AIR ADMITTANCE VALVES FOR DOMESTIC PROPERTIES

Guidance Notes

BRITISH PLASTICS FEDERATION PIPES GROUP

AIR ADMITTANCE VALVES FOR DOMESTIC PROPERTIES

Introduction

For any system which drains waste water from a property to function correctly, the soil and waste pipes need to be ventilated. Without ventilation, air pressure changes inside the pipework due to the operation of domestic appliances would cause waste traps on the appliances to lose their water seal.

Until the early 1970s, the only way to achieve this was to install an open soil pipe (stack) through the roof, terminating outside of the property with its recognisable balloon grating or wire cage to prevent access by wildlife.

Whilst open stack ventilation is still common practice, air admittance valves have been available in the UK for over 40 years. They provide an alternative, and aesthetically more attractive, means of venting the drainage system.

This guide provides information on the function and best practice for specifying, locating and installing air admittance valves on gravity fed soil and branch pipes which discharge to a sewer.

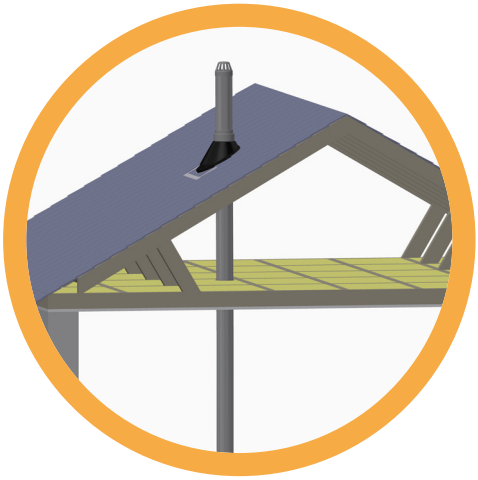
Ventilation Options

Across the UK, Building Regulations and statutory guidance allow for ventilation by either open soil pipes or air admittance valves. The preferred solution, being the simplest and most familiar to install, is the open soil pipe. It requires minimal maintenance and the visible termination point above the roof means it is less likely to be blocked off during future building work by householders.

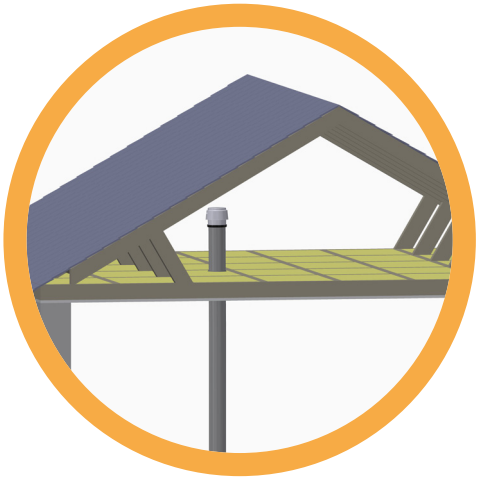
Open soil pipes within 3 m of any opening to the building need to terminate at least 900 mm above the opening, for example a window or balcony. Additionally, they require capping with a balloon grating or wire cage to prevent any wildlife from seeking a warm refuge whilst not restricting the flow of air.

Air admittance valves (AAVs) are installed directly on to the soil stack without the need for a hole to be made in the property roof, reducing the amount of pipework required and the costs of making good the roof, and minimising future risk of weather damage and water ingress. AAVs are normally located in the roof space and can provide the same ventilation capacity as an open system. They are particularly suitable for installation on stub stacks – a short stack from ground floor appliances which avoids the need for a full house height pipe.

Whilst not permitted by statutory guidance, except in Scotland under controlled conditions, the use of air admittance valves on the outside of the property is commonly used to overcome space restrictions between the stack and a window opening or to ventilate appliances without access to the main soil stack, for example in a property extension.



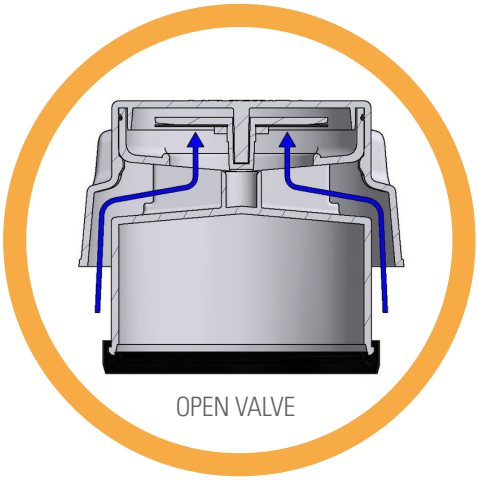
Typical soil stack



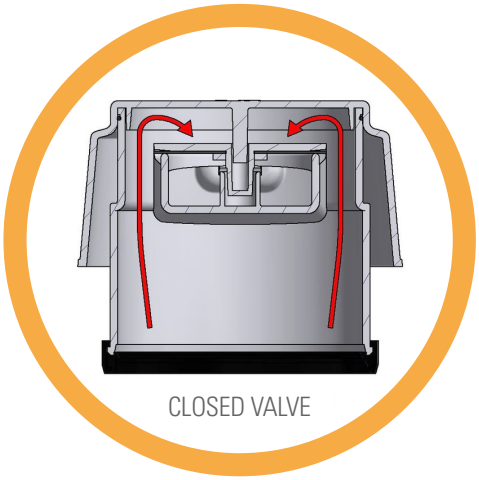
AAV terminating in roof space

Function

Air admittance valves are designed to fit to a vertical pipe inside the building. The valve houses a seal, usually manufactured from EDPM or Silicon Rubber, which lifts and falls in response to negative pressure caused by WC flushing and the draining of appliances. This simple mechanical principle allows air to flow into the drainage system, thereby breaking the vacuum, which would otherwise create a siphon in the traps. At the same time, the valve prevents the escape of foul air back into the appliance.



OPEN VALVE



CLOSED VALVE

Regulations and Standards

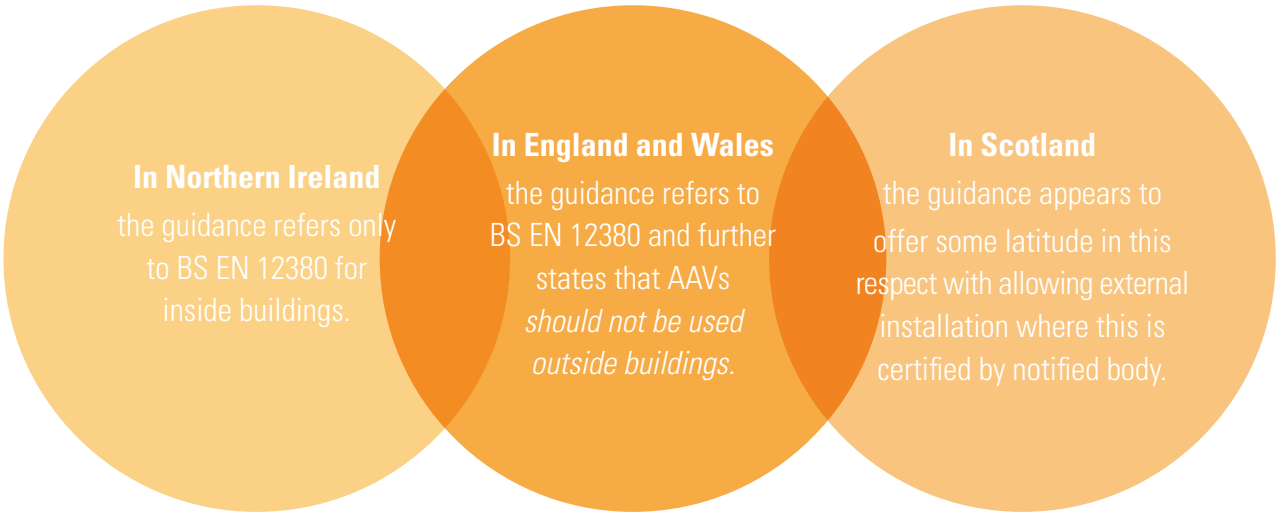
Statutory Requirements and Guidance

The Building Regulations 2000 require that an adequate system of drainage is provided to carry foul water from appliances within a building to a sewer, septic tank or cesspit.

Across the UK, the statutory guidance interpreting these Regulations is broadly similar, requiring that the drainage system is ventilated by an open soil pipe or the use of air admittance valves. The use and installation of AAVs is set out below.

SCOTLAND	ENGLAND AND WALES	NORTHERN IRELAND
Technical Handbook Clause 3.7.8	Approved Document H Clause 1.33	Technical Booklet N Clauses 2.13 & 2.15
Allows for the installation of Air Admittance Valves where they are fitted: • in accordance with BS EN 12380 or • in compliance with the conditions of certification of a notified body.	Allows for the installation of air admittance valves where they are fitted in accordance with BS EN 12380.	Allows for the installation of air admittance valves where they are fitted in accordance with BS EN 12056: Part 2 and BS EN 12380.

In respect of the use of AAVs in an external installation, guidance differs slightly across the UK:



Product Standards

Air admittance valve manufacturers design and test their products to **BS EN 12380 Air admittance valves for drainage systems. Requirements, test methods and evaluation of conformity** taking into account the requirements for the use and installation of valves to **BS EN 12056-2 Gravity drainage systems inside buildings. Sanitary pipework, layout and calculation.**

BS EN 12380 defines the requirements for air admittance valves to be used in gravity drainage systems installed inside buildings in accordance with BS EN 12056-2.

The requirements can be summarised as follows:

- Product Type and Requirements for: Operating Temperature Range and Installation Position, Connection type, Air Tightness, Durability, Air Flow Capacity.
- Test Methods used to assess: Impact and Handling Resistance, Air Tightness, Endurance and Temperature Cycling, Opening Characteristics and Air flow, Sub Zero Operation.
- Evaluation of Conformity: Type Testing and Production Quality Control including CE marking and labelling.

BS EN 12380 uses a designation system for valves according to their operating temperature and location with respect to connect appliances. This is shown in the table below and the following example.

Determining Factor	Range / Position	Designation
Permitted to be located below flood level of connected appliances	Yes	A
	No	B
Operating Temperature Range	-20 °C to +60 °C	I
	0 °C to +60 °C	II
	0 °C to +20 °C	III

Source: BS EN 12380: 2002 Table 1 Operating conditions and designation of air admittance valves

Example:

An AAV that is permitted to be installed below an appliance's flood level and can operate in air temperatures of -20°C to +60°C would be designated an A 1 rated valve in Approved Document H and BS EN 12056-2: 2000 Section 6.

Further information on choosing a valve with the correct rating is provided in the 'design choices section' of this guidance.

BS EN 12056-2 details the requirements for the use of air admittance valves in gravity drainage systems installed inside buildings, with particular reference to positioning and dimensions of the proposed valve as part of the chosen drainage ventilation configuration.

Guidance from all key industry bodies such as CIBSE and NHBC follow the requirements of BS EN 12380.

THE BRITISH PLASTICS FEDERATION (BPF) PIPES GROUP AND ITS MEMBERS STRONGLY ADVISE THAT COMPLIANCE WITH BS EN 12380 IS VERIFIED BY A THIRD-PARTY (UKAS ACCREDITED OR EQUIVALENT).

Under the Construction Products Regulations (CPR), construction products placed on the market in the European Economic Area (EEA) and covered either by a harmonised European Standard or conforming to a European Assessment Document (EAD), must be CE marked. BS EN 12380: 2002 Annex ZA sets out the responsibilities of the manufacturer for demonstrating compliance with essential requirements listed in the Annex by testing and factory production control and for affixing a CE mark on the valve and packaging. The use of a CE mark does not replace verification by a third party of compliance with BS EN 12380.

Soil and waste system ventilation

Stack Ventilation

Soil and waste drainage systems inside buildings can be configured in a number of ways to provide adequate ventilation. These are detailed in BS EN 12056-2: 2000: Section 4, but in each case, there is a basic requirement to control air pressure fluctuations in the pipework.

Stack ventilation is achieved through two main approaches:

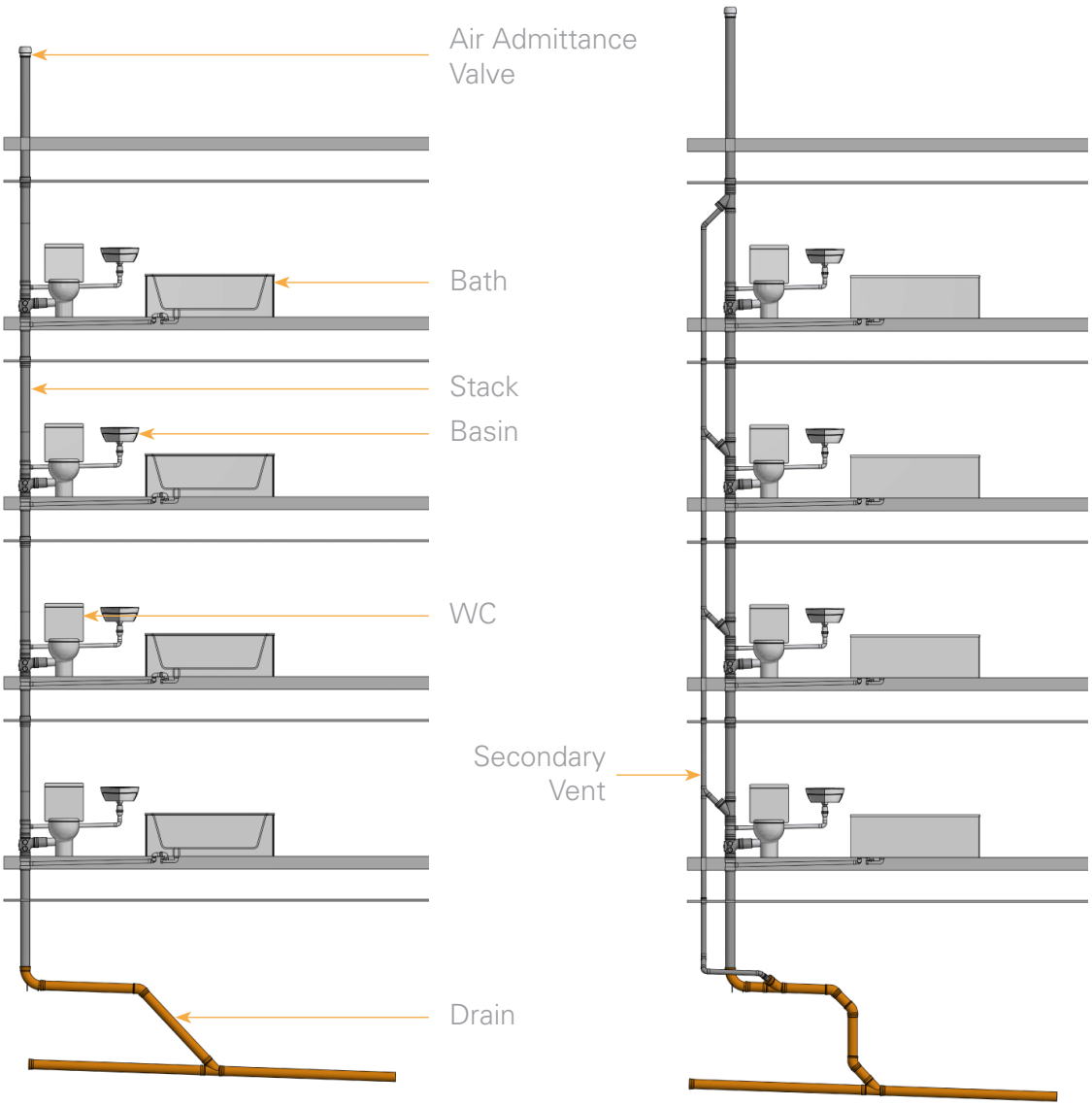
- Primary ventilation - pressures are controlled by air flow in the main stack.
- Primary and secondary ventilation - pressures are controlled through the installation of a separate ventilating stack and/or secondary branch ventilation pipe connecting to the stack vent.

Air admittance valves are suitable for both primary and secondary ventilation. Typically, they are designed to fit 110 mm or 82 mm pipe for stack ventilation. As foul sewer gases inside the pipe system cannot escape through the seal, AAVs can be installed inside a building, usually terminating between joists in a roof space, without a risk to public health.

The schematic below shows air admittance valves on the main stack for each ventilation approach.

Primary Ventilation

Primary and Secondary Ventilation



Branch Pipe Ventilation

Where the air capacity in the branch pipework gives sufficient protection to trap seals, air pressure fluctuations can be controlled without additional ventilation. General guidance for an unventilated discharge branch such as pipe size, number of appliances and pipe gradients is provided in Approved Document H and BS EN 12056-2: 2000 Section 6.

Additional ventilation may be required and can be created by installing secondary ventilation for the whole system, see above, or adding branch ventilation using smaller AAVs. Guidance on additional ventilation of branch pipework in given in Approved Document H and BS EN 12056-2: 2000: Section 4.

Air admittance valves are suitable for venting branch pipes i.e. pipework connecting to WCs, wash hand basins, baths/shower, sinks and appliances to the soil stack. Smaller valves are designed to fit 32 mm, 40 mm, or 50mm waste pipes.

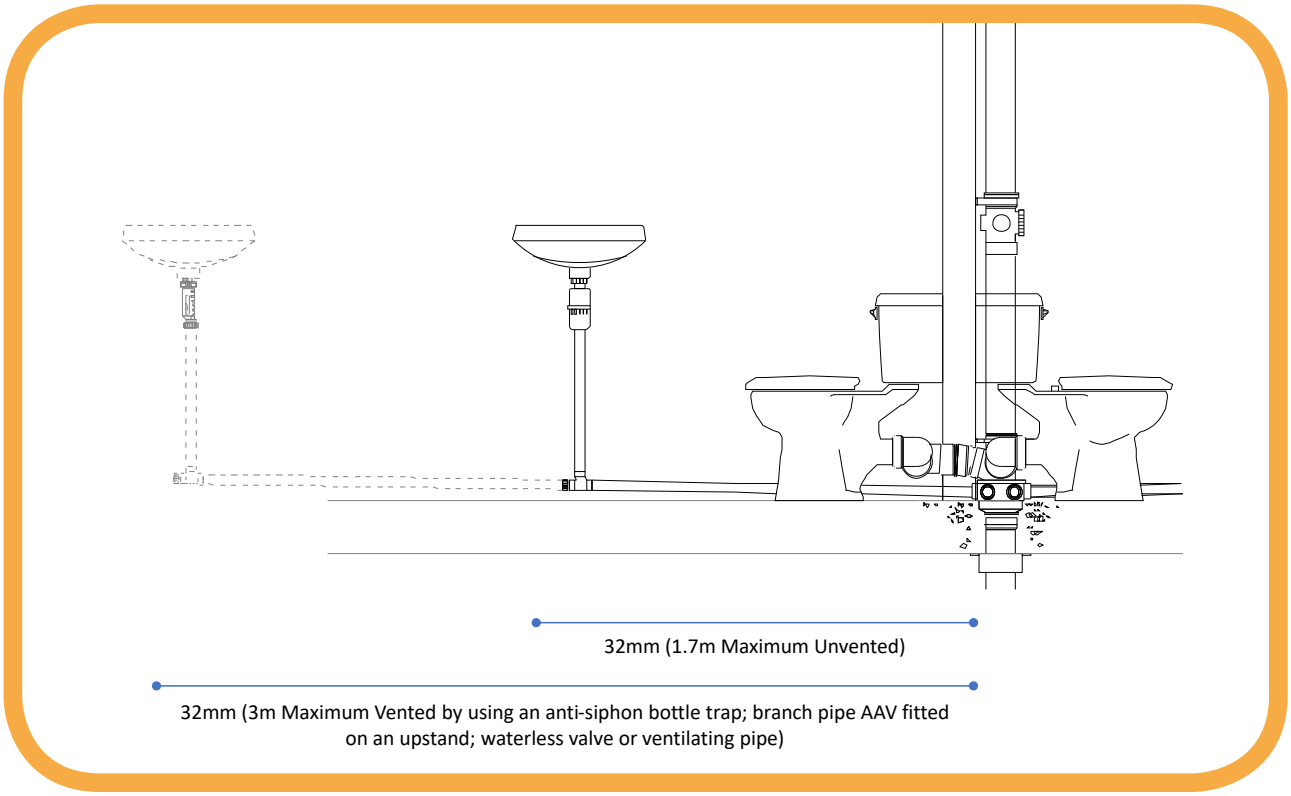
Adequate pipe ventilation is required on branch pipes to prevent the risk of self-siphonage (i.e. the loss of a water seal in the trap due to too much water, flowing at full bore with inadequate ventilation, inducing a negative pressure).

Branch pipe ventilation can be achieved by installing a small air AAV on an upstand; fitting anti-siphon water traps or waterless traps. The options are shown schematically below.

Example:

Tables 6 and 9 of BS EN 12056-2: 2000 provide guidance on the limitations for unvented and vented discharge branches. In this example, a 32 mm waste pipe is connected to a washbasin. Table 6, row 1, shows that the maximum length of pipe from the sink waste to the stack is 1.7 m (unventilated branch) but can be increased to 3 m (Table 9, row 1) if the branch pipework is ventilated.

The additional ventilation required could be provided by a small AAV or using secondary ventilation.



The additional ventilation required could be provided by a small AAV or using secondary ventilation.

Design

Capacity

The hydraulic capacity required of drainage inside a building is dependent upon the number and type of sanitary appliances connected to the system. Each appliance can be described in terms of discharge units (DU), i.e. the average discharge rate from the appliance in litres per second (l/s). BS EN 12056-2: 2000, Table 2 (column 4, System III) sets out typical discharge units - for instance, a bath is 1.3 l/s, whereas as a shower without a plug is 0.4 l/s.

The sum of the discharge units from all appliances connected to the drainage system are used to calculate the expected flow rate of waste water in the drainage system, taking into account the frequency of use of appliances. Tables and formulae for calculating the hydraulic capacity required for a drainage system are set out in BS EN 12056-2:2000: Section 6. The size of a primary ventilated soil stack can then be selected using the calculated hydraulic capacity and Table 11 of BS EN 12056-2: 2000.

Where an air admittance valve is used to ventilate a stack instead of leaving it open to the atmosphere, the minimum airflow rate is calculated from the total flow rate (Q_{tot}) from the appliances in the property. In selecting an AAV, the minimum airflow rate is eight times the total flow rate.

Example:

Bath (DU = 1.3), shower without a plug (DU = 0.4), WC (DU = 1.2 to 1.7) and wash basin (DU = 0.3). Sum of discharge units = 1.3 + 0.4 + 1.7 + 0.3 = 3.7 l/s.

Sizing ventilated soil stack: Using section 6.3, BS EN 12056-2: 2000, for a domestic property without pumped or continuously running appliances, the total flow rate (Q_{tot}) from these appliances is the same as the waste water flow rate (Q_{ww}) and calculated as 0.5 x √3.7 = 0.96 l/s. Table 11 of BS EN 12056-2: 2000 indicates that a primary ventilated soil stack of 70mm would be suitable, but as a WC is connected to the system in our example, the minimum pipe size is 100 mm.

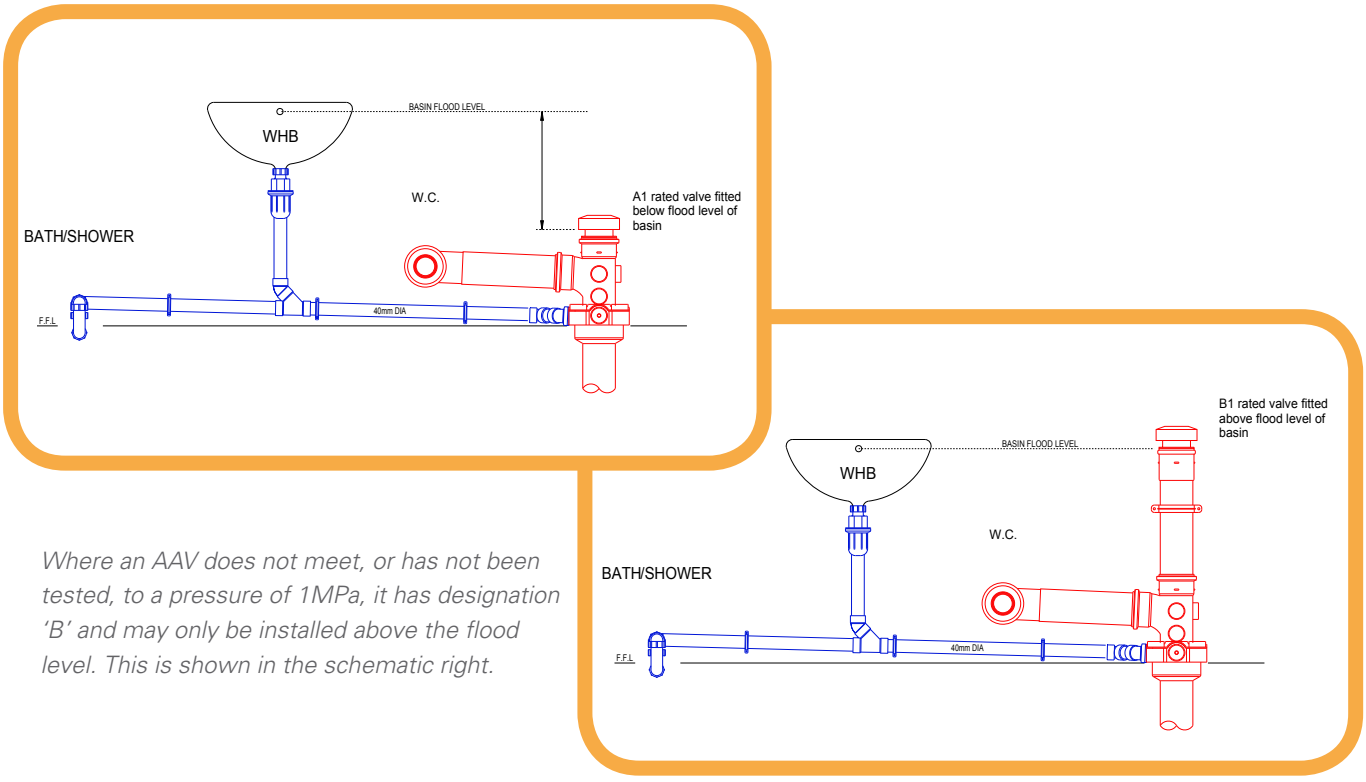
Sizing AAV: Using section 6.5, BS EN 12056-2: 2000, for the example given here the minimum air flow rate Q_a is calculated as 8 x 0.96 l/s = 7.68 l/s.

Whilst EN 12056-2 sets out a consistent calculation method for air flow rates, there is a range of air admittance valves available in the UK market. It is important to check manufacturer's literature to select an AAV which will meet the minimum air flow rates and deliver the performance required by the property.

Ratings

BS EN 12380 uses a designation system for valves according to their operating temperature and location with respect to connect appliances, see the section on Product Standards in this guidance.

An AAV with designation 'A' will have passed a pressure test of 10 MPa (1 m of water gauge pressure) and can be installed below the flood level. This is shown in the schematic below.

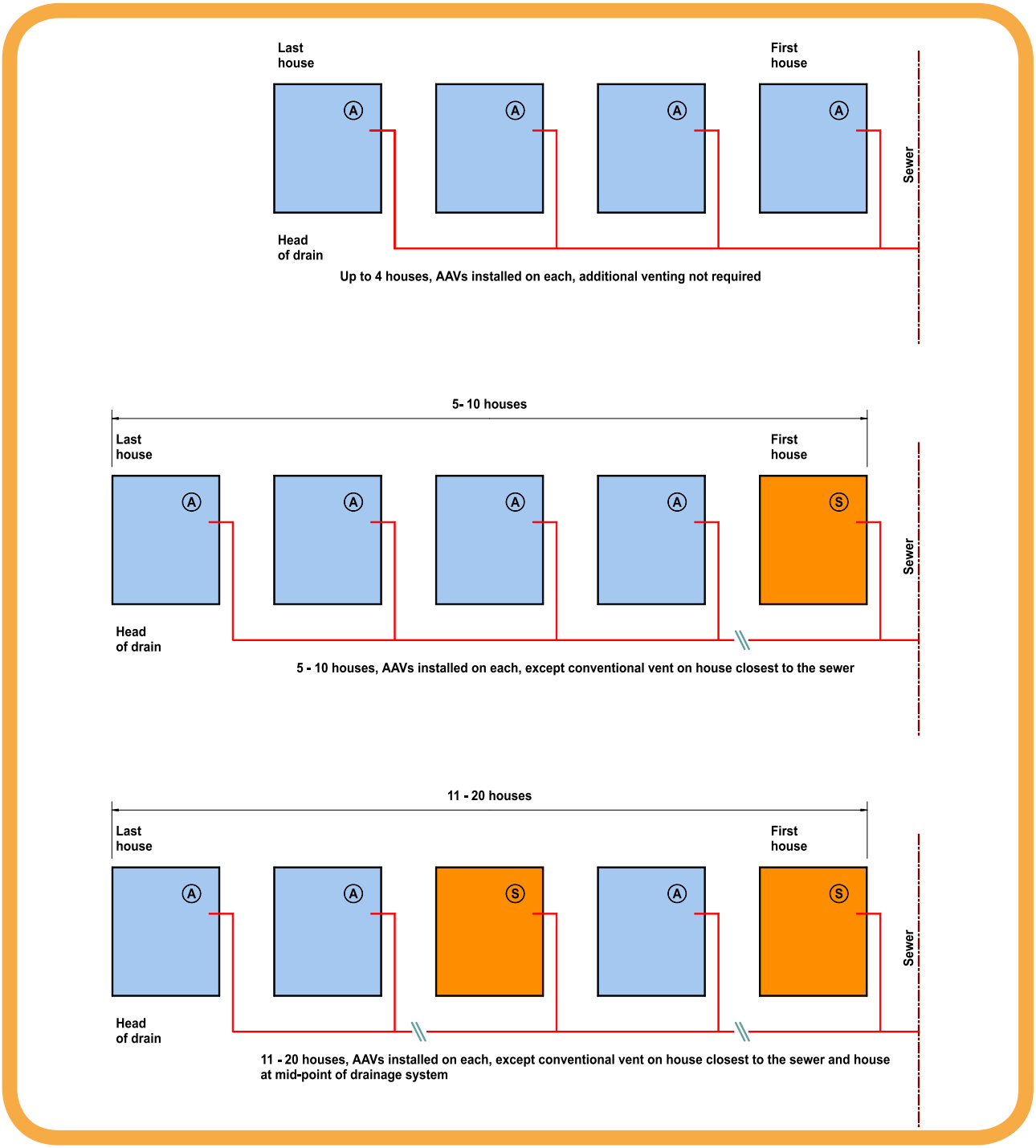


Where an AAV does not meet, or has not been tested, to a pressure of 1MPa, it has designation 'B' and may only be installed above the flood level. This is shown in the schematic right.

Plot Drainage

In a multiple housing situation, if all houses were fitted with an AAV, there is a risk that flows in underground drainage could create excessive back pressures on each connected dwelling. Evidence of this would be 'bubbling' and rising water levels in WCs and other appliance traps. To manage this risk, it is recommended that the house closest to the main sewer, i.e. the first house, and every subsequent 10th house is also installed with an open stack vent. This is shown schematically here.

It is important that homeowners occupying properties with an open stack vent installed for drain ventilation do not compromise this during any future renovation and home improvement.



Ⓢ = stack open to atmosphere Ⓐ = stack with AAV

Location

New Build Properties

Good practice:

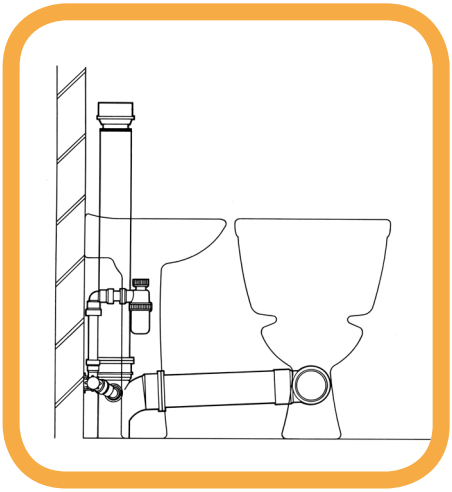
- AAV located in area with adequate ventilation – avoid restrictions to air intake.
- AAV located inside a duct or boxing – ventilate the box using grilles or gaps.
- AAV located in roof space – situate above insulation.
- AAV should be accessible for inspection, maintenance and testing.
- AAV can be used as a rodding point in the event of blockages – locate above the spillover level of the lowest appliance.

Type A valves (see section on 'ratings') may be located below the spillover level of a connected appliance. However, consideration should be given to access for inspection, maintenance and testing and flood risk. If the AAV is installed below the spillover level, the resilience of the property to flooding may be compromised. If installed above, the AAV offers a clear visual indication of a blockage before a flood occurs.

Renovations and Property Alterations

AAVs can also be installed on stub stacks. This presents a useful access point, but care should be taken to ensure that the AAV is accessible and that any boxing is vented.

On the ground floor, a separate group of appliances (e.g. cloakroom) may be connected to a drain using an unventilated stub stack. An AAV is not required if the vertical drop from the centre line of the WC branch to the invert level of the drain is no more than 1.5 m and the centre line of the highest appliance is no more than 2.5 m to the level invert of the drain. However, where stub stacks discharge directly to a drain, the head of the drain should be ventilated. AAVs are widely used on stub stacks to avoid any doubt about ventilation and to provide a convenient access point for maintenance.



Property Extensions

The design of a property extension may make the venting of a soil stack through the roof space or inside the property using an AAV difficult. Except in Scotland where the valve has been certified by a notified body, installation of an AAV outside of the property is not permitted by Regulation. Nevertheless, it has become common practice to do so. Designers should carefully consider the following when locating an AAV outside of a property.

Good practice:

- AAV should be tested for outside use - check suitability with manufacturer.
- Testing should include resistance to weathering including operation in low and high temperatures, protection from ingress of water, debris etc.
- AAV should be accessible for inspection, maintenance and testing
- Instructions for maintenance should be provided to the property owner

Installation

Good Practice

It is important to follow the manufacturer's installation manual when installing air admittance valves; however, there are some general guidelines which are applicable to all AAVs.

- Keep AAV away from dusty environments – an AAV contains a lubricated seal, dust can enter the valve and stick to this seal, causing issues with the effectiveness of how the valve seals when in the closed position. It may be necessary to install the AAV at a later stage of an installation to protect them from building dust.
- Store the AAV sealed and upright.
- Manufacturers provide their AAVs with different connect types, see examples below.

FIN SEAL

UNIVERSAL ENDED

SOLVENT WELD SOCKET

A valve which is installed with a fin seal, universal connection or a spigot ended valve inserted into a ring seal will also allow for removable access for rodding purposes.

An AAV requires a free movement of air around the valve to ensure correct and effective operation. If an AAV is installed within a duct or riser it is important that this area is vented. Ventilated grilles or discreet gaps around the boxing may be an option. For further information see NHBC Technical Guidance 8.1/16.

Insulation and Condensation

Valves which are A1 or B1 rated are suitable for conditions down to minus 20°C. However, it may be necessary to provide insulation where there is a possibility of condensation forming and freezing within the valve body.

Installation Checklist

BUILDING CONTROL CHECK LIST	TICK
Is it accessible?	
Is there clearance around the valve (for air flow)?	
Is designation correct for applications?	
Is it suitably insulated?	
Are manufacturer's instructions available and used?	
Is it external? is this permissible in region / does manufacturer says it is suitable?	
3rd party approval / mark to BS EN 12380?	

Ongoing Maintenance and Operation

- Refer to manufacturer's installation guide for information on ongoing maintenance and operation. Some air admittance valves are sealed units and therefore cannot be serviced. Some, however, can be accessed by the removal of the cap. It may be necessary on occasions to clean and re-grease any seals.
- A sign of a faulty air admittance valve may be foul smells entering the building either through the valve or through an appliance caused by siphonage of the trap.
- Air admittance valves act as an early indicator of blockages in the pipe system. If a blockage is forming downstream of the appliances, the WC level will be higher than usual and wash hand basins and other appliances will be slower to drain. Action can then be taken to deal with any blockage before the system overflows.

A list of members who manufacture and supply plastic pipes for air admittance valves for domestic properties is provided on the BPF Pipes Group website,
https://bpfpipesgroup.com/application-groups/ag2-building-services/