CPD For Domestic Ventilation

Agenda

- Introduction
- Ventilation strategies and how they work
- The importance of installation practice to system performance
- The critical elements to ensure system performance
- Installation guidance
- Planning and design
- Commissioning

Why?

- Houses are becoming more airtight.
- If systems are not installed correctly ventilation can be dramatically reduced or in some cases be non existent.
- Without correct installation of the system the ventilation requirements of Approved Document F of the Building Regulations may not be achieved.
- Expensive re work may be required if ducting is incorrectly installed.

Effects of poor ventilation

- Excessive condensation not removed by the ventilation system can cause mould growth which leads to cosmetic and structural damage to the fabric of the dwelling.

- Mould growth and other pollutants from every day living can create very poor indoor air quality (IAQ) within the dwelling. This can cause potentially serious health issues.

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How Ventilation Systems Work

Ventilation can be defined as:

‘The replacement of stale indoor air with ‘fresh’ outdoor air through purpose-provided openings

The objective of a good ventilation strategy is to provide a balance between energy efficiency and indoor air quality

Whilst this can be achieved in the design and specification process, the way systems are installed is crucial to delivering the required performance and ensuring regulatory compliance

Ventilation also provides a means to control thermal comfort and this, along with other methods, is considered in Part L of the Building regulations and its supporting Approved Documents

How Ventilation Systems Work

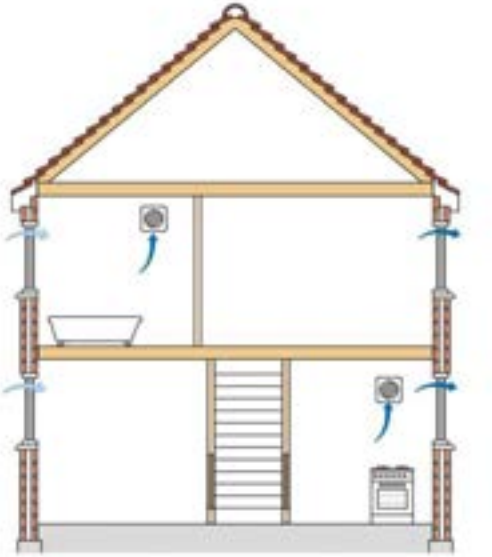
Ventilation strategies

- Whole building ventilation to provide a continuous supply of fresh air from outside, and to dilute and disperse water vapour and pollutants that are either not removed by extract ventilation or are generated in other rooms in the home

- Extract ventilation in wet rooms where most water vapour and/or pollutants are released e.g. kitchens, bathrooms, utility rooms and WC's. This is to remove these pollutants directly to outside and minimise their spread into the rest of the building

- Purge ventilation throughout the building to aid removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating. Typically windows are opened, where necessary, to purge a room

System 1: Intermittent Fans & Background Ventilation



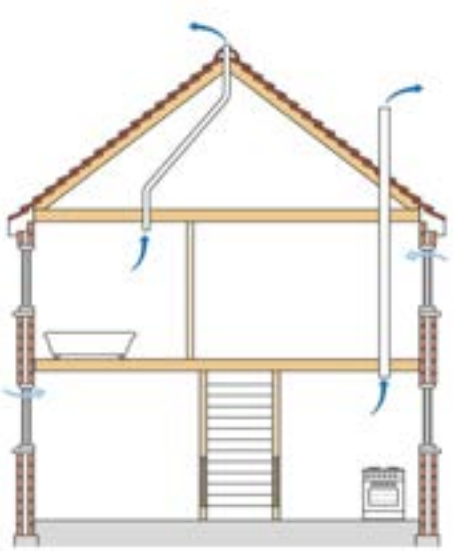
- Mechanical Intermittent Extract Fans located in the wet rooms to extract pollutants quickly at a high rate

- Can be controlled either;
  - Manually via remote/light switch or pull cord
  - Automatically, typically via humidity sensor

- Normally wall or ceiling mounted and ducted direct to outside air using the most economical route

- Replacement air enters the building via background ventilators, typically in the form of window vents located in the head of window frames

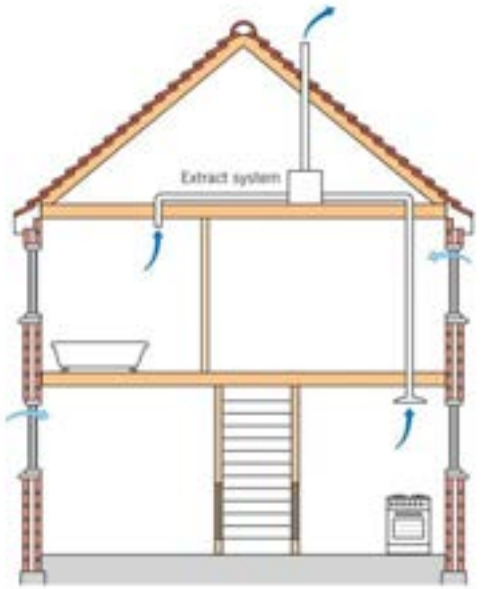
System 2 - Passive Stack Ventilation



A PSV System provides continuous ventilation. The driving force being the “stack effect” and the “wind effect”. (Hot air rises and the wind passing over the outlet helps to draw the air out of the building).

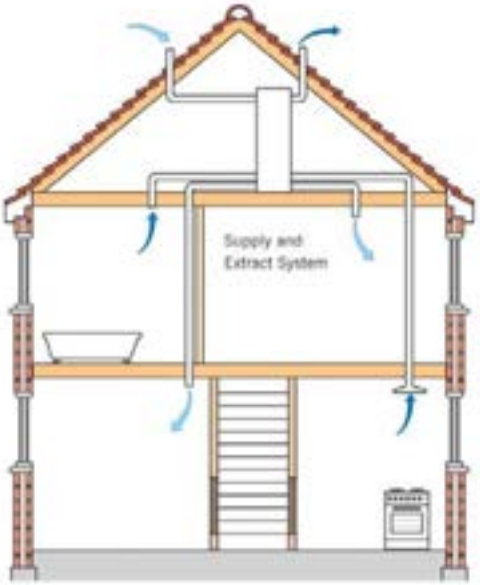
- Separate ducts should be taken from each wet room
- Ducts should ideally use no more than one offset (ie no more than two bends).
- Offsets should be no more than 45°.
- Placing the outlet terminal at the ridge of the roof is the preferred option.
- If the outlet is more than 0.5 mtr from the roof ridge it must extend to at least ridge height.

System 3 – Continuous Mechanical Extract (MEV)



- Extracts continuously at a low rate and incorporates a boost facility to extract pollutants at a higher rate as required
- Can be controlled either;
  - Manually via single or multiple switches including light switches
  - Automatically, typically via humidity or other sensors
- Normally sited remotely in a loft space or cupboard and ducted via rigid duct to outside air using the most economical route
- Replacement air enters the building via background ventilators, typically in the form of window vents located in the head of window frames. These should be fitted in each room except wet rooms form which air is extracted

System 4 – Balanced Mechanical Supply & Extract with Heat Recovery (MVHR)



- Supplies & extracts air continuously at a low rate and incorporates a boost facility to extract pollutants and supply fresh outdoor air at a higher rate as required

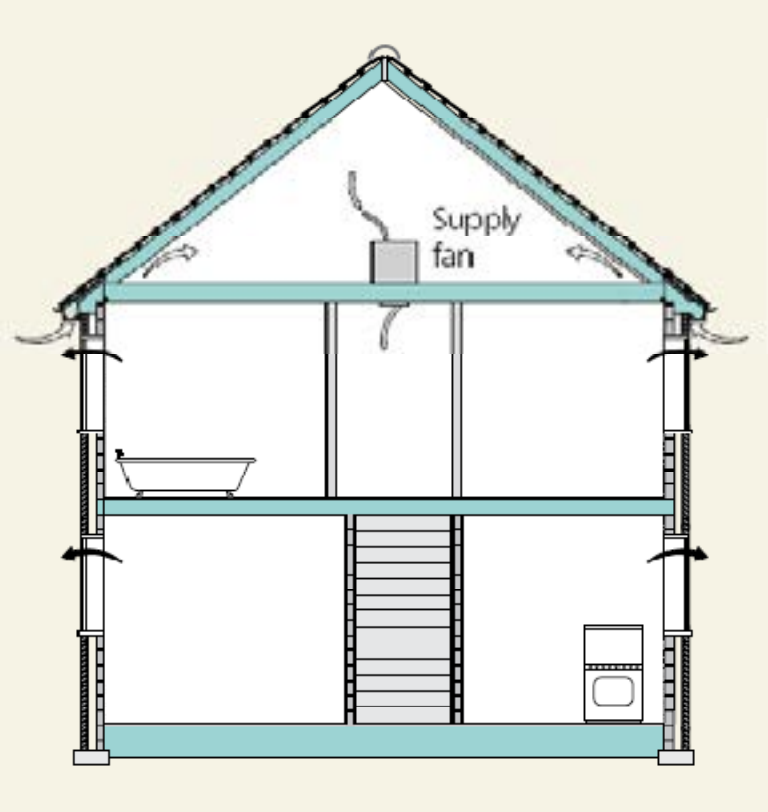
- Can be controlled either;
  - Manually via single or multiple switches including light switches
  - Automatically, typically via humidity or other sensors

These should be clearly marked and located in an accessible location in or near the wet rooms

- Normally sited remotely in a loft space or cupboard and ducted via rigid duct to outside air using the most economical route

- Replacement air is dealt with by the balanced system. Background ventilators in windows are not required

Alternative System – Positive Input Ventilation



- These are alternative systems usually consisting of a centrally mounted unit continuously supplying fresh air to the centre of a dwelling

- It is recommended that trickle vents with an equivalent area of 2500mm are included in all habitable rooms and moisture producing areas (unless an independent certification scheme states otherwise)

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Importance of Installation Practice to System Performance

- **It is vital that ventilation systems are installed correctly, to ensure ventilation rates are met. This can be achieved by;**
  - Using rigid ducts for the majority of the installation
  - Using minimal amounts of flexible duct to aid connections
  - Minimising bends and taking the most economical route
  - Providing airtight seals with good quality sealing tape
  - Providing mechanical fixes with cable ties or worm-drive clips

- This will ensure systems can be commissioned and balanced to deliver the designed airflow rates inline with Building Regulations document, Part F: 2006

Importance of Installation Practice to System Performance

Do

✓ Ensure ducts take the path of least resistance to maintain system efficiency. Reducing amount of bends and flexible duct in the duct routes will help maintain performance. Flat ducts of an appropriate size for the system can be used instead of rigid round duct

Don't

x Allow ducts to be unsupported

x Introduce more bends than necessary

Here, the system is using too much flexible duct and has sharp bends in close proximity, which will greatly affect performance

Importance of Installation Practice to System Performance

Do

- ✓ Use rigid duct for the majority of the duct route
- ✓ Plan the route carefully to avoid unnecessary bends over and above the design drawings
- ✓ Mechanically fix and tape joints to ensure an airtight seal

Don't

- x Use flexible duct for the entire installation. This duct can easily be crushed in the roof space. Current system performance is not great but over time will diminish further as this duct is not fixed for its working life and has potential to collapse

Importance of Installation Practice to System Performance

Do

✓ Read installation instructions carefully and consider fully how the ducts will connect. In this case the ducts have been aligned so that a short straight taut flexible connection can be simply made

Don't

x Cram flexible duct into small areas where it can be crushed. This will reduce the amount of air able to pass through it, and will cause too much air resistance.

x Snake ducts unnecessarily. This duct can easily be crushed had the loft insulation been placed over it. It is recommended to use rigid ducts wherever possible to not only improve system efficiency, but future proof the installation

Importance of Installation Practice to System Performance

Do

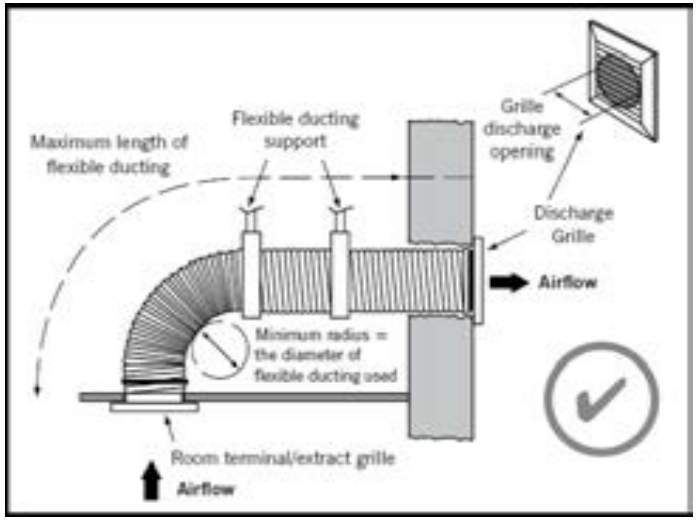
✓ Ensure ducts are fixed to surface securely and sealed. This will ensure that the system performs inline with the design drawings

Don't

x Attempt to fabricate components not suitable for the transfer of air. You can see that this branch connection is leaking air. The airflow requirements at the room grille will not be met as a result, causing delays in the commissioning process

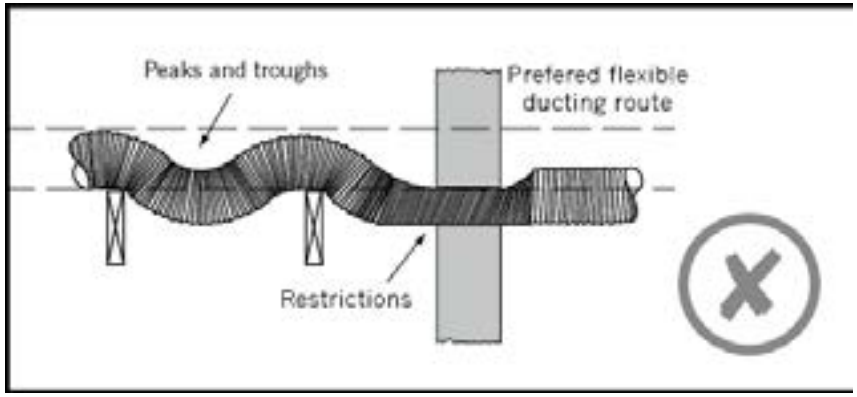
x Rush the connections. Failure to achieve a suitable connection onto this central extract system will cause large volumes of air to leak out. This means there will be limited airflow at the room grille

Importance of Installation Practice to System Performance



DO

- Ensure the duct route takes the most economical route out of the building
- Ensure that duct is adequately supported
- Ensure that bends are swept to offer the least amount of resistance



DON'T

- Allow duct route to sag, causing peaks and troughs
- Pass duct through an opening that allows a restriction to form causing resistance

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Critical Elements - Duct Routes

- Use specified size and type of duct
- Endeavour to follow design drawing layouts, unless constraints in the building require another route to be taken.
- You must obtain agreement for variances from design drawings
- Take the most direct route possible out of the dwelling (in-line with proposed design layout)
- Do not introduce unnecessary bends into the system
- Avoid changes in duct size/shape as this will increase resistance

Critical Elements - Connections

- Failure to adequately connect and seal ductwork will result in poor performance levels with any ventilation system
- This ultimately leads to problems during the commissioning process as the ventilation system under performs and fails to comply with building regulations

Recommendations for Connections

- Use a good proprietary sealing tape as per manufacturers recommendations on all duct types
- Mechanically fix flexible connections after taping with a suitably sized cable tie or worm-drive clips
- Mechanically fix rigid ducts and seal with low modular silicon and/or duct tape to seal joints to aid an airtight connection.
- Adequately support ductwork to avoid movement and weakening of joints

Critical Elements - Terminals

- Room Terminal: Extract/exhaust grille (intermittent fans only)
  - Ensure that the free area of the grille opening is a minimum of 85% of the free area of the ducting used
- Room Terminal: Extract/supply air grille (central systems)
  - Ensure that the grille opening is adjustable to achieve room extract rates as detailed within Approved Document F
- PSV internal terminals
  - Ensure that the free area of the grille opening is a minimum of 100% of the ducting being used

Critical Elements - Background Ventilators

- Check that the ventilator has not been obstructed by finishing materials inside or out
- Check that air can flow through the ventilator

Critical Elements - Controls

The effective control of ventilation systems is important

- Mechanical systems will fail to comply with building regulations if they cannot achieve a constant low speed and if required a boost facility during moisture generation

Recommendations for Controls

- Refer to manufacturers design drawings or client specification to determine requirements for controlling any system
- Refer to manufacturers installation instructions to ascertain which wiring arrangement is most appropriate for the installation
- A competent person (such as Part P approved) must be responsible for the electrical installation

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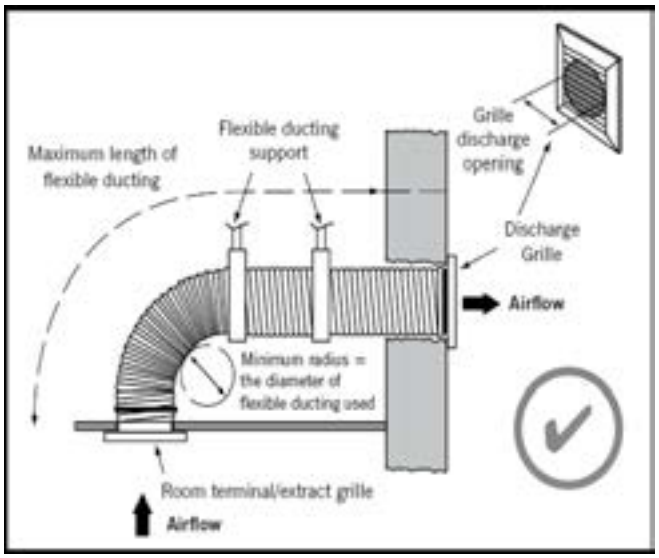
Alignment of ducts

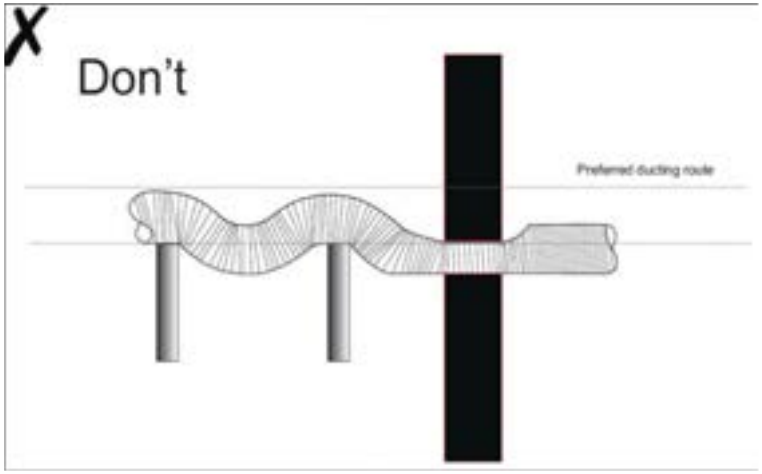
- Ducting should be aligned to minimise flow resistance (e.g. cutting the duct to the correct length, using the minimum number of bends, and minimising kinks, etc)

- The use of flexible duct must be minimised. Where used it must be pulled taut (flexible duct has higher resistance to airflow)

- Duct must be positioned where it cannot be damaged through occupier use in the space that it is installed e.g. high up in an airing cupboard or away from a loft hatch

Alignment of ducts





- Horizontal ducting must slope slightly downwards away from the fan to prevent backflow of any moisture into the product
- The inner radius of any bend must be greater or equal to the diameter of the ducting being used.

- The circular profile of flexible ducting must be maintained throughout the full length of the duct run.
- An alternative profile of duct must be used if the duct route requires it passing through a restricted space. The free area must be maintained and not increase resistance to airflow
- Flexible ducting must be installed with the correct bracket support to avoid peaks, troughs, and distortion of the duct profile

Fire Protection

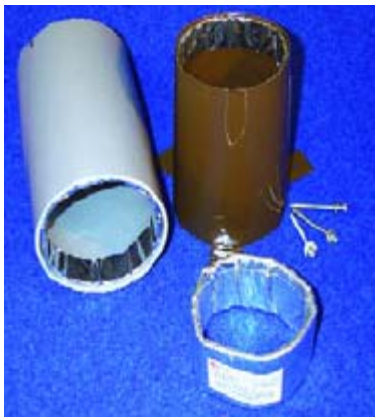
- It is in the remit of the system designer to advise on building regulations document Part B; 2006 for fire protection
- The designer must identify the fire strategy for the building, particularly on loft conversions and refurbishments
- Duct routes must be planned to avoid protected areas, such as hallways and stairways where possible

Fire Protection Products

- A wide range of fire protection products are available from many manufacturers
- Fire products should be selected based on their suitability

  - For the construction type; Solid, Hollow, Plasterboard
  - For the level of protection required; 30mins, 1, 2 or 4hrs rated

- Typically these types of product are the most common



Intumescent
Vent grilles

Intumescent
Wraps

Intumescent
Pipe collars

Installation Guidance – Minimising Flexible Ducts and Why

- Flexible ducts offer little benefit to system efficiency and there are specific rules in SAP Q to limit their use
- Better SAP Q results are achieved with rigid duct
- Flexible ducts as a general rule offer 100% more resistance to airflow than a rigid duct and are prone to change shape during and post installation
- Challenge your designer if excessive flexible duct is specified
- If installing flexible ducts with any ventilation system, follow the guidance in Appendix E, of Building Regulations Part F; 2006

Flexible Duct – The Do’s and Don’ts

Do’s for Flexible duct

- ✓ Ensure the duct route takes the most economical route out of the building
- ✓ Pull flexible duct taut and use only the amount necessary
- ✓ Adequately support the duct to avoid movement
- ✓ Ensure bends are swept to offer the least amount of resistance

Don’ts for Flexible duct

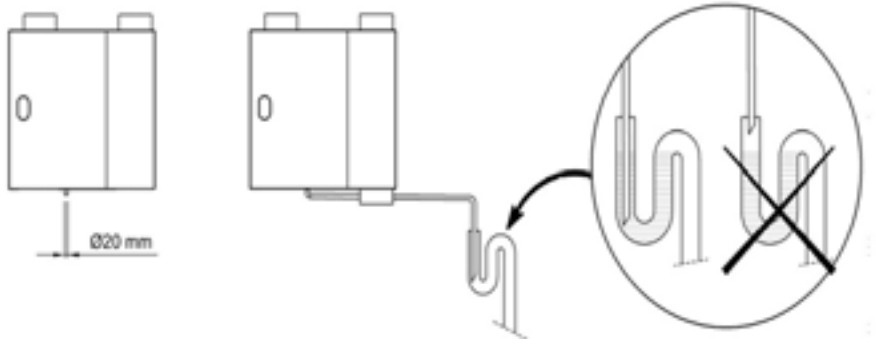
- x Allow duct route to sag, causing peaks and troughs
- x Pass a duct through an opening that allows a restriction to form causing resistance

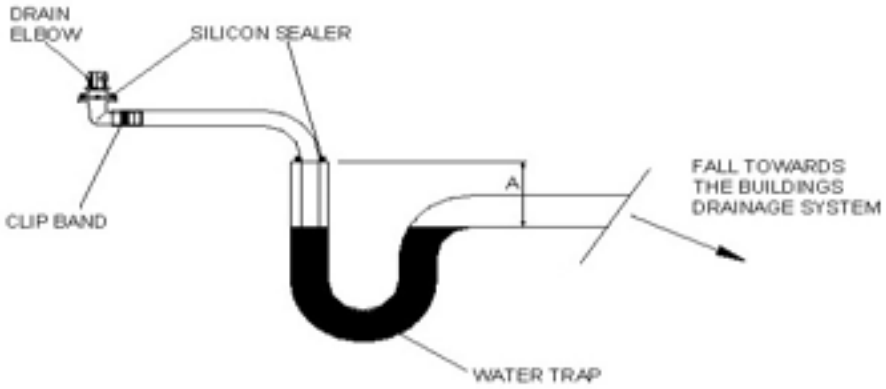
Condensate Traps

Connecting the condensate discharge

The condensate discharge line is fed through the lower panel. The condensate must be discharged into a trap which is then connected to the foul water system of the dwelling. The condensate discharge comes separately with the unit and the installer must screw it into the underside of the appliance.

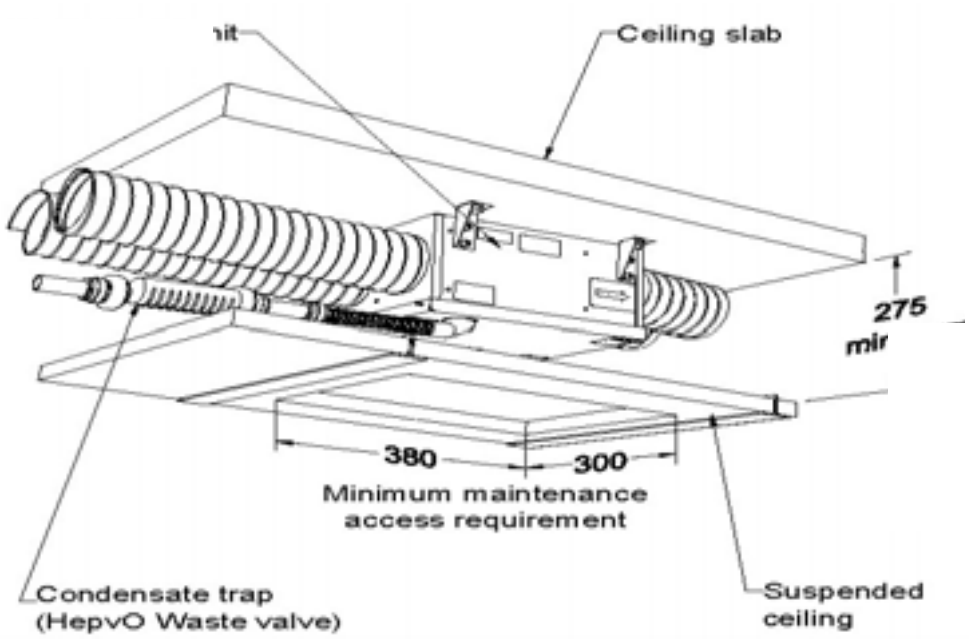
See the drawing below for an example of a connection to a drainpipe.





Discharge pipe must enter the U trap far enough to enter the water within the trap as shown.

Condensate Traps



The unit must be positioned so that the condensate outlet will accommodate a trap and the condensate conveyed properly with a continuous gradient to a suitable positioned down pipe. Connect the drainage system as appropriate using PVC pipe work, joined using PVC cement to ensure waterproof joints. Fit a flexible tube adjacent to the unit to allow the cover to be moved clear during maintenance.

Also note that a blocked condensate outlet pipe due to insufficient pipe gradient will quickly lead to water damage

Best Practice Jointing of Ducts

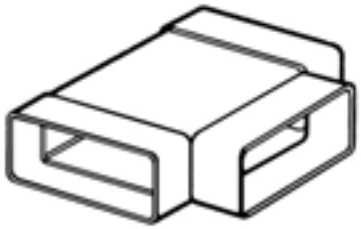
- Air leakage testing of low and medium pressure ductwork is not mandatory under HVCA DW/143
- The integrity of the ductwork depends on the successful application of the correct jointing method :-

For rigid ducting

- Solvent cementing for uPVC & PVC but not PP
  (Solvents are Not Recommended for rectangular duct section)
- Hot air welding
- Most systems have socket and spigot joints, these can be mechanically fixed and sealed with low modular silicon and/or duct tape to seal joints.

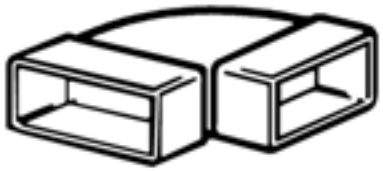
Best Practice Jointing of Ducts

A small selection of jointing components for duct showing socket and spigot



Horizontal T-Piece

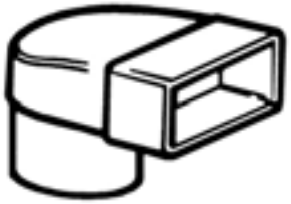
Flat Channel Connector



Horizontal 90° Bend

Round to Rectangular Adaptor

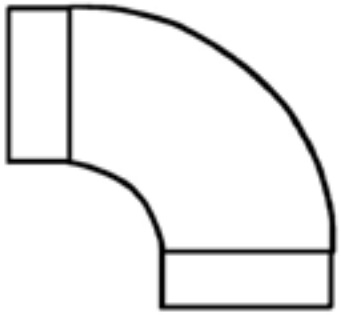
Circular Supply Diffusers



Elbow Bend with Spigot

Circular Equal Tee

Circular Female Coupler



Circular 90° Bend

Best Practice Jointing of Ducts

- Rigid duct should be mechanically fixed at the joints and to the structure close to joints. This is more important if the duct is in a roof space that is going to be used as storage and the ducting could get dislodged and leakage could occur at the joints.

- Diffusers should also be mechanically fixed to the ducting and sealed with tape.

- When using insulated flexible duct the inner sleeve should be attached to the spigot first with a foil or duct tape, the outer sleeve should be attached using a cable tie or worm-drive clip and taped.

Best Practice Jointing of Ducts

Duct mechanically fixed and silicon sealed

Duct mechanically fixed and taped

Jointing of Ducts ?

T Connection ? the S bend is not much better. One joint is mechanically fixed but not taped

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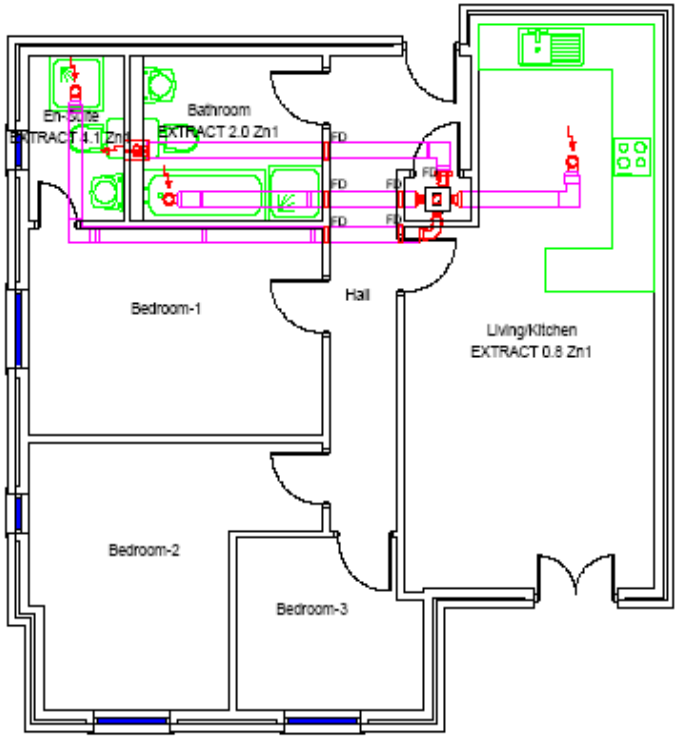
Design

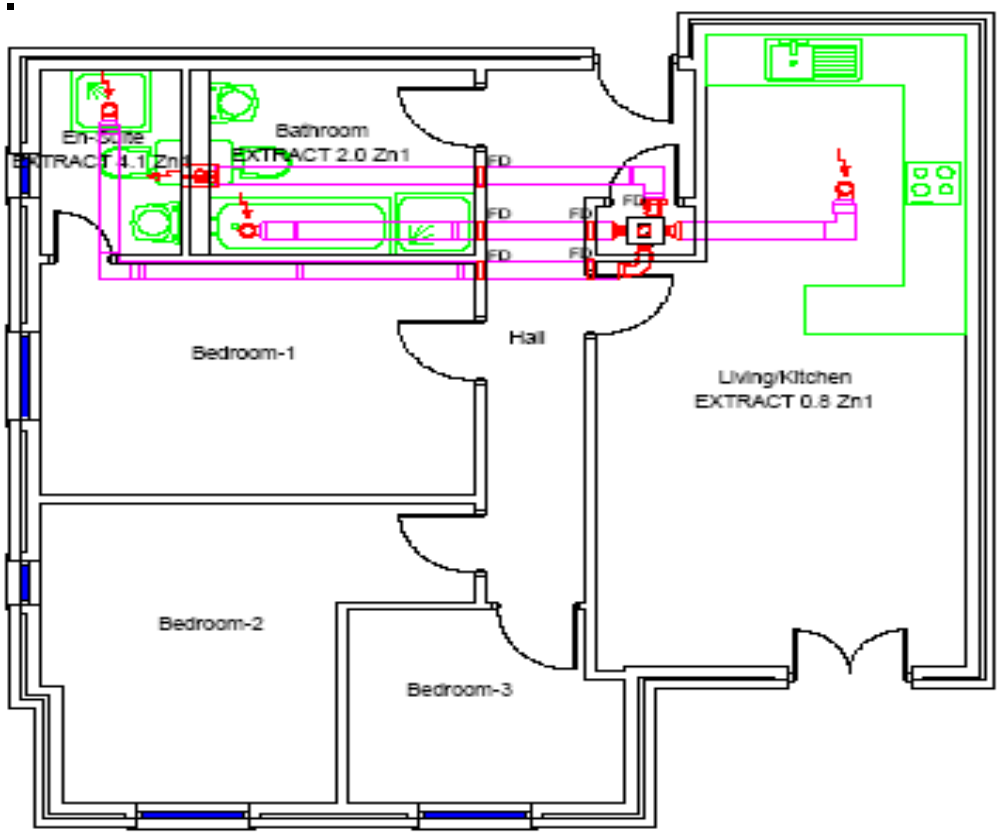
- Understanding the design: Duct runs, terminals inside and out, position of vent unit and controls, installation of condensate drainage.
- How to check the design of the system against the actual site situation and what to do if it differs.
- What changes have to be made to the ventilation design, and is it possible or does the structure need changing and who is going to pay.
- Have you got the right product on site to complete the work with the changes?
- If the builder is to change the structure so the original design can be used you will still need to agree on a time for you to return to site to carry out your work.

MEV System showing ducts in Purple and terminals in Red plus fire dampers are also in Red but with a reference of ‘FD’. The extract in this Flat is through the roof (so other trades may be involved)



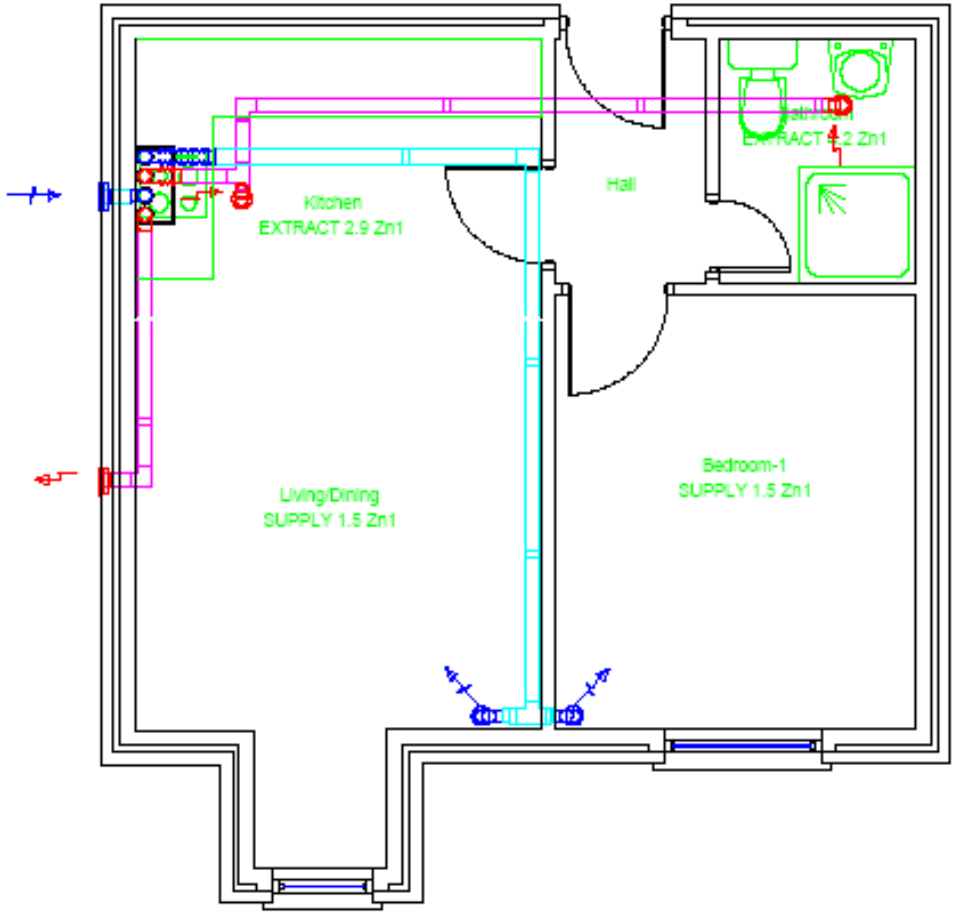
Note: Check that window vents / background ventilation has been provided.

This Flat is on the top floor but if it had been any other floor the extract point could have been through the nearest outside wall. So you could have 2 drawings looking almost the same, or notes to identify the difference.

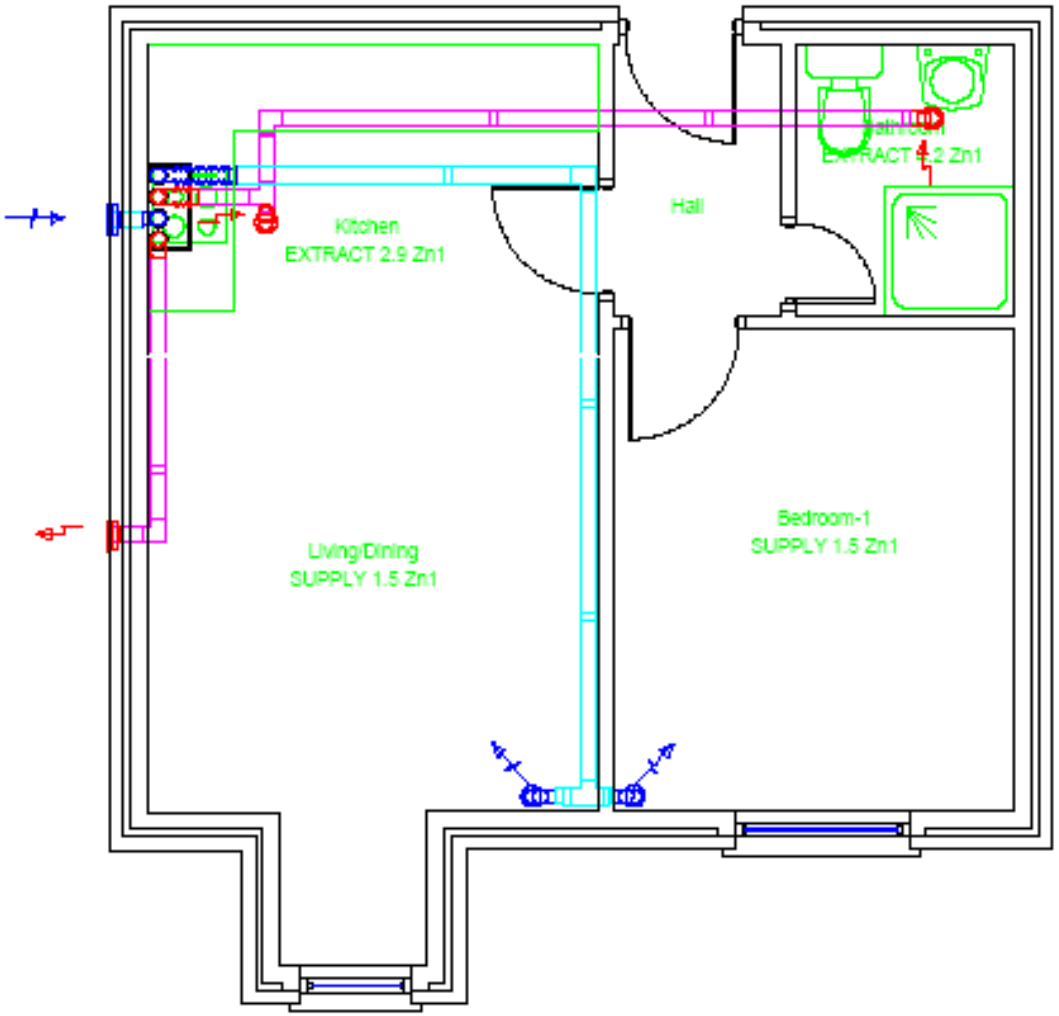


Note: Check that window vents / background ventilation has been provided.

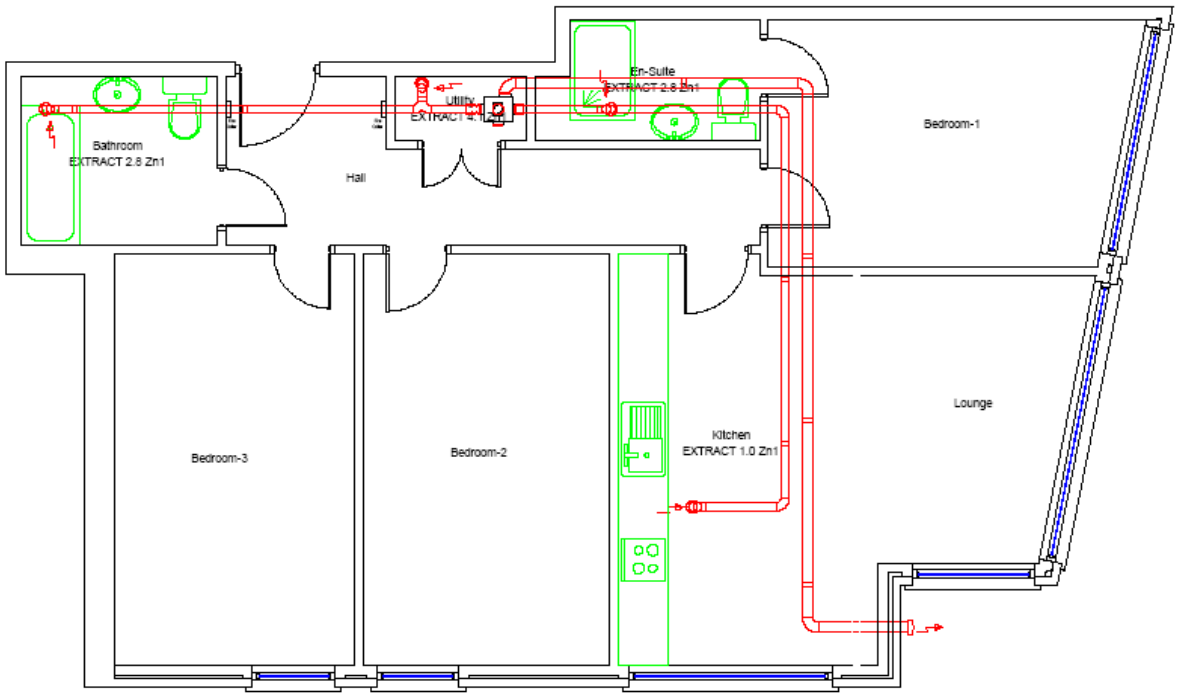
MVHR System showing extract ducting in Purple and supply ducting in Turquoise. Incoming air Blue terminal and Red for extract these are the same colours for the internal terminals.



Note that the replacement Air terminals are away from the extract point so to help create good all round air movement within the flat.



Sometimes duct runs are longer than need be. As you can see the location of the unit and where the external terminal is allowed to exit the building has determined duct runs in this flat.



Planning the installation

- Once any design issues have been resolved you need to plan your work, and confirm if other contractors i.e. electricians are involved and who is doing what and when.

- It is unlikely you will be able to complete a job in one visit, and you will need to plan with the builder when you can carry out the stages of fixing required between other trades work.

- Ideally you should be the first services trade as pipe work and wiring is far more flexible when it comes to installing them. Rigid duct by its very name is not.

First Fix

- This is normally the duct runs (inaccessible at a later stage)
  - Once complete you will need to have this work signed off by the builder as it may be some weeks before you return to this site
  - Try to obtain a formal sign off
  - Try to obtain a variation order if changes apparent on return
- Mark drawing where ducting has been temporarily terminated
  - You need to know where to drill holes for terminals and connections!

First Fix

Before ceilings are installed

Before studding is installed

Second fix (complete installation)

- All terminals to be fixed.
  - Installation of ventilation unit to be completed including electrical connection via a fused spur
  - Ducting to be connected to the ventilation unit including to outer atmosphere duct and grille(s).
  - When needed condensate drains are also to be installed.
  - All necessary controls to be installed and fan speed settings to be established and set.
- You will again require this work to be signed off by the builder as a completed installation but still not commissioned.

External Terminals

- Where these terminals pass through the structure they should be positioned so any water penetrating through external grilles will run back to the outside of the dwelling

- If roof terminals are used this would normally be installed by another trade and again this must meet the precise specification as laid down in the original design.

- Where manufacturers recommendations are not available, inlet and extract terminals should be kept a minimum of 300mm apart

- Location of these terminals should be kept clear of flue exhausts (see BS 5440) and openable windows

Installation of Unit (MEV)

These units can be suspended by nylon cord / strapping in the loft to prevent noise transfer or could be structurally mounted and where need be have acoustic/anti-vibration mountings between the unit and the structure.

The units must be installed in a position that will permit access for maintenance purposes.

A local isolator must be provided within 1 metre to enable the unit to be isolated.

Installation of Unit (MVHR)

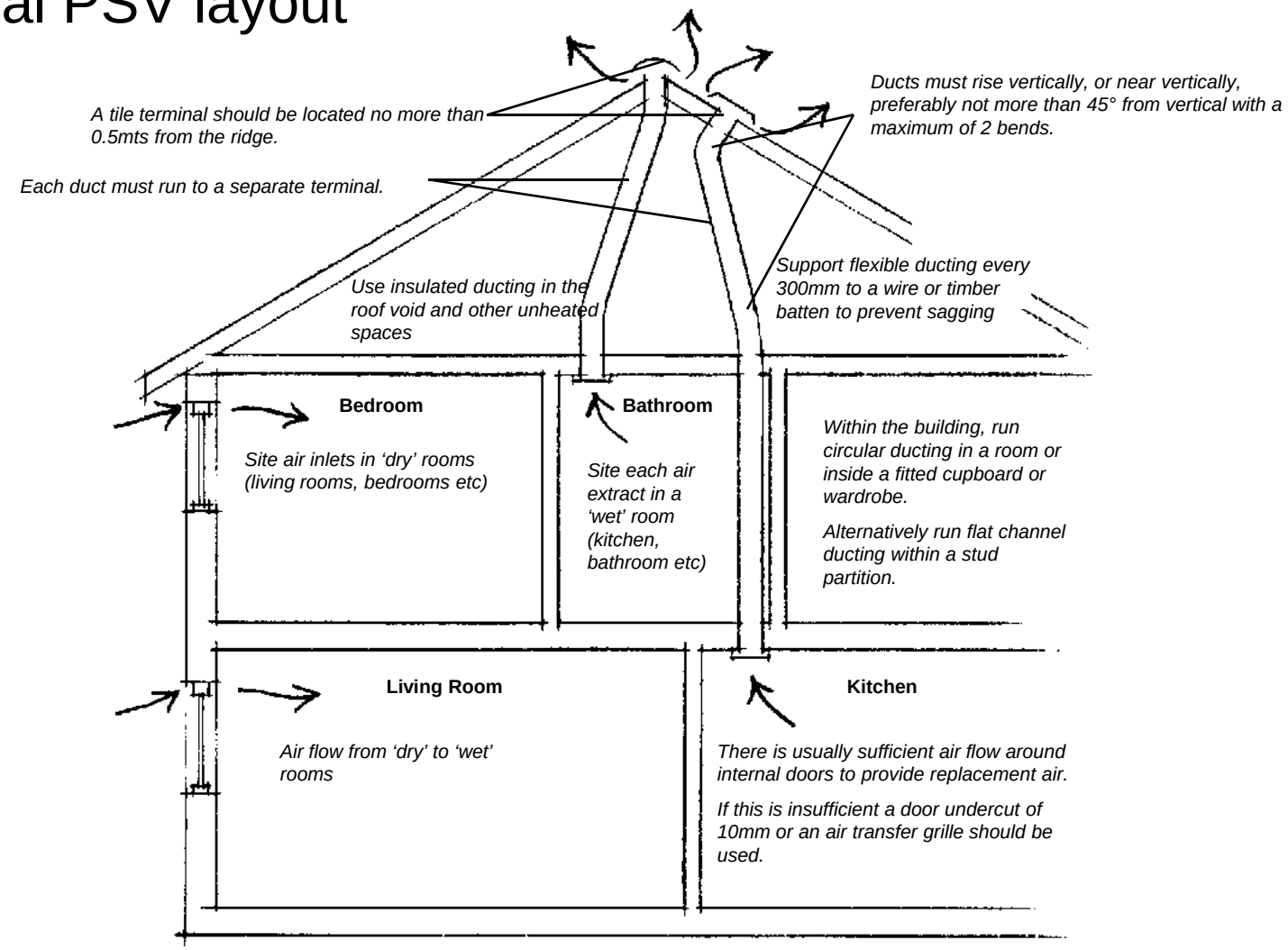
- Usually heavier than MEVs
  Usually structurally mounted
  Will need acoustic/ ant-vibration mountings

- Must be installed in a position that will permit access for maintenance and filter change

- A local isolator must be provided within 1 metre to enable the unit to be isolated

Installation of PSV

Typical PSV layout



Installation of PSV

Terminals

- Positioning of tile terminal crucial to system performance
- Terminate systems on the roof with a recommended ridge terminal as outlined in design.
- A tile terminal should be located no more than 0.5m from the ridge (note: if a terminal is positioned more than 0.5mts from the ridge it must extend above the ridge line)
- Each extract must be connected by separate ducting to a separate terminal.
- If possible tile/slate terminals should be installed on the leeward side of the roof relative to the prevailing wind.
- Both tile and ridge terminals must have condensation control feature.
- Follow the detailed fixing instructions supplied with each terminal.
- After terminal installation, connect insulated duct to the terminal.

Installation of PSV

Ridged Connection

- Use pre-formed bend sections so that any angle formed with the vertical is less than 45°.
- Support the duct to prevent undue strain on the join with the ridge/tile terminal
- Ensure that the roof structure is suitably strengthened to allow for installation of the ridge / tile terminal.

Flexible

- Carefully measure the length of flexible ducting required.
- Cut ducting to approx. 300mm longer than the distance between inlet grille and outlet terminal to give sufficient material to make smooth bends for connection to the terminals.
- The ducting should be fully extended so that it does not sag or wrinkle, but it must not place any strain on connections or fixings.
- Take particular care to avoid sagging.
- Support all flexible ducting at 300mm intervals where it passes through a roof space.
- Seal all connections with tape and then secure with a clamp.
- Connections between insulated and uninsulated ducting require a male sleeve coupling.

Installation of PSV

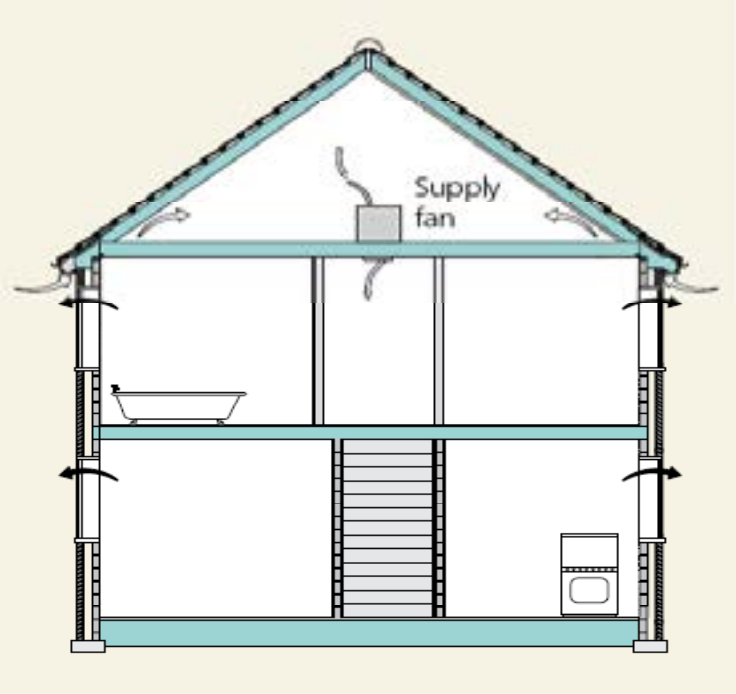
Background Ventilators

- Install air inlets in ‘dry’ habitable rooms, e.g. living rooms and bedrooms. Note: Extracts to be located in ‘wet’ rooms only
- Site inlets where shown in the design layout, in windows or walls, so as to avoid discomfort (typically 1.75m above floor level)
- For optimum performance inlets should be humidity sensitive

Most Common Generic Faults

- Incorrect terminals used causing condensation problems
- Incorrect positioning of terminals meaning non-vertical duct runs
- Flexible ducting being too long with too many bends
- Ducting not properly supported causing it to sag or become detached
- Supports too tight around the duct, restricting air flow
- Incorrect inlets used meaning system non-conformance to building regulations

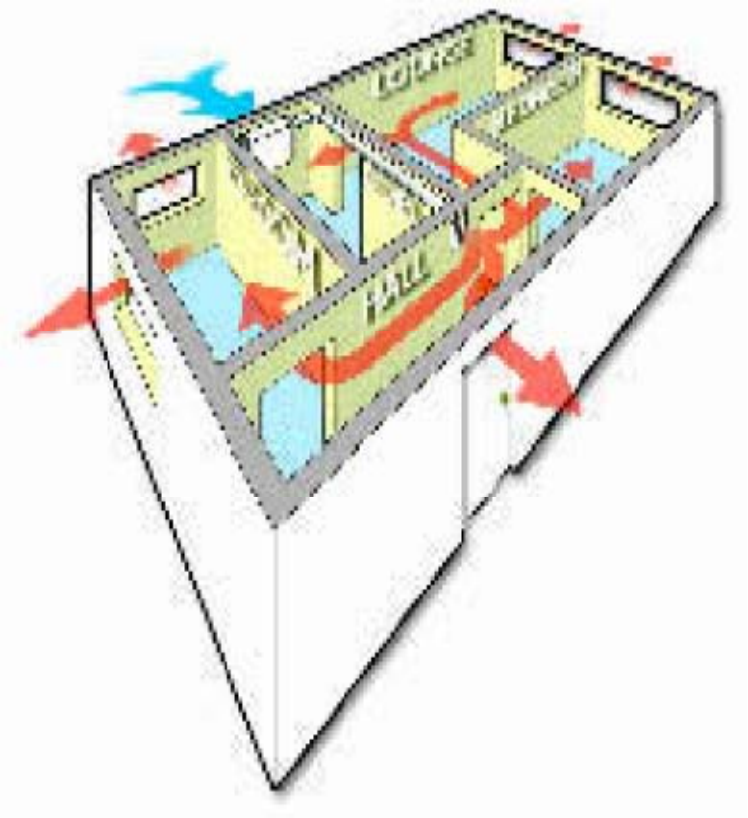
Positive Input Ventilation – Loft Mounted Systems



- Systems are normally provided with a short length of large (200mm) diameter duct attached. The unit should be sited so that the duct is not twisted or distorted.
- Site the unit so that access to the loft space is not restricted.
- Ensure loft party wall is intact (if present) and no damage/leaks to flues/chimney
- PIV is suitable for use in traditionally ventilated roof spaces, and those using breathable membranes. It is not suitable for use in un-ventilated warm roofs

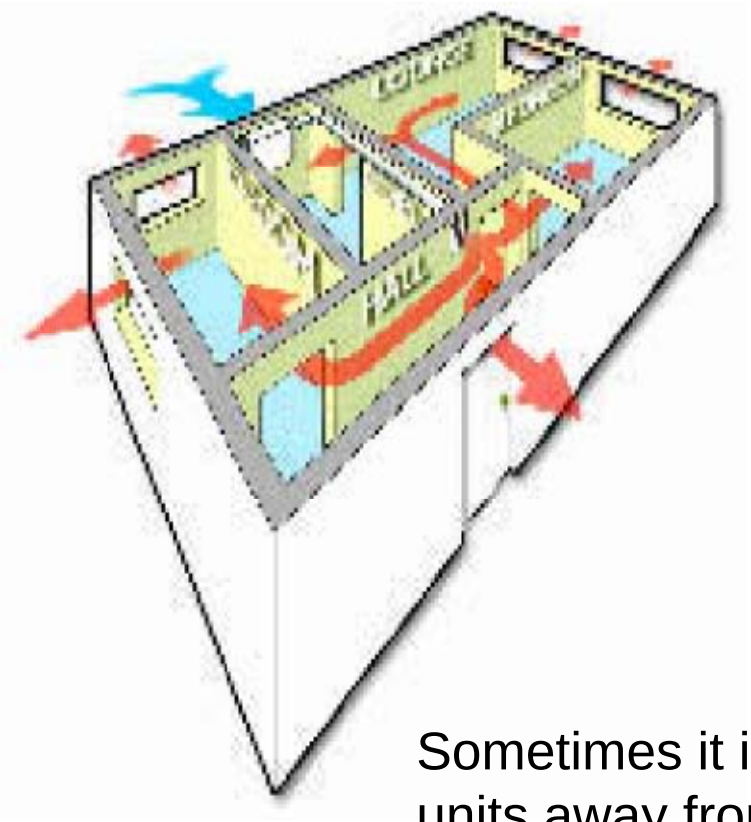
- To reduce the instance of re-circulation from the house the upstairs ceiling should be as airtight as possible.
- Supply air diffusers should be located 1M from walls to minimise cold draughts, & 1M from smoke detectors, so as not to reduce the speed of detection. When this is not possible sides should be blanked off with material provided & in accordance with the manufacturers instructions

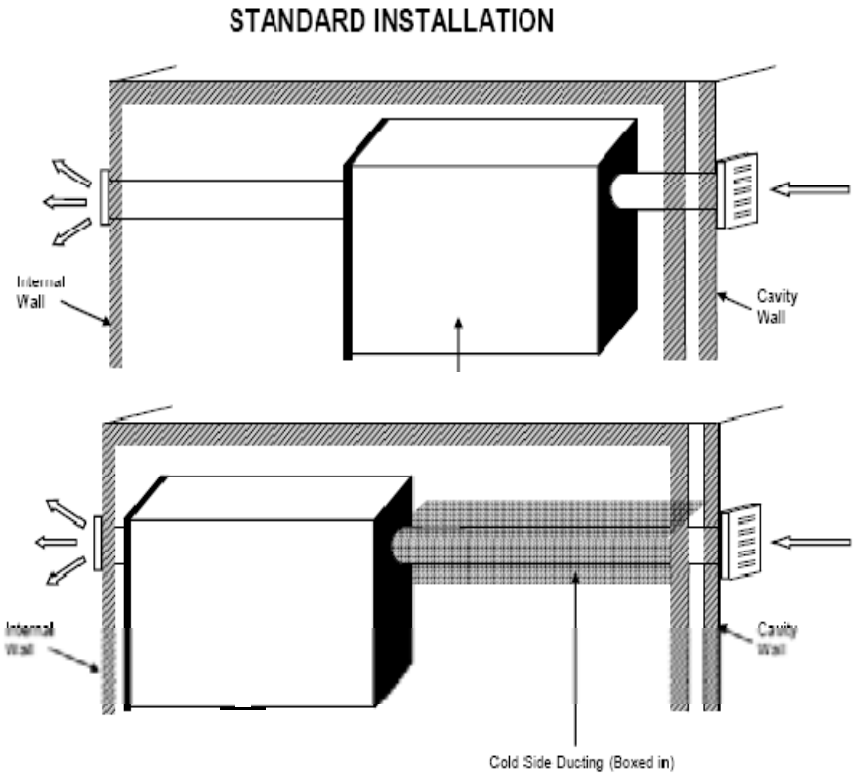
Positive Input Ventilation – Supply air from outside (Wall Mounted)



- The air intake should not be within 3m of a boiler fuel outlet
- Ducted wall mounted PIV systems are not designed for large system resistances
  - Therefore ensure that duct runs are kept as straight as possible (maximum of 10m length combined with no more than 2 x 90° bends)
  - The duct work should only be of rigid construction

Positive Input Ventilation – Supply air from outside (Wall Mounted)





Sometimes it is necessary to install wall mounted PIV units away from the external wall in a more central position or in a cupboard. In this situation rigid insulated duct should be used between atmosphere and the unit

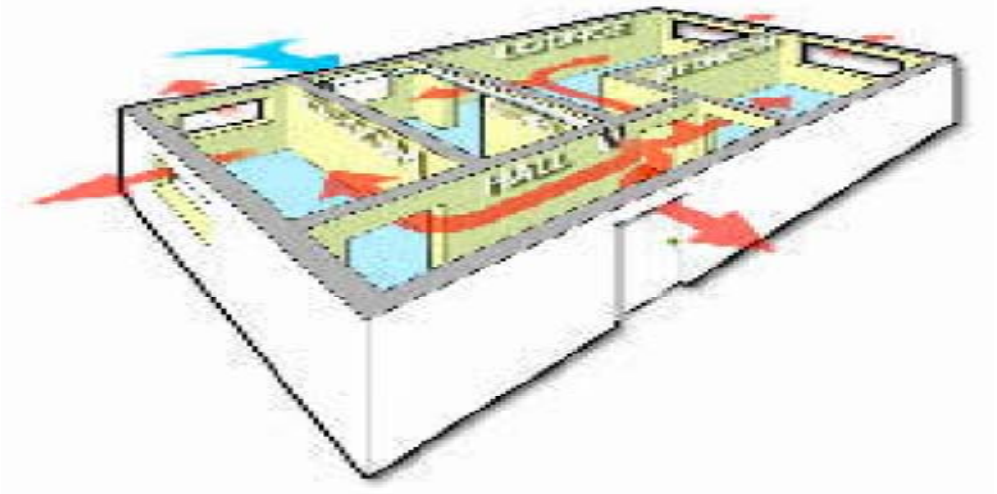
Positive Input Ventilation – Supply air from outside (Wall Mounted)

Do

- ✓ Size the unit to match house size and occupancy level (also applies to loft mounted)
- ✓ Always bring supply air into the hallway / landing at a high level

Don't

- × Never site a PIV unit in a bathroom as condensation can occur on the outside of the unit or duct work
- × Although most PIV units are extremely quite do not locate them in a bedroom where they cause a nuisance to the occupants



Positive Input Ventilation & Background Ventilation (Trickle Vents)

- All PIV systems will create a very slight positive pressure within homes. Even in very airtight homes this will not normally be an issue, as there is still a reasonable amount of natural leakage so as not to cause excessive pressurisation

- If trickle vents are present this will not effect the performance of the system

- As a precaution in dwellings < 120m3 it is recommended that trickle ventilators are included for to reduce excessive pressurization.

Agenda

- Introduction
- Ventilation strategies and how they work
- The importance of installation practice to system performance
- The critical elements to ensure system performance
- Installation guidance
- Planning and design
- Commissioning

Commissioning

- Ventilation systems should be designed, installed and commissioned in a way that is not detrimental to the health of occupants
- Systems should be commissioned so that on completion the system and their controls are left in the intended working order for the provision of adequate ventilation for the people in the building
- All ventilation systems should be commissioned to demonstrate installed capabilities
- Manufacturers instructions take precedence unless additional criteria is specified on the design drawing
- Agreement with the site manager will be required to ensure power is provided on site at the time of commissioning.

Commissioning

- Check design drawing is available
  - Check for any additional specific requirements i.e. for protection against fire and the spread of smoke or for noise reduction
- Check that manufacturers instructions are available
- Check installation matches design drawing including any background ventilators where required
- Check installation has the correct control devices fitted
- Check that any condensate pipes are fitted and terminated correctly
- Check airflow meter is suitable for system
- Note any alterations to the design and report them to relevant person
- Note all system defects and report them to the responsible person.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Commissioning

- Ventilation systems with supply and extract grilles, typically MVHR systems, check that the airflow at each grille is flowing in the correct direction.

- PSV systems check that the airflow rises into the duct.

Commissioning

- When adjusting airflow rates refer to manufacturers instructions to obtain the most efficient set point for the required airflow

- When the airflow rate has been set individual duct runs can be adjusted by means of balancing dampers or adjusters fitted within the supply or extract grilles

Commissioning

- Extract only ventilation systems, use a suitable airflow meter, ensuring it is positioned in the correct direction of flow, and measure the airflow at the point of entry. Compare results against design drawing and adjust airflow up or down as required

- Extract and Supply systems, use a suitable airflow meter, ensuring it is positioned in the correct direction of flow, and measure the airflow at the point of entry and supply. Compare results against design drawing and adjust airflow up or down as required

Suitable airflow meters

Calibrated meter with direction of flow indicator

Commissioning

- Check sequence of system controls for correct operation particularly any humidity controls
- Complete commissioning sheet and pass a copy to the responsible person
- Where possible, instruct the user on the use of the system
- Check user instructions are available for the occupier.