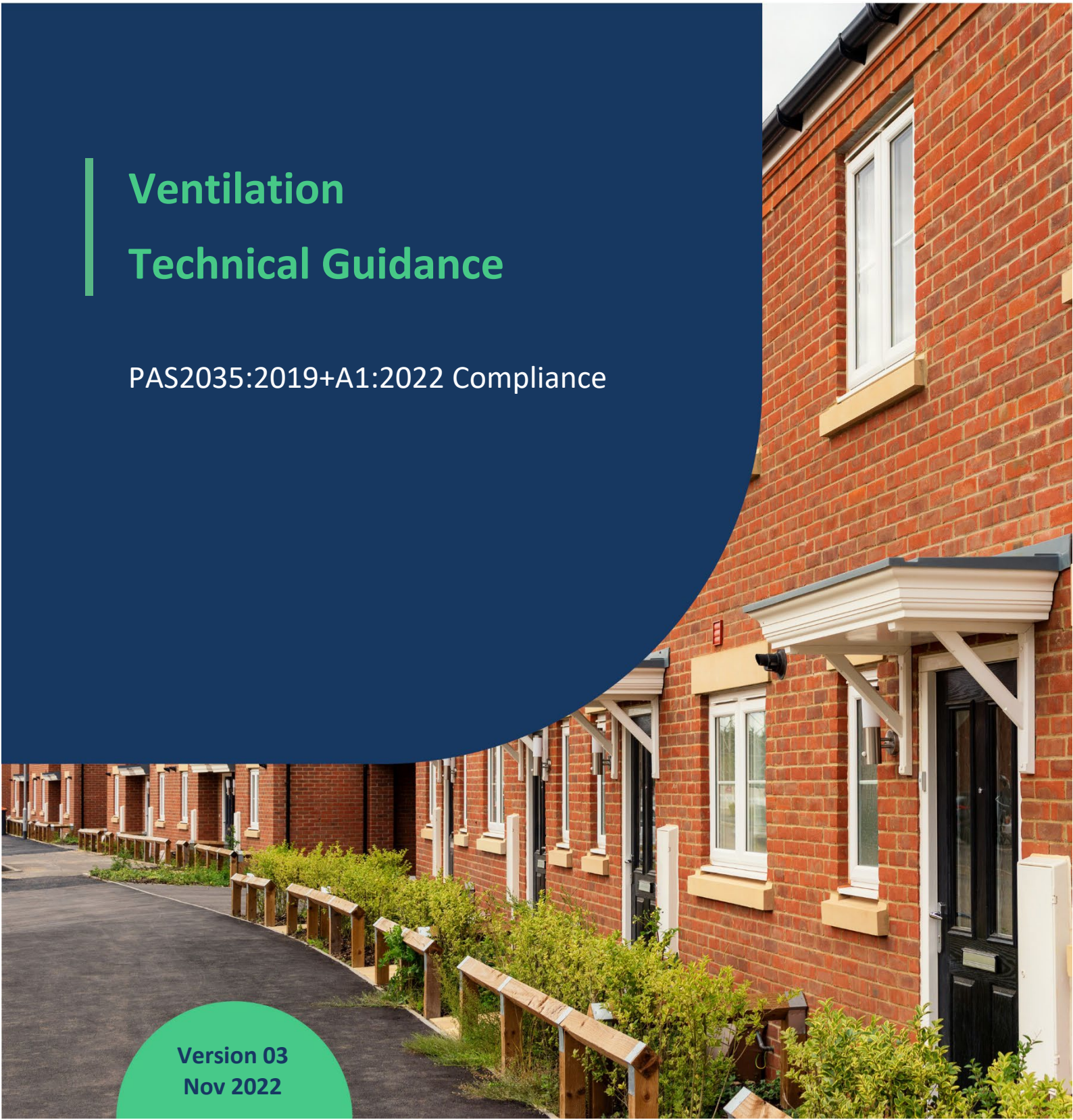
Ventilation
Technical Guidance

PAS2035:2019+A1:2022 Compliance



Version 03
Nov 2022

1. Overview

This guidance document has been prepared to assist Retrofit Assessors, Designers and Coordinators registered with **ecmk**. The aim of this guide is to provide a clear understanding of the necessity of correctly assessing ventilation requirements and developing an upgrade plan where necessary to comply with PAS2035 when installing any fabric or air tightness energy efficiency measure (EEM).

This guidance has been updated to include revisions to the following documents:

- PAS2035:2019+A1:2022;
- Building Regulations 2010 Ventilation, Approved Document F, Volume 1: Dwellings 2021 revisions (Hereafter referred to as **ADF1** in this document);
- IAA Guidance for Background Ventilation Assessment of Existing Buildings.

One of the most significant changes in Approved Document F, that should be considered, is the increased requirement for background ventilation. This is explained in section 4.2 Background Ventilation. The revisions in ADF1 are effective as of 15 June 2022.

This guide is by no means exhaustive, full details of the relevant regulations, industry guidance and compliance requirements can be found in the documents referenced at the end of this guide.

Revision 03
This revision includes updates on the following: -

1. Worked examples to demonstrate the number of background ventilators for three different scenarios, including where there is an open plan kitchen/habitable room.
2. Revised Ventilation Assessment Process Chart.
3. Link to a Ventilation Assessment Template that can be used to generate a detailed Ventilation Strategy Report and Calculation Sheet which has been designed to comply with ADF1 and PAS2035.

2. Table of Contents

3. Why do we need to Assess and Possibly Upgrade the Ventilation System for Retrofit Projects?

The correct installation of any retrofit fabric or air tightness measure e.g. Loft, cavity, external or internal wall, floor insulation, replacement windows or doors and draught proofing, will increase the air tightness of the building envelope. This will reduce the infiltration of fresh air entering the building. This reduction of fresh air must be compensated for. PAS2035 requires that we do this by: -

1. Assess the existing ventilation system.
2. Upgrade where necessary.

If we don't do this, there will probably be an inadequate amount of fresh air entering the dwelling to displace moist or stale air – potentially leading to poor internal air quality, condensation and mould.

Therefore, a ventilation assessment must be carried out whenever the installer designs a retrofit system that includes the addition or upgrade of any fabric or air tightness energy efficiency measures (EEM's).

In addition to complying with PAS2035, there is a legal obligation to comply with the requirements detailed in Building Regulations 2010 Ventilation, Approved Document F, Volume 1: Dwellings 2021 revisions (ADF1).

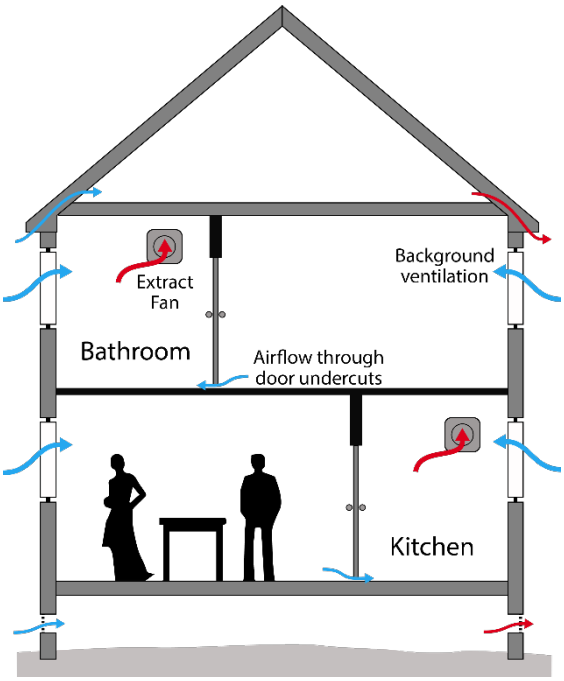


Figure 1

4. What is a Ventilation Strategy?

A ventilation strategy relies on a combination of the three following key elements: -

Element	Description
Extract Ventilation	From rooms where water vapour or pollutants are likely to be released. (e.g. bathrooms and kitchens), to minimise their spread to the rest of the building. Ventilation fans may be either intermittent operation or continuous operation.
Whole Dwelling Ventilation	Provides fresh air to the building and to dilute, disperse and remove water vapour and pollutants not removed by extract ventilation and allows air movement between rooms via door undercuts
Purge Ventilation	Used intermittently for the ventilation of rooms or spaces at a relatively high rate to rapidly dilute and remove pollutants (e.g. fumes from painting) and/or disperse water vapour produced by occasional activities.

The first two elements provide a strategy to ensure a net flow of fresh air into the living spaces, through the dwelling and out through the wet rooms. *(Please see figure 1.)*

The following text provides an overview of the different ventilation mechanisms used, specifications required and guidance to help achieve compliance.

5. What are the Key Ventilation Mechanisms?

5.1. Extract Ventilation

Extract ventilation to the outside of the dwelling should be provided in all wet rooms to extract moist or stale air from the room to the outside of the dwelling. Wet rooms include the following spaces:

a. Kitchens

b. Utility rooms

c. Bathrooms

d. Sanitary Accommodation / WC

There are many different types of mechanical extract fans – the most commonly used for retrofit projects are electrically powered continuous mechanical extract (MEV) or intermittent mechanical extract fans (IEV).

Intermittent Extract Ventilation (IEV)

Table 1.1 below from ADF1, details the minimum extract rates in litres per second (l/s) for intermittent operation extract systems.

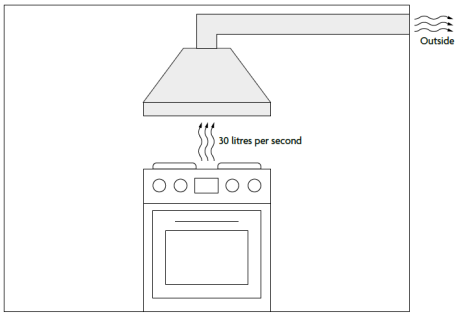
PAS2035 states that any intermittent or continuous extract ventilation fans should be checked in accordance with BSRIA guide BG46/2015 to ensure that they are providing adequate air movement, and any incidence of inadequate air movement should be reported as part of the assessment. Whilst **this is not mandatory**, this would always be **recommended as best practice**, particularly when assessing the adequacy of an existing higher flow rate fan, such as that installed in a kitchen without cooker hood extraction.

Table 1.1 Minimum extract ventilation rates for intermittent extract systems

Room	Intermittent extract rate (l/s)
Kitchen (cooker hood extracting to the outside)[1]	30
Kitchen (no cooker hood or cooker hood does not extract to the outside)[2]	60
Utility room	30
Bathroom	15
Sanitary accommodation[3]	6

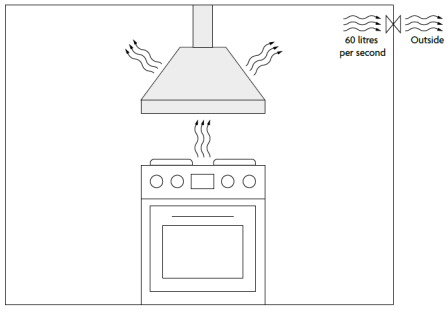
NOTES:

1. See Diagram 1.1.
2. See Diagram 1.2.
3. As an alternative for sanitary accommodation, the purge ventilation guidance may be used.



NOTE:
1. The cooker hood should span at least the full width of the cooker.

Diagram 1.1 Minimum kitchen extract ventilation rate in cases where a cooker hood extracts to the outside[1]



NOTE:
1. The diagram includes a recirculating cooker hood for illustration. A recirculating cooker hood on its own does not provide a means of ventilation that complies with Part F of the Building Regulations.

Diagram 1.2 Minimum ventilation rate for kitchen extract where a cooker hood does not extract to the outside[1]

Where an IEV is found to be defective or not capable of delivering adequate performance, in accordance with PAS2035 Annex C 3.5, this must be upgraded with a compliant type of ventilation – generally the most

convenient type being continuous extract ventilation. Please see section 8. PAS 2035 Annex C 3.5 Ventilation Upgrade, for further details.

Continuous Extract Ventilation (CMEV or DMEV)

Continuous extract ventilation generally uses less energy than traditional intermittent ventilation and is therefore a much more cost effective and low carbon option – also they are quicker and easier to install. Minimum extract ventilation rates for continuous extract systems are specified in Table 1.2. A continuous rate is given for the general operation of the fan and a high rate for when additional extraction is required.

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

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

NOTE:

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

Internal Wall Insulation (IWI) Projects – Extract Ventilation Requirements

Generally, only the installation of insulation on 100% of internal walls is compliant with PAS2035:2019. However, in many cases wet rooms such as kitchens and bathrooms will have permanent fixtures installed which cannot be **easily or practically** removed for the purpose of installing the insulation. In this case, these wet rooms can be omitted as long as: -

a.) The room can be heated to 18°C when occupied, and

b.) **Continuous extract ventilation** is installed in the wet rooms in question.

Ref: IAA Guidance: https://www.theiaa.co.uk/partial-insulation-for-iwi/

Or https://www.gov.uk/government/publications/retrofit-internal-wall-insulation-best-practice

Extract Ventilation in Rooms Containing Open Flued Combustion Appliances

If extract ventilation is required in rooms that contain, or in rooms adjacent to open flued combustion appliances or solid fuel open fires, a post-install safety test must be carried out in accordance with Approved Document J. **This must be carried out to confirm that combustion appliances operate safely regardless of whether the extract fans are running or not.**

5.2. Background Ventilation

All rooms with external walls should be equipped with background ventilators. There are tables and notes within ADF1 that provide estimates for the minimum number of ventilators based on the physical aspects of the property or the extract ventilation type (e.g. Notes 2 & 3 in Table 1.7). These are in place to cover unique property types where the minimum number of ventilators may exceed the number of rooms with external walls i.e. the requirement for ventilators in every room with an external wall would not provide sufficient background ventilation for that property type.

A background ventilator is a small ventilation opening designed to provide controllable whole building ventilation. These must be present in **every habitable** room in the dwelling to allow the entry of fresh air into the room to replace the air being extracted from wet rooms.

The typical types of ventilators used are trickle vents – located at the top of windows or provided by core vents. Background ventilation should normally be positioned 1.7m above floor level to avoid discomfort from cold draughts.

Specific Guidance on Background Ventilation

1. If the dwelling has more than one exposed façade, the area of background ventilators on each façade should be similar, to allow cross-ventilation through the dwelling.

2. 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.

3. The minimum total area of background ventilators in each room should follow the guidance in ADF 1 Table 1.7, copied overleaf.

4. The total number of ventilators installed in the dwelling's habitable rooms and kitchens should be at least the following:
    a. Four ventilators if the dwelling has one bedroom;
    b. Five ventilators if the dwelling has more than one bedroom.

5. If the dwelling has a kitchen and living room which are not separate rooms, at least three ventilators of the same area as for other habitable rooms in Table 1.7 should be provided in the open-plan space.

Background Ventilation Equivalent Area

The size of background ventilators (including trickle ventilators) is given in ADF1 as an **equivalent area in mm^2**, not as a *free area* or *air permeability*. The minimum **equivalent area** on the background ventilator shall have been **tested and recorded in accordance with BS EN 13141-1.** This will also normally be stamped on the ventilator product.

If the actual equivalent area for the ventilator is not available or detailed on a data sheet as having been tested in accordance with BS EN 13141-1, the **ventilator may not be fully compliant with ADF1** and therefore should not be used.

The revised version of Document F, 2021, is effective as of 15th June 2022, and includes increased minimum equivalent areas for background ventilators. Please refer to Table 1.7 overleaf for full details.

Background Ventilation Requirements for use with Continuous Intermittent Extract Ventilation

Table 1.7 Minimum equivalent area of background ventilators for natural ventilation[1]

Room	Minimum equivalent area of background ventilators for dwellings with multiple floors	Minimum equivalent area of background ventilators for single-storey dwellings
Habitable rooms[2][3]	8000mm²	10,000mm²
Kitchen[2][3]	8000mm²	10,000mm²
Utility room	No minimum	No minimum
Bathroom[4]	4000mm²	4000mm²
Sanitary accommodation	No minimum	No minimum

NOTES:

1. The use of this table is not appropriate in any of the following situations and expert advice should be sought.
   - If the dwelling has only one exposed façade.
   - If the dwelling has at least 70% of its openings on the same façade.
   - If a kitchen has no windows or external façade through which a ventilator can be installed.
2. Where a kitchen and living room accommodation are not separate rooms (i.e. open plan), no fewer than three ventilators of the same equivalent area as for other habitable rooms should be provided within the open-plan space.
3. The total number of ventilators installed in a dwelling's habitable rooms and kitchens should be no fewer than five, except in one-bedroom properties, where there should be no fewer than four.
4. If a bathroom has no window or external façade through which a ventilator can be installed, the minimum equivalent area specified should be added to the ventilator sizes specified in other rooms.

What is the Minimum Number of Background Ventilators Required in a Dwelling?

Previously this was determined by a calculation based upon the gross floor area of the dwelling and the number of bedrooms. Revised Document F, 2021 covers this in points 2, 3 and 4 in the notes in table 1.7 above.

It should be noted that for points 2. and 3. listed under table 1.7 above - The number of ventilators refers to individual ventilators sized at the individual values listed for each room type within table 1.7.

Open Plan Kitchen and Living Room Accommodation

Point 2 in table 1.7 states: "Where a kitchen and living room accommodation are not separate rooms (i.e. open plan), no fewer than three ventilators of the same equivalent area as for other habitable rooms should be provided within the open-plan space."

This applies **only where intermittent extract ventilation (IEV) is installed** in the kitchen in the open plan space, in which case the background ventilators must be located at least 500mm from the extract fan. Also, the 3 ventilators required will be in addition to the minimum number of ventilators calculated for the property. Please see the worked example (A) below for clarification.

Worked Example (A.) Ref Table 1.7 Point 2. - to Illustrate the Minimum Number of Ventilators Required. (open plan kitchen/diner) with intermittent extract ventilation

For example that a 2-storey property has 6 rooms with external walls:

- Bathroom (equipped with intermittent extract ventilation)
- 3 bedrooms
- Kitchen/diner open-plan space (equipped with intermittent extract ventilation)
- Lounge

This will require a minimum of 6 background ventilators, based upon the number of rooms with external walls.

However, the kitchen/diner will require 3 ventilators in accordance with Point in table 1.7, one ventilator has already been accounted for by considering the number of rooms with external walls, therefore the kitchen diner will require 2 additional vents to cover the total requirement of 3 vents for that room, totalling **8 background vents required for the property.** Please see table A below for details.

Table A. Worked Example - 2 Storey Property with 6 Rooms with External Walls and an Open Plan Kitchen/Diner Using Intermittent Extract Ventilation

Room	Number of Background Vents
Bathroom (with IEV)	1 x 4,000mm^2
3 Bedrooms	3 x 8,000mm^2
Kitchen/diner open-plan space (with IEV)	3 x 8,000mm^2
Lounge/Living Room	1 x 8,000mm^2
Total number of ventilators sized per Table 1.7	**8 Vents**

Worked Example (B.) to Illustrate the Minimum Number of Ventilators Required Ref Point 3 (based upon number of bedrooms) in table 1.7.
"The total number of ventilators installed in a dwelling's habitable rooms and kitchens should be no fewer than five". Example: for a dwelling with multiple floors, 3 bedrooms, a separate living room, dining room, and a kitchen and bathroom (all with external walls), - **from table 1.7,** this would require a minimum of 5 ventilators in total, correctly sized at 8,000mm^2 equivalent area for habitable rooms and 8,000mm^2 for the kitchen.

However, in this instance, the dwelling effectively has 6 rooms with external walls, the minimum number of ventilators would therefore be **6 ventilators correctly sized at 8,000mm^2 and one for the bathroom at 4,000mm^2 equivalent area**, 7 vents in total.

Table B. Worked Example - 2 Storey, 3 Bedroom Property Using Intermittent Extract Ventilation

Room	Number of Background Vents
Bathroom (with IEV)	1 x 4,000mm^2
3 Bedrooms	3 x 8,000mm^2
Kitchen (with IEV)	1 x 8,000mm^2
Lounge/Living Room	1 x 8,000mm^2
Dining Room	1 x 8,000mm^2
Total number of ventilators sized per Table 1.7	**7 Vents**

Where it is not possible to obtain or install a window trickle vent with an equivalent area of 8,000mm^2, the installer will be required to install a greater number of ventilators with an equivalent area e.g. 2 x 4,000mm^2 instead of an 8,000mm^2 unit.

Clear evidence will have to be uploaded, demonstrating that the correct number of ventilators have been installed (or are pre-existing) for each habitable and wet rooms, where applicable, to comply with Table 1.7. Copies of the product data sheet of the ventilator should also be uploaded, demonstrating that the equivalent area of the ventilator has been tested in accordance with BS EN 13141-1.

Background Ventilation Requirements for use in Conjunction with Continuous Extract Ventilation

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

a. Should not be in wet rooms in **conjunction with continuous extract ventilation** (DMEV) as at the lower fan flow rate, this will only serve to continuously bypass the air in the room. Background ventilation should **only be installed in wet rooms where intermittent extract ventilation (IEV) or Positive Input Ventilation (PIV)** is already existing or is being installed. In the case where an IEV is being used, vents should be located at least 500mm from the extract fan.

b. Provide a minimum equivalent area of **4,000mm^2** for each habitable room in the dwelling.

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

Worked Example (C.) to Illustrate the Minimum Number of Ventilators Required for Continuous Extract Ventilation Reference PAS2035 Paragraph 1.64

Looking at the same property as in worked example B. – a dwelling with multiple floors, 3 bedrooms, a separate living room, dining room, and a kitchen and bathroom all with external walls).

This would require a total of 5 vents with 4,000mm^2 equivalent area.

Table C. Worked Example - 2 Storey, 3 Bedroom Property Using Continuous Extract Ventilation

Room	Number of Background Vents
Bathroom (with MEV)	No requirement
3 Bedrooms	3 x 4,000mm^2
Kitchen (with MEV)	No requirement
Lounge/Living Room	1 x 4,000mm^2
Dining Room	1 x 4,000mm^2
Total number of ventilators sized per para 1.64	**5 Vents**

Insulation and Assurance Authority (IAA)
Background Ventilation Assessment of Existing Buildings

The IAA has produced a best practice guide for the assessment of background ventilation to be used pre and post installation of retrofit works in a dwelling.

Where the test produces acceptable results (outlined below), this would demonstrate that the property has sufficient air permeability so as not to warrant background ventilation upgrades. Thereby saving the necessity to cut holes in windows or walls for the purpose of upgrading background ventilation.

The assessment process uses the Pulse Air Permeability Testing Equipment to assess the air permeability of a dwelling to ascertain whether the dwelling has sufficient air permeability pre and post install so as not to warrant the requirement for additional background ventilation or upgrades to door undercuts.

A compliant assessment can only be conducted by IAA trained operatives that are certified and listed on the IAA's website for Approved Background Ventilation Assessors.

The process assesses the air permeability of the whole house and every bedroom. Acceptable test results that would indicate that background ventilation upgrades are not required for the dwelling are:

- Whole house test result ≥ **1.0 Ach @ 4Pa** *(air changes per hour at 4 Pascals)*
- Each bedroom tested ≥ **1.5 Ach @ 4Pa**

It should be noted that this assessment process only considers background ventilation and does not have any bearing on the requirements for extract or purge ventilation, which should still be correctly assessed and upgraded if required.

A copy of this guidance can be found at https://www.theiaa.co.uk/background-ventilation-assessment-of-existing-buildings-1/

For further information regarding Background Ventilation Assessment of Existing Buildings Training please click on the link: Ventilation & Air Tightness Testing Training | The IAA CS

Combustion Ventilation Considerations

Following best practice, existing combustion ventilation **cannot be considered as background ventilation**. Background ventilation, by definition, must be controllable, whereas combustion ventilation must remain permanently open.

Note: Purge ventilation, windows with 'night vent' facility or door undercuts **cannot be considered as an alternative** to background 20

ventilation. This will result in a non-compliant installation.

5.3. Purge Ventilation

Purge ventilation is required in each **habitable room** and should be capable of extracting at least four air changes per hour per room directly to the outside. It is manually controlled ventilation of rooms at a relatively high rate to rapidly dilute pollutants and/or water vapour e.g. smoke from burnt food or spillage of water. Purge ventilation can typically be provided by an opening window and is classed as intermittent i.e. only to accommodate occasional activities.

The minimum opening areas that should be achieved for purge ventilation are listed in ADF1 Table 1.4 below.

Table 1.4 Purge ventilation openings

Opening type	Minimum total area of openings
Hinged or pivot windows with an opening angle of 15 to 30 degrees	1/10 of the floor area of the room
Hinged or pivot windows with an opening angle of greater than or equal to 30 degrees	1/20 of the floor area of the room
Opening sash windows	
External doors	

Hinged or pivot windows with an opening angle of less than 15 degrees are not suitable for purge ventilation.

Is there a solution where a habitable room does not have purge ventilation?

Where an opening window is not available to provide purge ventilation, a mechanical fan capable of extracting at 4 ACH (Air Changes per hour) on a boost setting to the outside could be used. 4 ACH can be found by calculating the volume of the room and converting this from **4 x room volume/hr** to **l/s** to give the flow rate of a suitable fan.

Worked Example for Extract Fan Flow Rate to Achieve 4 ACH *(Air Changes per Hour)*

Room Dimensions = 3.0m x 3.0m x 2.5m high = **22.5m³**

4 ACH = 4 x 22.5m³ = **90.0m³/hr**

(*1m³ = 1,000 Litres, 1 hour = 3,600 seconds*)

Convert 4 ACH to l/s = 90.0m³/hr x $\frac{1,000}{3,600}$ = **25l/s Flow Rate Required**

Alternatively, the requirement to provide adequate purge ventilation, the room can be ventilated through either of the following:

a. Another habitable room.

b. A conservatory.

The habitable room or conservatory should have openings to the outside to provide both of the following.

a. Purge ventilation with a minimum total area given in Table 1.4 should be achieved based on the combined floor area of the habitable rooms (or the habitable room and the conservatory).

b. Background ventilation of at least 10,000mm² equivalent area.

Between the two rooms, there should be a permanent opening with a minimum area of 1/20 of the combined floor area of the two rooms (see Diagram 1.3 overleaf).

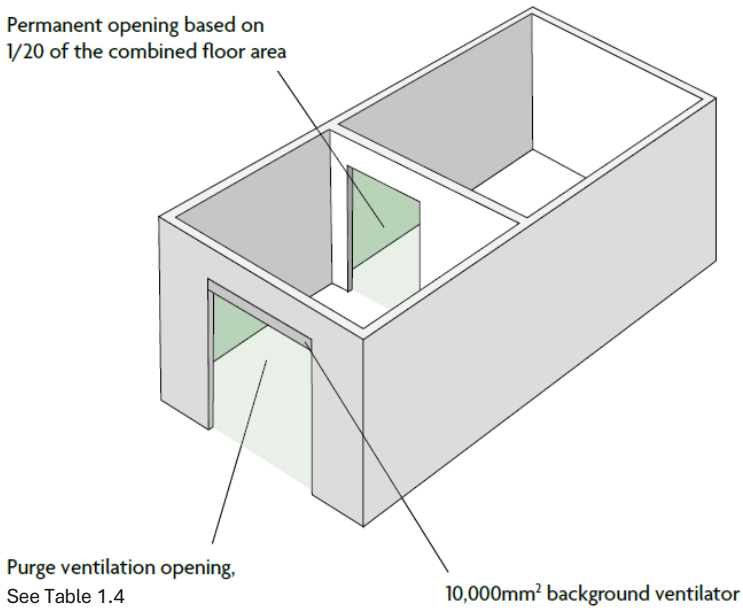


Diagram 1.3 Two habitable rooms treated as one room for ventilation purposes

6. Installation of Ventilation Systems

The following provides overall guidance on the installation of ventilation systems, with a particular focus on extract ventilation ducting:

1. Ventilation should always be installed to meet both of the following conditions:
   a. Comply with the guidance in **ADF1**.
   b. Not compromise the performance of the system or systems being installed.
2. Adequate space should be available for access to maintain ventilation equipment.
3. Rigid ducts should be used wherever possible.
4. Flexible ductwork, where installed, should meet all of the following conditions.
   a. Only used for final connections.
   b. Lengths should be a maximum of 1.5m.
5. Any flexible ducts should be installed so that the full internal diameter is maintained, and flow resistance is minimised. This is achieved by taking both of the following actions:
   a. Pulling the duct taut.
   b. Ensuring that ductwork does not pass-through orifices with a smaller diameter than the duct itself.
6. 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.
7. Where ducting passes through an unheated space e.g. a cold loft, this should be insulated.

7. Whole Building Ventilation Summary

Combining the three mechanisms and door undercuts, provides **whole building ventilation** by means of **extract ventilation** removing moist or stale air from wet rooms, this is in turn replaced by fresh air entering the dwelling through **background ventilators** via the **undercuts in all internal doors**. Occasional pollutants or moisture being removed from the dwelling by means of **purge ventilation.** *(See figure 1.)*

8. How do we Assess the Existing Ventilation System in a Dwelling?

CoreLogic's PAS Hub Software and App are designed to make it as simple as possible for your Retrofit Assessors and Coordinators, to help you comply with PAS2035.

By working through our Assessor App, the software will help you assess the existing ventilation system and provide guidance on any upgrades to the ventilation system and the individual ventilation mechanisms.

9. PAS 2035 Annex C 3.5 Ventilation Upgrade Suitable Types

PAS2035 species that where ventilation is to be upgraded, the minimum acceptable type of ventilation shall be one of the following:

8. **Continuous MEV** consisting of one or more fans tested in accordance with BS EN 13141-6 and extracting moist "stale" air from all "wet" spaces, combined with background ventilators tested in accordance with BS EN 13141-1 in all living spaces and bedrooms to admit a balancing supply of "fresh" external air;

9. **Continuous whole-dwelling MVHR** tested in accordance with BS EN13141-7, extracting moist "stale" air from "wet" spaces and providing a balanced supply of "fresh" external air to all living spaces and bedrooms; or

10. **Continuous PIV** tested in accordance with BS EN 13141-11, providing a supply of "fresh" external air to the centre of the dwelling, combined with background ventilators tested in accordance with BS EN 13141-1 in all living spaces and bedrooms to allow moist "stale" air to escape.

10. Air-tightness – other measures to consider

In addition to insulation measures, other measures impacting upon airtightness that must also be taken into consideration include (but not limited to):

- draught proofing existing windows and doors;
- secondary glazing;
- replacement of existing windows and doors;
- sealing up of existing chimneys and flues; and
- the replacement of any open-flued heating or hot water appliance with a room-sealed appliance (i.e. one with a balanced flue).

11.Door Undercuts

To ensure good transfer of air through the dwelling, there should be an undercut of minimum area of 7,600mm^2 in **all internal doors** between the bottom of the door and the floor finish. This is equivalent of 10mm for a standard 760mm width door (roughly the thickness of a pen or pencil). This should be achieved by making an undercut of 10mm above the floor finish, or by 20mm undercut above the floorboards, or other surface, if the finish has not been fitted.

There are products on the market that can be installed at the bottom of the doors instead of undercuts, including grills and moulded vents, these are acceptable as long as they provide an **effective ventilation area of 7,600mm^2** per internal door.

11.1. Door Undercuts PAS2035 Compliant Evidence Guidelines

To ensure full compliance, please adhere to the following when providing evidence: -

1. Please provide evidence of **all internal doors** (labelling the room in the photographs);
2. Photograph the undercut **with the door closed** *(as per figure 2)* as this is when the undercut is important;
3. Ensure the photographs clearly illustrate the depth of undercut by either placing a pen or pencil in the gap or hold a tape measure against the gap *(ref per figure 2)* - (taking the photo at a low angle and ensuring that it is in focus).

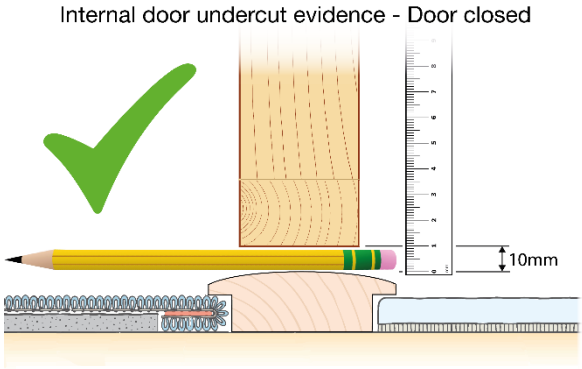


Figure 2 - Correct Evidence with Door Closed

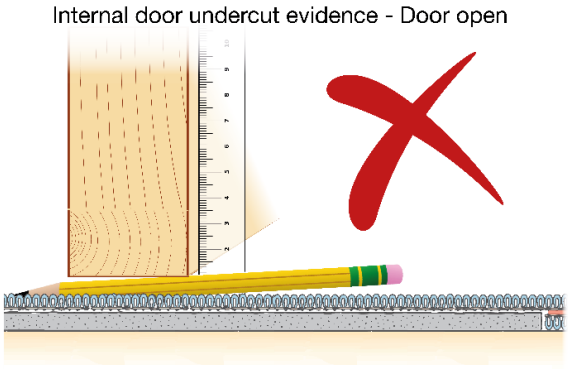


Figure 3 - Incorrect Evidence with Door Open

Where the property has been successfully tested in accordance with the IAA Guidance for Background Ventilation Assessment of Existing Buildings, the Retrofit Coordinator will be required to assess whether door undercut upgrades are required for the property.

12.Positive Input Ventilation (PIV)

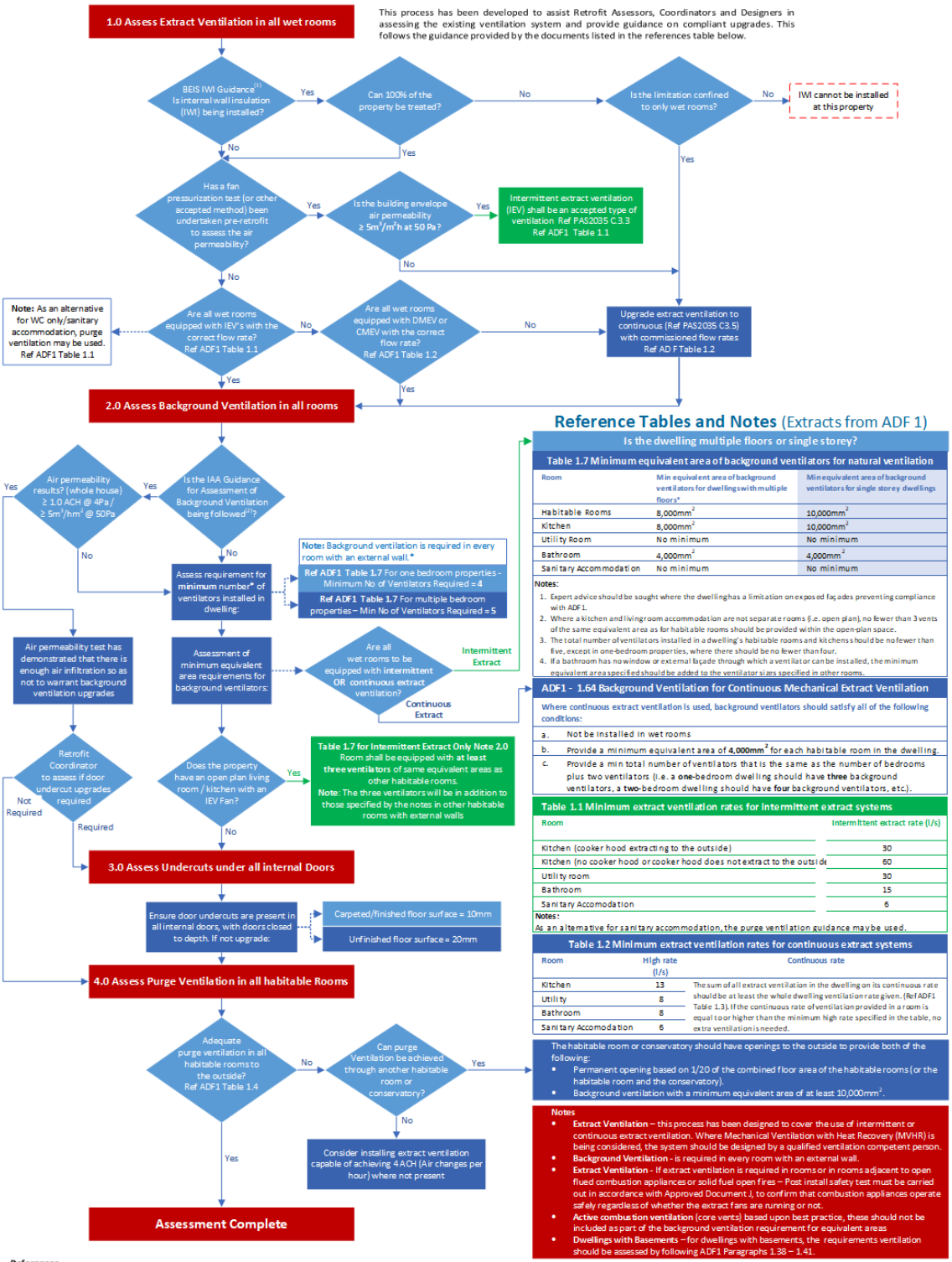
Note this system is currently acceptable under PAS2035:2019 without the need for extract ventilation in wet rooms. Note that **background ventilation would still be required in wet rooms** to allow for moist / stale air to escape. Also, we would still recommend extract ventilation is installed in wet rooms if not already present. As noted in "*PAS2035: PIV systems can drive warm moist air through gaps and holes into cold parts of the construction, and into construction voids (e.g. beneath floors), with a consequent risk of condensation and mould growth*."

Where PIV is being considered as part of a ventilation system, installers are still required to install appropriate background ventilation and door undercuts**. PIV must not be installed with Internal Wall Insulation (IWI)**, as this will increase the risk of interstitial condensation due to warm wet air being actively pushed into the building fabric by the PIV system.

13.Ventilation Assessment Process

The chart below aims to provide a clear process to follow when assessing, testing, designing, and upgrading the ventilation system in a dwelling. This can be downloaded from:
https://assessorhub.net/SchemeDocuments/VentilationAssessmentProcess

Ventilation Assessment Process for Fabric Measures Ref PAS2035 & ADF1 2021



Reference Tables and Notes (Extracts from ADF 1)

Is the dwelling multiple floors or single storey?

Table 1.7 Minimum equivalent area of background ventilators for natural ventilation

Room	Min equivalent area of background ventilators for dwellings with multiple floors*	Min equivalent area of background ventilators for single storey dwellings
Habitable Rooms	8,000mm²	10,000mm²
Kitchen	8,000mm²	10,000mm²
Utility Room	No minimum	No minimum
Bathroom	4,000mm²	4,000mm²
Sanitary Accommodation	No minimum	No minimum

Notes:
1. Expert advice should be sought where the dwelling has a limitation on exposed façades preventing compliance with ADF1.
2. Where a kitchen and living room accommodation are not separate rooms (i.e. open plan), no fewer than 3 vents of the same equivalent area as for habitable rooms should be provided within the open-plan space.
3. The total number of ventilators installed in a dwelling's habitable rooms and kitchens should be no fewer than five, except in one-bedroom properties, where there should be no fewer than four.
4. If a bathroom has no window or external façade through which a ventilator can be installed, the minimum equivalent area specified should be added to the ventilator sizes specified in other rooms.

ADF1 - 1.64 Background Ventilation for Continuous Mechanical Extract Ventilation

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

a. Not be installed in wet rooms
b. Provide a minimum equivalent area of **4,000mm²** for each habitable room in the dwelling.
c. Provide a min total number of ventilators that is the same as the number of bedrooms plus two ventilators (i.e. a **one**-bedroom dwelling should have **three** background ventilators, a **two**-bedroom dwelling should have **four** background ventilators, etc.).

Table 1.1 Minimum extract ventilation rates for intermittent extract systems

Room	Intermittent extract rate (l/s)
Kitchen (cooker hood extracting to the outside)	30
Kitchen (no cooker hood or cooker hood does not extract to the outside)	60
Utility room	30
Bathroom	15
Sanitary Accomodation	6

Notes:
As an alternative for sanitary accommodation, the purge ventilation guidance may be used.

Table 1.2 Minimum extract ventilation rates for continuous extract systems

Room	High rate (l/s)	Continuous rate
Kitchen	13	The sum of all extract ventilation in the dwelling on its continuous rate should be at least the whole dwelling ventilation rate given. (Ref ADF1 Table 1.3). If the continuous rate of ventilation provided in a room is equal to or higher than the minimum high rate specified in the table, no extra ventilation is needed.
Utility	8	
Bathroom	8	
Sanitary Accomodation	6	

The habitable room or conservatory should have openings to the outside to provide both of the following:
- Permanent opening based on 1/20 of the combined floor area of the habitable rooms (or the habitable room and the conservatory).
- Background ventilation with a minimum equivalent area of at least 10,000mm².

Notes
- **Extract Ventilation** – this process has been designed to cover the use of intermittent or continuous extract ventilation. Where Mechanical Ventilation with Heat Recovery (MVHR) is being considered, the system should be designed by a qualified ventilation competent person.
- **Background Ventilation** - is required in every room with an external wall.
- **Extract Ventilation** - If extract ventilation is required in rooms or in rooms adjacent to open flued combustion appliances or solid fuel open fires – Post install safety test must be carried out in accordance with Approved Document J, to confirm that combustion appliances operate safely regardless of whether the extract fans are running or not.
- **Active combustion ventilation** (core vents) based upon best practice, these should not be included as part of the background ventilation requirement for equivalent areas
- **Dwellings with Basements** – for dwellings with basements, the requirements ventilation should be assessed by following ADF1 Paragraphs 1.38 – 1.41.

References
1. BEIS Guide to Best Practice Retrofit Internal Wall Insulation, September 2021
2. Insulation Assurance Authority (IAA) Background Ventilation Assessment of Existing Buildings V1.1
3. Building Regulations 2010 Ventilation, Approved Document F, Volume 1: Dwellings, 2021 Edition
4. Building Regulations 2010 Combustion Appliances and Fuel Storage Systems Document J, 2013 Amendments
5. PAS2035:2019+A1:2022 Retrofitting dwellings for improved energy efficiency Specification and guidance

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14.Ventilation Training and Accreditation

Ventilation systems are to be commissioned and tested by competent operatives holding suitable qualifications. This accreditation is currently available via the competent persons course provided by the NICEIC (National Inspection Council for Electrical Installation Contracting).
https://www.niceic.com/contractor/training/health-and-safety-courses/domestic-ventilation

15.Building Regulations Approval – Mechanical Extract Ventilation

All mechanical extract ventilation systems are to be notified to building regulations through a Competent Person Scheme (CPS). Currently Intermittent Extract Ventilation (IEV) is the exception to this requirement. Also, PIV systems currently cannot be notified by a Competent Person Scheme and therefore must be notified directly to a Building Control Officer.

16.Ventilation Strategy Template

ecmk has created a detailed Ventilation Assessment and Strategy Template to help installers assess existing ventilation and calculate/plan the requirements for any upgrades. This can be downloaded from:
https://assessorhub.net/SchemeDocuments/SchemeDocuments/VentilationStrategy

17.What Evidence is Required for Compliant Trustmark Lodgment?

To help make the pre and post approval processes as fast and efficient as possible for Retrofit Coordinators, Installers are required to **provide clear photographic evidence** demonstrating compliance with PAS2035.

Clear photographic evidence of all existing and ventilation upgrades is required to evidence:

- **Extract Ventilation** - Photographs of each individual extract fan in each wet room and photographs of the corresponding external vents;
- **Extract Ventilation** – for all extract ventilation installs/upgrades - Ventilation Installer Competency and Certification (i.e. NICEIC or BPEC Domestic Ventilation Systems Competent Person);
- **Background Ventilation** – a record of all existing background vents and additional vents required to upgrade the ventilation – clearly evidencing that the revised higher areas required for background ventilation have been provided (Ref ADF1 Table 1.7);
- **Purge Ventilation** – records of all purge ventilation (i.e. photographs of opening windows);
- **Door Undercuts** - Photographs of **each internal door** illustrating the undercut either by means of a pencil inserted into the gap, or a tape measure being held up against the undercut – please ensure that these are taken **with the door closed**; *(ref per figure 2).* Note this is required regardless of the dwelling being tested in accordance with IAA Guidance for Background Ventilation Assessment of Existing Buildings;[1]
- **Condensation / Mould** – assessment of any existing issues.

[1] Where background ventilation has been tested in accordance with the IAA Guidance, the Retrofit Coordinator shall assess whether door undercut upgrades are required based upon the floor plan of the property, existing whole dwelling ventilation system, and any proposed ventilation upgrades.

Additional Ventilation Evidence Required for Lodgement

- **Ventilation Strategy** – detailed assessment of the existing ventilation system and where this does not comply with PAS2035 / Building Regulations ADF1, comments on where and how this will be upgraded. This should consider:
    - Extract ventilation in wet rooms;
    - Background ventilation in habitable rooms (and wet rooms where applicable[2]);
    - Adequate door undercuts on all internal doors[3];
    - Purge ventilation;
    - Any evidence of mould and/or condensation at the dwelling.
- **Product Data Sheets** – data sheets for all ventilation upgrade products – (particularly for background ventilation detailing the equivalent area of the ventilator as tested to BS EN 13141-1)

Additional Evidence Required for where IAA Background Ventilation Assessment Has Been Followed

Where the IAA guidance has been used to assess the requirements of background ventilation and door undercuts, evidence requirement as listed in the guidance:

- Householder agreement;
- Pre-existing ventilation assessment documentation and evidence;
- Annotated floor plans as per Section 3 of the IAA Guidance;
- Pre and post background ventilation test documented results and corresponding certificates;
- Lifestyle and potential issues addressed and customers advised;
- Consumer awareness information pack;
- Signed post works checklist;
- Copies of all relevant Pulse Test Certificates (Pre and post install);
- Tester competency certification;
- Tester registration on IAA Website - Approved Background Ventilation Assessors; IAA Approved Background Ventilation Assessors (theiaa.co.uk)
- Ventilation strategy for use with Pulse Test - recording that background ventilation has been assessed in accordance with the IAA Guidance and upgrades are not required.

Note: templates for items a. – g. can be downloaded from the IAA website from the following link: Background ventilation documents | IAA - The Insulation Assurance Authority (theiaa.co.uk)

18.Glossary

[2] Where background ventilation has been tested in accordance with the IAA Guidance, the ventilation strategy should comment that: "background ventilation upgrades are not required as the air permeability of the property has been tested in accordance with IAA guidance and found to be ≥1.0 ACH"

[3] Where background ventilation has been tested in accordance with the IAA Guidance, the Retrofit Coordinator shall assess whether door undercut upgrades are required based upon the floor plan of the property, existing whole dwelling ventilation system, and any proposed ventilation upgrades.

- **ACH** – Air changed per hour - is the number of times that the total air volume in a room or space is completely removed and replaced in an hour.
- **ADF1** - Building Regulations 2010 Ventilation, Approved Document F, Volume 1: Dwellings, 2021 Edition.
- **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 or 4Pa.
- **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.
- **Background ventilator** - A small ventilation opening designed to provide controllable whole dwelling ventilation.
- **Building control body** - A local authority or an approved inspector.
- **Continuous mechanical extract ventilation** - Mechanically driven ventilation that continuously extracts indoor air and discharges it to the outside.
- **Dwelling** - A self-contained unit designed to accommodate a single household.
- **Equivalent area** - A measure of the aerodynamic performance of a ventilator. The equivalent area of a background ventilator is determined at 1Pa pressure difference in accordance with Table 1.7.
- **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 living purposes e.g. living room, dining room, office / study, bedrooms.
- **Heat recovery** - Applied to mechanical supply and extract systems or a single room ventilator, extract air is passed over a heat exchanger and the recovered heat is put into the supply air.
- **Highly airtight dwellings** - Dwellings that achieve one of the following:
    - A design air permeability lower than $5m^3/(h \cdot m^2)$ at 50Pa;
    - An as-built air permeability lower than $3m^3/(h \cdot m^2)$ at 50Pa.
- **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). An intermittent operation may be under either manual or automatic control.
- **Permanent opening** - An opening between rooms or floors that has no means of closing it, e.g. an open stairwell or two rooms that have been joined by removing part of a wall.
- **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).
- **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.
- **Utility Room** - A room containing a sink or other feature or equipment that may reasonably be expected to produce significant quantities of water vapour.
- **Wet Room** – a room used for domestic activities (e.g. cooking, clothes washing and bathing) and include kitchens, bathrooms, shower rooms, utility rooms, and sanitary accommodation/WCs.
- **Whole dwelling 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 dwelling.

19.References

- Building Regulations 2010 Ventilation, Approved Document F, Volume 1: Dwellings, 2021 Edition
- Building Regulations 2010 Combustion Appliances and Fuel Storage Systems Document J, 2013 Amendments
- Building Regulations 2010 Combustion Conservation of Fuel and Power in Existing Dwellings, Approved Document L1B, 2018 Amendments
- Building Regulations 2010 Overheating Requirement O1: Overheating mitigation Regulations: 40B, 2021
- PAS2030+A1 2020 and PAS2035+A1 2022 Updates 31 January 2022 - Annex C (Normative) Requirements for provision of adequate ventilation
- The IAA Background Ventilation Assessment of Existing Buildings - Best Practice Guide – v1.1
- BS EN 13141-1:2019 Ventilation for buildings - performance testing of components/products for residential ventilation. Part 1. Externally and internally mounted air transfer devices
- BSRIA Guide Domestic Ventilation Systems - a guide to measuring airflow rates (BG 46/2015)
- BEIS Guide to Best Practice Retrofit Internal Wall Insulation, September 2021
- Domestic Ventilation Compliance Guide 2010 Edition, Department for Communities and Local Government, July 2011