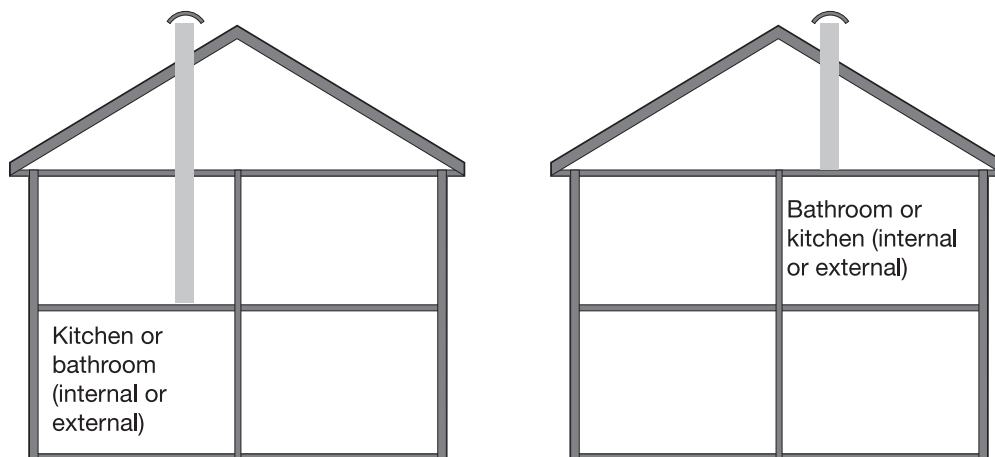
Table 3: System 2 installation requirements		
	Installation clauses	Supplementary information
1.0 Ductwork preparation and installation	<p>Manufacturer’s details and specific instructions</p> <ul style="list-style-type: none"> a. The information provided in this Table sets out the minimum recommended procedures for typical System 2 installations. b. For further product-specific information, refer to the manufacturer’s installation instructions. c. Internal duct diameters and/or cross sectional areas should be no less than the sizes given in ADF, Table 5.2b. 	
	<p>Preparation</p> <ul style="list-style-type: none"> a. Ducting routes and offsets should be planned such that their final installation is in accordance with the illustrated guidance given in Diagrams 2 and 3. b. Separate ducts should be taken from the ceilings of the kitchen, bathroom, utility room or WC to separate terminals on the roof. Do not use common outlet terminals or branched ducts. c. Where ductwork penetrates building’s air barrier, the continuity of barrier must be maintained. The nature of the barrier and ease of achieving an effective seal should be considered before holes are drilled. d. It is important to consider the planning and installation of ductwork in co-ordination with other trade activities and installations, such that routes are designed without compromise to the required ventilation air flow rates. 	<p><i>Ideally, all ducts should be installed as near vertical as site constraints allow.</i></p> <p><i>Both rigid ducting and flexible ducting are suitable for PSV systems and have similar resistance to airflow at typical PSV system airflow rates.</i></p>

Table 3: System 2 installation requirements (continued)		
	Installation clauses	Supplementary information
1.0 Ductwork preparation and installation (continued)	<p>Installation</p> <ul style="list-style-type: none"> a. Carefully measure the length of duct to be used such that it is just sufficient to fit between the ceiling terminal and the outlet terminal. Flexible ducting should be fully extended but not taut, allowing approximately 300 mm extra to make smooth bends in an offset system. b. Ducting should be properly supported along its length to ensure that the duct can run straight without distortion or sagging and that there are no kinks at any bends or the connections to ceiling terminals and outlet terminals. Flexible ducting generally requires more support than rigid ducting. c. In the roof space the duct should be secured to a wooden strut that is securely fixed at both ends. A flexible duct should be allowed to curve gently at each end of the strut to attach to the ceiling terminal and roof outlet terminal. d. A rigid duct should be used for system stability for the part of a PSV system which is outside, above the roof slope. It should project down into the roof space far enough to allow firm support. e. Ensure that the duct is securely fixed to the roof outlet terminal so that it cannot sag or become detached. f. Ducting should be insulated where it passes through unheated areas and voids (e.g. loft spaces) with the equivalent of at least 25 mm of a material having a thermal conductivity of ≤ 0.04 W/m.K to reduce the possibility of condensation forming. g. Where a duct extends externally above roof level the section above the roof should be insulated or a condensate trap should be fitted just below roof level. 	
2.0 Ventilation air inlets and discharge terminals	<p>Background ventilators</p> <ul style="list-style-type: none"> a. Background ventilators should be provided to meet the minimum required equivalent area of ventilation specified by Table 5.2b of ADF. b. For wall mounted background ventilators make an opening in wall in accordance with manufacturer's instructions for the size required. Ensure that there are no obstructions in the opening. c. Install the wall or window ventilator product in accordance with manufacturer's instructions. d. Ensure that wall or window ventilator products are sealed to their surrounds using a proprietary sealant as recommended by the manufacturer. 	<p><i>Background ventilators fitted in windows are usually installed during manufacture. Close co-ordination between supplier and installer is recommended to ensure correct location of ventilators.</i></p> <p><i>Background ventilators installed in walls may require a proprietary wind cowl to reduce wind noise and prevent over ventilation.</i></p>

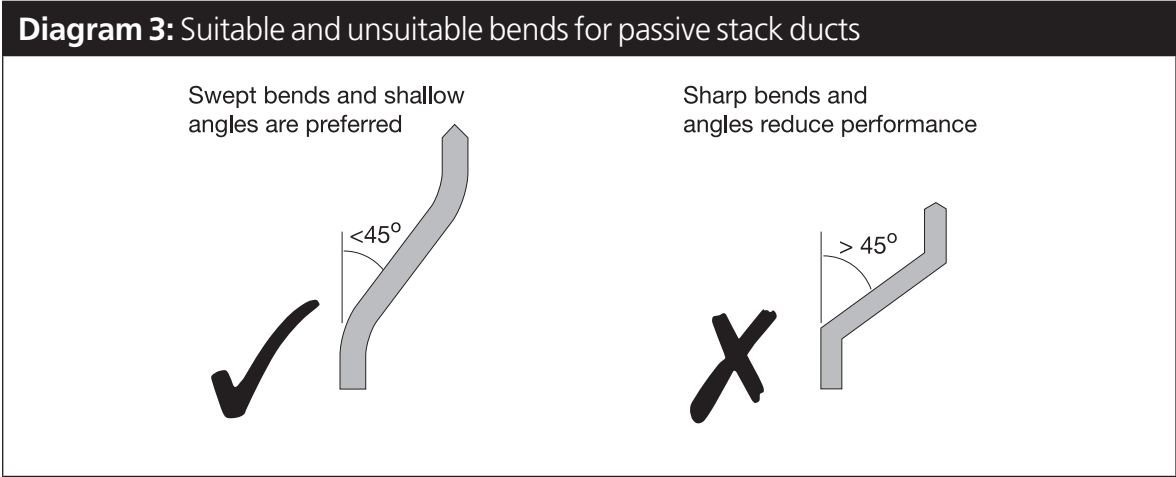
Table 3: System 2 installation requirements (*continued*)

	Installation clauses	Supplementary information
2.0 Ventilation air inlets and discharge terminals (continued)	<p>Extract terminals – wall and ceiling mounted</p> <p>a. PSV extract terminals should be located in the ceiling or on a wall less than 400 mm below the ceiling.</p> <p>b. The extract terminal should have a free area of not less than the duct cross-sectional area. If a conversion fitting is required to connect the duct to the terminal then the duct cross-sectional area should be maintained (or exceeded) throughout the conversion fitting so as not to restrict the flow.</p>	<i>In non-sanitary accommodation, humidity controlled terminals may be used to increase the airflow during periods of increased humidity and reduce the airflow during periods of low humidity. Humidity controls should not be used for sanitary accommodation where odour is the main pollutant.</i>
	<p>Discharge terminals</p> <p>a. Proprietary products should be used that are compatible with the PSV duct system that has been installed.</p> <p>b. The roof terminal should not allow ingress of large insects or birds and should be designed so that rain is not likely to enter the duct and run down into the dwelling.</p> <p>c. The terminal should also be designed such that any condensation forming inside it cannot run down into the dwelling but will run off externally onto the roof.</p> <p>d. A tile ventilator used to terminate a PSV system on the roof slope should be positioned no more than 0.5 m from the roof ridge. If the duct penetrates the roof more than 0.5 m from the ridge, it should extend above the roof slope to at least ridge height.</p>	<i>Refer to Diagram 2 for further details.</i>
3.0 Miscellaneous	<p>Air transfer</p> <p>a. To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600 mm² in all internal doors above the floor finish. This is equivalent to an undercut of 10 mm for a standard 760 mm width door.</p> <p>b. Ensure that the air transfer provision is unrestricted after floor finishes have been laid (e.g. carpets should not encroach). This should be achieved by making an undercut of 10 mm above the floor finish if the floor finish is fitted, or by a 20 mm undercut above the floorboards, or other surface, if the finish has not been fitted.</p>	

Table 4: System 2 commissioning (inspection only)		
	Minimum commissioning requirements	Supplementary information
1.0 Ductwork and terminals	<p>Visual inspections</p> <p>The following points should be observed and recorded in Section 5:</p> <ul style="list-style-type: none"> a. System installation complies with the installation clauses given in Table 3. b. Number and size of terminal points satisfy Table 5.2b in ADF. c. All ductwork and terminals are in good condition with no obvious defects that will be hazardous or affect the system performance. 	
2.0 Background ventilators	<p>Visual inspections</p> <p>The following points should be observed and recorded:</p> <ul style="list-style-type: none"> a. Correct size, number, orientation and location of air inlets satisfy Table 5.2b in ADF. b. Remove any temporary protection and packaging from all background ventilators, and check functionality (i.e. do shutters open/close correctly). c. Ensure that an adequate seal has been provided between ventilator product and wall/window frame. 	<i>The equivalent area should be displayed on the background ventilator product.</i>

Diagram 2: Suitable layouts for PSV systems**(a) Kitchen and bathroom ducts with ridge terminals****(b) Kitchen and bathroom ducts penetrating roof with terminals at ridge height**

The layouts shown in Diagram 2 are considered to be suitable for the majority of dwellings of up to four storeys. Placing the outlet terminal at the ridge of the roof (Diagram 2(a)) is the preferred option for reducing the adverse effects of wind gusts and certain wind directions. A tile ventilator may be used to terminate a PSV system on the roof slope but the terminal should be positioned no more than 0.5 m from the roof ridge. If the duct penetrates the roof more than 0.5 m from the ridge, it should extend above the roof slope to at least ridge height to ensure that the duct terminal is in the negative pressure region above the roof (Diagram 2(b)).



Ducts should use no more than one offset (i.e. no more than two bends) and these should be of the “swept” rather than “sharp” type to minimise flow resistance. Offsets at an angle should be no more than 45° to the vertical (Diagram 3).

Section 3: Continuous mechanical ventilation systems

3.1 System 3 – Continuous mechanical extract – centralised and de-centralised

The information provided in Tables 5 and 6 gives guidance on the installation and commissioning of continuous mechanical extract ventilation (MEV) systems for dwellings. The relevant design guidance is given in ADF, in particular, Table 5.2c.

3.2 System 4 – Continuous mechanical balanced systems with heat recovery – centralised and single room

The information provided in Tables 7 and 8 gives guidance on the installation and commissioning of continuous mechanical balanced ventilation with heat recovery (MVHR) systems for dwellings. The relevant design guidance is given in ADF, in particular, Table 5.2d. The guidance is also suitable for single room heat recovery ventilators (SRHRV).

3.3 SAP 2009 – In-use factors

In-use factors are applied in SAP to the energy performance of continuous mechanical ventilation systems. These factors allow for several issues including the quality of the installation and commissioning (see draft SAP 2009 for more details). It may be appropriate to reduce these in-use factors for suitably qualified people adopting this installation and commissioning compliance guide. Evidence will first be required of the improved energy performance of this approach.

Table 5: System 3 installation requirements		
	Installation clauses	Supplementary information
1.0 Continuous extract fans – centralised Continuous extract fans – decentralised	Manufacturer’s details and specific instructions a. The information provided in this Table sets out the minimum recommended procedures for typical System 3 installations. b. For further product-specific information, refer to the manufacturer’s installation instructions. c. The suitability of connection of a continuous fan system to a cooker hood must follow the manufacturer’s guidance.	
	Location of fan unit a. The fan unit should be located as according to manufacturer’s specifications. b. Ensure final location of equipment offers sufficient space to allow access for maintenance. c. Fan units should be installed to allow sufficient space for replacement at end of its operational life – whole unit or key mechanical/electrical components. This should be achievable without need to remove fixed structures or remove significant lengths of connected ductwork. d. The fan unit should be installed on a suitable sound structure, which is stable and level.	<p><i>The location of the fan unit should minimise overall duct run length, both from the internal extract terminals/grilles to the fan unit and from the fan unit to the external discharge terminal.</i></p> <p><i>Refer to the manufacturer’s specification for appropriate environmental conditions. Unconditioned spaces, e.g. lofts, may become very hot in summer, which may have implications for both mechanical and electronic component life.</i></p> <p><i>The fan unit spigot arrangement may dictate the location and orientation of installation to ensure optimum performance refer to the manufacturer’s instructions.</i></p> <p><i>If a fan unit is to be installed in an unheated space, it may require insulation fitting to minimise the potential of condensation forming within the fan unit casing.</i></p>

Table 5: System 3 installation requirements (*continued*)

	Installation clauses	Supplementary information
1.0 Continuous extract fans – centralised Continuous extract fans – decentralised (continued)	Preparation for installation <ol style="list-style-type: none"> A hole of a suitable dimension through the fabric of the building will be required for the installation of the duct. The hole will need a slight downward angle towards the outside to prevent water ingress. Where ductwork penetrates building’s air barrier, the continuity of barrier must be maintained. The nature of the barrier and ease of achieving an effective seal should be considered before holes are drilled. For ceiling mounted fans or terminals/grilles, the holes should be cut to the minimum required size such that the fan/grille spigot fits snug into the hole. It is important to consider the planning and installation of ductwork in co-ordination with other trade activities and installations, such that routes are designed without compromise to the required ventilation air flow rates. 	
	Installation <ol style="list-style-type: none"> The fan unit should be installed using the manufacturer’s supplied or recommended fixing brackets. 	<i>Acoustic/anti-vibration isolation may be required. This will depend on the nature of the mounting structure; refer to the manufacturer’s instructions.</i>

Table 5: System 3 installation requirements (continued)		
	Installation clauses	Supplementary information
2.0 Ductwork	<p>Duct installation – General notes</p> <p>a. Ducts should be sized to minimise pressure loss and noise generation. This is achieved by sizing of the ducts to limit the air velocity.</p> <p>b. The routing of ducts should minimise overall duct length and minimise the number of bends required. It is particularly important to minimise bends in main ducts operating at higher air velocities.</p> <p>c. The need for privacy (acoustic separation) between rooms should be considered when planning duct layout.</p> <p>d. Where room air extract terminals/grilles are not fitted with filters, sufficient space to allow access for cleaning ducts should be provided.</p> <p>e. Ducting should be insulated where it passes through unheated areas and voids (e.g. loft spaces) with the equivalent of at least 25 mm of a material having a thermal conductivity of ≤ 0.04 W/m.K to reduce the possibility of condensation forming. Where a duct extends above roof level the section above the roof should be insulated or a condensate trap should be fitted just below roof level.</p> <p>f. Horizontal ducting, including ducting in walls, should be arranged to slope slightly downwards away from the fan to prevent backflow of any moisture into the product.</p> <p>g. Vertical ducting will require a condensate trap in order to prevent backflow of any moisture into the product.</p> <p>h. Perforated insulated flexi duct, used to minimise airborne acoustic transmission, should not be used between the fan unit and external discharge terminal to prevent condensation occurring within the insulation material.</p> <p>i. Where ducts pass through fire barriers, they must be appropriately fire stopped in accordance with the requirements of Part B of the Building Regulations (Fire Safety).</p>	<p><i>The duct size and type specified by the system designer should always be used to minimise pressure loss and noise generation. Main ducts should be run at the same size as the fan unit spigot. Duct size should then be reduced for branch ducts.</i></p> <p><i>A radial layout may achieve acoustic separation more effectively than a branched layout.</i></p> <p><i>The performance of the ventilation system relies on efficient air distribution and it is vital that duct installation is not left until the last moment when the only means of overcoming obstructions is to install flexible ducts where rigid ducts had been specified.</i></p>
	<p>Installation of ducts – rigid</p> <p>a. Ducts should not be installed where they can be easily damaged, for example run across open loft areas where they may be stood on or have items placed on them, breaking seals and possibly crushing the duct.</p> <p>b. Connection of components should not result in significant air flow resistance. Components should be proprietary and fit easily together without distortion.</p> <p>c. Rigid duct runs must be adequately supported.</p>	<p><i>Distortion of rectangular duct may result in significant reduction of the free internal area of the duct, increasing the flow resistance and making sealing more difficult.</i></p>

Table 5: System 3 installation requirements (<i>continued</i>)		
	Installation clauses	Supplementary information
2.0 Ductwork (continued)	<p>Installation of ducts – flexible</p> <ul style="list-style-type: none"> a. Ducts should not be installed where they can be easily damaged, for example; run across open loft areas where they may be stood on or have items placed on them, crushing the duct and restricting or preventing all air flow through the duct. b. Flexible duct should be pulled taught to ensure that the full internal diameter is obtained and flow resistance minimised. This is considered to have been achieved if the duct is extended to 90% of its maximum length. c. Flexible ductwork should be supported at suitable intervals to minimise sagging. d. Bends in flexible duct should have a minimum inside radius equal to the diameter of the duct – see Diagram 1. If tighter bends are required, rigid bends should be used. 	<i>It is suggested that flexible ducts should be supported at intervals not exceeding 600 mm.</i>
	<p>Duct connections</p> <ul style="list-style-type: none"> a. All duct connections require sealing. Where ducts are installed against a solid structure this can be difficult to achieve. In such locations preassembly of duct sections should be considered. This will require that connections are permanent to ensure the seal is maintained during installation. b. Where access to ducts will not be possible after construction is complete, i.e. ductwork within floor and wall voids, consideration should be given to permanent connection and sealing with an appropriate non-hardening sealant, not using duct tape to achieve connection and sealing. c. Connection of lengths of flexible duct must use a rigid connector and jubilee clips or similar to ensure a long term seal achieved. Connections of lengths of flexible duct should not be taped-only. 	
3.0 Ventilation air inlets and internal air transfer	<p>Background ventilators</p> <ul style="list-style-type: none"> a. Background ventilators should be provided to meet the minimum required equivalent area of ventilation specified by Table 5.2c of ADF. b. For wall mounted background ventilators make an opening in wall in accordance with manufacturer's instructions for the size required. Ensure that there are no obstructions in the opening. c. Install the wall or window ventilator product in accordance with manufacturer's instructions. d. Ensure that wall or window ventilator products are sealed to their surrounds using a proprietary sealant as recommended by the manufacturer. 	

Table 5: System 3 installation requirements (continued)		
	Installation clauses	Supplementary information
3.0 Ventilation air inlets and internal air transfer (continued)	<p>Air transfer</p> <ul style="list-style-type: none"> a. To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600 mm² in all internal doors above the floor finish. This is equivalent to an undercut of 10 mm for a standard 760 mm width door. b. Ensure that the air transfer provision is unrestricted after floor finishes have been laid (e.g. carpets should not encroach). This should be achieved by making an undercut of 10 mm above the floor finish if the floor finish is fitted, or by a 20 mm undercut above the floorboards, or other surface, if the finish has not been fitted. 	
4.0 Room extract air terminals/ grilles	<p>Extract terminals/grilles – General notes</p> <ul style="list-style-type: none"> a. All room air extract terminals should be installed as detailed by the system designer. b. Room air extract terminals should be installed as close to ceiling level as practical, to ensure warm moist air is removed from each space. 	
	<p>Fixed terminals – grilles or louvers</p> <ul style="list-style-type: none"> a. If the room extract air terminals are fixed, ensure that effective balancing of the system can be achieved. If this is not provided within the fan unit then dampers should be installed within the duct system to allow balancing when the system is commissioned. 	
	<p>Adjustable terminals/grilles</p> <ul style="list-style-type: none"> a. Ensure each terminal/grille can be locked in its commissioned position once system balance has been achieved. It is vital for the correct operation of the system that the system remains balanced in its commissioned state. 	
5.0 External discharge terminal	<p>Discharge terminals – roof and wall mounted</p> <ul style="list-style-type: none"> a. Proprietary terminals should be used. b. Ensure that the free area of the terminal opening is a minimum of 90% of the free area of the ducting being used. c. The location of the external discharge terminal should ensure that the potential for recirculation of extract air through ventilation air inlets is minimised. 	

Table 5: System 3 installation requirements (<i>continued</i>)		
	Installation clauses	Supplementary information
6.0 Controls	<p>Controls – General notes</p> <ul style="list-style-type: none"> a. Continuous ventilation systems should not allow the occupier to turn off the fan other than at the local isolator. Provision of an on/off function will result in the fans being operated intermittently and the required continuous air flow ventilation rates not being achieved. b. Where sensors are not pre-installed within the fan unit, or additional optional sensors can be installed, only the sensors specified by the manufacturer of the fan unit should be installed. c. If sensors are duct mounted, their location should be noted and provisions for access for maintenance or replacement made. d. If control of the fan speed is undertaken manually, the operation of the fan in boost mode should be made obvious. This will minimise the likelihood of it being left in this mode unnecessarily. e. Humidity control should not be used in sanitary accommodation, as odour is the main pollutant. 	<i>Installation of alternative sensors may result in control functions not performing correctly.</i>
	<p>Controls – Location and configuration</p> <ul style="list-style-type: none"> a. Installation of manual controls for the system must meet the requirements of Part M of the Building Regulations. b. Installation of room sensors should follow the manufacturer's guidance on positioning. c. Where control of the fan speed is undertaken manually, switching should be provided locally to the spaces being served, i.e. bathrooms and kitchen. Provision of a single centrally located switch is insufficient and will result in fans being left in inappropriate modes of operation. 	<i>Approved Document M suggests that switches should be located between 450 mm and 1200 mm from finished floor level (Section 8.3 Page 69 ADM).</i>
7.0 Continuous extract fans – decentralised	<p>In-duct installation</p> <ul style="list-style-type: none"> a. The fan unit should be adequately supported using the manufacturer's supplied or recommended fixing brackets. b. Access should be provided to the fan unit for maintenance and replacement at the end of its operational life. 	

Table 6: System 3 commissioning		
	Minimum commissioning requirements	Supplementary information
1.0 System overview	<p>Visual inspections</p> <p>The following points should be observed and recorded in Section 5:</p> <ol style="list-style-type: none"> System installation complies with the installation clauses given in Table 5. System is installed in accordance with design criteria. All ductwork and terminals are in good condition with no obvious defects that will be hazardous or affect the system performance. 	
	<p>Initial start-up</p> <ol style="list-style-type: none"> Check that air flow direction is correct at each room terminal. Check for any abnormal noises on start-up or when the system is running in normal background ventilation mode. 	<i>Some fan units have a start-up diagnostic sequence that runs the fans at maximum speed for a period before reverting to normal operation – refer to the manufacturer’s operating instructions.</i>
2.0 Air flow balancing and measurement	<p>Air flow balancing</p> <ol style="list-style-type: none"> The system should be balanced to ensure that design air flow rates are achieved at each room terminal/grille. There are several combinations of room terminal/grille (hereon referred as terminal) and fan control that may be used in domestic systems, the fan manufacturer’s instructions should be followed to achieve balancing. If specific details are not included the following steps should be: <ol style="list-style-type: none"> Adjustable terminals and a fixed (stepped) speed fan. The fan speed should be set to achieve the desired continuous flow rate. The index terminal flow rate is set to full open and all other grilles are adjusted to achieve the required flows at each terminal. If the total flow rate cannot be achieved through all the terminals then the fan speed should be increased. If all the terminals have to be closed significantly to achieve only the required air flow rate then reduce the fan speed and rebalance the terminals. Adjustable terminals and controllable speed fan. The fan speed should be set approximately to achieve the desired continuous flow rate. The index terminal flow rate is set with the terminal fully open and all other terminals are adjusted to achieve the required flows at each terminal. If the index terminal has to be closed to achieve only the required air flow rate, then reduce the fan speed and rebalance the terminals. 	<i>The index terminal/grille can be assumed to be the furthest from the fan unit.</i>

Table 6: System 3 commissioning (continued)		
	Minimum commissioning requirements	Supplementary information
2.0 Air flow balancing and measurement (continued)	<p>3. Fixed terminals with flow adjustment by duct damper or similar device at the fan unit. As 1. or 2. above depending on the type of fan speed control.</p> <p>4. Adjustable terminals and fixed volume flow fan. The fan speed should be set to achieve the desired continuous flow rate. The index terminal flow rate is set with the terminal full open and all other terminals are adjusted to achieve the required flows at each terminal. Adjustment of the terminals achieves balancing only; total flow rate is governed by the fan control setting. Great care should be taken not to close the terminals too far as the fan unit will always maintain a constant volumetric flow rate; closing the terminals will only require the fan to work harder to achieve a given air flow rate.</p> <p>5. Fixed terminals with automatic flow adjustment at the fan unit. The fan speed should be set to achieve the desired continuous flow rate. The flows are balanced by automatic devices located within the fan unit, no adjustment can be made.</p>	
	<p>Air flow measurements</p> <p>a. Ensure that background ventilators or other air transfer devices are open.</p> <p>b. Ensure all internal and external doors and windows are closed, including rooms in which measurements are being carried out.</p> <p>c. Air flow measurements should be performed using a calibrated airflow device with proprietary hood attachment and results recorded in litres per second (l/s). Reference should be made to design airflow rates.</p> <p>d. Record the airflow rate at each room terminal onto the commissioning sheet in Section 5, along with the design air flow rate for each terminal. Measurements should be taken at both maximum rate and minimum rate fan speeds.</p> <p>e. It is recommended that a vane anemometer or similar device is used to balance and measure the air flow rates at each room terminal. The instrument will require a hood to be attached to allow it to cover the terminal.</p> <p>f. The instrument should be calibrated annually and be capable of achieving an accuracy of $\pm 5\%$.</p>	<p><i>The most common method is the use of a vane anemometer, or similar, placed in a hood which covers the terminal to measure the extract airflow rate</i></p> <p><i>Calibration of measurement equipment should be undertaken annually by returning the instrument to a UKAS accredited calibration centre.</i></p>

Table 6: System 3 commissioning (continued)		
	Minimum commissioning requirements	Supplementary information
3.0 Controls	<p>Installation</p> <ul style="list-style-type: none"> a. Ensure all local controls have been installed following the manufacturer’s instructions. b. Ensure all local controls are adequately labelled, indicating their function clearly. c. If sensors have been installed separately from the fan unit ensure installation follows the manufacturer’s instructions. d. Where control of the fan is automated, the controls should be configured to minimise the occurrence of hunting (the continual increase and decrease of the fan speed). e. If manual control of, for example, heat exchanger by-pass is provided, clear and detailed instructions must be made available to the occupier. 	<p><i>If hunting (the continual increase and decrease of fan speed) does occur, occupants may seek to modify the control of the system or turn it off altogether to remove the noise nuisance.</i></p>
	<p>Testing operation</p> <ul style="list-style-type: none"> a. As far as practical the correct operation of each control function should be tested. 	

Table 7: System 4 installation requirements		
	Installation clauses	Supplementary information
1.0 Continuous supply and extract with heat recovery – centralised	<p>Manufacturer’s details and specific instructions</p> <p>a. The information provided in this Table sets out the minimum recommended procedures for typical System 4 installations.</p> <p>b. For further product-specific information, refer to the manufacturer’s installation instructions.</p> <p>c. The suitability of connection of a continuous fan system to a cooker hood must follow the manufacturer’s guidance.</p>	
	<p>Continuous single room supply and extract with heat recovery</p> <p>Location of fan unit</p> <p>a. The fan unit should be located as specified by the system designer.</p> <p>b. Fan units should be installed to allow sufficient space to undertake routine maintenance on filters and heat exchanger block as appropriate.</p> <p>c. Fan units should be installed to allow sufficient space for replacement at end of its operational life – whole unit or of key mechanical/electrical components. This should be achievable without need to remove fixed structures or remove significant lengths of connected ductwork.</p> <p>d. The fan unit should be installed on a suitable sound structure, which is stable and level.</p> <p>e. If the fan unit is not pre-insulated, insulation should be added to minimise the potential of condensation forming within, or on, the fan unit casing.</p> <p>f. A condensate drain should be installed from the fan unit to an appropriate drain location. The condensate pipe should be installed to have a minimum 5° fall from the fan unit.</p> <p>g. The condensate drain should be adequately secured and where passing through an unheated space must be adequately insulated to prevent freezing.</p> <p>Additional notes for SRHRV</p> <p>a. Do not install the unit in the corner of a room as this may result in short circuiting of air flows.</p>	<p><i>The location of the fan unit should minimise overall duct run length, both from the internal terminals/ grilles to the fan unit and from the fan unit to the external discharge terminal.</i></p> <p><i>Refer to the manufacturer’s specification for appropriate environmental conditions.</i></p> <p><i>Unconditioned spaces, e.g. lofts, may become very hot in summer, which may have implications for both mechanical and electronic component life.</i></p> <p><i>The fan unit spigot arrangement may dictate the location and orientation of installation to ensure optimum performance refer to the manufacturer’s instructions.</i></p> <p><i>If a fan unit is to be installed in an unheated space, it may require external insulation fitting to minimise the potential of condensation forming within the fan unit casing.</i></p> <p><i>The rate of condensate forming may be up to several litres per day and therefore the appropriateness of the drain location should consider this.</i></p>

Table 7: System 4 installation requirements (continued)		
	Installation clauses	Supplementary information
1.0 Continuous supply and extract with heat recovery – centralised Continuous single room supply and extract with heat recovery (continued)	Preparation for installation a. A hole of a suitable dimension through the fabric of the building will be required for the installation of the duct. The hole will need a slight downward angle towards the outside to prevent water ingress. b. Where ductwork penetrates building's air barrier, the continuity of barrier must be maintained. The nature of the barrier and ease of achieving an effective seal should be considered before holes are drilled. c. For ceiling mounted fans or terminals/grilles, the holes should be cut to the minimum required size such that the fan/grille spigot fits snug into the hole. d. It is important to consider the planning and installation of ductwork in co-ordination with other trade activities and installations, such that routes are designed without compromise to the required ventilation air flow rates.	
	Installation a. The fan unit should be installed using the manufacturer's supplied or recommended fixing brackets.	<i>Acoustic/anti-vibration isolation may be required. This will depend on the nature of the mounting structure, refer to the manufacturer's instructions.</i>
2.0 Ductwork	Duct installation – General notes a. Ducts should be sized to minimise pressure loss and noise generation. This is achieved by sizing of the ducts to limit the air velocity. b. The routing of ducts should aim to minimise overall duct length and minimise the number of bends required. It is particularly important to minimise bends in main ducts operating at higher air velocities. c. The need for privacy (acoustic separation) between rooms should be considered when planning duct layout. d. Where room air extract terminals/grilles are not fitted with filters, consideration should be given for the need to access ducts for cleaning. e. Ducting should be insulated where it passes through unheated areas and voids (e.g. loft spaces) with the equivalent of at least 25 mm of a material having a thermal conductivity of ≤ 0.04 W/m.K to reduce the possibility of condensation forming. Where a duct extends externally above roof level the section above the roof should be insulated or a condensate trap should be fitted just below roof level.	<i>The duct size and type specified by the system designer should always be used to minimise pressure loss and noise generation. Main ducts should be run at the same size as the fan unit spigot. Duct size should then be reduced for branch ducts. A radial layout may achieve acoustic separation more effectively than a branched layout. The performance of the ventilation system relies on efficient air distribution and it is vital that duct installation is not left until the last moment when the only means of overcoming obstructions is to install flexible ducts where rigid ducts had been specified.</i>

Table 7: System 4 installation requirements (continued)		
	Installation clauses	Supplementary information
2.0 Ductwork (continued)	<p>f. Ducts within the building heated envelope carrying cold air between the external supply/discharge terminals and the fan unit should be insulated and wrapped additionally with a vapour barrier outside the insulation to prevent condensation occurring within the insulation material.</p> <p>g. Horizontal ducting, including ducting in walls, should be arranged to slope slightly downwards away from the fan to prevent backflow of any moisture into the product.</p> <p>h. Vertical ducting will require a condensate trap in order to prevent backflow of any moisture into the product.</p> <p>i. Perforated insulated flexi duct, used to minimise airborne acoustic transmission, should not be used between the fan unit and external discharge terminal to prevent condensation occurring within the insulation material.</p> <p>j. Where ductwork penetrates building's air barrier, identify on building drawings and ensure that continuity of barrier is maintained.</p> <p>k. Where ducts pass through fire barriers, they must be appropriately fire stopped in accordance with the requirements of Part B of the Building Regulations (Fire Safety).</p>	
	<p>Installation of ducts – rigid</p> <p>a. Ducts should not be installed where they can be damaged, for example run across open loft areas where they may be stood on or have items placed on them, breaking seals and possibly crushing the duct.</p> <p>b. Connection of components should not result in significant air flow resistance. Components should be proprietary and fit easily together without distortion.</p> <p>c. Rigid duct runs must be adequately supported.</p>	<i>Distortion of rectangular duct may result in significant reduction of the free internal area of the duct, increasing the flow resistance and making sealing more difficult.</i>
	<p>Installation of ducts – flexible</p> <p>a. Ducts should not be installed where they can be damaged, for example run across open loft areas where they may be stood on or have items placed on them, crushing the duct and restricting or preventing all air flow through the duct.</p> <p>b. Flexible duct should be pulled taught to ensure that the full internal diameter is obtained and flow resistance minimised. This is considered to have been achieved if the duct is extended to 90% of its maximum length.</p> <p>c. Flexible ductwork should be supported at suitable intervals to minimise sagging.</p> <p>d. Bends in flexible duct should have a minimum inside radius equal to the diameter of the duct – see Diagram 1. If tighter bends are required, rigid bends should be used.</p>	<i>It is suggested that flexible ducts should be supported at intervals not exceeding 600 mm.</i>

Table 7: System 4 installation requirements (continued)		
	Installation clauses	Supplementary information
2.0 Ductwork (continued)	<p>Duct connections</p> <ul style="list-style-type: none"> a. All duct connections require sealing. Where ducts are installed against a solid structure this can be difficult to achieve. In such locations preassembly of duct sections should be considered. This will require that connections are permanent to ensure the seal is maintained during installation. b. Where access to ducts will not be possible after construction is complete, i.e. ductwork within floor and wall voids, consideration should be given to permanent connection and sealing with an appropriate non-hardening sealant, not using duct tape to achieve connection and sealing. c. Connection of lengths of flexible duct must use a rigid connector and jubilee clips or similar to ensure a long term seal is achieved. Connections of lengths of flexible duct should not be taped-only. 	
3.0 Internal ventilation air transfer	<p>Air transfer</p> <ul style="list-style-type: none"> a. To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600 mm² in all internal doors above the floor finish. This is equivalent to an undercut of 10 mm for a standard 760 mm width door. b. Ensure that the air transfer provision is unrestricted after floor finishes have been laid (e.g. carpets should not encroach). This should be achieved by making an undercut of 10 mm above the floor finish if the floor finish is fitted, or by a 20 mm undercut above the floorboards, or other surface, if the finish has not been fitted. <p>Additional notes for SRHRV</p> <ul style="list-style-type: none"> c. Free air movement between rooms is not required as each room contains a single room heat recovery ventilator (SRHRV) unit. These units have a balanced supply and extract air flow rate. It is however recommended that the provisions given in 3a and 3b are maintained to minimise any imbalance of flows within rooms. 	

Table 7: System 4 installation requirements (continued)		
	Installation clauses	Supplementary information
4.0 Room supply and extract air terminals/ grilles	<p>Supply and extract terminals/grilles – General notes</p> <ul style="list-style-type: none"> a. All room air extract terminals should be installed as detailed by the system designer. b. Room air extract terminals should be installed as close to ceiling level as practical, to ensure warm moist air is removed from each space. c. Room supply air terminals must not be located adjacent to walls, unless designed to discharge air away from the wall, as this may result in down draughts. d. In open plan areas where both supply and extract terminals may be installed, e.g. kitchen diners, the terminals should be adequately separated to ensure short circuiting is minimised. e. The number and location of terminals installed in a space should ensure effective air distribution and ensure that air noise is not a nuisance when the system is operating at boost air flow rates. 	
	<p>Fixed terminals – grilles or louvers</p> <ul style="list-style-type: none"> a. If the supply and extract air terminals are fixed, ensure that effective balancing of the system can be achieved. If this is not provided within the fan unit then dampers should be installed within the duct system to allow balancing when the system is commissioned. 	
	<p>Adjustable terminals/grilles</p> <ul style="list-style-type: none"> a. Ensure each terminal/grille can be locked in its commissioned position once system balance has been achieved. It is vital for the correct operation of the system that the system remains balanced in its commissioned state. 	
<p>5.0 External discharge terminal MVHR</p> <p>External supply and discharge terminal</p>	<p>Supply and discharge terminals – roof and wall mounted</p> <ul style="list-style-type: none"> a. Proprietary terminals should be used. b. Ensure that the free area of the terminal opening is a minimum of 90% of the free area of the ducting being used. c. The location of the external discharge terminal should ensure that the potential for recirculation of extract air through the supply air terminal is minimised. 	<p><i>It is recommended that the supply and extract air terminals are separated by a minimum of 300 mm horizontally if placed on the same façade of a building.</i></p>

Table 7: System 4 installation requirements (continued)		
	Installation clauses	Supplementary information
6.0 Controls	<p>Controls – General notes</p> <ul style="list-style-type: none"> a. Continuous ventilation systems should not allow the occupier to turn off the fan other than at the local isolator. Provision of an on/off function will result in the fans being operated intermittently and the required continuous air flow ventilation rates not being achieved. b. Where sensors are not pre-installed within the fan unit, or additional optional sensors can be installed, only the sensors specified by the manufacturer of the fan unit should be installed. c. If sensors are duct mounted, their location should be noted and provisions for access for maintenance or replacement made. d. If control of the fan speed is undertaken manually, the operation of the fan in boost mode should be made obvious. This will minimise the likelihood of it being left in this mode unnecessarily. e. Humidity control should not be the only control used in sanitary accommodation, as odour is the main pollutant. 	<i>Installation of alternative sensors may result in control functions not performing correctly.</i>
	<p>Controls – Location and configuration</p> <ul style="list-style-type: none"> a. Installation of manual controls for the system must meet the requirements of Part M of the Building Regulations. b. Installation of room sensors should follow the manufacturer's guidance on positioning. c. Where control of the fan speed is undertaken manually, switching should be provided locally to the spaces being served, i.e. bathrooms and kitchen. Provision of a single centrally located switch is insufficient and will result in fans being left in inappropriate modes of operation. 	<i>Approved Document M suggests that switches should be located between 450 mm and 1200 mm from finished floor level (Section 8.3 Page 69 ADM)</i>
7.0 Single room heat recovery ventilator (SRHRV) devices	<p>Ventilation of whole building</p> <ul style="list-style-type: none"> a. These products provide balanced ventilation for one room only; the ventilation of all spaces should meet the requirements of the Building Regulations. 	

Table 8: System 4 commissioning		
	Minimum commissioning requirements	Supplementary information
1.0 System overview	<p>Visual inspections</p> <p>The following points should be observed and recorded in Section 5:</p> <ol style="list-style-type: none"> System installation complies with the installation clauses given in Table 7. System is installed in accordance with design criteria. All ductwork and terminals are in good condition with no obvious defects that will be hazardous or affect the system performance. 	
	<p>Initial start-up</p> <ol style="list-style-type: none"> Check that air flow direction is correct at each room terminal, supply and extract. Check for any abnormal noises on start-up or when the system is running in normal background ventilation mode. 	<i>Some fan units have a start-up diagnostic sequence that runs the fans at maximum speed for a period before reverting to normal operation – refer to the manufacturer’s operating instructions.</i>
2.0 Air flow balancing and measurement	<p>Air flow balancing</p> <ol style="list-style-type: none"> The system should be balanced to ensure that design air flow rates are achieved at each room terminal/grille. There are several combinations of room terminal/grille (referred to as a terminal from now on) and fan control that may be used in domestic systems; the fan manufacturer’s instructions should be followed to achieve balancing. If specific details are not included the following steps should be: <ol style="list-style-type: none"> Adjustable terminals and a fixed (stepped) speed fan. The fan speed should be set to achieve the desired continuous flow rate. The index terminal flow rate is set to full open and all other terminals are adjusted to achieve the required flows at each terminal. If the total flow rate cannot be achieved through all the terminals then the fan speed should be increased. If all the terminals have to be closed significantly to achieve only the required air flow rate then reduce the fan speed and rebalance the terminals. Adjustable terminals and controllable speed fan. The fan speed should be set approximately to achieve the desired continuous flow rate. The index terminal flow rate is set with the terminal fully open and all other terminals are adjusted to achieve the required flows at each terminal. If the index terminal has to be closed to achieve only the required air flow rate, then reduce the fan speed and rebalance the terminals. 	<i>The index terminal/grille can be assumed to be the furthest from the fan unit.</i>

Table 8: System 4 commissioning (<i>continued</i>)		
	Minimum commissioning requirements	Supplementary information
2.0 Air flow balancing and measurement (<i>continued</i>)	<p>3. Fixed terminals with flow adjustment by duct damper or similar device at the fan unit. As 1. or 2. above depending on the type of fan speed control.</p> <p>4. Adjustable terminals and fixed volume flow fan. The fan speed should be set to achieve the desired continuous flow rate. The index terminal flow rate is set with the terminal full open and all other terminals are adjusted to achieve the required flows at each terminal. Adjustment of the terminals achieves balancing only; total flow rate; is governed by the fan control setting. Great care should be taken not to close the terminals too far as the fan unit will always maintain a constant volumetric flow rate; closing the terminals will only require the fan to work harder to achieve a given air flow rate.</p> <p>5. Fixed terminals with automatic flow adjustment at the fan unit. The fan speed should be set to achieve the desired continuous flow rate. The flows are balanced by automatic devices located within the fan unit, no adjustment can be made.</p>	
	<p>Air flow measurements</p> <ol style="list-style-type: none"> Ensure all internal and external doors and windows are closed, including rooms in which measurements are being carried out. Air flow measurements should be performed using a calibrated airflow device with proprietary hood attachment and results recorded in litres per second (l/s). Reference should be made to design airflow rates. Record the airflow rate at each room terminal onto the commissioning sheet in Section 5, along with the design air flow rate for each terminal. Measurements should be taken at both maximum rate and minimum rate fan speeds. It is recommended that a vane anemometer or similar device is used to balance and measure the air flow rates at each room terminal. The instrument will require a hood to be attached to allow it to cover the terminal. The instrument should be calibrated annually and be capable of achieving an accuracy of $\pm 5\%$. <p>Additional notes for SRHRV</p> <ol style="list-style-type: none"> The supply and extract configuration of some fan units may prevent measurement of the air flow rates. In such cases, if the manufacturer's installation instructions have been followed the air flow rates specified for that product must be assumed to have been achieved. 	<p><i>Calibration of measurement equipment should be undertaken annually by returning the instrument to a UKAS accredited calibration centre.</i></p>

Table 8: System 4 commissioning (*continued*)

	Minimum commissioning requirements	Supplementary information
3.0 Controls	<p>Installation</p> <ul style="list-style-type: none"> a. Ensure all local controls have been installed following the manufacturer's instructions. b. Ensure all local controls are adequately labelled, indicating their function clearly. c. If sensors have been installed separately from the fan unit ensure installation follows the manufacturer's instructions. d. Where control of the fan is automated, the controls should be configured to minimise the occurrence of hunting. e. If manual control of, for example, heat exchanger by-pass is provided, clear and detailed instructions should be made available to the occupier. 	<p><i>If hunting (the continual increase and decrease of the fan speed) does occur, occupants may seek to modify the control of the system or turn it off altogether to remove the noise nuisance.</i></p>
	<p>Testing operation</p> <ul style="list-style-type: none"> a. As far as practical the correct operation of each control function should be tested. 	

Section 4: System completion and handover

This section outlines the minimum information to be handed over to the end user immediately after the ventilation system has been installed and commissioned.

4.1 Documentation to be handed over to the end user

Operation and maintenance manual

The operation and maintenance manual should contain specific instructions for the end user on how and when to use the ventilation system, including information on the intended use of available fan settings. Information should also be provided to suggest when the system components should be cleaned and maintained.

The following information should be provided where relevant:

- manufacturer's contact details;
- use of air inlets for background ventilation;
- location of and setting automatic controls (e.g. humidity and timer controls);
- location and use of on/off and boost settings for mechanical ventilation system;
- adjustable extract air terminals on vertical PSV ducts;
- instructions on how cleaning and maintenance should be carried out, including replacement filters;
- location of filters if not installed within the fan unit. (If no filters installed on extract terminals – how are ducts accessed for cleaning and recommendations for how cleaning is undertaken and interval);
- recalibration or checking of sensors and their location.

The operation and maintenance manual should also contain relevant manufacturers' literature which was supplied with the system or with individual components of the system. This might include components specifications, installation guidance, operating instructions, maintenance schedules, guarantees, registration card, spare part lists, means of obtaining spare parts, etc.

Completion checklist and commissioning sheet

The three-part sheet detailed in Section 5 should be signed and completed and included in the Operation and Maintenance manual.

Section 5: Completion checklist and commissioning sheet

This installation completion checklist and commissioning sheet is divided into three distinct parts:

- **Part 1** contains the particulars of the system, installation address and installer's details.
- **Part 2a** should be completed for all systems, and functions as an installation checklist.
- **Part 2b** is a visual inspection, or pre-commissioning checklist, and should be completed for all systems.
- **Part 3** should be completed for all systems that employ fan units, including intermittent extract fans, and requires air flow measurements to be recorded.

The three parts should be completed in full, and a copy should form part of the operation and maintenance manual.

Checking design against measured air flow rates

For Systems 1, 3 and 4, the measured air flow rates should be recorded on Part 3: *Commissioning details*, as part of the commissioning procedures given in Tables 2, 6 and 8. The measured values will need to be compared with their respective design values. Compliance with the design will be met if the measured rates for each are equal to, or greater than the design value. If any measured value is less than the design value, adjustment should be made to correct the system and all air flows re-measured until they meet the design values.

Instrument calibration

Measurement of air flows should be performed using equipment that has been calibrated at a UKAS accredited calibration centre. Calibration should be performed annually for each air flow measurement device used to record final air flow rates in Part 3. The Building Control Body (BCB) reserve the right to request copies of calibration certificates, which should be produced within seven working days of such requests.

Demonstrating compliance

All three parts should be completed, with the relevant Parts 2 and 3 signed by a person who is competent and responsible for the installation and for the commissioning of the system that has been installed.

The three-part form needs to be completed for each installation address, and a copy should be submitted to the BCB as evidence the installation has been correctly installed, inspected and commissioned.

Part 1 – System details and declarations

1.1 Installation Address Details	
Dwelling name/number	
Street	
Locality	
Town	
County	
Post Code	
1.2 Installation Details	
System classification*	System
<i>Enter System 1 to 4 as defined by Approved Document F 2010</i>	
Manufacturer	
Model numbers	
Serial number (where available)	
Location of fan units	1.
	2.
	3.
	4.
	5.
1.3 Installation Engineer's Details	
Engineer's Name	
Company	
Address Line 1	
Address Line 2	
Telephone Number	
Post Code	
1.4 Commissioning Engineer's Details (if different to 1.3)	
Engineer's Name	
Company	
Address Line 1	
Address Line 2	
Telephone Number	
Post Code	

**Note. If a system has been installed that is not defined by Systems 1 to 4 in Approved Document F, further installation checks and commissioning procedures may be required. Seek particular guidance from the manufacturer for these systems.*

Part 2a – Installation details

2.1 Installation Checklist – General (all Systems)		Tick as appropriate	
Has the system been installed in accordance with manufacturer's requirements?		Yes	No
Have relevant system installation clauses been followed as detailed in Tables 1, 3, 5, and 7 as applicable?		Yes	No
If any deviation from Tables 1, 3, 5 and 7, these should be detailed here.			
Description of installed controls (e.g. timer, central control, humidistat, PIR, etc)			
Location of manual/override controls			
2.2 Installation Engineer's Declaration			
Engineer's Signature			
Registration Number (if applicable)			
Date of Inspection			

Part 2b – Inspection of installation

This section should be completed by the commissioning engineer prior to completing Part 3.

2.3a Visual Inspections – General (all Systems)		
Total installed equivalent area of background ventilators in dwelling?		mm
Total floor area of dwelling?		m²
Does the total installed equivalent ventilator area meet the requirements given in Tables 5.2a, 5.2b, or 5.2c in ADF?	Yes	No
Have all background ventilators been left in the open position?	Yes	No
Have the correct number and location of extract fans/terminals been installed that satisfy Table 5.2a in ADF?	Yes	No
Is the installation complete with no obvious defects present?	Yes	No
Do all internal doors have sufficient undercut to allow air transfer between rooms (i.e. 10 mm over and above final floor finish)?	Yes	No
Has all protection/packaging been removed (including background ventilators) such that system is fully functional?	Yes	No
For ducted systems, has the ductwork installation been installed in such manner that air resistance and leakage is kept to a minimum?	Yes	No
Are the correct number and size of background ventilators provided that satisfy ADF?	Yes	No
Has the entire system been installed such that there is sufficient access for routine maintenance and repair/replacement of components?	Yes	No
2.3b Visual Inspections – General (Systems 3 and 4 only)		
Have appropriate air terminal devices been installed to allow system balance?	Yes	No
Has the heat recovery unit (System 4 only) and all ductwork been effectively insulated where installed in unheated spaces?	Yes	No
Condensate connection is complete and drains to an appropriate location (System 4 only)?	Yes	No
2.3c Other Inspections – General (Systems 1, 3 and 4 only)		
Upon initial start up, was any abnormal sound or vibration experienced, or unusual smells detected?	Yes	No

Part 3 – Commissioning details

3.1 Commissioning Equipment

Schedule of air flow measurement equipment used, (model and serial)		Date of last UKAS calibration
1.		
2.		
3.		

3.2 Air Flow Measurements – System 1 Only

Fan reference (as 1.2)	Measured Extract Rate (l/s)	Design Extract Rate (l/s) Refer to Table 5.1a in ADF
Extract Fan 1.		
Extract Fan 2.		
Extract Fan 3.		
Extract Fan 4.		
Extract Fan 5.		

For kitchen extract canopies, only the highest setting needs to be recorded.

3.3 Air Flow Measurements (Extract) – Systems 3 and 4 only

Room reference (location of terminals)	Measured Air Flow High Rate (l/s)	Design Air Flow High Rate (l/s) Refer to Table 5.1a in ADF	Measured Air Flow Low Rate (l/s)	Design Air Flow Low Rate (l/s) Refer to Table 5.1a in ADF
Kitchen.				
Bathroom				
En Suite				
Utility				
Other...				
Other...				
Other...				

3.4 Air Flow Measurements (Supply) – System 4 only

Room reference (location of terminals)	Measured Air Flow High Rate (l/s)	Design Air Flow High Rate (l/s) Refer to Table 5.1b in ADF	Measured Air Flow Low Rate (l/s)	Design Air Flow Low Rate (l/s) Refer to Table 5.1b in ADF
Living Room 1				
Living Room 2 (if present)				
Dining Room				
Bedroom 1				
Bedroom 2				
Bedroom 3				
Bedroom 4				
Bedroom 5				
Study				
Other...				

3.5 Commissioning Engineer's Declaration

Engineer's Signature	
Registration Number (if applicable)	
Date of Commissioning	

Proposals for amending Part L and Part F of the Building Regulations – Consultation consists of three volumes:

Volume 1: Proposals for amending Part L and Part F of the Building Regulations Consultation

Volume 2: Proposed technical guidance for Part L

Volume 2: Proposed technical guidance for Part F

Volumes should not be despatched separately

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