Best Practice Guidance

Positive Input Ventilation (PIV) System

October 2017
1. INTRODUCTION

This best practice document has been produced to provide independent generic guidance on the application, installation and commissioning of PIV units in existing homes.

Different regions of the UK have different regulatory, compliance and guidance documents in relation to residential ventilation. It is impractical to cater for all parts of the UK in this guide. As the vast majority of the UK’s existing housing stock is in England this guide is based around the various documents that apply in England in relation to the ventilation of buildings.

For residential ventilation work in Scotland, Wales and Northern Ireland this Code of Practice will provide a good source of advice and information. It should however be noted that in all cases the requirements of the individual countries Building Regulations and/or any local building bylaws must be observed, and where necessary the advice of the Local Authority Building Body should be taken.

It is important to note that this guide relates solely to the provision of PIV units into existing homes. For the purposes of this document new build applications are omitted in their entirety.

This document should be read in conjunction with the PCA Code of Practice for Investigation and Provision of Ventilation in Existing Dwellings which sets out the general criteria for the assessment of condensation and ventilation within Existing buildings.

2. DEFINITIONS

For the purposes of this document, the definitions in The PCA Code of Practice for the Investigation and Provision of Ventilation in Existing Dwellings, BS 6100: Part 5 and Building Regulations Approved Document F apply with the following amendments/additions:

- **“Cold roof” space (loft)**
  A common UK roof construction method where the insulation is laid between the ceiling joists (i.e. over a normal flat ceiling). During the heating season the roof structure above the insulation is colder than the living space.

- **Cold side ducting**
  Ductwork carrying cold air being drawn from an external source to the PIV unit.

- **Diffuser**
  A diffuser is the ceiling or wall mounted grille that allows the incoming air to enter the living space of the property from the PIV unit.

- **Positive Input Ventilation (PIV)**
  The principle of providing a continuous supply of fresh air centrally to a home to dilute, displace and replace the contaminated air in a home with better quality external air. Also known as background air changes.

- **Positive Input Ventilation (PIV) Unit**
  A ventilation unit and associated components which can be mounted in a property or in the roof space (loft) above it which are specifically designed to ventilate a home using the principle of Positive Input Ventilation. PIV units are available which can draw air in via a “cold roof” space (loft) directly from outside via a system of ducting or a combination of both.

- **Roof space heat gain**
  PIV units which draw external air in via a “cold roof” space (loft) can take advantage of tempering of the incoming air as a consequence of solar gain and heat loss from the rooms below. It is estimated this roof space heat gain can result in a PIV unit typically supplying air to a home which is on average 3 degrees centigrade warmer during a typical heating season than if the air was supplied or drawn into a home directly from the outside as would be the case with air entering through background ventilators (e.g. trickle vents) or windows. Building Research Information Paper IP12/00 provides useful information on this roof space heat gain.
3. CONCEPT AND BACKGROUND OF PIV

How PIV works

PIV works by continually diluting, displacing and replacing indoor air with filtered, low moisture content external air from either the loft of an external source. This air is delivered to a central point in a property and, in turn, each room off this central point benefits. PIV systems are adjustable, so the amount of ventilation they provide can be adjusted to the amount of moisture being produced or the size of the home.

PIV systems come in two varieties, loft mounted and wall mounted and whilst it can be a very effective method of ensuring a continuous air exchange within a property, the surveyor and the occupant must be made aware of its limitations and must acknowledge that it many instances it must be considered as part of a ventilation system and not used in isolation.

PIV is classified under Approved Document F of the Building Regulations 2010 (As Amended) as an alternative ventilation strategy.
Loft mounted PIV

Loft mounted PIV works by drawing air continuously from a well-ventilated loft space and delivering this air into the house via a ceiling mounted diffuser. It will have typically 3 to 5 degrees solar gain by being in the loft space. The air that is forced into the living space is filtered to remove particles e.g. pollen.

The fresh filtered supply air simply dilutes, and displaces the existing air, improving indoor air quality and managing moisture levels within the home.

Wall mounted PIV

The principle of PIV also works for homes without a loft. The same way fresh air is taken from the loft space, air can be taken from ducting through an external wall and then fed into the property. They can also be used to ventilate basements, cellars and other areas that would benefit from a continuous supply of air. The unit is usually situated in a convenient location, such as a kitchen cupboard or hallway, and is ducted to a central location.

Wall mounted PIV can include integral heaters for tempering the air. This is not a heat source, and is only used to temper incoming air from outside.

The diffuser usually installed at high level in a central location within the hallway, although discharging the air down the length of the hallway (away from the front door) should also prove acceptable. It should be noted that as the air is coming from outside then through ducts to a central diffuser, the duct run itself may need to be boxed in. Thermal ducting should be used where appropriate to avoid issues of condensation on the duct itself.

Unit performance may be enhanced if an existing heat source can warm the discharged air e.g. by locating the diffuser above a radiator.

4. INSPECTION CONSIDERATIONS

When inspecting a structure to determine whether there is a ventilation problem, it is essential to consider the possible presence of other sources of dampness. Even if the instructions given are limited to the detection of atmospheric dampness, other problems should be highlighted if they are present and reasonably obvious to a specialist surveyor.

The primary focus of the survey when investigating internal atmospheric moisture related problems should be to determine what is out of balance within the internal environment and resulted in the problem i.e. mould growth or condensation.

Further information on the practice of undertaking surveys can be found in the ‘Code of Practice for the Investigation and Provision of Ventilation in Existing Dwellings.’

Once it has been determined that additional ventilation is required, the surveyor must consider which options are suitable for the property and occupants. This section details inspection considerations when specifying PIV units.

The property type

One of the first considerations should be the property type, this will have a significant impact on whether a PIV system is suitable. Properties without central hallways or with remote wet rooms may not be suitable for PIV systems or may require additional supplementary extractor fans.

If the property is a high-rise flat without a loft area additional consideration is required due to the complex nature and health and safety implications of these installations.
Three storey properties

There is a requirement to protect a stairwell when there are rooms above 4.5 metres or a 3+ storey building. The reason for this is to allow those on the 2nd floor and above the time to get down the stairs and out of the building to safety.

With this in mind, it means that in 3 storey buildings there are special diffuser requirements and guidance should therefore be sought from the manufacturer to ensure the design is compliant with fire regulations.

Where to diffuse the incoming air on a wall/non-loft PIV

With any PIV installation, it is vital that the incoming air is introduced at a central point within the property. A central hallway is normally where air should be diffused. If air is diffused incorrectly or solely into a room directly where there is an issue, the solution will not be fully effective.

Important additional checks

When carrying out your survey you must assess the feasibility of the particular installation location or route. It is important to find a location which would not be too close to lintels, pipes or boiler flues. As wall mounted PIV unit brings air into the property, the distance between the proposed incoming air flow and boiler flue must be 100cm or greater. If the inlet is above a boiler flue then the distance needs to be 300cm or greater. Equally, if installing an extractor fan, the distance between the proposed air outlet and boiler flue must be 30cm or greater. This ensures no products of combustion from the gas boiler ingress through the extractor fan outlet. For oil fired boilers the distance between the outlet and boiler flue must be a minimum of 40cm or greater.

Ensure enough space is allocated when proposing the drilling of a core hole. If drilling a core hole next to a window there needs to be a gap of 15 cm between the core hole and the window. This is to ensure the structure of the property remains sound.

With loft installations the loft space should be inspected to ensure there is as little air leakage into the roof space from any adjacent roof spaces (e.g. in terraced and semi-detached homes) and from the rooms below as possible.

When considering the possibility of installing a loft mounted PIV system into a terraced or semi-detached property, the party wall in the loft area must be fully intact. Any breakages in the party wall will prevent the commissioning of the unit. Where there is an incomplete party wall and a PIV unit installed in the event of a fire within an adjoining property the PIV may draw harmful smoke into the property. If there is an incomplete party wall the breakage in the wall should be rectified prior to any installation. If this is not achievable then a unit with a smoke detector device that disables the unit in the event of smoke from an adjoining property should be considered.

When specifying a loft PIV unit ensure the loft area is not airtight as this will prevent the system from working effectively. The presence of daylight is often a good indication of sufficient leakage. Additional ventilation of the roof space may be required in very tight roofs e.g. voids with tightly fitted breather membranes.

When establishing the suitability of a loft mounted ventilation system is to ensure that there are no ceiling leakages. For example, a poorly sealed loft hatch or uncapped spotlights may also cause moisture migration into the loft. If any of these scenarios are present then moisture from within the property may rise through these leakage areas and subsequently enter the loft and be brought back into the property via the positive input ventilation system located in that loft area. As such, a cyclical effect will occur thus reducing the effectiveness of the ventilation system.

Ensure there is no evidence of any vermin or bats in the loft area. If the presence of either is suspected then the relevant advice should be sought.
Asbestos Containing Materials (ACMs)

Where the fabric of a building will be disturbed by the installation of ventilation equipment, ducting or grilles, a risk assessment shall be carried out in accordance with the requirements of the Control of Asbestos Regulations 2012 and any actions recommended should be complied with.

Artex is one of the most common asbestos containing materials that may be disturbed during a ventilation system install. The surveyor and installation team must have Category A asbestos awareness training. This does not give the installer the right to disturb any suspected ACM. If you encounter a suspected ACM you should seek advice from a suitably qualified and competent person.

5. OCCUPIER ENGAGEMENT

The way the system works should be explained to the occupier at the survey stage and should also be reinforced during the installation process. This is equally important for homeowners and tenants (social & private housing) alike.

Items that should be explained in detail are:

Maintenance

All manufacturers have air filters on their units. The industry norm is for these filters to last for a period of 5 years, though some may be less. The client should be made aware of the maintenance requirements at the report stage.

Heaters

Loft and wall mounted PIV units can contain heaters (usually between 400w – 500w). These heater units are designed to temper the incoming air during cold weather.

It is important that the occupier is made aware that the heater function is not designed to act as a replacement for any part of the heating system of the property and that when in operation the heater element will increase the running costs of the unit.

During colder weather, the unit will cool the area around where the diffuser has been fitted. The diffuser is fitted to these areas generally because it is the most central point in the property to allow it to control any condensation
problem to the maximum amount of rooms in the property and also because it is the part of the property in which the occupants spend the least amount of time.

This issue generally only affects properties with small hallways or landings and normally only during exceptionally cold weather. It should also be noted that this is less likely to be an issue with a well-designed and correctly commissioned PIV installation.

The occupier should be made aware that the units speed settings can be adjusted post installation. The occupier should also be notified that the units should not be switched off for any length of time greater than 24 hours.

If during your survey visit you identify that this will be an issue to the occupier, you may wish to consider an alternative ventilation strategy.

**Single glazing**

In cold periods, due to the poor thermal efficiencies of single glazed windows, the condensation problem on windows may reduce slightly but condensation on windows may still occur. The client should be made aware of this.

6. **INSTALLATION**

Manufacturer installation instructions must be followed in full. Failure to follow instructions properly can result in poor performance and may put the occupants and the structure at risk. It is also likely to invalidate the manufacturer’s warranty and absolve them of any liability. The installation guidance notes which follow are in addition to those supplied by the manufacturer. Where there is conflict between these notes and manufacturer’s instructions, then the manufacturers’ instruction should take precedence.

Any PIV unit should only be installed by technically competent and qualified personnel in accordance with all regulatory requirements.

Any supporting fans should be ducted to the outside and not directly into the roof space. The roof space access hatch should be insulated and draught stripped and any other ceiling penetrations sealed as much as possible to prevent movement of the house air into the roof space and recirculated by the PIV unit.

PIV units which draw in air directly from outside, e.g. wall mounted fans or loft units ducted to external walls due to an airtight loft, should have an inlet grille located at least 1500mm away from any flue discharge, extract fan discharge, drainage vent or any other potential source of polluted air. Such inlet grilles should be of a low resistance type and should not be fitted with fly mesh as they can substantially reduce airflow which in turn will decrease the performance of the unit considerably.

Very careful consideration should be given to positioning the PIV unit’s supply air diffuser in relation to smoke and carbon monoxide detectors. If in any doubt, the specific manufacturer should be contacted for guidance.

Where any component of a PIV unit passes through a fire resisting wall/floor or a fire compartment then appropriate measures must be incorporated by the installer to ensure the fire resistance of the structure is maintained in the event of fire. Such measures may include intumescent collars or fire dampers. If the air from a PIV unit is supplied into a protected escape route then it is highly recommended that the PIV unit is linked to a smoke detector in such a way as to ensure the PIV is automatically switched off on operation of any such smoke detector.

**Location of the unit (Loft version)**

1. The loft unit should be located in the loft space above the central hall and in such a location to minimise the overall duct length and bends.
2. The loft unit should be installed to allow sufficient space to undertake routine maintenance of the unit as
3. The installer should refer to the manufacturers installation instructions for detailed guidance.
4. The loft diffuser needs to be positioned in the central hallway.
5. Diffuser grilles should be fitted a minimum of 1000mm away from a central heating thermostat.

**Where to diffuse the air from a wall mounted PIV**

With any PIV installation it is vital that the incoming air is introduced at a central point within the property. The air should be delivered via the diffuser into a central hallway. If this cannot be achieved, performance can be compromised and client should be made aware.

**Inlet ductwork and location of a wall mounted PIV**

Condensation can occur on the inlet ductwork of a wall mounted PIV (the ductwork from outside the home to the wall mounted PIV). As a result, this may need insulating and/or boxing in. Careful consideration should be given to the location of the wall mounted PIV in order to minimise any inlet ductwork.

**Door clearance**

For a PIV solution to be fully effective it is recommended that clearances under doors are a minimum of 10mm to encourage good air flow in accordance with Approved Document F Means of Ventilation.

**7. SUPPORTING FANS**

There are instances where it will be necessary to fit additional supporting extractor fans. This is particularly the case in older properties where the layout of the property does not lend itself well to PIV.

As a general guide, if all rooms in the property are accessible from the central hallway and landing then the fitting of supporting fans is generally deemed to not be necessary. Exceptions to this may include houses with high occupancy levels.

Areas that may benefit from supporting fans are en-suite bathrooms or shower rooms, a bathroom that does not have any openable windows or a kitchen or utility room that is not accessible from the central hallway or landing. Continuous running extractor fans or similar should be considered for these rooms.
8. SAMPLE SITE PLANS

The following section provides guidance on PIV unit positioning in a number of typical scenarios. These are meant as guidelines and if in doubt the manufacturer should be consulted.

Typical terrace layout that would suit the installation of a loft PIV unit
Small apartment with no central hallway, or loft space that would not suit the installation of a PIV unit. The diffuser should not be fitted into a kitchen or bathroom.

A bungalow layout without a central hallway and a remote bathroom that would not be suitable for PIV.
9. COMMISSIONING

As required under Approved Document F, if a PIV unit can be tested and adjusted, it must be commissioned and a commissioning notice given to the local Building Control Body (BCB), or a competent person scheme. This also applies to any supporting fans that may be installed with a PIV unit which can be tested and adjusted. It is not necessary to notify a BCB in advance if the work is completed by a person registered with a competent person scheme that covers such work. Approved Document F gives much more detailed information on this notification process and reading and understanding of this process is highly recommended.

It is vital that a PIV unit is commissioned properly to prevent over or under ventilation of a home and to ensure that the unit is optimised to perform to the best of its capability. This normally involves setting the various modes for the specific unit being installed. Most units require the PIV unit to be installed and electrically connected before the various mode settings can be set. However, there are some PIV units where the mode settings can be set before the unit is installed or electrically connected which then operate the unit at the desired settings when it is installed and electrically connected.

When the PIV unit and enhancement fans have been commissioned, the person commissioning them should spend time with the home occupants explaining how they work, what they should expect by way of performance and what maintenance will be required. They should also provide the occupants, and the home owner if different, with hard copies of operational and maintenance information on the equipment installed.

Normal airflow mode setting

The steps which follow are based around the table below from Approved Document F with increased or decreased airflows depending on each individual property.

**Step 1** Estimate airflow rate in litres/second (l/s) based on occupancy level (count a large dog as 1 occupant and a small dog and cat as ½ occupant each)

<table>
<thead>
<tr>
<th>Occupants</th>
<th>Flow Rate (l/s)</th>
</tr>
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<tbody>
<tr>
<td>1-3</td>
<td>17 l/s</td>
</tr>
<tr>
<td>4</td>
<td>21 l/s</td>
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<tr>
<td>5</td>
<td>25 l/s</td>
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<td>6</td>
<td>29 l/s</td>
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<td>7</td>
<td>33 l/s</td>
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<tr>
<td>8</td>
<td>37 l/s</td>
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<tr>
<td>9</td>
<td>41 l/s</td>
</tr>
<tr>
<td>10</td>
<td>45 l/s</td>
</tr>
</tbody>
</table>

**Step 2** Estimate airflow rate based on total internal floor area

Total internal floor area in m² x 0.3 = l/s

**Step 3** Take the higher rate of Step 1 or 2 = l/s

**Step 4** If necessary, add the following flow rates to the airflow rate in Step 3:

- Add 4 l/s for a poorly insulated property (e.g. single glazing, un-insulated walls and ceilings)
- Add 4 l/s for higher than typical moisture production in property (e.g. excessive indoor clothes drying, high levels of cooking activity, bottled gas heater, fish tanks, etc.)

Final Estimated Flow Rate = l/s

(continued...)
Step 5  Check/compare Final Estimated Airflow Rate to occupancy level i.e.
Final Estimated Airflow Rate l/s ÷ occupancy level = l/s per occupant (Occupancy Ratio).
If Occupancy Ratio is greater than 20 l/s per occupant please contact a PIV specialist for advice on whether or not a lower Final Estimated Airflow Rate than that in Step 4 is recommended.

Step 6  Set the PIV unit to the nearest Normal Airflow mode rate setting equal to or greater than the Final Estimated Airflow Rate in Step 4 or other reduced rate as Step 5 above. To avoid excessive ventilation and consistency with Approved Document L1B, the Normal Airflow mode rate setting of the PIV unit should not be set more than 4 l/s higher than the Final Estimated Airflow Rate.
Performance enhancing ventilation units installed at the same time as a PIV unit in a home should also be commissioned properly, in accordance with manufacturer’s instructions and by technically competent and qualified personnel in accordance with all regulatory requirements.

10. OPERATIONAL MODES
This section details the various operation modes of PIV units.

Normal airflow mode
This is the mode that a PIV unit will run at for the vast majority of its operational time. It is this airflow setting which needs to be set carefully at commissioning stage to suit the individual requirements of the property. Some PIV units incorporate sensors and controls to optimise airflow and switch the unit between Normal Airflow mode and other modes including Heat Recovery mode, Moisture Content Control mode and Standby mode. Some units also have an Override Boost mode activated manually by the occupants via a switch or via sensors located in the living space.

Heat Recovery mode
A control function which increases the PIV unit’s airflow when the loft temperature reaches the Heat Recovery mode trigger temperature, with the intention to supply additional warmed air into the home. PIV units are available with fixed or adjustable airflow increase percentages and fixed or adjustable heat recovery mode trigger temperature settings.

This mode may not be available on some PIV units. Units with this feature have either a factory set and fixed Heat Recovery mode trigger temperature (typically 19 degrees centigrade) or an adjustable trigger temperature. It is recommended that PIV units which can be adjusted have the trigger temperature set to 1 degree centigrade above the average temperature the surveyor/installer thinks the area of the home the unit will supply air into will be heated to. PIV units are also available with fixed or adjustable airflow increase percentages.

Standby mode
A control function designed to switch a PIV unit off when the incoming air temperature reaches the Standby mode trigger temperature to save energy and prevent undesirable warm air being introduced unnecessarily into the home e.g. during hot summer days. PIV units are available with fixed or adjustable Standby mode trigger temperature settings. If continuous running of a PIV unit is required, for example if a PIV unit is being used to control radon gas in a home, then this function should be disabled or a continuous running PIV unit without this function should be installed.

This mode may not be available on some PIV units. Units with this feature have either fixed Standby mode trigger temperature (typically 25 degrees centigrade) or an adjustable trigger temperature which can be set to switch the unit off at higher or lower loft temperatures.
**Moisture Content Control mode**

A control function which monitors the PIV unit’s incoming air temperature and moisture content and regulates the units airflow accordingly when incoming air temperatures are low.

PIV units with this function normally allow the installer to enable or disable it as required.

**Override Boost mode**

A function where the PIV unit’s automatic controls can be overridden to operate the unit at its maximum airflow by means of a manual user control or automatically via sensors in the living space (e.g. humidity and CO2 sensors).

Manufacturer instructions should be followed if this mode is to be used.

**11. LEGISLATION**

The following legislation is referred to in this document:

The Health and Safety at Work etc Act 1974  
Building Regulations Approved Document F  
Control of Asbestos Regulations 2012  
Approved Document L1b

Employers should satisfy themselves that they have knowledge of the duties placed on them by all relevant legislation.

**12. ACKNOWLEDGEMENTS**

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Envirovent  
Nuaire

The information contained in this document is given in good faith and believed to be correct. However, it must be stressed that of necessity it is of a general nature. The precise condition may alter in each individual case and the Association is therefore unable to accept responsibility for any loss howsoever arising from the use of the information contained therein.