ONLINE VERSION

HM Government

The Building Regulations 2010

Ventilation

F

APPROVED DOCUMENT

Volume 2: Buildings other than dwellings

Requirement F1: Means of ventilation

Regulations: 39 and 44

2021 edition – for use in England

ONLINE VERSION

ONLINE VERSION

2021 edition

This approved document supports Part F of Schedule 1 to the Building Regulations 2010.

This approved document takes effect on 15 June 2022 for use in England. It does not apply to work subject to a building notice, full plans application or initial notice submitted before that date, provided the work for each building is started before 15 June 2023. Full detail of the transitional arrangements can be found in Circular Letter 01/2021 published on gov.uk.

ONLINE VERSION

Introduction

What is an approved document?

Approved documents are approved by the Secretary of State and give practical guidance on common building situations about how to meet the requirements of the Building Regulations 2010 for England. Different approved documents give guidance on each of the technical parts of the regulations. These are all listed in the back of the approved documents. In addition to guidance, some approved documents include provisions that must be followed exactly, as required by regulations or where methods of test or calculation are approved by the Secretary of State.

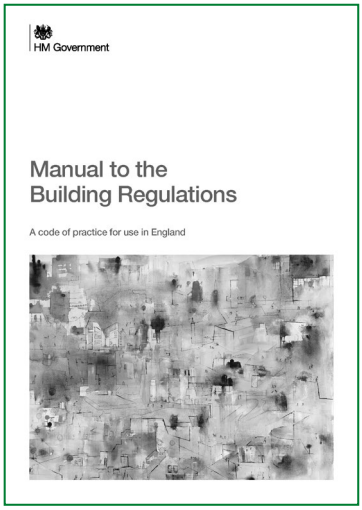
Each approved document covers the requirements of the Building Regulations 2010 relating to a different aspect of *building work*. *Building work* must also comply with all other applicable requirements of the Building Regulations 2010 and all other applicable legislation.

How is construction regulated in England?

Most *building work* being carried out in England must comply with the Building Regulations 2010. The Building Regulations are made under powers in the Building Act 1984.

Building Regulations protect the health and safety of people in and around buildings, they also provide for energy and water conservation and access to and use of buildings.

The *Manual to the Building Regulations* (references to this in the introduction are taken from the first edition) gives an overview of the building regulatory system in England. You can access the most recent version of the manual at: www.gov.uk/guidance/building-regulations-and-approved-documents-index.



How do you comply with the Building Regulations?

Building work must meet all relevant requirements of the Building Regulations. To comply with the Building Regulations, it is necessary both to follow the correct procedures and meet technical performance requirements.

The approved documents set out what, in ordinary circumstances, may be accepted as one way to comply with the Building Regulations. Note, however, that:

- Complying with the guidance in the approved documents does not guarantee that *building work* complies with the requirements of the regulations – the approved documents cannot cover all circumstances. Those responsible for *building work* must consider whether following the guidance in the approved documents is likely to meet the requirements in the particular circumstances of their case.
- There may be other ways to comply with the requirements than those described in an approved document. If those responsible for meeting the requirements prefer to meet a requirement in some other way than described in an approved document, they should seek to agree this with the relevant building control body at an early stage.

ONLINE VERSION

ONLINE VERSION

Those responsible for *building work* include agents, designers, builders, installers and the building owner. For further information, see Chapter 7 in Volume 1 and paragraphs A26, B2 and F2 in Volume 2 of the *Manual to the Building Regulations*.

The Building Regulations can be contravened by not following the correct procedures or not meeting the technical performance requirements. If the building owner or those responsible for the works contravene the Building Regulations, the local authority may prosecute them in the magistrates' court. For further information on enforcement and sanctions in the existing system, see Chapter B in Volume 2 of the *Manual to the Building Regulations*.

What do the Building Regulations cover?

'*Building work*' is a legal term for work covered by the Building Regulations. Where a building is not exempt, the Building Regulations apply to all types of *building work* as defined in regulation 3 of the Building Regulations. For further information, what constitutes *building work* is covered in Chapter A, Volume 2 of the *Manual to the Building Regulations*.

The Building Regulations contain sections dealing with definitions, procedures and the expected technical performance of *building work*. For example, the Building Regulations:

a. define what types of building, plumbing and heating work is classed as *building work* in regulation 3 (for further information see paragraphs A14 to A16 in Volume 2 of the *Manual to the Building Regulations*).

b. specify types of building that are exempt from the Building Regulations (for further information see Table A1 and paragraph A11 in Volume 2 of the *Manual to the Building Regulations*).

c. set out the notification procedures to follow when undertaking *building work* (for further information see Figure 2.1 in Volume 1 of the *Manual to the Building Regulations*).

d. set out the technical requirements (see Table 7.1 in Volume 1 of the *Manual to the Building Regulations*) with which the individual aspects of building design and construction must comply in the interests of the health and safety of building users, of energy efficiency (for further information see paragraphs A12(d)–(f), A14(f)–(h), A22, A23, B2(c) and F24 in Volume 2 of the *Manual to the Building Regulations*), and of access to and use of buildings.

e. set out the standards for building materials and workmanship in carrying out *building work* (for further information see Chapter 7 in Volume 1, and paragraphs F8 to F11 in Volume 2 of the *Manual to the Building Regulations*).

When must a building control body be notified?

It is often necessary to notify a building control body of planned *building work*. To help ensure that work complies with the Building Regulations, those responsible for *building work* may need to use one of the two types of building control body listed below:

a. a local authority building control body (for further information see Chapter B in Volume 2 of the *Manual to the Building Regulations*)

b. an approved inspector (for further information see Chapter E in Volume 2 of the *Manual to the Building Regulations*).

ONLINE VERSION

If *building work* consists only of installing certain types of services or fittings (e.g. fuel-burning appliances or replacement windows) and the building owner employs an installer that is registered with a relevant competent person scheme designated in the regulations, a building control body does not need to be notified.

For further information about competent person schemes, see Chapter 5 in Volume 1 and Chapter C in Volume 2 of the *Manual to the Building Regulations*.

How to use this approved document

Each approved document contains:

- general guidance on the performance expected of materials and *building work* in order to comply with each of the requirements of the Building Regulations, and
- practical examples and solutions on how to achieve compliance for some of the more common building situations.

They may not provide appropriate guidance if the case is unusual in terms of its design, setting, use, scale or technology. Non-standard conditions may include any of the following:

- difficult ground conditions
- buildings with unusual occupancies or high levels of complexity
- very large or very tall buildings
- large timber buildings
- some buildings that incorporate modern construction methods.

Anyone using the approved documents should have sufficient knowledge and skills to understand the guidance and correctly apply it to the *building work*. This is important because simply following the guidance does not guarantee that your *building work* will comply with the legal requirements of the Building Regulations. Each approved document contains legal requirements (which you must follow) and guidance (which you may or may not choose to follow). The text in a box with a green background at the beginning of each section of an approved document is taken from the Building Regulations. This text sets out the legal requirements.

The explanation which follows the legal requirements is guidance (see Diagram *i* below). The guidance then explains one or more ways to demonstrate how *building work* can be shown to comply with the legal requirements in common circumstances. The terms in green lettering in an approved document are key terms, listed and explained in the appendix to that approved document. Guidance in the approved documents addresses most, but not all, situations that building owners will face. Situations may arise that are not covered. You or your advisers will need to carefully consider whether following the guidance will mean that the requirements of the Building Regulations will be met.

ONLINE VERSION

B2

Requirement B2: Internal fire spread (linings)

This section deals with the following requirement from Part B of Schedule 1 to the Building Regulations 2010.

Requirement

Requirement	*Limits on application*
Internal fire spread (linings)	
B2. (1) To inhibit the spread of fire within the building, the internal linings shall—	
(a) adequately resist the spread of flame over their surfaces; and	
(b) have, if ignited, either a rate of heat release or a rate of fire growth, which is reasonable in the circumstances.	
(2) In this paragraph "internal linings" means the materials or products used in lining any partition, wall, ceiling or other internal structure.	

1

Intention

In the Secretary of State's view, requirement B2 is met by achieving a restricted spread of flame over internal linings. The building fabric should make a limited contribution to fire growth, including a low rate of heat release.

It is particularly important in circulation spaces, where linings may offer the main means by which fire spreads and where rapid spread is most likely to prevent occupants from escaping.

Requirement B2 *does not* include guidance on the following.

a. Generation of smoke and fumes.

b. The upper surfaces of floors and stairs.

c. Furniture and fittings.

2

Key

1 The law: extract from the Building Regulations 2010.

2 Statutory guidance.

Diagram *i* The relationship between regulations and guidance in the approved documents

For further information about the use of technical guidance, see Chapter 7 in Volume 1 and Chapter F in Volume 2 of the *Manual to the Building Regulations*.

Where to get further help

If you are unsure whether you have the knowledge and skills to apply the guidance correctly, or if you do not understand the technical guidance or other information in this approved document or the additional detailed technical references to which it directs you, you should seek further help. Some sources of help are listed below.

a. Your building control body may be able to help in many cases.

b. If you are registered with a competent person scheme, the scheme operator should be in a position to help.

c. Suitably qualified and experienced construction professionals should also be engaged where necessary.

ONLINE VERSION

ONLINE VERSION

Contents

Introduction i
- What is an approved document? i
- How is construction regulated in England? i
- How do you comply with the Building Regulations? i
- What do the Building Regulations cover? ii
- When must a building control body be notified? ii
- How to use this approved document iii
- Where to get further help iv

Section 0: Introduction 1
- Summary 1
- Application 1
- Selected key interactions with other parts of the Building Regulations 3

Requirement F1(1): Means of ventilation 5
- Intention 5

Section 1: Ventilation provision 6
- General 6
- Noise 6
- Access for maintenance 7
- The ventilation strategy in this approved document 7
- Performance-based guidance 7
- Equivalent area of ventilators 8
- Installation of ventilation systems 8
- Indoor air quality monitoring 8
- Ventilation for offices 9
- Ventilation of car parks 11
- Ventilation for buildings other than offices and car parks 12

Section 2: Minimising the ingress of external pollutants 15
- Control of ventilation intakes 16
- Location of exhaust outlets 17

Section 3: Work on existing buildings 18
- General 18
- Replacing windows 19

ONLINE VERSION

ONLINE VERSION

Requirement F1(2) and regulations 39 and 44 20
Intention 21

Section 4: Commissioning and providing information 22
Commissioning of ventilation systems 22
Operating and maintenance instructions 22

Appendix A: Key terms 24

Appendix B: Performance-based ventilation 27
Introduction 27
Performance criteria for buildings other than dwellings 27
Assumptions used in applying performance criteria for offices in Section 1 29
Extract ventilation 29

Appendix C: CO_2 monitoring 30
Types of CO_2 monitor to use 30
How to use a CO_2 monitor 30
How the measurements can help you take action 31
Where CO_2 monitors will be less effective 31

Appendix D: Standards referred to 32

Appendix E: Documents referred to 33
Legislation 33
Other documents 33

ONLINE VERSION

Section 0: Introduction

Summary

0.1 This approved document is Approved Document F, Volume 2: Buildings other than dwellings. It gives guidance on how to comply with Part F of Schedule 1 to the Building Regulations. For guidance relating to dwellings, use Approved Document F, Volume 1: Dwellings.

0.2 This approved document contains the following sections:

Approved document section	Related Building Regulations requirements
Section 0: Introduction	n/a
Section 1: Ventilation provision	Requirement F1(1)
Section 2: Minimising the ingress of external pollutants	
Section 3: Work on existing buildings	
Section 4: Commissioning and providing information	Requirement F1(2) and regulations 39 and 44
Appendix A: Key terms	n/a
Appendix B: Performance-based ventilation	n/a
Appendix C: CO_2 monitoring	n/a
Appendix D: Standards referred to	n/a
Appendix E: Documents referred to	n/a

Application

0.3 The guidance in Approved Document F, Volume 2 applies only to buildings other than dwellings.

For blocks of flats with shared communal rooms, this approved document should be consulted for those rooms.

NOTE: Rooms for residential purposes and buildings that contain only rooms for residential purposes are not dwellings and are covered by the guidance in this approved document.

Exemptions

0.4 Certain types of building are exempt from the Part F requirements of the Building Regulations. These are outlined in paragraphs A7 to A13 of the *Manual to the Building Regulations*.

ONLINE VERSION

Historic and traditional buildings

0.5 Work to the following types of buildings may not need to comply fully with the ventilation standards in this approved document.

a. Those listed in accordance with section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990.

b. Those in a conservation area designated in accordance with section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990.

c. Other historic buildings with a vapour-permeable construction that both absorbs moisture and readily allows moisture to evaporate. These include those built with wattle and daub, cob or stone and constructions using lime render or mortar.

0.6 Work to a building in paragraph 0.5 should comply with the ventilation standards in this approved document where reasonably practicable. The work should not result in either of the following outcomes.

a. Unacceptably affect the significance of the listed building, conservation area or scheduled monument.

b. Increase the risk of long-term deterioration of the building fabric or fittings.

0.7 New extensions to historic and traditional buildings should comply with all ventilation standards in this approved document unless there is a need to match the external appearance or character of the extension to that of the host building.

0.8 The local authority's conservation officer should be consulted when undertaking work to a building in paragraphs 0.5a or 0.5b.

Emergency repairs

0.9 For emergency repairs, if it is not possible to notify the building control body in advance, the building control body should be notified as soon as possible. If the installer is registered with a competent person scheme, see Chapter 5 in Volume 1 and Chapter C in Volume 2 of the *Manual to the Building Regulations*.

Minor works

0.10 Minor works must comply with the relevant requirements of the Building Regulations, but the building control body does not need to be notified.

For mechanical ventilation and air-conditioning systems, minor works include any of the following.

a. Replacing parts.

b. Adding an output or control device if testing and adjusting the system would not affect its energy efficiency or would not be possible.

c. Providing a self-contained mechanical ventilation or air-conditioning appliance when all the following apply.

i. Any electrical work is exempt from a requirement to give advance notice to a building control body.

ii. Testing and adjusting the system would not affect its energy efficiency or would not be possible.

iii. The appliance is not installed in a room that contains an open-flued combustion appliance.

ONLINE VERSION

Live/work units

0.11 A unit that contains both living accommodation and space for commercial purposes (e.g. for a workshop or office) should be treated as a dwelling if the commercial part can be reverted to domestic use.

0.12 The commercial part of the building can be reverted to domestic use if all of the following apply.

a. There is direct access between the commercial space and the living accommodation.

b. The commercial space and living accommodation are within the same thermal envelope.

c. The living accommodation comprises a substantial proportion of the total area of the unit. What constitutes a 'substantial proportion' should be assessed on a case-by-case basis by the building control body.

NOTE: A large non-domestic building that contains a small flat for a manager is not treated as a dwelling. A dwelling that contains a room used as an office or utility space is still treated as a dwelling.

Mixed-use developments

0.13 When constructing a dwelling as part of a larger building that contains other types of accommodation, sometimes called a mixed-use development, refer to the two volumes of Approved Document F as follows.

a. For guidance on each individual dwelling, use Approved Document F, Volume 1: Dwellings.

b. For guidance on the non-dwelling parts of the building, such as shared communal rooms and commercial or retail space, use this approved document: Approved Document F, Volume 2: Buildings other than dwellings.

Selected key interactions with other parts of the Building Regulations

0.14 The approved documents set out what, in ordinary circumstances, may be accepted as one way to comply with the Building Regulations. Those designing or undertaking building work remain responsible for assessing, on a case-by-case basis, whether specific circumstances require additional or alternative measures to comply with the regulatory requirements. There are interactions between many of the requirements of the Building Regulations. Guidance on some key interactions is given below.

Interaction with Part B

0.15 The requirements of Part B apply if, for example, ducts pass through any of the following.

a. A fire resisting structure.

b. A fire compartment.

c. A protected stairway.

0.16 This approved document gives guidance on window openings for ventilation. In addition, Approved Document B gives guidance on the size of escape windows. The larger of the window openings specified in Approved Document B or Approved Document F should be applied in all cases.

ONLINE VERSION

Interaction with Part J

0.17 Ventilation fans might cause combustion gases to spill from open-flued appliances. These combustion gases might fill the room instead of going up the flue or chimney, even if the combustion appliance and fan are in separate rooms.

0.18 The guidance in Approved Document J should be followed when installing and testing ventilation appliances. Combustion appliances must operate safely whether or not fans are running.

Interaction with Part L

0.19 Energy efficiency should be considered when specifying ventilation systems. Energy efficiency, including the control of infiltration, is dealt with under Part L of the Building Regulations.

Interaction with Part K and Part M

0.20 Manual controls, where provided for a ventilation device, should be within reasonable reach of the occupants. Follow the guidance in Approved Documents K and M.

Interaction with Part O

0.21 This document sets minimum standards for purge ventilation for rapidly diluting indoor air pollutants and extracting water vapour where necessary in habitable rooms in buildings other than dwellings. For domestic-type buildings, Part O may require a higher standard than the guidance given in this document for purge ventilation to remove excess heat. In this case, the higher of the two standards should be followed.

ONLINE VERSION

Requirement F1(1): Means of ventilation

This section deals with the requirements of Part F1(1) of Schedule 1 to the Building Regulations 2010.

Requirement

Requirement	*Limits on application*
Means of ventilation **F1.** (1) There shall be adequate means of ventilation provided for people in the building.	Requirement F1 does not apply to a building or space within a building: a. into which people do not normally go; b. which is used solely for storage; or c. which is a garage used solely in connection with a single dwelling.

Intention

In the Secretary of State's view, requirement F1(1) is met in a new building other than a dwelling if it has a means of ventilation that achieves all of the following.

a. Extracts water vapour and indoor air pollutants from areas where they are produced in significant quantities before they spread through the building, following the guidance on extract ventilation in Section 1 for the relevant building type.

b. Supplies a minimum level of outdoor air for occupants' health, following the guidance for whole building ventilation in Section 1 for the relevant building type.

c. Rapidly dilutes indoor air pollutants and disperses water vapour when necessary in occupiable rooms and sanitary accommodation, following the guidance for purge ventilation in Section 1 for the relevant building type.

d. Monitors air quality in specific types of occupiable rooms, following the guidance in paragraphs 1.21 to 1.23.

e. Minimises the entry of external pollutants, following the guidance in Section 2.

f. Achieves all of the following, as far as is reasonably practicable.

   i. Produces low levels of noise, following the guidance in paragraphs 1.5 and 1.6.

   ii. Offers easy access for maintenance, following the guidance in paragraph 1.7.

   iii. Provides protection from rain.

   iv. Provides protection from cold draughts.

   v. Does not significantly risk occupants' health.

In the Secretary of State's view, requirement F1(1) is met for work on an existing building other than a dwelling by following the guidance in Section 3.

Section 1: Ventilation provision

General

1.1 The aim of requirement F1(1) is to protect the health of occupants of the building by providing adequate ventilation. Without adequate ventilation, mould and internal air pollution may become hazardous to health and the risk of transmission of airborne infection is increased.

NOTE: The guidance in this approved document is not designed to deal with the products of tobacco smoking or vaping.

1.2 This approved document sets out guidance for ventilation provision in the following types and uses of buildings and occupiable rooms.

a. Specific types of occupiable rooms – follow paragraphs 1.21 to 1.23.

b. Offices – follow paragraphs 1.24 to 1.37.

c. Car parks – follow paragraphs 1.38 to 1.40.

d. Building types other than offices or car parks – follow paragraph 1.41.

1.3 Other ventilation solutions may be used, if it can be shown to the building control body that they satisfy requirement F1(1).

1.4 The guidance set out in this approved document has been designed to meet the indoor pollutant levels in Appendix B where the outside air is of reasonable quality. In areas where the outside air is not of reasonable quality, Section 2 provides guidance on limiting the entry of external air pollutants.

Noise

1.5 Mechanical ventilation systems, including both continuous and intermittent mechanical ventilation, should be designed and installed to minimise noise. This includes doing all of the following.

a. Correctly sizing and joining ducts.

b. Ensuring that equipment is appropriately and securely fixed, such as using resilient mountings where noise carried by the structure of the building could be a problem.

c. Selecting appropriate equipment, including following paragraph 1.6.

1.6 For mechanical ventilation systems, fan units should be appropriately sized so that fans operating in normal background ventilation mode are not overly noisy, taking into consideration the use and likely background level of noise from other sources. This might require fans to be sized so that they do not operate near maximum capacity when in normal background ventilation mode.

Access for maintenance

1.7 Reasonable access should be provided for maintaining ventilation systems, including all of the following.

a. Providing access to replace filters, fans and coils.

b. Providing access points for cleaning ductwork.

c. Providing access for the general maintenance of plant.

The ventilation strategy in this approved document

1.8 The ventilation strategy in this approved document relies on a combination of all of the following.

a. Extract ventilation from rooms where water vapour or pollutants are likely to be released (e.g. bathrooms, sanitary accommodation and kitchens in buildings other than dwellings), to minimise their spread to the rest of the building. Ventilation fans may be either intermittent operation or continuous operation.

b. Whole building ventilation to provide fresh air to the building and to dilute, disperse and remove water vapour and pollutants not removed by extract ventilation.

c. Purge ventilation to remove high concentrations of pollutants and water vapour. Purge ventilation is used intermittently and required only for pollutants produced by occasional activities (e.g. fumes from painting).

d. Monitoring of indoor air quality.

1.9 Ventilation may be delivered through natural ventilation, mechanical ventilation or a combination of both.

1.10 Naturally ventilated buildings should follow additional guidance on ventilation in CIBSE's AM10. Mixed mode buildings should follow additional guidance on ventilation in CIBSE's AM13.

1.11 The ventilation systems in this approved document are examples of systems that comply with Part F of the Building Regulations. Other ventilation systems may be acceptable if they can be shown to meet an equal level of performance.

Performance-based guidance

1.12 Performance criteria for acceptable levels of moisture and pollutants are given in Appendix B. Ventilation rates designed to meet the performance criteria are given in this guidance or in the documents referred to.

1.13 Some ventilation system designs can, in certain circumstances, result in lower ventilation rates than those stated in this guidance or in the documents referred to (e.g. systems with automatic controls). Where lower ventilation rates are proposed, expert advice should be obtained to demonstrate that the solution meets the performance standards in Appendix B.

Equivalent area of ventilators

1.14 The size of background ventilators (including trickle ventilators) is given in this approved document as an equivalent area in mm^2, not as a free area. **BS EN 13141-1** includes a method of measuring the equivalent area of background ventilator openings.

1.15 Background ventilators should have the equivalent area marked where it will be easy to see from inside the building when installed, to aid verification by building control bodies.

Installation of ventilation systems

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

a. Comply with the guidance in paragraphs 1.17 to 1.20.

b. Not compromise the performance of the system in use.

1.17 Rigid ducts should be used wherever possible. Where necessary, flexible ducts may be used for final connections, but their lengths should be kept to a minimum. All flexible ductwork should meet the standards of BSRIA's BG 43/2013.

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

a. Minimising the overall length of duct.

b. Minimising the number of bends required.

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

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

1.20 Mechanical ventilation systems must be commissioned in accordance with an approved procedure. See Section 4 of this approved document.

Indoor air quality monitoring

1.21 In new buildings, the following types of occupiable room, unless they are rooms of the size described in paragraph 1.22, should have a means of monitoring the indoor air quality. This may be achieved using CO_2 monitors or other means of measuring indoor air quality.

a. Occupiable rooms in offices.

b. Occupiable rooms where singing, loud speech or aerobic exercise or other aerosol generating activities are likely to take place. These may include rooms, for example, in gymnasiums, other indoor sports venues, dance studios, theatres, concert halls, public houses, nightclubs, places of assembly, as well as in other types of building.

c. Occupiable rooms where members of the public are likely to gather. These may include rooms, for example, in public buildings, hotels, gymnasiums, indoor sports venues, dance studios, theatres, concert halls, public houses, nightclubs, places of assembly, as well as in other types of building.

d. Occupiable rooms which are maintained at both low temperatures and low levels of humidity. These may include rooms used for chilled food processing and occupied cold stores.

1.22 The guidance in paragraph 1.21 does not apply to the following sizes of room.

a. Small spaces up to 125m^3 volume, or 50m^2 floor area.

b. Large spaces over 800m^3 in volume, or 320m^2 floor area.

1.23 Where CO_2 monitors are used, they should meet all of the following.

a. Be non-dispersive infrared (NDIR) type CO_2 monitors.

b. Be mains powered.

c. Be placed at breathing height and away from windows, doors or ventilation openings where practicable.

d. Be placed at least 500mm from people where practicable.

NOTE: Additional details on CO_2 monitoring for indoor air quality can be found in Appendix C.

Ventilation for offices

Extract ventilation for offices

1.24 Extract ventilation should be provided in offices in all the following areas.

a. Sanitary accommodation.

b. Bathrooms.

c. Washrooms.

d. Food and beverage preparation areas.

e. Rooms that are designed to contain printers and photocopiers in substantial use (more than 30 minutes per hour).

NOTE: Rooms that are designed to contain printers and photocopiers in substantial use (more than 30 minutes per hour) should not be designed to be occupied.

1.25 For rooms designed to contain printers and photocopiers in substantial use (more than 30 minutes per hour), both of the following should apply.

a. The air extract rate should be 20 litres per second per machine during use.

b. The whole building ventilation rate should be met.

1.26 Sanitary accommodation and bathrooms should have an intermittent air extract rate of both of the following.

a. 15 litres per second per shower or bath.

b. 6 litres per second per WC pan or urinal.

1.27 Extract ventilators in sanitary accommodation should be capable of continuous operation if required.

1.28 Food and drink preparation areas should have an intermittent air extract rate of either of the following.

a. If the area is *only* for using a microwave and preparing drinks: 15 litres per second.

b. If the area is for using a domestic-type hob or cooker, either of the following.

i. If the extract ventilator is adjacent to the hob/cooker: 30 litres per second.

ii. If the extract ventilator is remote from the hob/cooker: 60 litres per second.

NOTE: This guidance does not apply to commercial kitchens, which should follow the specific guidance in Table 1.1.

1.29 Specialist buildings and spaces should follow the guidance in Table 1.1.

1.30 For naturally ventilated offices that do not use mechanical supply and extract ventilation, both of the following should apply.

a. The locations of extract ventilators should be both of the following.

i. As high as practicable.

ii. A maximum of 400mm below the ceiling.

b. Where used, passive stack ventilation terminals should be located in the ceiling.

1.31 For a room with no openable window, the extract ventilation should operate both:

a. while the room is occupied

b. for a minimum of 15 minutes after occupants have left the room.

Whole building ventilation rates for offices

1.32 Outdoor air should be supplied for occupiable rooms in offices at whichever of the following will provide the higher total rate.

a. 10 litres per second per person.

b. 1 litre per second per m^2 floor area.

1.33 Common spaces in offices, including rooms or spaces used solely or mainly for circulation, such as corridors and lift lobbies, should be provided with either of the following.

a. Natural ventilation by appropriately located ventilation opening(s) with a total opening area of at least 1/50 of the floor area of the common space.

b. Mechanical ventilation installed to provide a supply of outdoor air of 0.5 litres per second per m^2 of floor area of the common space.

1.34 If there are significant levels of pollutants other than body effluents/odour, additional ventilation may be required. The calculation method provided in CIBSE's Guide A *Environmental Design* should be followed to determine the whole building ventilation rate.

Purge ventilation for offices

1.35 Each office should have the means to provide purge ventilation, to reduce pollutants before the office space is occupied or after activities such as painting.

The purged air should both:

a. be taken directly to the outside

b. *not* be recirculated to any other part of the building.

Controls for offices

1.36 Controls should be provided for ventilators so that the ventilation in each room can be adjusted. For mechanical supply and extract ventilation, either manual controls or automatic controls are acceptable.

Recirculation of air within ventilation systems in offices

1.37 Ventilation systems that, under normal operation, recirculate air between more than one space, room or zone should also be able to operate in a mode that reduces the risk of the transmission of airborne infection. This can be achieved by one or more of the following.

a. Systems capable of providing 100% outdoor air to the levels specified in paragraphs 1.32 to 1.34 to all occupiable rooms and common spaces, without recirculating air.

b. Systems incorporating a UV-C germicidal irradiation system that is able to disinfect the air that is being recirculated. This type of system is commonly located within the heating, ventilation and air conditioning (HVAC) system or ductwork.

c. Systems designed so that they can incorporate HEPA filters, if required, which are able to provide filtration of the recirculated air.

NOTE: For some system types some recirculation is necessary or desirable in normal operation. Use of any full outdoor air mode, UV-C germicidal irradiation or HEPA filtration may not be necessary under normal conditions of operation.

Ventilation of car parks

1.38 For car parks below ground level, enclosed car parks and multi-storey car parks, the ventilation rate should be designed, and equipment installed, to limit carbon monoxide to both of the following.

a. Average concentration: a maximum of 30 parts per million over an eight-hour period.

b. Peak concentration, such as by ramps and exits: a maximum of 90 parts per million over a 15-minute period.

NOTE: Guidance on the ventilation of car parks to manage the risk of fire is given in Approved Document B.

1.39 As an alternative to paragraph 1.38, either of the following may be considered to provide adequate ventilation.

a. If the car park has natural ventilation, openings at each car parking level should comply with both of the following.

   i. Have a minimum aggregate equivalent area of 1/20 of the floor area at that level.

   ii. Have a minimum of 25% of the aggregate equivalent area on each of two opposing walls.

b. If the car park has mechanical ventilation, either of the following should apply.

   i. All of the following.

   - Permanent natural ventilation openings with a minimum equivalent area of 1/40 of the floor area.
   - A mechanical ventilation system capable of at least three air changes per hour.
   - For exits and ramps, where cars queue inside the building, provision to ensure a local ventilation rate of at least ten air changes per hour.

   ii. Both of the following.

   - For a car park in a basement, the provision of a mechanical ventilation system capable of at least six air changes per hour.
   - For exits and ramps, where cars queue inside the building, provision to ensure a local ventilation rate of at least ten air changes per hour.

1.40 Further guidance can be found in the following documents.

a. The Association of Petroleum and Explosives Administrations' *Code of Practice for Ground Floor, Multi Storey and Underground Car Parks*.

b. CIBSE's Guide B2 *Ventilation and Ductwork*.

c. The Health and Safety Executive's publication EH40/2005 *Workplace Exposure Limits*.

d. ASHRAE's *ASHRAE Handbook – HVAC Applications*, chapter 16 'Enclosed Vehicular Facilities'.

Ventilation for buildings other than offices and car parks

1.41 Adequate means of ventilation in buildings other than offices and car parks may be demonstrated by meeting the relevant standards set out in CIBSE's Guide A. Sources of further guidance, and relevant regulations, are listed in Table 1.1.

NOTE: For residential non-domestic buildings within the scope of Part O of the Building Regulations (overheating), higher purge ventilation rates may be required.

Table 1.1 Ventilation for buildings other than offices and car parks

Building/space/activity	Regulations and guidance (also see CIBSE's Guide A and Appendices D and E)
Animal rooms	CIBSE Guide B2 *Ventilation and Ductwork* (2016) *Code of Practice for the Housing and Care of Animals Bred, Supplied or Used for Scientific Purposes* (Home Office, 2014)
Building services plant rooms	Dangerous Substances and Explosive Atmospheres Regulations 2002 Provision for emergency ventilation to control dispersal of contaminating gas releases (e.g. refrigerant leak) is given in paragraphs 23 to 25 of HSE Guidance Note HSG 202 *General Ventilation in the Workplace – Guidance for Employers*. **BS EN 378-3** *Refrigerating systems and heat pumps. Safety and environmental requirements – Installation site and personal protection* Follow manufacturers' guidance for adequate provision of air for service equipment.
Catering and commercial kitchens	HSE Catering Information Sheet No. 10: *Ventilation in catering kitchens* (2017) BESA DW 172 *Specification for Kitchen Ventilation Systems* (2018) CIBSE Guide B2 *Ventilation and Ductwork* (2016)
Cleanrooms	CIBSE Guide B2 *Ventilation and Ductwork* (2016)
Common spaces[1]	Either: a. natural ventilation by appropriately located ventilation opening(s) with a total opening area of at least 1/50 of the floor area of the common space b. mechanical ventilation installed to provide a supply of fresh air of 0.5 litres per second per m^2 of floor area.
Data centres	CIBSE Guide B2 *Ventilation and Ductwork* (2016)
Dealing rooms	CIBSE Guide B2 *Ventilation and Ductwork* (2016)
Factories and workshops	Control of Substances Hazardous to Health (COSHH) Regulations 2002 Factories Act 1961 Health and Safety at Work etc. Act 1974 BESA TR 40 *Guide to Good Practice for Local Exhaust Ventilation* (2020) CIBSE Guide B2 *Ventilation and Ductwork* (2016) **NOTE:** Requirements are often exceeded by other criteria, such as the ventilation requirements of the particular manufacturing process.
Farms	Welfare of Farmed Animals (England) Regulations 2007 **BS 5502** *Buildings and structures for agriculture*
Gymnasiums	Sport England Design Guidance Note: *Fitness and Exercise Spaces* (2008)
Healthcare buildings: non-surgical	CIBSE Guide B2 *Ventilation and Ductwork* (2016) NHS Activity DataBase Health Technical Memorandum (HTM) 03-01 (Department of Health) Health Building Notes (HBN) – various (Department of Health)
Hospitals	CIBSE Guide B2 *Ventilation and Ductwork* (2016) NHS Activity DataBase Health Technical Memorandum (HTM) 03-01 (Department of Health) Health Building Notes (HBN) – various (Department of Health)
Hotels	CIBSE Guide B2 *Ventilation and Ductwork* (2016)

Table 1.1 Continued

Building/space/activity	Regulations and guidance (also see CIBSE's Guide A and Appendices D and E)
Industrial ventilation	*Industrial Ventilation: A Manual of Recommended Practice for Design* (American Conference of Government Industrial Hygienists, 2019) *Industrial Ventilation: A Manual of Recommended Practice for Operation and Maintenance* (American Conference of Government Industrial Hygienists, 2020) HSG 258 *Controlling Airborne Contaminants at Work* (HSE, 2017)
Museums, libraries and art galleries	**BS 4971** *Conservation and care of archive and library collections* **BS EN 16893** *Conservation of Cultural Heritage. Specifications for location, construction and modification of buildings or rooms intended for the storage or use of heritage collections*
Places of assembly	CIBSE Guide B2 *Ventilation and Ductwork* (2016)
Prison cells	PSI 17/2012 *Certified Prisoner Accommodation* (Ministry of Justice, 2012)
Sanitary accommodation	Same as for offices in paragraph 1.26: sanitary accommodation should have an intermittent air extract rate of both of the following. a. 15 litres per second per shower or bath. b. 6 litres per second per WC pan or urinal. Extract ventilators in sanitary accommodation should be capable of continuous operation if required.
Schools and education	Education (School Premises) Regulations 1999 Building Bulletin 101 *Guidelines on Ventilation, Thermal Comfort and Indoor Air Quality in Schools* (ESFA, 2018) 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 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 that require containment or fume extraction. Building Bulletin 101 can also be used for children's centres and other early years settings, including day nurseries, playgroups, etc.
Shops and general retail premises	CIBSE Guide B2 *Ventilation and Ductwork* (2016)
Sports centres and swimming pools	CIBSE Guide B2 *Ventilation and Ductwork* (2016) Sport England *Sports Halls Design and Layouts: Updated and Combined Guidance* (2012)
Supermarkets and food stores	CIBSE Guide B2 *Ventilation and Ductwork* (2016)
Transportation buildings and facilities	CIBSE Guide B2 *Ventilation and Ductwork* (2016)

NOTE:

1. Common spaces are as defined in Appendix A.

Section 2: Minimising the ingress of external pollutants

2.1 Ventilation systems should be designed to minimise the intake of external air pollutants following paragraphs 2.2 to 2.6 if either of the following applies.

a. The pollutant values in the location of the building exceed any of the limits in Table 2.1. This may have been determined through an air quality assessment. Where modelling or monitoring data is required, expert advice should be sought.

b. The building is located near to any of the following sources of significant local pollution.

i. Road traffic, including traffic junctions and underground car parks.

ii. Combustion plant (such as heating appliances) running on conventional fuels, most commonly natural gas.

iii. Other combustion processes (for example, waste incineration, thermal oxidation abatement systems).

iv. Discharges from industrial processes.

v. Fugitive (i.e. not effectively controlled) discharges from industrial processes and other sources.

vi. Exhaust discharges from building ventilation systems.

vii. Construction and demolition sites, which are a source of particles and vaporous discharges.

viii. Other significant sources of local air pollution which may be detrimental to health.

Table 2.1 Limit values from Schedule 2 to the Air Quality Standards Regulations 2010

Pollutant	Exposure limit	Exposure time
Carbon monoxide	10mg/m^3	8-hour average
Sulphur dioxide	350µg/m^3	1-hour average
	125µg/m^3	1-day average
Nitrogen dioxide	200µg/m^3	1-hour average
	40µg/m^3	1-year average
Benzene	5µg/m^3	1-year average
Lead	0.5mg/m^3	1-year average
$PM_{2.5}$	25µg/m^3	1-year average
PM_{10}	50µg/m^3	1-day average
	40µg/m^3	1-year average

NOTE: This section only gives guidance for typical situations. Expert advice may also be able to provide additional guidance on the suitability of other technologies to minimise the intake of external air pollutants, including filtration.

NOTE: The Building Research Establishment's *Ventilation for Healthy Buildings: Reducing the Impact of Urban Air Pollution* provides guidance on minimising the ingress of external pollutants into non-domestic urban buildings.

Control of ventilation intakes

2.2 Ventilation intakes should be located away from the direct impact of the sources of local pollution.

NOTE: CIBSE's TM64 and TM40 give further guidance.

2.3 Where urban traffic is a source of pollution, the air intakes for buildings next to busy urban roads should be both of the following.

a. As high as possible.

b. Located on the less polluted side of the building.

Mechanical ventilation may be the most practical way of achieving this requirement.

2.4 If practicable, ventilation intakes should not be located in courtyards or enclosed urban spaces where air pollutants are discharged. If this is unavoidable, intakes should be located to meet both of the following conditions.

a. As far as possible from the source of pollutants.

b. In an open or well-ventilated area.

2.5 In areas where wind often comes from opposing directions (e.g. a valley), the air intakes should point in the opposite direction to the exhaust outlets.

2.6 Where sources of pollution vary with the time of day, such as urban road traffic, it may be acceptable, for time-limited periods, to take one of the following actions.

a. Reduce the flow of external air into ventilation intakes.

b. Close ventilation intakes when the concentrations of external pollutants are highest.

NOTE: In these circumstances, expert advice should be sought.

Location of exhaust outlets

2.7 Exhaust outlets should be located so that both of the following are achieved.

a. Re-entry of exhaust air into a building, or entry into nearby buildings, is minimised.

b. There is no harmful effect on the surrounding area.

2.8 Where there is a prevailing wind direction, exhaust outlets should be downwind of intakes.

2.9 Exhaust outlets should not discharge into any of the following.

a. Courtyards.

b. Enclosures.

c. Architectural screens.

NOTE: Chapter 13 of McGraw Hill's *Indoor Air Quality Handbook* provides further guidance.

Section 3: Work on existing buildings

General

3.1 When building work in an existing building includes work on ventilation, for example:

a. building an extension

b. adding a wet room

c. replacing part of the ventilation system

the work should meet the relevant standards in this approved document.

3.2 When other building work is carried out that will affect the ventilation of the existing building, for example:

a. replacing windows or doors

b. doing energy efficiency work

the ventilation of the building should either:

a. meet the standards in the relevant approved document

b. not be less satisfactory than before the work was carried out.

NOTE: Ventilation through infiltration should be considered to be part of the ventilation provision of a building. Reducing infiltration might reduce the indoor air quality of the building below the standards given in Appendix B.

3.3 When a building undergoes a material change of use, Part F of Schedule 1 to the Building Regulations applies to the building or part of the building that has changed use. Guidance in Section 1 should be followed.

NOTE: Ventilation equipment is considered to be a 'controlled service or fitting' and providing or extending this equipment in or in connection with a building is considered to be building work.

NOTE: Some building work does not need to be notified to the local authority. Details of such work are set out in the *Manual to the Building Regulations*.

3.4 If work is carried out which increases the energy efficiency of a building, airtightness may be increased. In these circumstances, any useful ventilation which was lost should be replaced in order to maintain a healthy indoor environment. When carrying out work which is likely to increase the airtightness of the building, it should be demonstrated to the building control body that the work meets the requirements of Part F1(1), where it is an applicable requirement. Refer to paragraphs 3.1 and 3.2 for the relevant standards that should be met. For domestic-type installation of common energy efficiency measures in existing buildings, Approved Document F, Volume 1: Dwellings contains guidance on meeting the requirements of Part F of the Building Regulations.

Replacing windows

Existing windows with background ventilators

3.5 If the existing windows have background ventilators, the replacement windows should include background ventilators. The new background ventilators should comply with the following conditions.

a. Not be smaller than the background ventilators in the original window.

b. Be controllable either automatically or by the occupant.

If the size of the background ventilators in the existing window is not known, the ventilator sizes in paragraph 3.6 may be applied.

Existing windows without background ventilators

3.6 Replacing the windows is likely to increase the airtightness of the building. If ventilation is not provided via a mechanical ventilation system, then increasing the airtightness of the building may reduce beneficial ventilation in the building. In these circumstances, it is necessary to ensure that the ventilation provision in the building is no worse than it was before the work was carried out. This may be demonstrated in any of the following ways.

a. Incorporating background ventilators in the replacement windows equivalent to the following.

i. Occupiable rooms.

- For floor areas up to 10m^2 – minimum 2500mm^2 equivalent area.
- For floor areas greater than 10m^2 – minimum 250mm^2 equivalent area per m^2 of floor area.

ii. Domestic-type kitchen – minimum 8000mm^2 equivalent area.

iii. Bathroom (with or without a toilet) and shower rooms – minimum 4000mm^2 equivalent area per bath or shower.

iv. Sanitary accommodation (and/or washing facilities) – minimum 2000mm^2 equivalent area per WC.

b. Other ventilation provisions, if it can be demonstrated to a building control body that they comply with the requirements of paragraph 3.2.

NOTE: If it is not technically feasible to adopt the minimum equivalent areas set out in paragraph 3.6, the background ventilators should have equivalent areas as close to the minimum value as is feasible.

NOTE: If an exposed façade is close to an area of sustained and loud noise (e.g. a main road), then a noise attenuating background ventilator should be fitted.

ONLINE VERSION

Requirement F1(2) and regulations 39 and 44

This section deals with the requirements of Part F1(2) of Schedule 1 and regulations 39 and 44 of the Building Regulations 2010.

Requirement

Requirement

F1. (2) Fixed systems for mechanical ventilation and any associated controls must be commissioned by testing and adjusting as necessary to secure that the objective referred to in sub-paragraph (1) is met.

Limits on application

Requirement F1 does not apply to a building or space within a building:

a. into which people do not normally go;

b. which is used solely for storage; or

c. which is a garage used solely in connection with a single dwelling.

Regulations

Information about ventilation

39. (1) This regulation applies where paragraph F1(1) of Schedule 1 imposes a requirement in relation to building work.

(2) The person carrying out the work shall not later than five days after the work has been completed give sufficient information to the owner about the building's ventilation system and its maintenance requirements so that the ventilation system can be operated in such a manner as to provide adequate means of ventilation.

Commissioning

44. (1) This regulation applies to building work in relation to which paragraph F1(2) of Schedule 1 imposes a requirement, but does not apply to the provision or extension of any fixed system for mechanical ventilation or any associated controls where testing and adjustment is not possible.

(2) This regulation also applies to building work in relation to which paragraph L1(b) of Schedule 1 imposes a requirement, but does not apply to the provision or extension of any fixed building service where testing and adjustment is not possible or would not affect the energy efficiency of that fixed building service.

(3) Where this regulation applies the person carrying out the work shall, for the purpose of ensuring compliance with paragraph F1(2) or L1(b) of Schedule 1, give to the local authority a notice confirming that the fixed building services have been commissioned in accordance with a procedure approved by the Secretary of State.

(4) The notice shall be given to the local authority—

(a) not later than the date on which the notice required by regulation 16(4) is required to be given; or

(b) where that regulation does not apply, not more than 30 days after completion of the work.

NOTE: Where the building control body is an approved inspector, see regulation 20 of the Building (Approved Inspectors etc.) Regulations 2010 (as amended).

ONLINE VERSION

ONLINE VERSION

Intention

In the Secretary of State's view, requirement F1(2) and regulation 44 are met if building work that involves installing a mechanical ventilation system, for a new or an existing building, follows the guidance in paragraphs 4.1 to 4.3 to achieve all of the following.

a. All fixed mechanical ventilation systems for which testing and adjustment is possible are tested and commissioned.

b. Commissioning results show that systems are operating as required to achieve adequate ventilation, including achieving the flow rates specified in this approved document.

c. Commissioning results show that controls are operating as required to achieve adequate ventilation.

d. The person carrying out the work gives notice to the building control body and building owner that commissioning has been carried out following the procedure given in this document.

In the Secretary of State's view, when building work that affects ventilation is carried out, the requirements of regulation 39 are met if the installer provides clear and simple written guidance for the building owner on how to operate and maintain the ventilation system, as described in paragraphs 4.4 to 4.9.

ONLINE VERSION

ONLINE VERSION

Section 4: Commissioning and providing information

Commissioning of ventilation systems

4.1 Mechanical ventilation systems must be commissioned to provide adequate ventilation. A commissioning notice must be given to the building control body.

4.2 Commissioning should be carried out in accordance with CIBSE's Commissioning Code M.

4.3 Ventilation ductwork commissioning should take account of guidance in BESA's DW 144 for metal ductwork, DW 154 for plastic ductwork and DW 143 for ductwork air leakage testing.

NOTE: When mechanical ventilation is commissioned, the use of fuel and power should also be considered in accordance with Part L of the Building Regulations (L1(b) of Schedule 1). Installers may provide notice of commissioning to cover Part F (F1(2) of Schedule 1) and Part L in the same document.

Operating and maintenance instructions

4.4 Sufficient information about the ventilation system and its maintenance requirements must be given to the building owner to allow the system to be operated effectively. This should include both design flow rates and maintenance requirements.

4.5 For new and existing buildings other than dwellings, information should be provided in a new or existing building log book. The log book should follow the guidance in CIBSE's TM31. Guidance on building log books is given in Approved Document L, Volume 2: Buildings other than dwellings.

4.6 A copy of the completed commissioning sheet should be given to the owner of the building.

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

4.8 The following information should be provided where relevant.

a. Manufacturer's contact details.

b. That background ventilators allow fresh air into the building and should be left open.

c. The location of automatic controls and how to set them.

d. The location of manual controls for the on/off and high rate settings for a mechanical ventilation system and how to use them.

e. How cleaning and maintenance of the system and its components should be carried out. This includes the location and specification of filters and how to assess when to replace filters.

f. How to access ducts for cleaning, how to undertake cleaning of plant and ducts and the intervals at which cleaning should be undertaken.

ONLINE VERSION

ONLINE VERSION

g. The location of sensors and how to recalibrate them.

h. Design flow rates.

i. The use of and interpretation of results from CO_2 or other air quality monitoring sensors.

j. Adjustment of outdoor air rate for recirculating systems.

k. Operation, maintenance and safety of any UV-C germicidal irradiation system installed.

4.9 The operation and maintenance information should also contain relevant manufacturers' literature, including the following, where relevant.

a. Component specifications.

b. Installation guidance.

c. Operating instructions.

d. Maintenance schedules.

e. Guarantees.

f. Registration card.

g. Spare part lists.

h. Instructions for obtaining spare parts.

ONLINE VERSION

A

Appendix A: Key terms

Except for the items marked * (which are from the Building Regulations 2010), these definitions apply only to Approved Document F, Volume 2: Buildings other than dwellings.

Air permeability The measure of airtightness of the building fabric. It is defined as the air leakage rate per hour per m^2 of envelope area at the test reference pressure differential of 50Pa.

Airtightness The resistance of the building envelope to infiltration when ventilators are closed. The greater the airtightness at a given pressure difference across the envelope, the lower the infiltration.

Automatic controls A system whereby a ventilation device is adjusted by a mechanical or electronic controller that responds to a relevant stimulus. That stimulus usually relates to the humidity of the air in a room, pollutant levels, occupancy of the space or pressure difference across the device.

Background ventilator A small ventilation opening designed to provide controllable whole building ventilation.

Bathroom A room that contains a bath or shower and which can also include sanitary accommodation.

Building control body A local authority or an approved inspector.

Common space A space where large numbers of people are expected to gather (e.g. a shopping mall or foyer of a cinema or theatre) or which is used mainly for circulation in buildings which do not contain dwellings (e.g. a corridor or lift lobby in an office building). This does not include areas used solely or principally for circulation in buildings containing dwellings, including corridors or lift lobbies in blocks of flats.

Continuous operation Uninterrupted running of a mechanical ventilation device, such as mechanical extract ventilation or mechanical supply and extract ventilation. The air flow rate provided by mechanical ventilation need not be constant but may be varied, under either manual or automatic control, in response to the demand for removal of pollutants or water vapour.

Dwelling A self-contained unit designed to accommodate a single household.

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

Expert advice Advice from a suitably qualified competent person. Examples from the ventilation industry of a person competent to give expert advice include a chartered or professional engineer, a building services specialist, a specialist ventilation manufacturer or members of professional trade bodies.

Extract ventilation The removal of air directly from an internal space or spaces to the outside. Extract ventilation may be by natural means or by mechanical means (e.g. by an extract fan or a central system).

Free area The geometric open area of a ventilator.

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

Infiltration The uncontrolled exchange of air between the inside and outside of a building, through gaps and cracks.

Intermittent operation When a mechanical ventilator does not run all the time, usually running only 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.

ONLINE VERSION

Manual controls A system whereby 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 (see automatic controls).

***Material change of use** Defined in regulation 5 as:

Where there is a change in the purposes for which or the circumstances in which a building is used, so that after that change:

a. the building is used as a dwelling, where previously it was not;
b. the building contains a flat, where previously it did not;
c. the building is used as an hotel or a boarding house, where previously it was not;
d. the building is used as an institution, where previously it was not;
e. the building is used as a public building, where previously it was not;
f. the building is not a building described in classes 1 to 6 in Schedule 2, where previously it was;
g. the building, which contains at least one dwelling, contains a greater or lesser number of dwellings than it did previously;
h. the building contains a room for residential purposes, where previously it did not;
i. the building, which contains at least one room for residential purposes, contains a greater or lesser number of such rooms than it did previously;
j. the building is used as a shop, where it previously was not; or
k. the building is a building described in regulation 7(4)(a), where previously it was not.

Mechanical supply and extract ventilation Any mechanically driven ventilation that both continuously supplies outdoor air to the inside of the building and continuously extracts indoor air and discharges it to the outside. This includes decentralised supply and extract ventilation, and mechanical ventilation with heat recovery (MVHR, a mechanical supply and extract ventilation system that includes a heat recovery mechanism).

Natural ventilation Ventilation provided by thermal, wind or diffusion effects through doors, windows or other intentional openings without the use of mechanically driven equipment. For the purposes of this approved document, a natural ventilation strategy may include decentralised extract ventilation from rooms where water vapour or pollutants are likely to be released to minimise their spread to the rest of the building.

Occupiable room A room in a building other than a dwelling that is occupied by people, such as an office, workroom, classroom or hotel bedroom. The following are not occupiable rooms: bathrooms, sanitary accommodation, utility rooms or rooms or spaces used solely or mainly for circulation, building services plant or storage purposes.

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

Purge ventilation Manually controlled ventilation of rooms or spaces at a relatively high rate to rapidly dilute pollutants and/or disperse water vapour. Purge ventilation may be provided by natural means (e.g. an openable window) or 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. background ventilators, PSV, extract fans, mechanical ventilation or air-conditioning systems).

***Room for residential purposes** Defined in regulation 2(1) as a room, or a suite of rooms, which is not a dwelling-house or a flat and which is used by one or more persons to live and sleep and includes a room in a hostel, an hotel, a boarding house, a hall of residence or a residential home, but does not include a room in a hospital, or other similar establishment, used for patient accommodation.

ONLINE VERSION

Sanitary accommodation A space containing one or more flush toilets (WCs) or urinals. Sanitary accommodation containing one or more cubicles counts as one space if there is free circulation of air throughout the space.

Shared communal rooms Rooms in buildings containing dwellings, which provide facilities for the residents, for example a laundry room, occupied lobby or gym. This does not include areas used solely or principally for circulation in buildings containing dwellings, including corridors or lift lobbies.

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

Thermal envelope The combination of thermal elements of a building which enclose a particular conditioned indoor space or groups of indoor spaces.

Utility room A room containing a sink or other feature or equipment that may reasonably be expected to produce significant quantities of water vapour.

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 permanent or closable) that opens directly to external air, such as the openable parts of a window, a louvre or a background ventilator. It also includes any door that opens directly to external air.

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 extract ventilation, purge ventilation or infiltration, as well as to supply outdoor air into the building.

ONLINE VERSION

Appendix B: Performance-based ventilation

Introduction

B1 This appendix sets out the levels of moisture and other pollutants that the provisions in this approved document are designed to control. The provisions are designed to control all of the following.

a. Bio-effluents, as described in paragraph B2a.

b. Moisture levels, as described in paragraph B2b.

c. Indoor air pollutants, as described in paragraph B2d.

NOTE: The guidance in this approved document may not be adequate to address pollutants from flueless combustion space heaters. This approved document does not directly address contamination from outdoor sources.

NOTE: A strategy for achieving good indoor air quality includes reducing the release of water vapour and air pollutants. This approved document does not provide guidance on such strategies.

Performance criteria for buildings other than dwellings

B2 The main guidance within this approved document focuses on offices. The main performance criteria applied are as follows.

a. There should be a supply rate, in the absence of tobacco smoke or other excessive pollutants, of 10 litres per second per person. This will also satisfy the requirement of 8 litres per second per person needed to control higher levels of bio-effluents.

b. There should be no visible mould on the inner surfaces of external walls of a properly heated building with typical moisture generation.

c. Mould can grow whether the building is occupied or unoccupied, so the performance criteria for surface water activity (as given in Table B2) should be met at all times, regardless of whether there are occupants. The other pollutants listed in Table B1 are only of concern when the building is occupied.

d. The performance criteria for indoor air pollutants are given in Table B1.

ONLINE VERSION

Table B1 Indoor air pollutants guidance values[1][2]

Pollutant	Exposure limit	Exposure time	Guidance
Carbon monoxide (CO)	100mg/m^3	15-minute average	WHO, 2010
	30mg/m^3	1-hour average	WHO, 2010
	35mg/m^3 (occupational exposure)	8-hour average	HSE, 2020
Nitrogen dioxide (NO_2)	200µg/m^3	1-hour average	WHO, 2010
	40µg/m^3	1-year average	WHO, 2010
Formaldehyde (CH_2O)	100µg/m^3	30-minute average	WHO, 2010
	10µg/m^3	1-year average	PHE, 2019
TVOC[3]	300µg/m^3	8-hour average	ECA, 1992/WHO, 2010
Ozone	100µg/m^3		DETR, 1994

NOTES:

1. No safe levels can be recommended for benzene or trichloroethylene so they have not been considered in the definition of ventilation rates in buildings. The best strategy for reducing their concentration indoors may be to control them at source.
2. Even if the designer and builder choose to reduce volatile organic compound (VOC) levels in buildings by controlling them at source, the ventilation requirements must still be met.
3. The total volatile organic compound (TVOC) metric is representative of all airborne indoor air VOC concentrations and should not be used as a direct indicator of health. The simplified metric is used as an indicator for the purposes of ventilation control strategies. As an alternative to the TVOC limit, individual VOC limits may be used where justified in accordance with the guidance in paragraph B3.

B3 As an alternative to using TVOC, the individual VOCs may be applied where their use is supported by robust independent evidence. Public Health England's *Indoor Air Quality Guidelines for Selected Volatile Organic Compounds (VOCs) in the UK* should be used. Testing against these metrics is likely to be more complex than testing against TVOC.

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

ONLINE VERSION

Assumptions used in applying performance criteria for offices in Section 1

General

B4 For the purposes of this approved document, for all offices (both new and existing, where Part F applies), the moisture criteria are likely to be met if, during the colder months of the year, the moving average surface water activity of the internal surfaces of external walls is always less than the value in Table B2, evaluated over each moving average period.

Table B2 Surface water activity

Moving average period	Surface water activity
1 month	0.75
1 week	0.85
1 day	0.95

Extract ventilation

B5 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 use in an hour.

a. 25mg/h for TVOC.

b. 3mg/h for ozone.

To meet the performance criteria for these pollutants requires an extract rate of 20 litres per second per machine during use.

B6 For sanitary accommodation, the extract rates used for dwellings have been applied.

B7 For food and beverage preparation areas, the extract rates used for dwellings have been applied.

ONLINE VERSION

Appendix C: CO_2 monitoring

NOTE: The guidance in this appendix is based on the Scientific Advisory Group for Emergencies (SAGE) EMG/SPI-B advisory group paper *Application of CO_2 monitoring as an approach to managing ventilation to mitigate SARS-CoV-2 transmission.*

People exhale carbon dioxide (CO_2) when they breathe out. If there is a build-up of CO_2 in an area it can indicate that ventilation needs to be improved.

Checking levels of CO_2 using a monitor can help to identify areas that are poorly ventilated.

Types of CO_2 monitor to use

Many different types of CO_2 monitor are available. The most appropriate portable devices for use in the workplace are non-dispersive infrared (NDIR) CO_2 monitors.

How to use a CO_2 monitor

The level of CO_2 in the air will vary within an indoor space. It is best to place CO_2 monitors at head height and away from windows, doors or air supply openings.

Monitors that are positioned too close to people may give a misleadingly high reading due to the CO_2 in exhaled breath. Monitors should therefore be positioned at least 500mm away from room occupants.

Measured levels of CO_2 within a space can vary throughout the day due to changes in number of occupants, activities being performed or ventilation rates in the space. The opening and closing of doors and windows can also have an effect.

The amount of CO_2 in the air is measured in parts per million (ppm). If measurements in an occupied space seem very low (far below 400ppm) or very high (over 1500ppm), it is possible that the monitor is not in a suitable location. The monitor may need to be moved to another position within the space, to get a more accurate reading.

Instantaneous or 'snapshot' CO_2 readings can be misleading, so several measurements should be taken throughout the day. The frequency of measurements should be sufficient to ensure that changes in the use of the room or space throughout the day are represented in the readings. Levels of CO_2 may also vary throughout the year, as outdoor temperatures, and therefore behaviour relating to opening windows and doors, change.

How to get the most accurate readings

a. Check that monitors are within the recommended calibration period.

b. Follow the manufacturer's instructions, including allowing the appropriate warm-up time for the device to stabilise

c. Know how to use the monitor correctly, including the time needed to provide a reading.

d. Take measurements at key times throughout the working day.

e. Record CO_2 readings, number of occupants, the type of ventilation in use at the time and the date. These will help you use the CO_2 records to decide if an area is poorly ventilated.

ONLINE VERSION

How the measurements can help you take action

CO_2 measurements should be used as a broad guide to ventilation within a space, rather than treated as 'safe thresholds'.

Outdoor levels are around 400ppm. A consistent indoor CO_2 value of less than 800ppm is likely to indicate that a space is well ventilated.

An average CO_2 concentration of 1500ppm over the period when a space is occupied is an indicator of poor ventilation. Action should be taken to improve ventilation if CO_2 readings are consistently higher than 1500ppm.

However, in locations where continuous talking or singing takes place, or there are high levels of physical activity (such as dancing, playing sport or exercising), providing ventilation sufficient to keep CO_2 levels below 800ppm is recommended.

Where CO_2 monitors will be less effective

CO_2 monitors may not be suitable for use in areas that rely on air-cleaning units because these remove contaminants from the air but do not remove CO_2.

In large, open spaces and spaces with high ceilings, such as food production halls or warehouses, air may not be fully mixed and the measurements made by CO_2 monitors may not be representative.

CO_2 monitors are of limited use in less populated areas.

ONLINE VERSION

Appendix D: Standards referred to

BS 4971 Conservation and care of archive and library collections [2017]

BS 5502 Buildings and structures for agriculture. Various relevant parts, including:

> **BS 5502-33** Guide to the control of odour pollution [1991 + AMD 10014]
>
> **BS 5502-52** Code of practice for design of alarm systems, emergency ventilation and smoke ventilation for livestock housing [1991 + AMD 10014]

BS EN 378-3 Refrigerating systems and heat pumps. Safety and environmental requirements – Installation site and personal protection [2016 + A1: 2020]

BS EN 13141-1 Ventilation for buildings. Performance testing of components/products for residential ventilation. Externally and internally mounted air transfer devices [2019]

BS EN 16893 Conservation of Cultural Heritage. Specifications for location, construction and modification of buildings or rooms intended for the storage or use of heritage collections [2018]

ONLINE VERSION

Appendix E: Documents referred to

Legislation

(available via www.legislation.gov.uk)

Air Quality Standards Regulations 2010, SI 2010/1001

Ancient Monuments and Archaeological Areas Act 1979, c. 46

Control of Substances Hazardous to Health Regulations 2002, SI 2002/2677

Dangerous Substances and Explosive Atmospheres Regulations 2002, SI 2002/2776

Education (School Premises) Regulations 1999, SI 1999/2

Factories Act 1961, c. 34

Health and Safety at Work etc. Act 1974, c. 37

Planning (Listed Buildings and Conservation Areas) Act 1990, c. 9

Welfare of Farmed Animals (England) Regulations 2007, SI 2007/2078

Other documents

American Conference of Government Industrial Hygienists (ACGIH)

(acgih.org)

Industrial Ventilation: A Manual of Recommended Practice for Design. Thirtieth Edition [2019]

Industrial Ventilation: A Manual of Recommended Practice for Operation and Maintenance. Second Edition [2020]

American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

(ashrae.org)

ASHRAE Handbook – HVAC Applications [2019]

Association of Petroleum and Explosives Administrations (APEA)

(apea.org.uk)

Code of Practice for Ground Floor, Multi Storey and Underground Car Parks. Second Edition [1995]

Building and Engineering Services Association (BESA)

(thebesa.com)

BESA DW 143 *Guide to Good Practice – Ductwork Air Leakage Testing* [2013]

BESA DW 144 *Specification for Sheet Metal Ductwork* [2016]

BESA DW 154 *Specification of Plastics Ductwork* [2000]

BESA DW 172 *Specification for Kitchen Ventilation Systems* [2018]

BESA TR 40 *Guide to Good Practice for Local Exhaust Ventilation* [2020]

Building Research Establishment (BRE)

(www.bre.co.uk)

Ventilation for Healthy Buildings: Reducing the Impact of Urban Air Pollution [2011]

Building Services Research and Information Association (BSRIA)

(www.bsria.com)

BG 43 *Flexible Ductwork: A Guide to Specification, Procurement, Installation and Maintenance* [2013]

Chartered Institution of Building Services Engineers (CIBSE)

(www.cibse.org)

AM10 *Natural Ventilation in Non-domestic Buildings* [2005]

AM13 *Mixed Mode Ventilation* [2000]

Commissioning Code M *Commissioning Management* [2003]

Guide A *Environmental Design* [2015]

Guide B2 *Ventilation and Ductwork* [2016]

TM31 *Building Log Book Toolkit* [2006]

TM40 *Health and Wellbeing in Building Services* [2020]

TM64 *Operational Performance: Indoor Air Quality – Emissions Sources and Mitigation Measures* [2020]

Department for Environment, Transport and the Regions (DETR)

Expert Panel on Air Quality Standards: Ozone [1994]

Department of Health Estates and Facilities Division (part of NHS Digital)

HTM 03-01 *Specialised Ventilation for Healthcare Premises: Part A – Design and validation* [2021]

HTM 03-01 *Specialised Ventilation for Healthcare Premises: Part B – Operational Management and Performance Verification* [2007]

Health Building Notes (various). Available at: https://www.england.nhs.uk/estates/health-building-notes

Education and Skills Funding Agency (ESFA)

(www.gov.uk/esfa)

Building Bulletin 101: *Guidelines on Ventilation, Thermal Comfort and Indoor Air Quality in Schools* [2018]. Available at: https://www.gov.uk/government/publications/building-bulletin-101-ventilation-for-school-buildings

European Concerted Action (ECA) on Indoor Air and its Impact on Man

Guidelines for Ventilation Requirements in Buildings. Working Group Report No. 11. EUR 14449 EN [1992]

Health and Safety Executive (HSE)

(hse.gov.uk)

HSE Catering Information Sheet No. 10, *Ventilation in catering kitchens* [2017]

EH40/2005 *Workplace Exposure Limits. Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations 2002 (as amended).* Fourth Edition [2020]

HSG 258 *Controlling Airborne Contaminants at Work. A Guide to Local Exhaust Ventilation (LEV).* Third Edition [2017]

HSG 202 *General Ventilation in the Workplace – Guidance for Employers* [2000]

Home Office

Code of Practice for the Housing and Care of Animals Bred, Supplied or Used for Scientific Purposes [2014]. Available at: https://www.gov.uk/government/publications/code-of-practice-for-the-housing-and-care-of-animals-bred-supplied-or-used-for-scientific-purposes

McGraw-Hill Education

(www.mheducation.com)

John Spengler, John McCarthy and Jonathan Samet, *Indoor Air Quality Handbook* [2001]

Ministry of Housing, Communities and Local Government (MHCLG)

Manual to the Building Regulations: A Code of Practice for Use in England [2020]

Ministry of Justice

(www.gov.uk/moj)

PSI 17/2012 *Certified Prisoner Accommodation* [2012]

National Health Service

Activity DataBase. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/148547/ADB_2012_Getting_Started_Guide.doc

Public Health England (PHE)

(www.gov.uk/phe)

Indoor Air Quality Guidelines for Selected Volatile Organic Compounds (VOCs) in the UK [2019]

Scientific Advisory Group for Emergencies (SAGE)

EMG/SPI-B advisory group. *Application of CO_2 monitoring as an approach to managing ventilation to mitigate SARS-CoV-2 transmission* [2021]

Sport England

(www.sportengland.org)

Sports Halls Design and Layouts: Updated and combined guidance [2012]

Design Guidance Note: *Fitness and Exercise Spaces.* Issue 002 [2008]

World Health Organization (WHO)

(www.who.int)

WHO Guidelines for Indoor Air Quality, Selected Pollutants [2010]

Other publications

Black MS and Wortham AW. *Emissions from Office Equipment*. Proceedings of the 8th International Conference on Indoor Air Quality and Climate, Indoor Air 99 [1999]

ONLINE VERSION

ONLINE VERSION

ONLINE VERSION

ONLINE VERSION

ONLINE VERSION

ONLINE VERSION

List of Approved Documents

The following documents have been published to give guidance on how to meet the Building Regulations. You can find the date of the edition approved by the Secretary of State at www.gov.uk.

Approved Document A
Structure

Approved Document B
Fire safety
Volume 1: Dwellings

Approved Document B
Fire safety
Volume 2: Buildings other than dwellings

Approved Document C
Site preparation and resistance to contaminants and moisture

Approved Document D
Toxic substances

Approved Document E
Resistance to the passage of sound

Approved Document F
Ventilation
Volume 1: Dwellings

Approved Document F
Ventilation
Volume 2: Buildings other than dwellings

Approved Document G
Sanitation, hot water safety and water efficiency

Approved Document H
Drainage and waste disposal

Approved Document J
Combustion appliances and fuel storage systems

Approved Document K
Protection from falling, collision and impact

Approved Document L
Conservation of fuel and power
Volume 1: Dwellings

Approved Document L
Conservation of fuel and power
Volume 2: Buildings other than dwellings

Approved Document M
Access to and use of buildings
Volume 1: Dwellings

Approved Document M
Access to and use of buildings
Volume 2: Buildings other than dwellings

Approved Document O
Overheating

Approved Document P
Electrical safety – Dwellings

Approved Document Q
Security – Dwellings

Approved Document R
Physical infrastructure for high-speed electronic communications networks

Approved Document S
Infrastructure for the charging of electric vehicles

Approved Document 7
Materials and workmanship

ONLINE VERSION

The Building Regulations 2010, Approved Documents are available from:

RIBA Books

Online: www.architecture.com/ribabooks
Telephone: +44 (0)20 7496 8383
Email: sales@ribabookshops.com

ISBN 978 1 914124 77 8

© Crown Copyright 2021

The content of this publication, excluding logos, may be reproduced free of charge in any format or medium for research, private study or for internal circulation within an organisation. This is subject to it being reproduced accurately and not used in a misleading context. The material must be acknowledged as Crown copyright and the title and edition of the publication specified. This document/publication is value added. You may re-use the content (not including logos) free of charge in any format or medium, under the terms of the Open Government Licence. To view this licence, visit: http://www.nationalarchives.gov.uk/doc/open-government-licence/ or write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or e-mail: psi@nationalarchives.gov.uk.

If you require this publication in an alternative format, please email: alternativeformats@communities.gov.uk.

Copyright in the typographical arrangement, excluding logos, of the cover and internal page layouts of this publication rests with the Publisher.

ONLINE VERSION