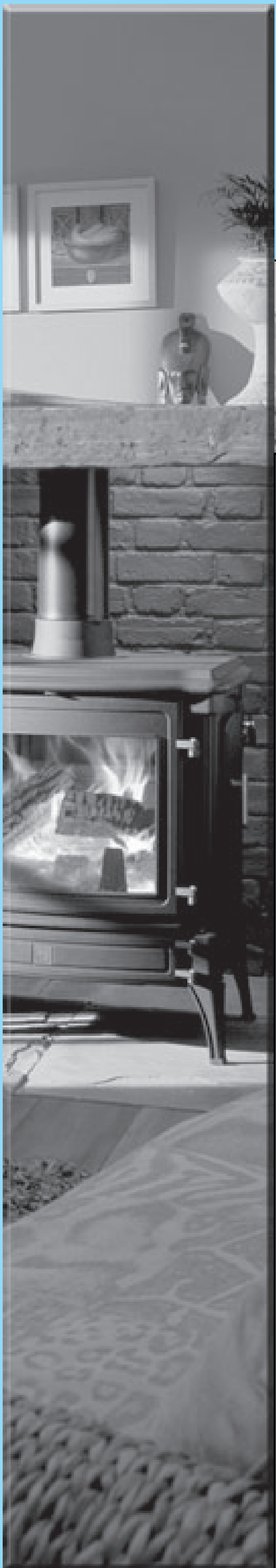


The Flue Guide

Conventional Flue Systems

IN1087 Edition D

Euroheat
The Stove Company

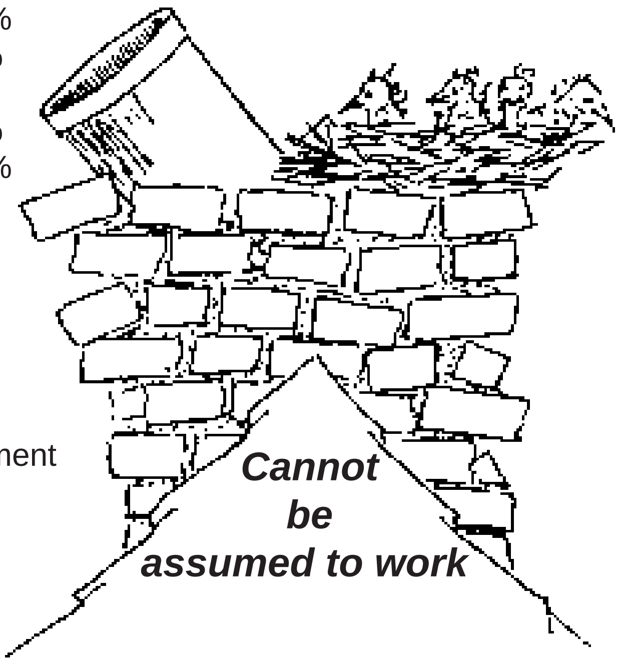
Euroheat have provided this document for general help and assistance with your flue requirements. The documents aim is to assist with the correct installation with our product range of Wood, Multifuel, Oil and Gas Stoves. However much of the enclosed information can be of assistance with other professionally designed stoves.

It is more than a coincidence that flue is ananagram of fuel; both need to be correct.

The installer is responsible under the health and safety at work act 1974 vi the caustic nature of fire cement and the possibility of disturbing asbestos and other materials such as ceramic in existing installations and to suggest appropriate protection to be given to the person (s) carrying out the installation. The complete installation must be carried out with due reference to the British Standards, Codes of Practice and Building Regulations relevant to the fuel type being installed, and the manufacturers installation instructions.
This document is a General Installation Guide only. It does not replace the installation instructions or building regulations. No installation should be undertaken unless the installer is suitably qualified.

Flue Size comparison / volume increase

4” or 100 mm to 5” or 125 mm is an increase of 62.4 %
4” or 100 mm to 6” or 150 mm is an increase of 134 %
5” or 125 mm to 6” or 150 mm is an increase of 44 %
5” or 125 mm to 7” or 175 mm is an increase of 228 %
6” or 150 mm to 7” or 175 mm is an increase of 38.5 %

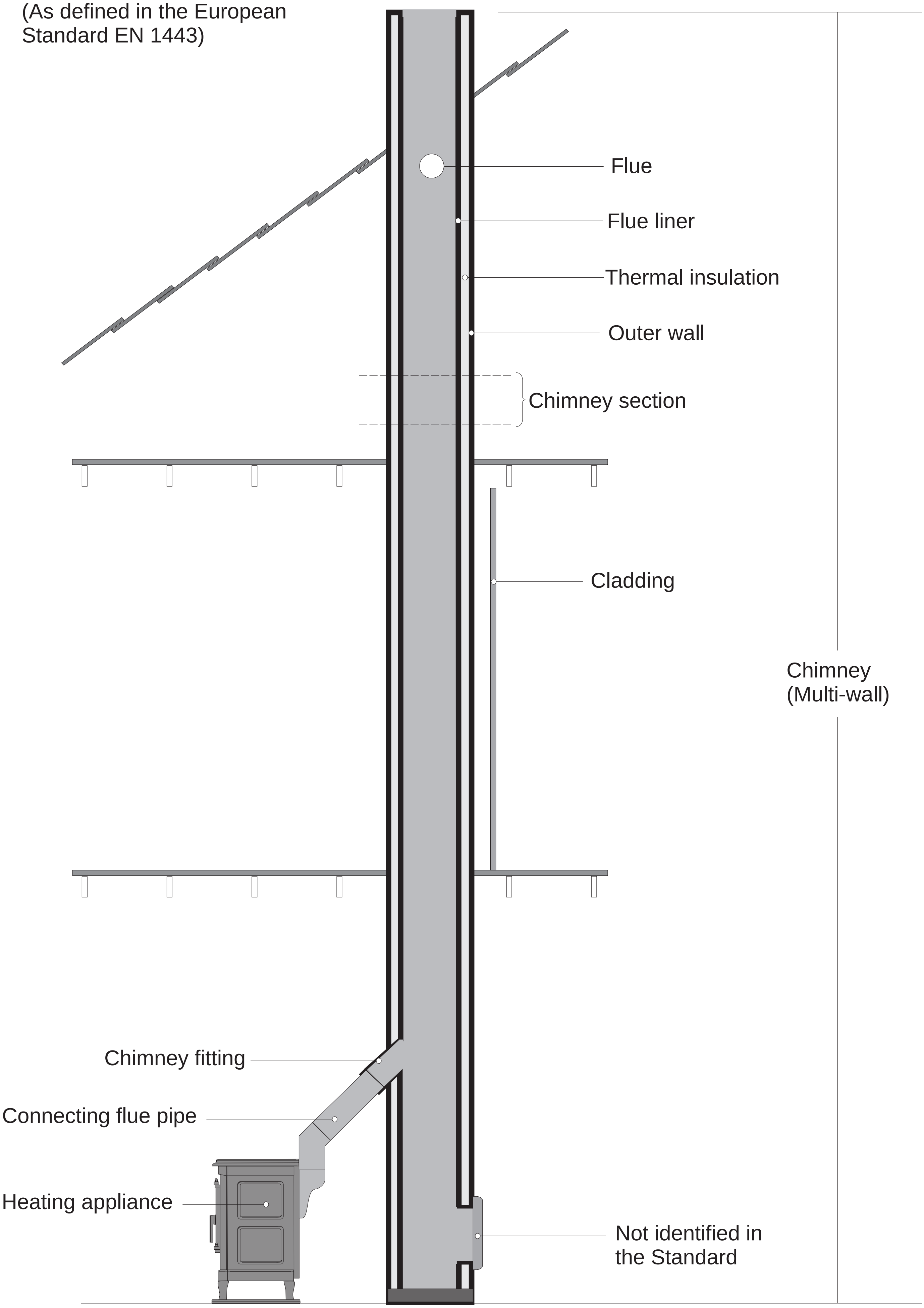


Pipe Diameter / Cross sectional area
4” or 100 mm = 11.7 sq. ” or 7854 sq. mm
5” or 125 mm = 19.0 sq. “ or 12271 sq. mm
6” or 150 mm = 27.4 sq. “ or 17671 sq. mm
7” or 175 mm = 38.5 sq. ” or 24825 sq. mm

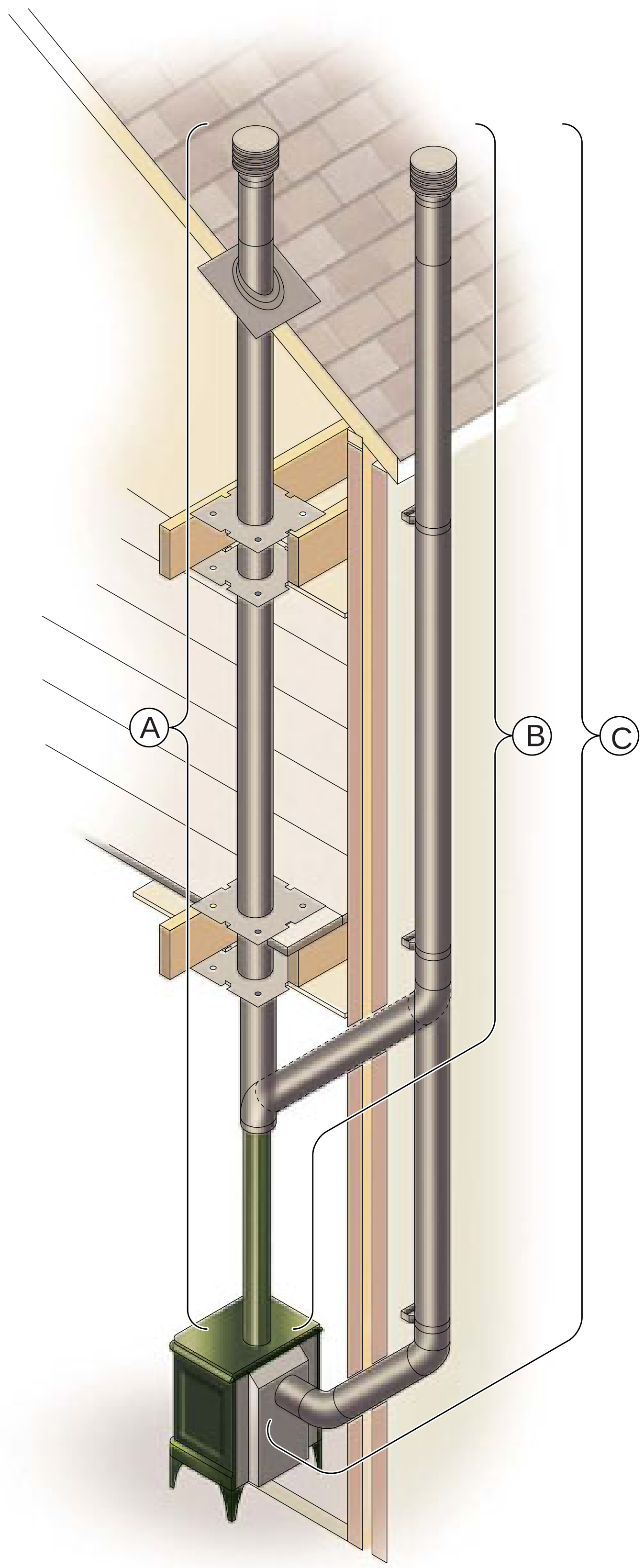
Use full documents and those referred to in this document
Building Regulations
Approved document J April 2002
Approved Document J: 2002 Edition:
Guidance and Supplementary Information on the UK Implementation of European
Standards for Chimneys and Flues October 2004.
Approved Document L1A 6th April 2006
Approved Document L1B 6th April 2006
Approved Document L2A 6th April 2006
Approved Document L2B 6th April 2006
Approved Document F Means of Ventilation 2006

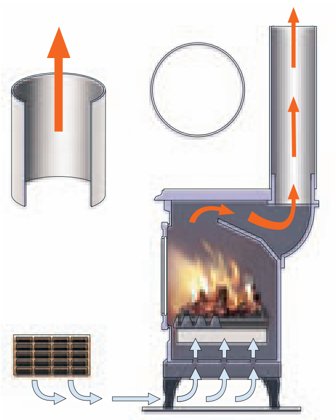
CHIMNEY TERMINOLOGY.

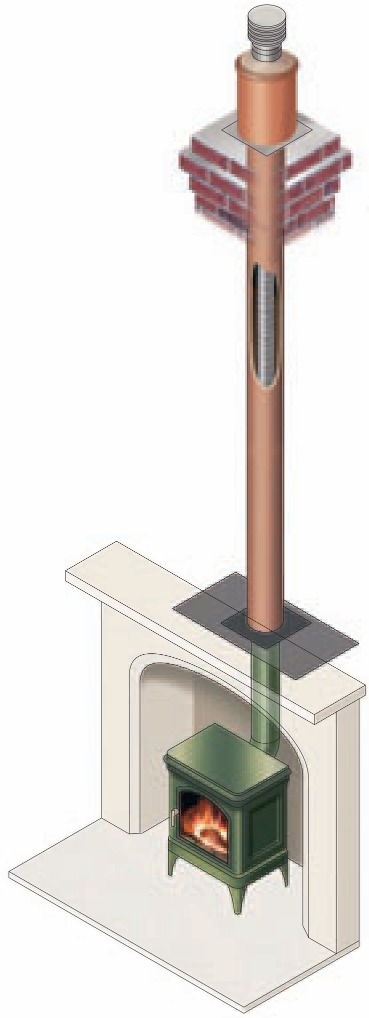
(As defined in the European Standard EN 1443)

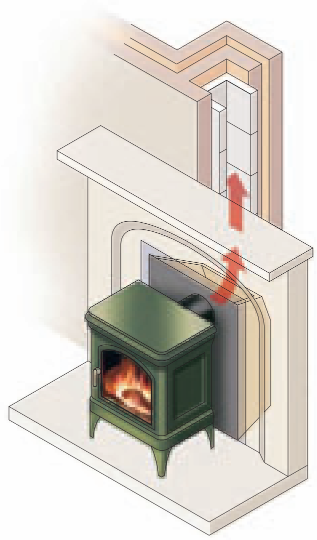


Conventional Gas Flue Installation



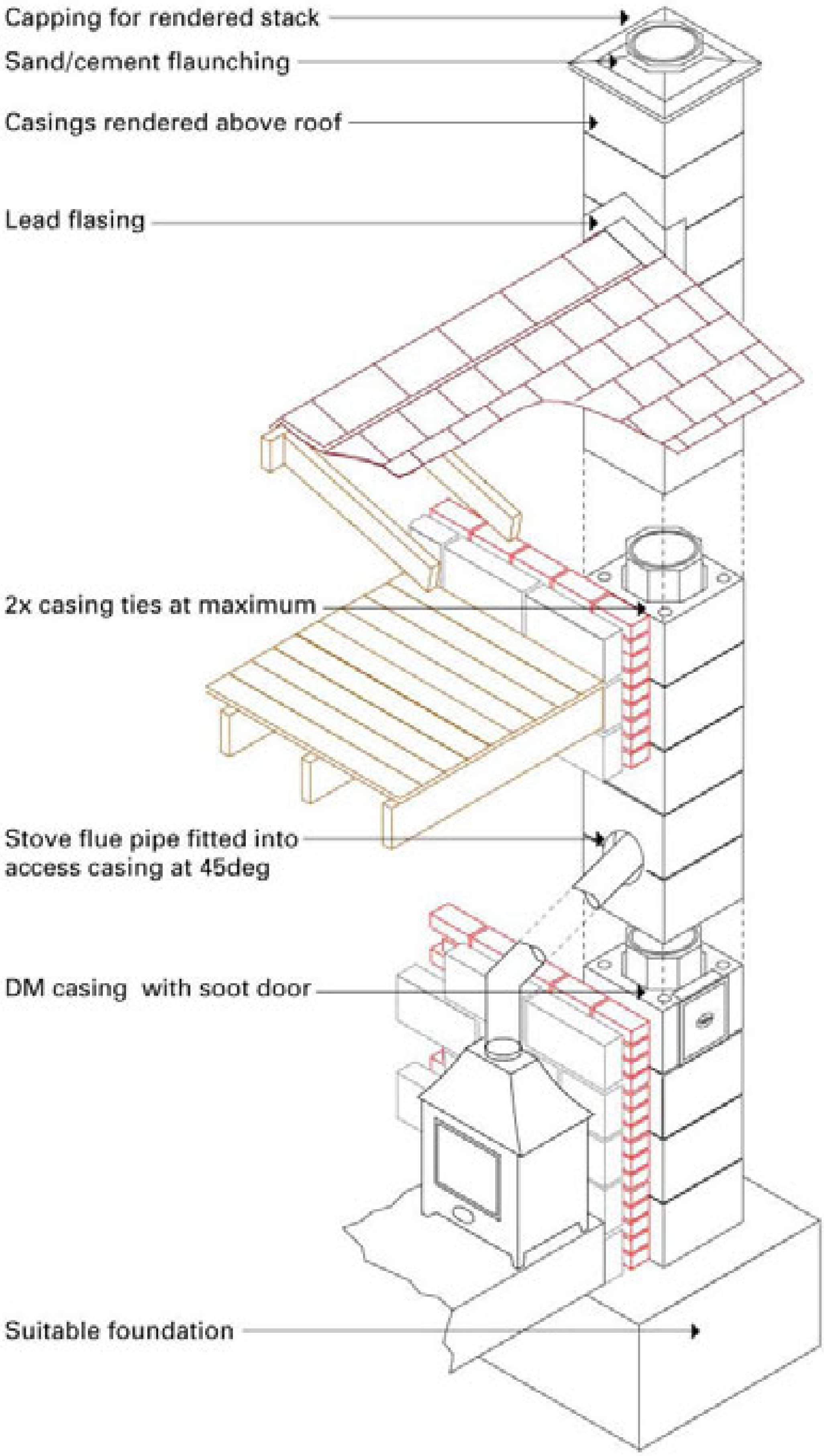






A Twin wall insulation internal to property
B. Top flue routed externally
C. Rear flue routed externally

Chimney Construction



Why is a flue necessary?

Combustion is a chemical reaction which gives off heat when the chemical components of the fuel are broken down and combined with oxygen. The oxygen needed for this reaction to occur is obtained from the air brought into the stove, and the flue allows both the products of combustion and the air which is depleted of oxygen to be passed directly into the atmosphere and diluted. The flue performs this task, but the speed at which it carries away these gases regulates the supply of fresh air to the stove. That this is controlled within defined parameters is vital to any stove achieving high combustion efficiency because insufficient air will not allow the complete oxidisation of the fuel and any air passing through the stove unnecessarily only serves to cool the stove.

What is flue draught?

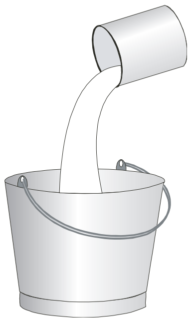
Because the flue plays such an important part in the efficiency and controllability of all naturally aspirated fuel burning appliances, its performance is quantified under the term "flue draught". This is the measurement of either the speed at which the gases travel in the flue or the difference in pressure between the incoming air and the outgoing gases.

What causes flue draught?

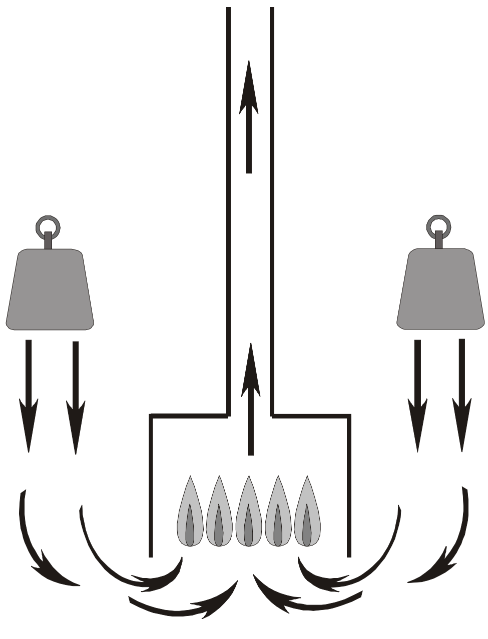
Flue draught is caused by two very different effects the flue is subjected to. Firstly the flow induced by the difference in temperature between the gases within the flue and that of the air outside the flue, and secondly the flow of wind around the property and the flue termination. Both of these are often misunderstood, so we have attempted to explain their causes and effects in detail.

Flue draught without wind.

After being involved in the combustion process the gases making up the products of combustion are heated and have expanded to become less dense than the surrounding air, and so rise because they weigh less than an equal volume of the surrounding air. Why they should rise is not complicated and can be illustrated by releasing water (a dense substance) over a bucket containing air (a less dense substance), where the water will fall to the bottom of the bucket, forcing the air upwards. Whilst air and water have very differing densities, cold and hot gases behave in the same way, and it is the weight of cold air which forces the hot air up the flue. With the greater the differences in temperatures, the greater differences in densities and the faster the gases will be driven up.



From this we can establish several important facts:-



1. A hot flue does not "draw" air into a stove, it is the differences of densities that motivate the lighter gases upwards.

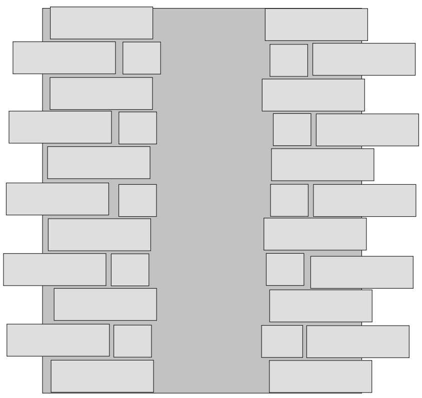
2. The greater the temperature difference between the gases within the flue and the surrounding air, the greater the difference in densities and the greater the motivation.

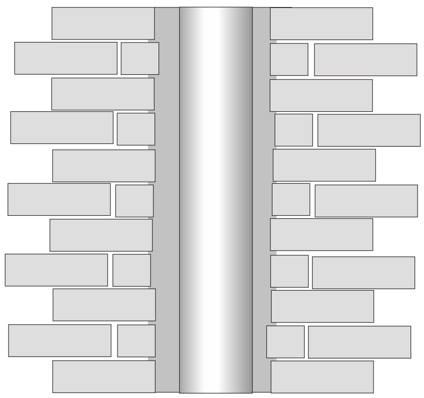
3. The taller the flue, the greater the weight of the equivalent volume of denser air, the greater the motivation.

A flue system for an open fire has an enormous margin for design error because it receives so much of the heat generated by the fire, and the fire is not expected to be controlled beyond the rate at which it is refueled. The efficiency of a stove is achieved because less of the heat generated by the fire is lost to the flue, and that the flue design allows consistent control of the fire. These impose design constraints which become progressively more restrictive as the stove's efficiency increases. With less motivation the flue route taken must provide the smoothest path possible to retain as much of the heat in the gases as possible.

If we look at the flue's prime function, which is to remove the harmful products of combustion, we find that even the chemicals themselves become more difficult to deal with at reduced flue temperatures. One of the more important chemicals formed by the combustion process is oxygen dihydrate, a chemical better known as water. The ability of the gases to "absorb" water is dependent on their temperature and when the gases are "saturated", the water will begin to condense out as the temperature falls. The point at which the water will be shed by the gases is known as the "dew point", but unlike the picturesque dew covered image of dawn, this condensate will combine with all the nasty acidic chemicals in the flue gases as it runs down the flue wall. Evidence of this can be seen on the walls of old properties where this acidic water has been absorbed by the masonry flue and has eaten away the lime mortar. This will be worse where the flue has been for a range or oven which take out more heat from the fire. If the fire has been primarily fueled with wood, the creosote and resinous tars may even reach the internal plaster not only staining them but posing a fire risk because these tars are combustible. The flue needs to maintain the gases above the dew point and this is achieved by making the flue as smooth as possible to reduce any friction between the wall and the gases which will allow the smallest possible diameter to be used and so minimize the surface area through which heat may be lost. A flue constructed from stainless steel satisfies all the requirements because it is smooth, impervious to the chemicals, its low mass allows rapid warming and it can be easily cleaned. Flexible metal flue liners should be installed in one unbroken length. Other than the sealing at the top and bottom the void between the flue and the chimney should be left empty except in circumstances where the void is deamed to be large.

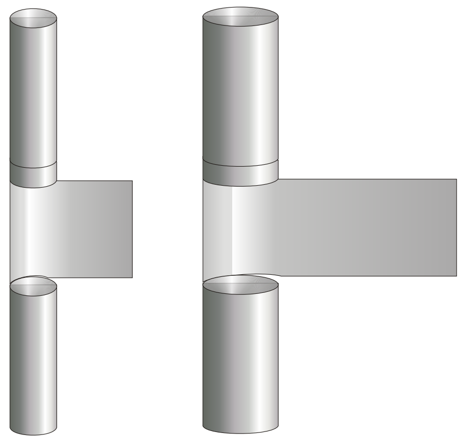
Existing chimneys should have a stainless steel liner fitted. If the void between the liner and masonry

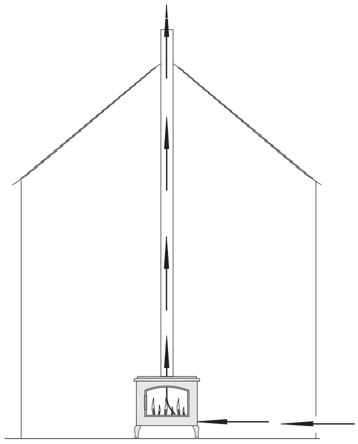


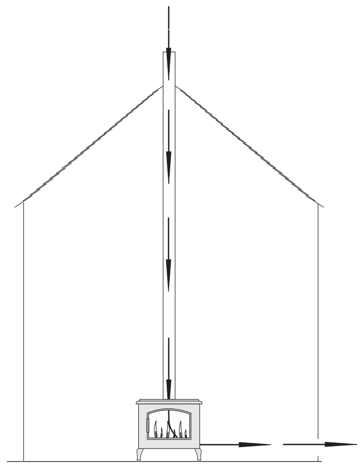


is large it may be filled with vermiculite to provide insulation it will then reach its operating temperature more rapidly. Where no chimney exists, a twin walled, interlocking stainless steel system should be used. The walls are separated by an insulating material.

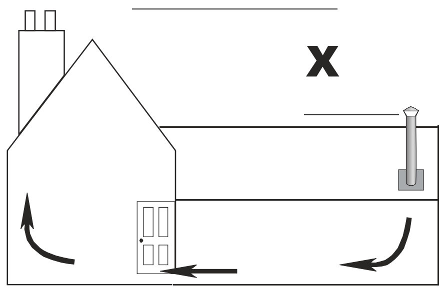
An appliance produces a known quantity of hot gases, capable of generating a flue draught, whatever the flue size, if its temperature difference is maintained. All flues allow heat loss and reduce the potential available. To reduce heat lost from the flue the most basic design consideration is to ensure its surface area is kept to a minimum, by fitting the smallest diameter recommended for the appliance.

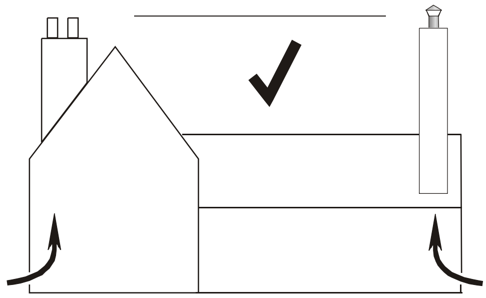






No flue operates in isolation, but is a component part of a complete system, with the stove and house affecting its performance. Whilst we normally think of flues only when the stove is operating, the same rules of heat induced flow in the flue apply when the stove is not lit. If the house is hotter than the outside air, the flue will perform as if the stove was lit, with the warm air from the house travelling up the flue. However, on those odd days when it suddenly becomes warm and the outside temperature is higher than the temperature in the house, the flue will operate in reverse with the possibility of sooty smells being introduced into the house, and will make it very difficult to light the stove. This reversed air flow may provide sufficient air for the stove to ignite and burn poorly, but the products of combustion will spill into the house. Because none of the heat from the fire is passing into the flue it will not warm to correct the air flow until the heat from the fire has warmed the stove to allow conduction of this heat to the flue. If reverse flow is noticed before lighting the stove a fan heater should be directed into the stove through the open door for several minutes before attempting to light the stove. (see page 28, Spring and Autumn syndrome)





A more complex example of reversed flow in flues is caused by multiple flues and differences in flue heights and again the effects will become evident even before any fire is lit. All the flues will tend to aspirate as in the previous example, but with increasing numbers of flues the throughput of air increases resulting in considerable loss of heat from the house. Reducing these heat losses, by improving the sealing of doors and windows has led to the loss of numerous small ventilation areas and unless provision has been made for specific ventilation to each flue the air flow in each flue will depend upon the balance of temperature and height of them and will inevitably result in the coldest or shortest flue acting as the incoming air supply. This will not only cause smells and difficulty in lighting the reverse flowing flue, this imbalance has the potential of becoming dangerous. A typical example would be where an open fire is in use and a stove is installed with a shorter flue. Because an open fire allows so much of its heat to escape up the flue the flue operates at a very much higher temperature than that of a stove’s flue resulting in an imbalance of draft motivation. If this imbalance is increased by a difference in height it is quite possible for the shorter flue to stall or even reverse flow when operating, allowing the oxygen depleted air from the stove to spill into the house.

Adequate permanent ventilation must always be provided for each fire in the house, whether open fires or stoves.

Ventilation must allow for any air extraction systems such as kitchen or shower room fans.

The heights of all flue terminals should be equal.

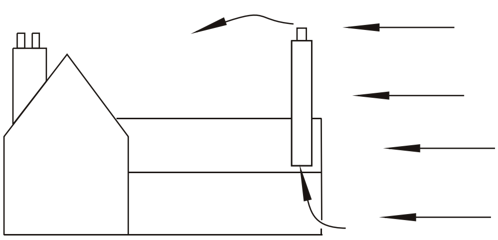
What effect does wind have?

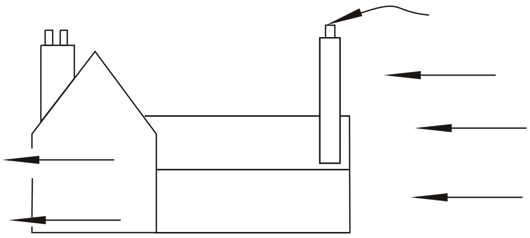
Because wind is inconsistent its effects pose an ever changing challenge for its control. We have already established that the flue cannot be looked at in isolation from the house and this will become even more evident as wind is taken into consideration. Regulations demand that permanent air venting must be provided for fuel burning appliances, but whilst their specified openings will operate as intended on a windless day, unless thought is given to their placement it is possible that an air vent may become worthless or even dangerous on a windy day.

If we look at the terminals we carefully balanced to perform similarly, we will find that when the wind blows in one direction, air will be pushed into one air vent increasing the air pressure into the stove whilst the other vent will be situated in an area of reduced pressure and may even allow air to be drawn out from the room. This problem can be minimized by siting air vents away from obvious wind traps and by fitting several vents, whose combined area is to the requirements, in different locations so that wind will affect each one differently, simultaneously.

The opening of windows and doors, even in light winds, may also affect the air flow, and may make lighting the stove difficult if the opening is down wind. If the stove is seen to be affected by wind at certain times it is worth investigating if extraction fans being turned on is a cause or that people having a discrete cigarette at an open window are unwittingly causing the problem.

If an air stream passes across the flue terminal it induces flue draught, which if we are to maintain

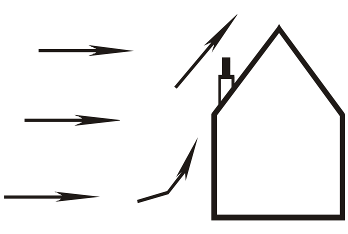


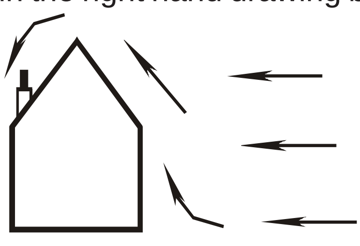


a quantifiable air supply to our stove, it needs to be controlled. If wind caused an air stream which was consistent in all but speed, the effect it has on the terminal could be cancelled out by placing a system of baffles or vanes over the terminal. However, wind is not simply a stream of air, it is a constantly changing mixture of speed, direction and pressure, and controlling the effect it has on the flue draught begins with ensuring that the terminal is not sited where this combination is too complex to deal with.

All obstructions to the wind will change its qualities and the most obvious obstruction will be the house itself. The impressive chimney structures which are found on many old houses were built to put the terminals well above the roof and the air pressures and turbulence caused by the roof. Changes in house designs, and the mistaken belief that tall chimneys were simply an extravagance has resulted in this clearance being reduced to a minimum and in some houses to the inadequate. This erroneous trend may well have been caused by the use of simplistic drawings of wind passing over a house. In the following illustrations wind is shown blowing towards the house from both directions.

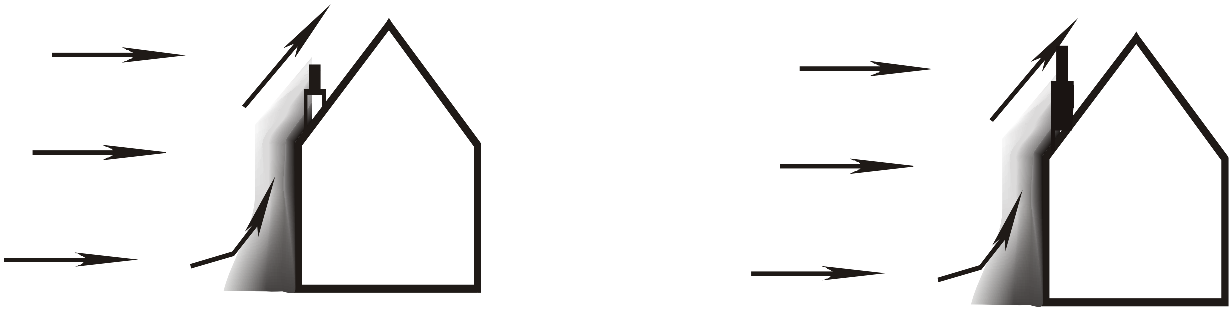
It would seem logical to assume the terminal in the left hand illustration would have wind blowing in the upwards direction with a resultant high draught. The wind in the right hand drawing blowing down





the terminal to reduce the flue draught. These types of drawings only show wind direction and make no allowances for pressure, but putting an obstruction in the face of wind causes high pressure to form at the wind side of the obstruction and low pressure at the other side. Now if pressures are taken into account the situations become more complex.

The following drawings remain simplistic but with the addition of even simplistic representations of pressure the original expectations have changed. In the left hand drawing the high pressure may well be high enough to negate the effects of wind speed and even stall the flue. The effect of pressure will become greater with the steepening of the roof angle and the lower the terminal. The theory of raising the terminal a little to clear the depth of the high pressure supposes this to exist only as a shallow skin over the roof, which is not true.

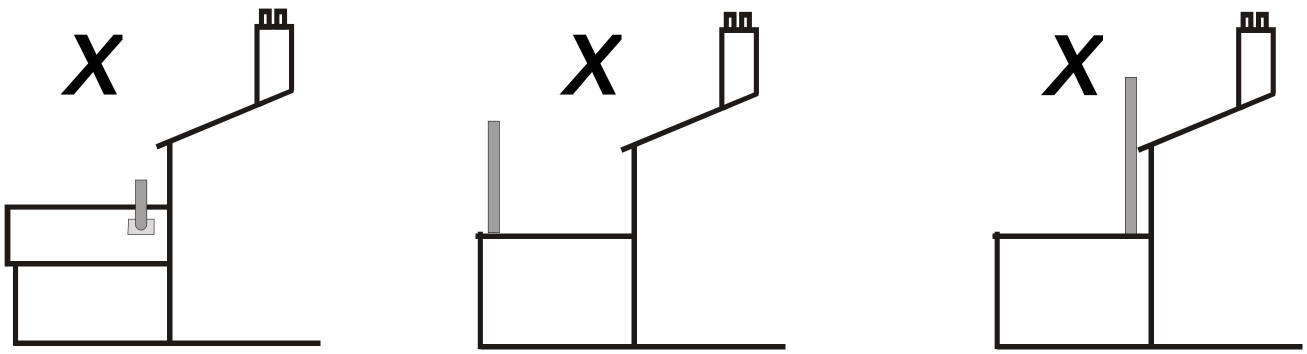


A building has more in common with a sail than the wind slipping properties of an aircraft and not only is the depth of high pressure far deeper than has been presupposed, the turbulence and pockets of varying pressures are more unpredictable. Again the following drawings are simplistic but they begin to illustrate the complexity of wind and pressures. The left hand drawing shows that simply raising the terminal a metre or so will have little effect and the right hand drawing shows the random conditions the terminal will be subjected to.

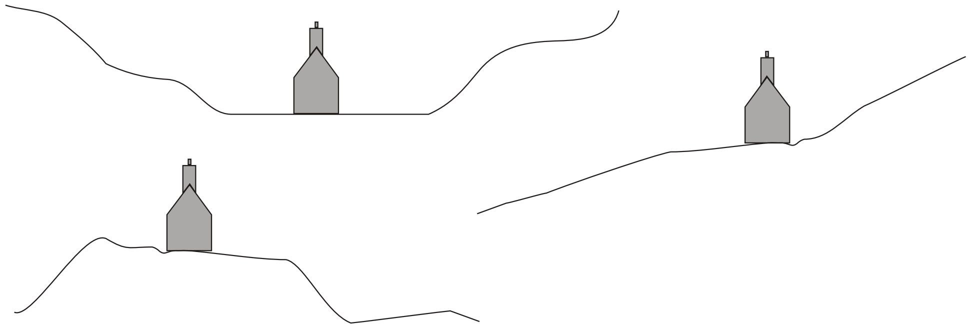
Perhaps the best illustration of air flow around a building is a windy day with fine snow falling. Several

minutes spent watching the snow's direction changes will not teach you the ability to predict air flow over and around a terminal but it will teach you that it is very much more complex and less predictable than drawings like these can show.

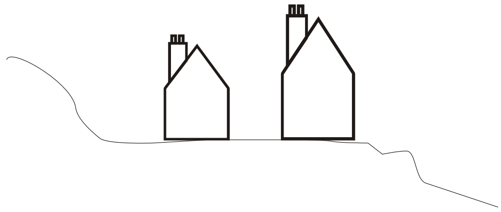
It should be obvious by now that the next illustrations are of flues which are fundamentally wrong for many reasons.



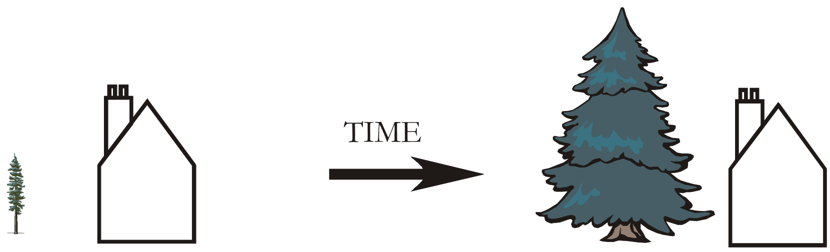
Even by putting the terminal in what should be an ideal position there is no certainty that consistent results can be obtained because the wind rarely arrives at the property unaffected by obstructions along its path or indeed by the very contours of the ground itself. Before looking for potential problems with the property that may be caused by obstructions nearby a far wider area should be looked at, taking time to look at other chimneys. If every old house nearby has what seems to be a disproportionately tall chimney it will be because of difficult wind patterns in the area and not because every builder liked working at high altitudes. Ask about smoking fires and try to relate the problem with wind direction and features which may cause turbulence over an area rather than just the property itself.
Having looked at the surrounding landscape, the obstructions nearby will need to be noted. Not only



will the terrain cause problems in this illustration, the houses will be affected by each other and the effects will be completely different with each change of wind direction.
The effect of trees in particular should not be underestimated because they may have no effect for

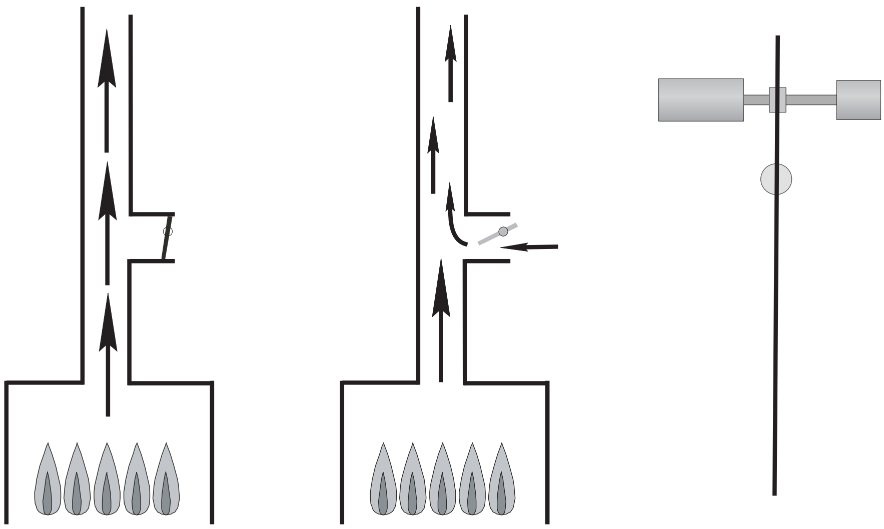


many years, but begin to affect the terminal with increasing intensity as they grow. They will also have different effects with or without leaves and when laden with snow.
There is rarely a simple and totally satisfactory solution to overcoming the problem of the effects of wind turbulence.



Methods of controlling the flue.

If there is to be any hope of controlling the flue it must be installed to put the terminal in the best possible position, it must have sufficient height and it must maintain temperature. So returning to the situation where the flue needs to operate on a still day we have had to ensure sufficient height and a minimum heat loss to enable the flue to give sufficient negative pressure in the stove on a mild day, it will cause too much negative pressure on a cold day, when the density differences between the atmosphere and the flue gases are greater. The device for sorting out this little problem is called a “barometric damper” or “flue stabilizer”, which can be fitted either in the flue or the flue way of the stove. It consists of a hinged flap with an adjustable balance weight which is adjusted to allow the flap to open when the negative pressure within the flue is too high. This immediately limits the pressure and by spilling cold air into the flue the resultant flow of gases are cooled and the ability for the flue to generate pressure is reduced.



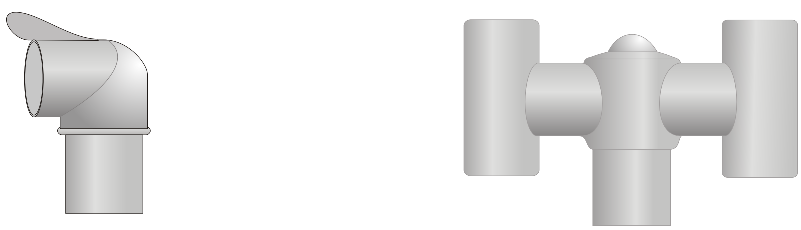
This device will also open whenever wind induces too much flow in the flue and so would seem to have solved all potential problems caused by an over enthusiastic flue, however, the more astute reader may have already spotted the weakness of this device, which is that it operates at only one setting. For a stove capable of burning fuel at different rates, the negative pressure induced by the flue will need to match the air supply to the fuel supply. An increase in flue temperature, as the fuel rate is increased, will achieve this, but if the damper blade has to be set to limit the negative pressure at any point below the stoves maximum rate the flue will probably be unable to achieve pressure required for the maximum rate. If the flue induces too much negative pressure in the stove throughout the entire range of firing rates it is possible to fit a plate to throttle the flue but because the throttling effect increases with the increasing flow within the flue it will only be an effective cure over a limited range and it will not control the effects of wind. The reality of these devices are that they are set to open at a mythical “ideal” with the hope that good fortune takes care of everything else. One stove manufacturer has developed a variable stabilizer which magnetically adjusts the pressure at which the blade opens to the required pressure at all burning rates, whatever the weather. A strongly biased opinion of this device prevents me writing further details of this amazing stabilizer, but because setting it up correctly is simple, none is needed.

Now we move to the other end of the flue and look at the terminal itself. While you were outside watching the snow swirling and travelling in any direction other than those drawn in “wind passing terminal” drawings you may have noticed that the simple chimney pot, which has been used for hundreds of years, is finally being replaced by more scientific terminals. With so many diverse shapes and sizes you would be forgiven for wondering which science they were based on, and indeed many of us wonder. In an age where technology with computer modelling and all the necessary test equipment have narrowed the discrepancies between the designs of solutions to problems it is interesting that cowls would seem to be the exception. But perhaps even more interesting is that each cowl design will have a number of people who will regard it to be a perfect solution and a similar number of people who regard it as worse than useless.

In its simplest form the chimney cowl is nothing more than a rain cap. These were unnecessary in a brick chimney because most of the rain falling down was absorbed by the bricks and the absorbed water evaporated out whenever the fire was lit. With appliances like stoves so little heat is wasted that we have to line and insulate the flue which gives a direct passage to the stove. The moment you fit anything above the flue terminal is the moment everything becomes horribly more complex than you ever imagined. The following drawings show that fitting a rain cap on a chimney pot will almost reverse the effect of vertically rising or falling wind. I accept that these winds are not normal but provide the extremes of possibility and between them are angles of wind that make the words "almost reverse" important.

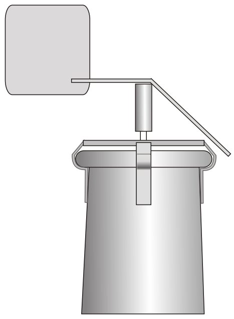
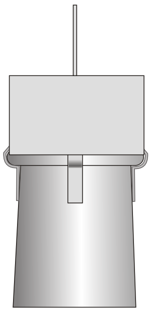
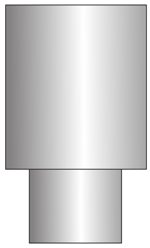
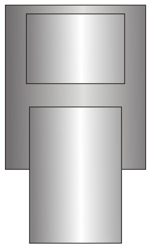
Almost all winds moving in an upward direction will be caught by the cowl to form an area of high pressure above the flue, but wind moving in a downward direction will also be able to blow into the flue as its angle decreases. When this angle is reached the effect will be a sudden change and all sudden changes are difficult to control. Changing the diameter of the cowl and its height above the flue in an attempt to stop this will make the flue worse in upward wind directions or let the rain in.
Before dismissing the simple rain cap cowl it must be remembered that we have given no consideration to effects the house itself will have on the wind direction and those together with other pressure factors

might make a cowl like this of certain proportions the perfect terminal.
It is this unknown element which makes the choice of cowl so difficult. A cowl which gives the solution to one problem flue may exacerbate the problems of a flue with identical problems in a similar house in a different location, but cowls can be put into very loose categories as to their purpose. Whilst almost all cowls claim to be "anti down draught" others purport to do more. Of the more simple shapes are those illustrated next.

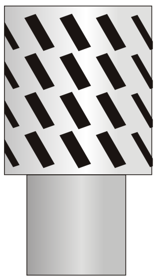
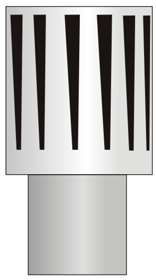


The left hand snorkel is mounted above the chimney pot on a bearing allowing it to be rotated by wind blowing at its vane and causing the opening to face down wind consistently. Whilst solving some problems, by maximizing the effect of wind, the resultant difference in flue draught between wind and windless conditions is too great for any stove and draught control system to cope with. The cowl on the right is often seen as an enormous terracotta affair on low or badly sited old chimneys and works by ensuring that all air passing results in the air flow causing air to be drawn out of the flue. This cowl manages to cope with almost every wind direction and a modern, light weight version is available, but as with the snorkel it tends to amplify the differences in the flue's performance making it difficult to control the draught within the parameters necessary for stoves.

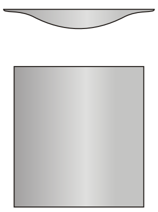
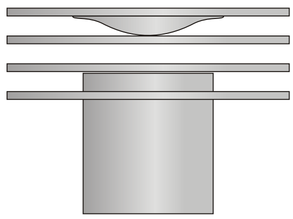
There are many variations using the basic principles of these cowls with varying degrees of success but all are capable of increasing the flue draught beyond the limitation of our control for stoves because they were originally designed for open fires.

Another approach to a cowl which should give less variation in wind generated flue draught is to cover the mouth of the flue with a box vented with slots, louvers or course mesh in an attempt to slow the wind speed passing the mouth of the flue. These may slow the air speed but because the box will need to be large enough to spread the area of the flue diameter it creates its own negative pressure on the downwind side while the upwind side, if the slots are doing anything at all will be limiting the high pressure entering. The net result will be a slower air flow but an increase in the negative pressure over the flue mouth caused by the box obstructing the air flow and creating a negative pressure pocket on the downwind side.

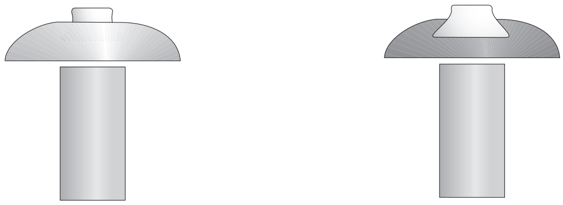
The effects of winds blowing in anything but a horizontal direction will depend on many things but the angle of the air stream may be such that it is not prevented from acting directly onto the flue mouth. Increasing the diameter of the box to prevent this will only increase the negative pressures generated at the downwind side.

Another solution to the problem of varying wind speed is to direct air passing over the flue downwards, and so create a high pressure zone above the flue which is proportional to the negative pressure and thereby cancelling each other out.

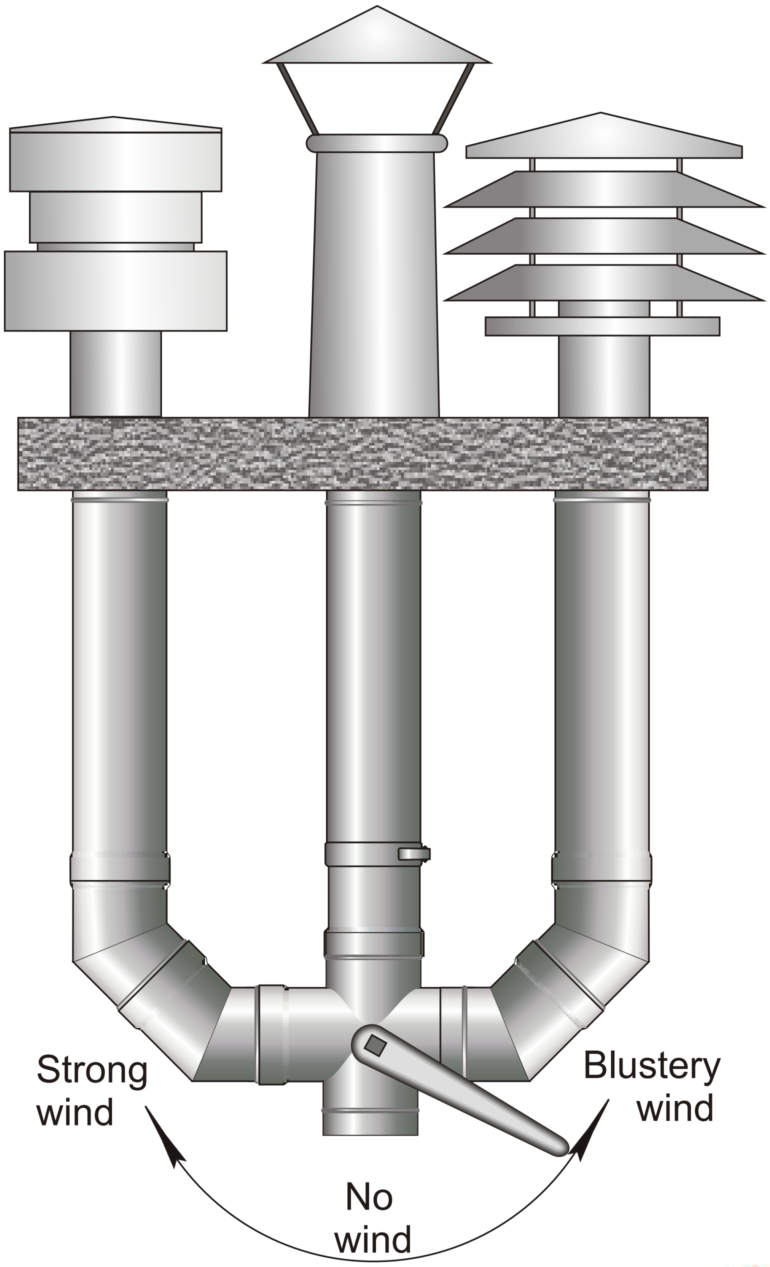
If the flue terminal was some hundred feet in the air, with nothing but flat land for a radius of a mile, the air would be passing the terminal in only one plane and this would work well. However flue terminals do not exist in isolation, they exist in close proximity to obstructions which divert the wind to act in many planes which will vary with wind direction. Whatever shape above the flue caused a high pressure zone when the wind passed it horizontally will not produce an identical effect with an air stream at anything other than horizontal flow. It can be improved by adding disks to divert the air into a horizontal flow and these will improve the ability to cope with air flow away from the horizontal, but the efficacy of the disks will be related to their diameter and at some point away from horizontal the air will simply slip past the discs. At the point at which the discs fail they will only serve to increase the effective diameter of the flue resulting in a greater negative pressure if the air stream is upwards. What happens when the air stream is downwards will depend on the proximity of any obstruction.

A more complex approach to the problem is the range of cowls that would seem to have been designed on a kitchen table using an assortment of mixing bowls. These cowls are designed to divert the air over the larger bowl creating a high pressure zone at the middle. This bowl has an open top through which a smaller bowl protrudes. The high pressure restricts the flue gases passing up through the cowl, sending them downwards to exit under the rim of the larger bowl. The shape and combination of the two bowls restricts the air flow out of the cowl when the air stream is in an upwards direction creating a positive pressure to counteract the negative pressure that would have been created above the flue mouth. The effect of a downwards flowing air stream will be diverted away from the flue mouth and again the combination of openings at the top and bottom of the larger bowl will prevent flue down draught affecting the flue.



Unfortunately, the differing sizes and shapes of the dishes means that their influence will not remain consistent with each for all wind speeds and all directions.

No cowl will solve all problems and no cowl will perform identically in every installation because no flue operates consistently. A flue which is operating at a low temperature is very different to one operating at its maximum temperature and flow rate. Cowls are tested as an isolated piece of equipment and many cowl manufacturers recognize that so many other factors will affect its performance that they offer a guarantee to accept its return if it fails to perform as anticipated in any particular installation. Although this gives the opportunity to try several cowls, simply fitting cowls randomly is not recommended because the novelty of scaffolding and the adrenaline rush of roof walking are fickle emotions and may evaporate before you find a suitable model. The correct choice of cowl is often a case of two wrongs nearly making a right and before seeking the advice of cowl manufacturers you should identify what the problem is and if possible rectify it before resorting to the expense of having a complex cowl fitted.



With all flues needing to work within well defined parameters if the appliance is to operate correctly and simply telling the appliance or cowl manufacturer that your flue has a good or bad draught is meaningless; it has to be measured and quantified. The measurement is not difficult with the correct equipment but it requires patience because it needs to be measured at all operating temperatures and different weather conditions if a full picture is to emerge.

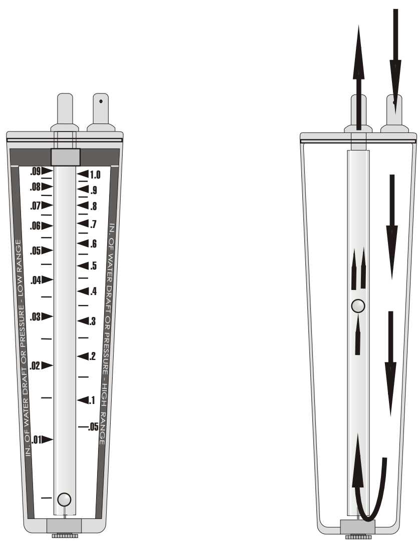
What are we ultimately trying to achieve?

Our aim is to ensure the correct amount of air is being supplied to the appliance for whatever rate of fuel we are burning. If the appliance is burning solid fuel, insufficient air will not only limit the rate at which it will burn but prolong the recovery of the fire with each fuel loading resulting in smoke and soot, too much air will make controlling the fire difficult. If the appliance is burning oil insufficient air will mean a percentage of the oil will only partially burn to give copious amounts of soot and less heat, too much air will cause noise similar to blowing at a flame, cool the flame to extinguish it prematurely, wasting potential heat and again cause sooting. The stove manufacturer will have calculated the total effective aperture for the air to pass into the stove and the pressure needed to pass the correct amount of air into the combustion chamber, to achieve complete combustion. By measuring the difference in pressure of the air inside the appliance to that outside the appliance to know if the ideal is being achieved.

How do we measure the flue's performance?

Flue draught can be measured as a speed, or the pressure difference it achieves with a particular appliance. We are interested in the pressure difference, which is measured in units of water gauge; the height of a column water that the pressure will support. A water filled manometer is a graduated tube of water and is used to measure gas pressure by directly connecting its vertical column of water to a pressure test point. The pressures involved with flues are so small it would be impossible to measure flue pressure in this way but inclined manometers which have the water column laying almost horizontal are used. Because water is the only moving element, these robust instruments are both permanently accurate and reliable whereas electronic and precision mechanical instruments tend to be more delicate and need periodic calibration. Another interesting instrument, which gives astonishingly accurate readings despite its simplicity, is the one illustrated below, which without even water to spill out, this little gauge is commissioning engineer's delight, except for the irritation of it being called a "Draught gauge" and we will refer to it later.

The principle of this instrument is to pass air down into the body and having a lightweight ball floating on the air flow upwards and out through the inner tube. By knowing the flow resistance of the air passage it has been possible to graduate the body so that the pressure is indicated by the height to which the ball is being lifted.

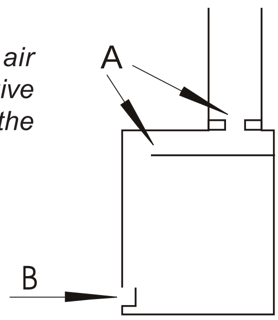


Monitoring the flue on a new installation.

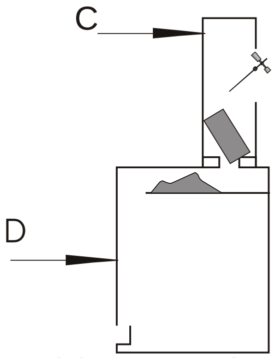
Before beginning to monitor the flue a vital piece of equipment that should be to hand is a note pad and pen. By the time you have made ten measurements you will have forgotten five. Be methodical by writing down firstly the weather conditions prevailing and each reading should include a descriptive note as to the way the stove was operating and if any adjustments to the stove have been made write these down as well. It may be unnecessary in many instances but if you need to seek advice or have cause to re-examine the stove at a later date because a cowl has been fitted or a tree has lost its leaves these notes will become invaluable.

If the appliance manufacture has provided the specific pressure readings required it is important when taking measurements that the pressure of the combustion chamber itself is measured. Any baffle or other intentional flue way restriction will result in a higher reading within the flue than the combustion chamber. whilst this difference will be dependent on the relative sizes of the restrictions to the size of the air inlet, and may be very small, it is important to eliminate all potential measurement errors. If a suitable test point is not provided, make one, or use a little ingenuity to access the combustion chamber directly; it will be worth the effort.

The relative remittances to air flow of all restrictions A, B will give differing pressures between the flue and combustion chamber.

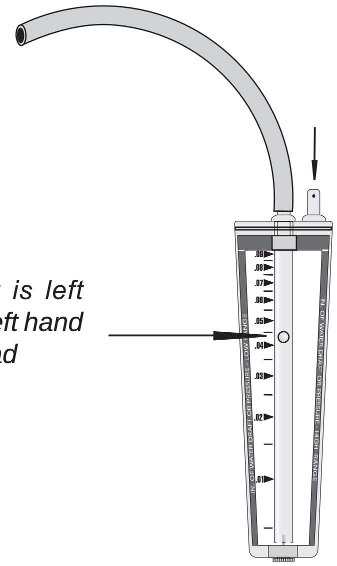


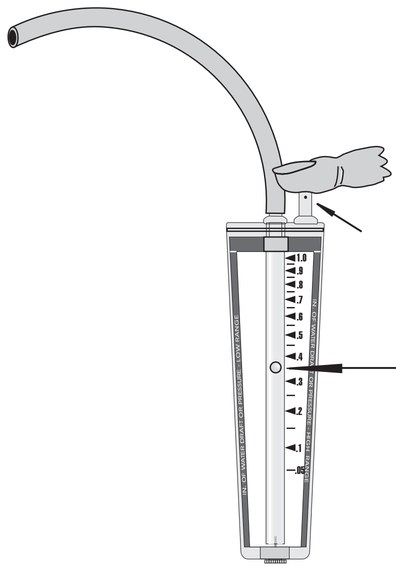
By keeping a record of the combustion chamber pressures at D, faults not apparent by testing the flue C will be easily detected.



If you are using the "draught" gauge mentioned earlier, by the time you have connected the connecting tube to the gauge's outlet point you will have noticed that the side showing pressure rather than air speed has two scales. By leaving the air inlet to the gauge open, the air flow is unrestricted and the lower scale on the left hand side is used, but by covering the inlet with a finger the air has to pass through a much smaller orifice at the side of the inlet, and the higher scale on the right hand side should be read.

If the inlet is left open, the left hand scale is read





If the inlet is closed and the inlet is through the restricted orifice the right hand scale is used

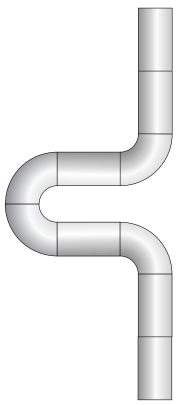
Before lighting the stove an indication of the flues natural state can be obtained. Ensuring all the stove's openings are closed and any draught stabilizer is in a closed position, connect the gauge to the test point and with the gauge being held in an absolute vertical position note the position of the ball and its movement. Any pressure reading at this time will be caused by wind and the temperature difference between the house fabric causing the flue to be at a higher temperature than that outside the house.

If no pressure is detected it is useful to put the hose onto the air inlet which will give a reading of any positive pressure. Never do this with when the stove is dirty or the dirt will contaminate the ball and tube making all readings unreliable until the tube has been cleaned and the ball replaced. If a positive pressure is indicated, no attempt should be made to light the stove until this has been reversed. If the outside air is warmer than the room in which the stove is installed, the flue can be warmed with a hair dryer or fan heater directed into the stove for a few minutes, taking care to remove the gauge before doing so. If the pressure cannot be rectified or is caused by wind, indicated by the gauge ball showing changing positive pressure, the flue terminal and all house ventilation should be looked at to find the cause. Do not attempt to light the stove until a negative pressure is measurable.

Installation Notes

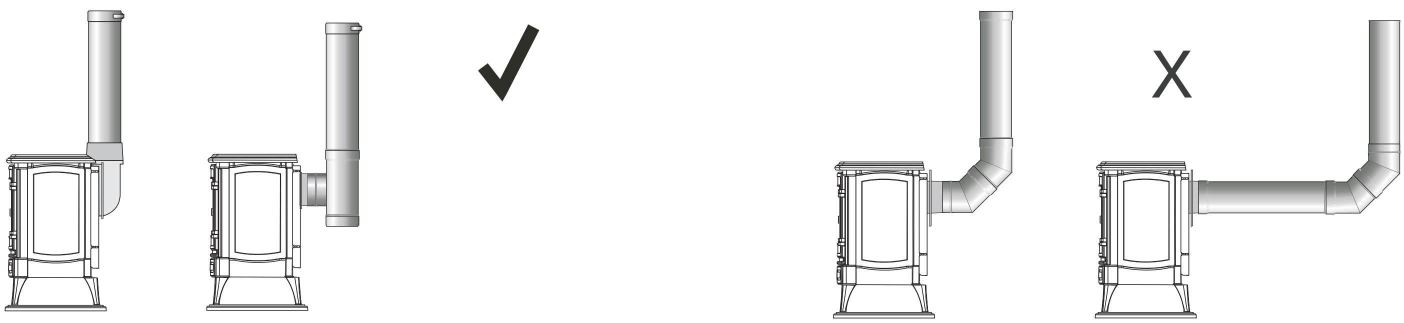
Assuming that the flue maintains much of its heat and density difference with the surrounding air, the taller the flue the greater the potential performance, because the column of hot “light” air is matched with a similar sized column of “heavy” air.

So far we have only considered flues as vertical tubes, but the reality is that of necessity many have several changes of direction. Making the flue gases change direction requires “effort” and so slows the flow; gases flowing horizontally have no incentive and rely on any existing vertical flow for momentum, and again waste considerable potential performance. Ironically the smaller the diameter of the flue and the faster the flue gases are travelling the more significantly the flue is affected by changes of direction, but this has to be weighed against the heat losses from the larger diameters.

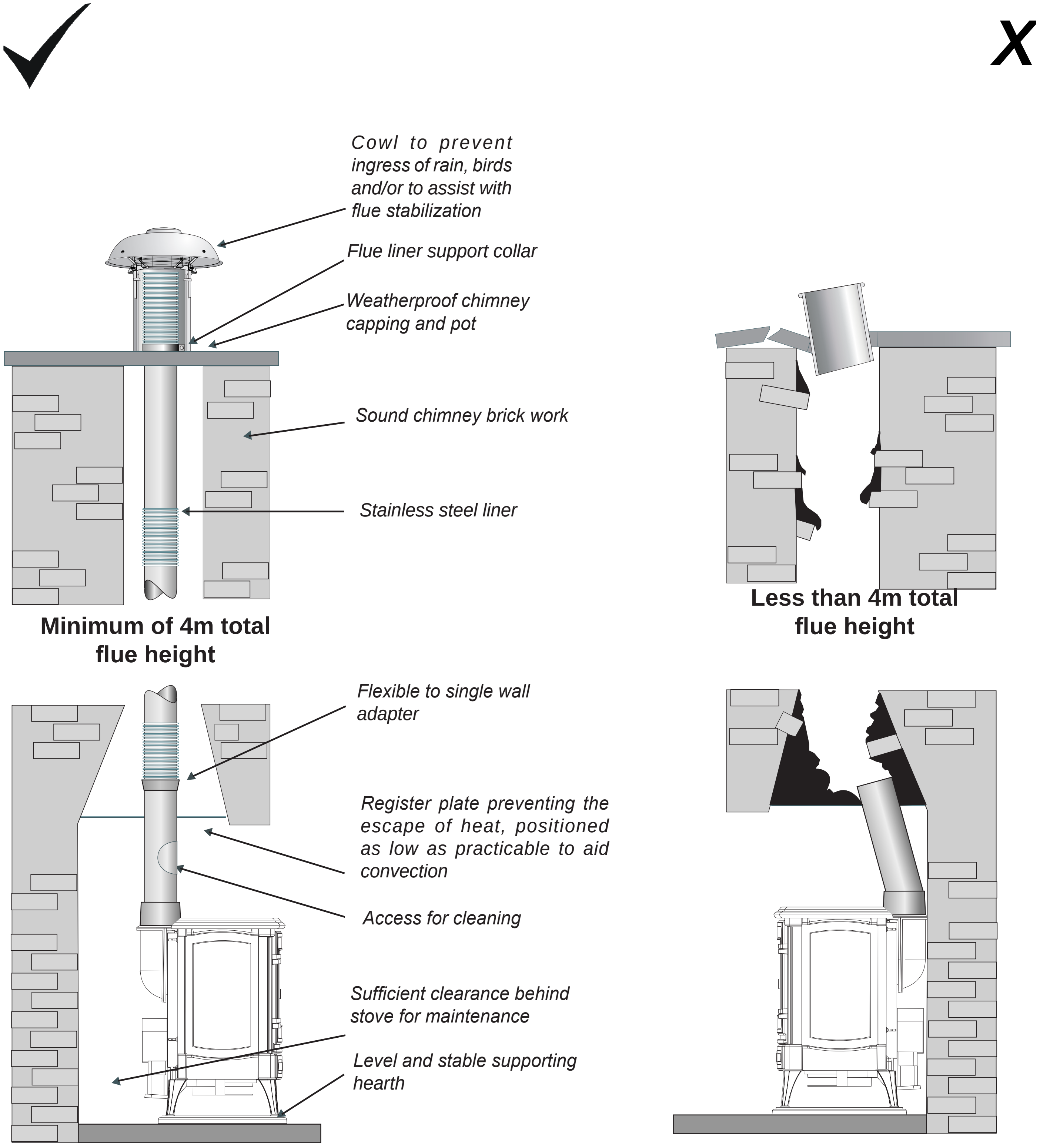


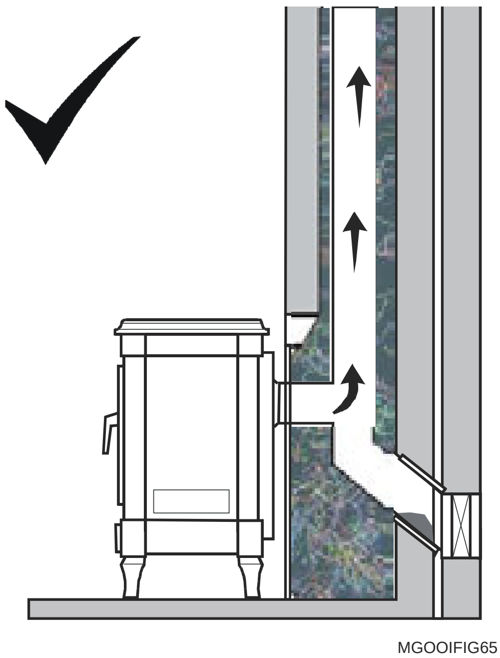
A complex flue may look impressive but its performance will be disappointing. It will not give the performance of the taller vertical illustration but that of the shorter vertical illustration. Install changes of direction only when there is no alternative.

Always try to leave the stove with the minimum horizontal length. If it is practicable to use a top mounted flue this is ideal, as is the use of back mounted Tee branch where any debri will collect in the unused branch and can be emptied by removing the end cap. Do not leave the stove with a bend or elbow because deposits will collect and restrict the flue at this point. Do not leave the stove with a horizontal run or the stove will be almost impossible to light. The performance of any flue will deteriorate as deposits coat the surface and accumulate at any change of direction. All flues should be regularly inspected not only for cleaning but to ascertain its condition because like everything it will eventually need replacement.

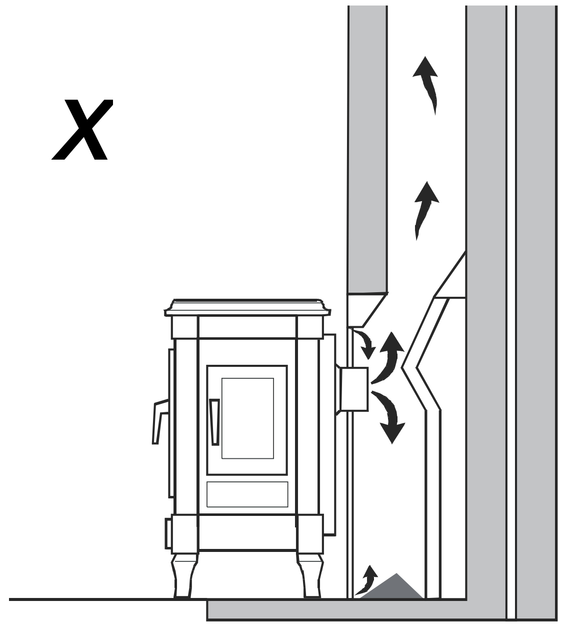


Installation into an Existing Chimney

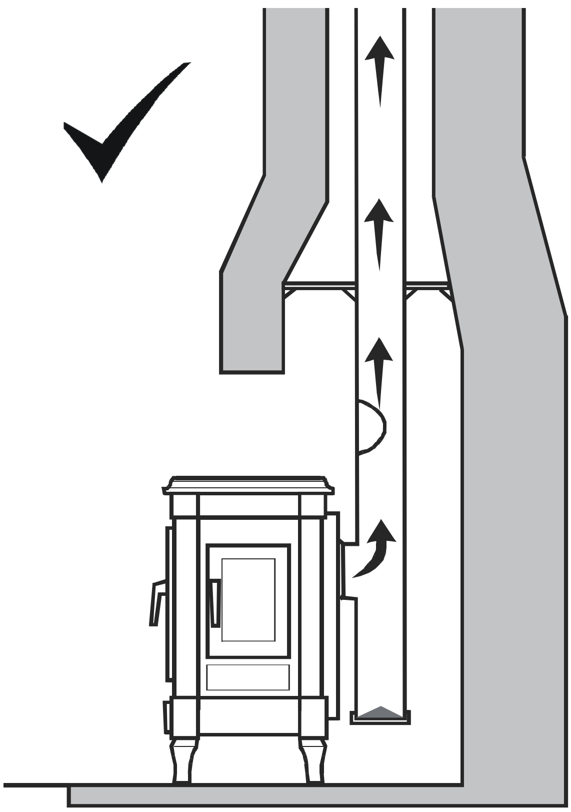


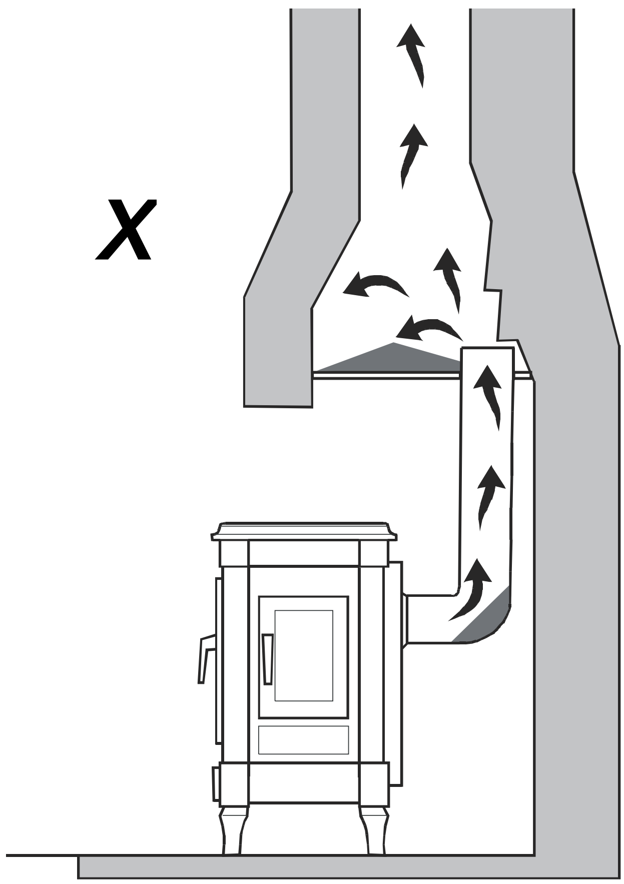


Access for cleaning, minimum horizontal path.



With no flue liner fitted and positioned on an unstable hearth makes sealing the flue reliably in this sort of installation impossible, and with no access for cleaning; this installation is dangerous.

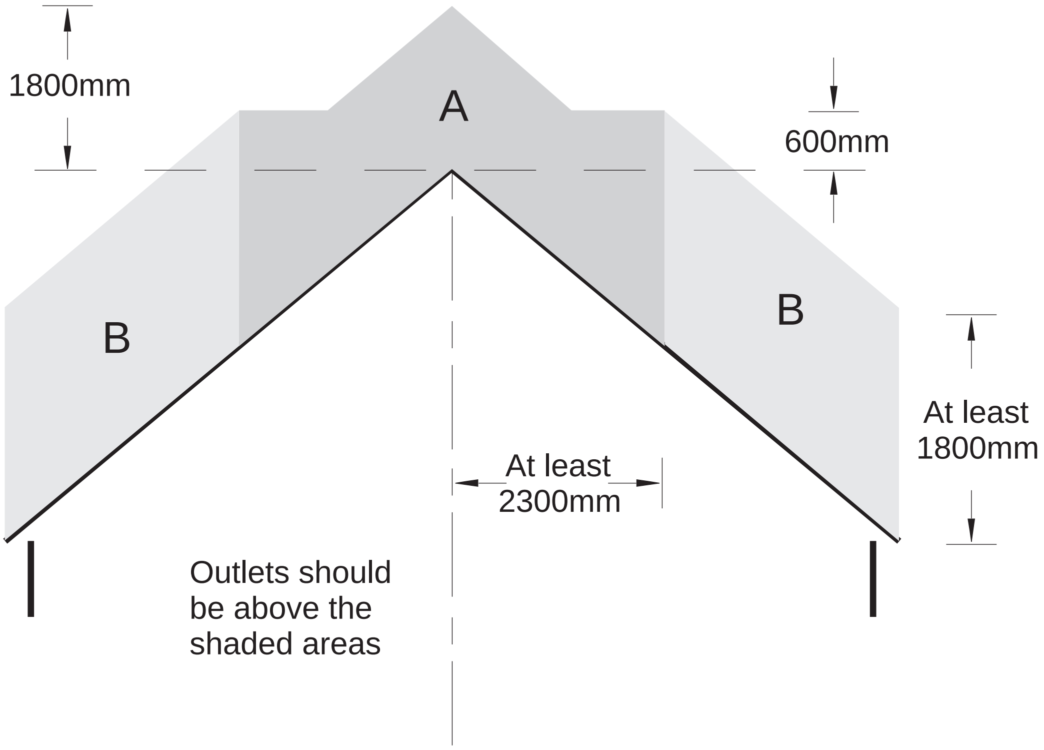




Additional Provisions For Appliances Burning Solid Fuel

Flue outlet positions for solid fuel appliance - clearances to easily ignited roof covering

The following information refers to The building regulations 2000 Approved Document J April 2002



Area	Location of flue outlet
A	at least 1800 mm vertically above the weather surface and at least 600 mm above the ridge
B	at least 1800 mm vertically above the weather surface and at least 2300 mm horizontally from the weather surface

Debris collection space

Where a chimney cannot be cleaned through the appliance, a debris collecting space which is accessible for emptying, and suitable sized opening(s) for cleaning should be provided at appropriate locations in the chimney.

Masonry and flue block chimney

Masonry chimneys should be built in accordance with Document J paragraphs 1.27 and 1.28. Flue block chimneys would be build in accordance with Document J paragraphs 1.29 and 1.30. The thickness of the walls around the flues, excluding the thickness of any flue liners should be in accordance with Document J diagram 2.4.

Separation of combustible material from fireplaces and flues

Combustible material should not be located where it could be ignited by the heat dissipating through the walls of fireplaces or flues. A way of meeting the requirement would be to follow the guidance in Document J diagram 2.5 so that combustible material is at least:

a) 200 mm from the inside surface of a flue or fireplace recess; or

b) 40 mm from the outer surface of a masonry chimney or fireplace recess unless it is a floorboard, skirting board, dado or picture rail, mantel-shelf or architrave. Metal fixings in contact with combustible materials should be at least 50 mm from the inside surface of a flue.

Additional Provisions For Gas Burning Appliances

Masonry chimneys

Masonry chimneys should be build in accordance with Document J paragraphs 1.27 and 1.28 in section 1.

Flue block chimneys

Chimneys can be constructed from factory-made flue block systems primarily designed for solid fuel as described in Document J paragraphs 1.29 and 1.30 in section 1. They can also be constructed from factory-made flue block systems comprising straight blocks, recess units, lintel blocks, offset blocks, transfer blocks and jointing materials complying with:

a) BS 1289-1:1986 for concrete flue blocks: or
b) BS EN 1806:2000 for clay/ceramic flue blocks with a performance class of at least FB4 N2.

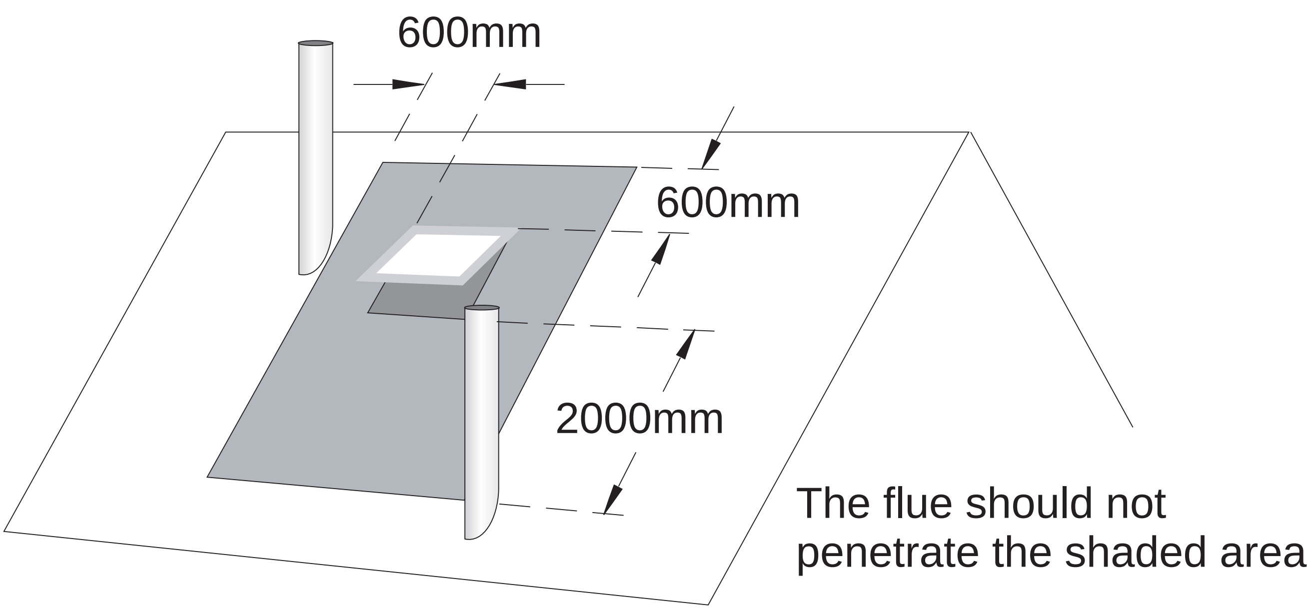
Flue block chimneys should be installed with sealed joints in accordance with the flue block manufacturer's installation instructions. Where bends or offsets are required, these should be formed using matching factory-made components.
Flue blocks which are not intended to be bonded into surrounding masonry should be supported and restrained in accordance with the manufacturer's installation instructions.

Factory-made metal chimneys

Chimneys for gas appliances may be constructed using systems described in Document J paragraphs 1.42 to 1.46 in section 1.
Factory-made metal chimneys should be guarded if they could be at risk of damage or the burn hazard they present to people is not immediately apparent.

Addition Provisions For Gas Burning Appliances

Location of outlets near roof windows from flues serving gas appliances



Location and shielding of flues

Combustible materials in the building fabric should be protected from the heat dissipation from flue so that they are not at risk of catching fire. A way of meeting the requirement would be to follow the guidance in the enclosed table.
Where a flue pipe or chimney penetrates a fire compartment wall or floor, it must not breach the fire separation requirements of Approved Document B.

Connecting flue pipes and factory-made chimneys should also be guarded if they could be at risk of damage or if they present a burn hazard to people that is not immediately apparent.

Relining of flues in chimneys

Lining or relining flues may be building work or in any case, such work should be carried out so that the objectives of requirements J2 to J4 are met (Document J paragraphs 1.34 and 1.35). Existing flues being re-used should be checked as described in Document J paragraph 1.36. For flue liners servicing gas appliances, ways of meeting the requirements include the use of

a) Liners as described in Document J paragraph 1.27;
b) Liners as described in Document J paragraph 2.20;
c) Flexible stainless steel liners independently certified as complying with BS 715:1993;
d) Other systems which have been independently certified as suitable for the purpose.

Flexible metal flue liners should be installed in one complete length without joints within the chimney. Other than for sealing at the top and the bottom, the space between the chimney and the liner should be left empty unless this is contrary to the manufacturer's instructions. Double skin flexible flue liners should be installed in accordance with manufacturer's installation instructions. BS 715 liners should be installed in accordance with BS 5440-1:2000.

Protecting buildings from hot flues

Flue within:	Protection measures
Connecting flue pipe	Flues should be at least 25mm from any combustible material (measured fromt he outer surface of the flue wall, or the inner wall in the case of multi-walled products). Where passing through a combustible wall, floor or roof (other than a compartment wall floor or roof) this separation can be achieved by a non-combustible sleeve enclosing the flue pipe or chimney with a 25mm airspace to the relevant flue wall. (The airspace could be wholly or partially filled with non-combustible insulating material).
Factory-made chimney complying with BS715:1993	
Factory-made chimney complying with BS 4543-1:1990 (1996),* BS 4543-2:1990 (1996), and BS 4543-3:1990 (1996)	Install in accordance with Document J paragraph 1.45.
Masonry chimney	Provide at least 25mm of masonry between flues and any combustible material.
Flue block chimney	Provide flue block walls at least 25mm thick

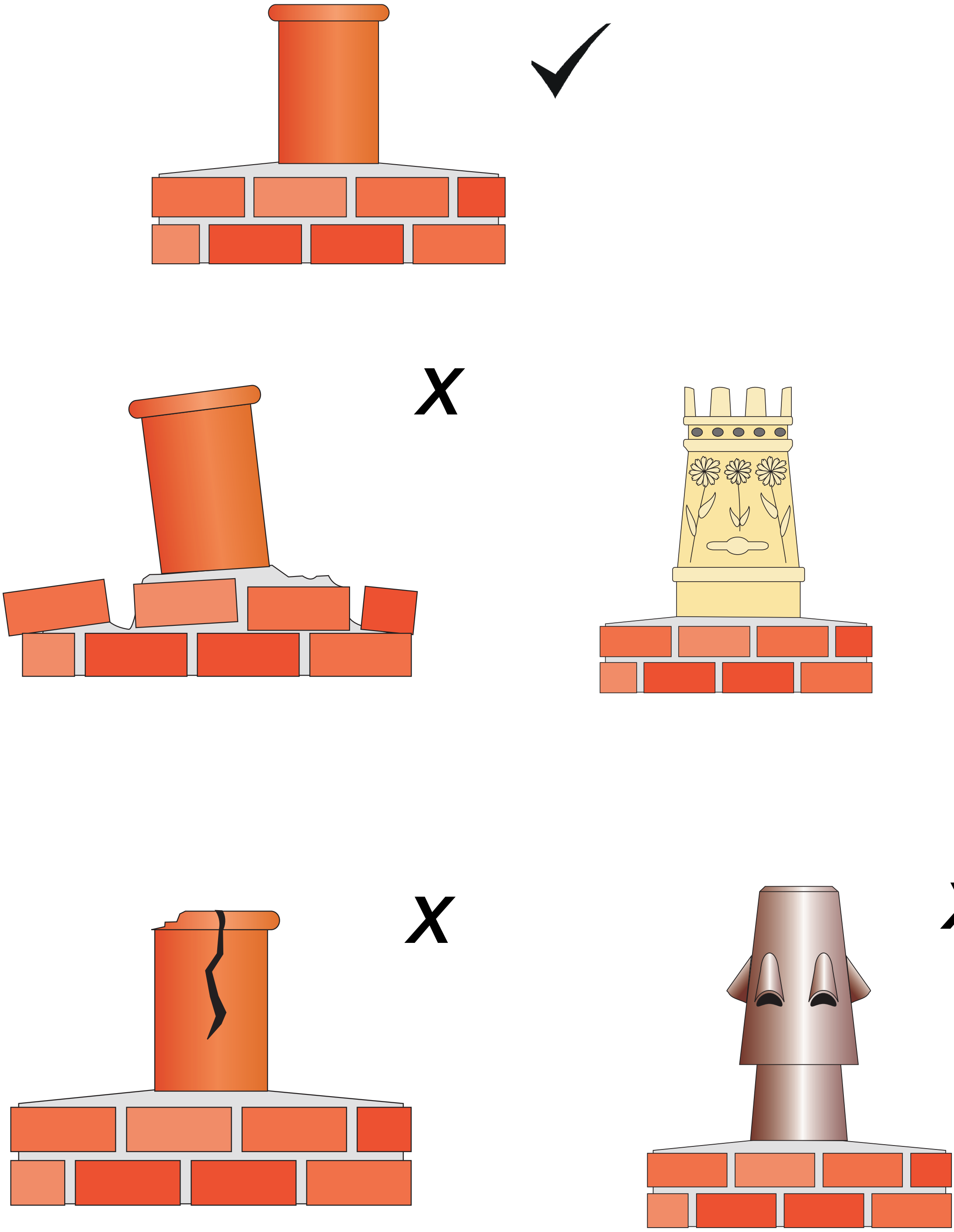
* BS4543-1:1990 (1996) withdrawn April 2000; partially superseded by BS EN 1859:2000

Guidance for the correct fitting of a flue terminal (cowl) to an existing chimney pot.

Pre-installation check

Is there safe and adequate access to the chimney?
Can the cowl be fitted with out the need for scaffolding or lifting equipment, bearing in mind current health and safety regulations?
Is there a suitable chimney pot fitted?
Pots must be of the plain type, without holes, slots or louvres and be in sound condition, free from cracks and any damage.

Suitable and Unsuitable Pots



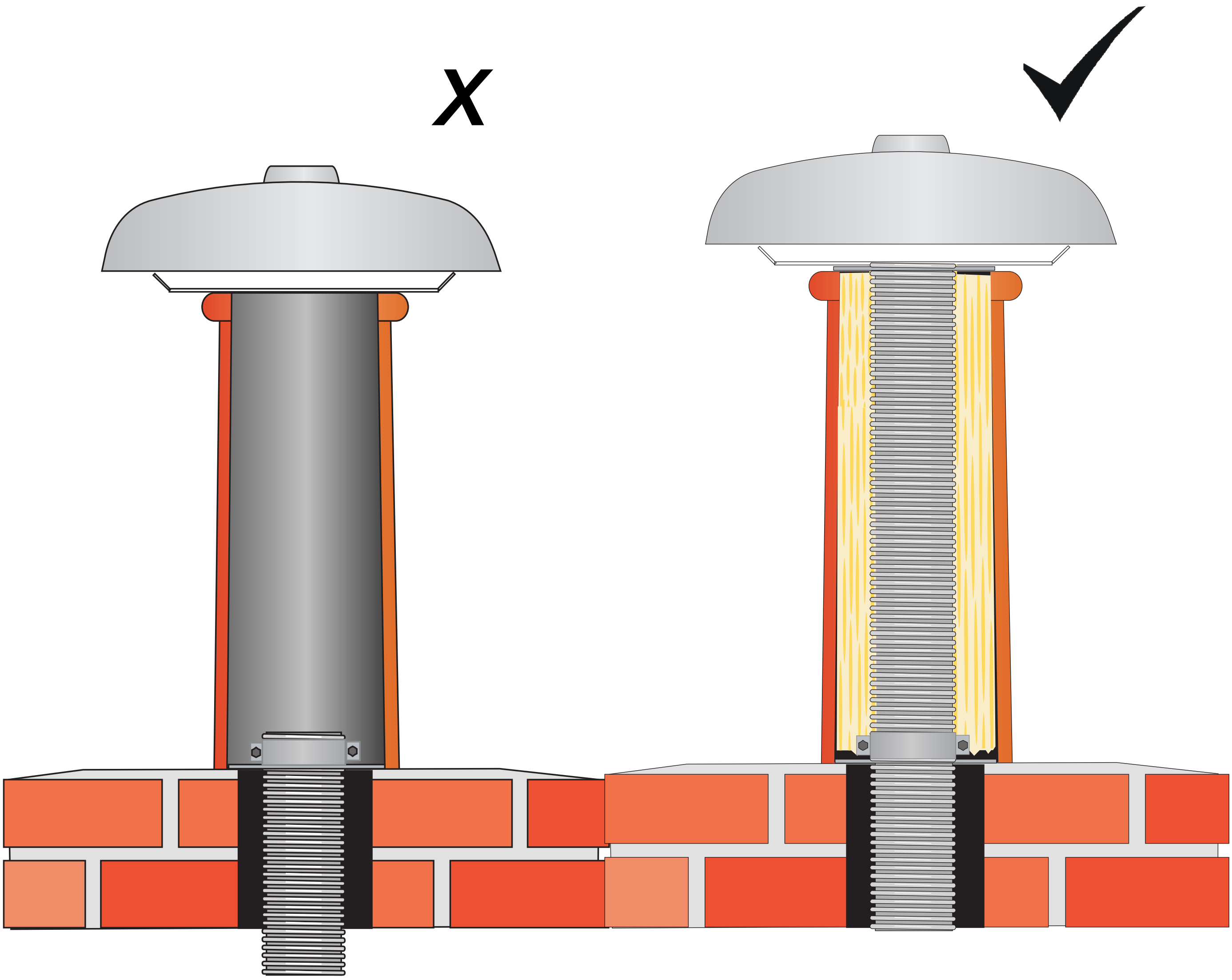
If the flue is lined.

Is the flue lined and does the flexible liner extend to the top of the chimney pot?

If the liner terminates at the base of the pot, the cowl may not perform as it is designed to do, due to turbulance formed inside the pot.

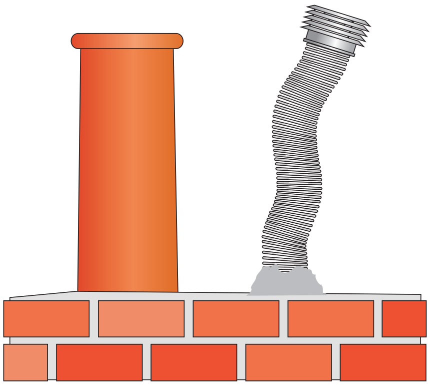
If the liner is fitted correctly and the manufacturers instructions recommended the cowl is fitted to the liner.

Does the cowl have the necessary adaptor plate fitted?



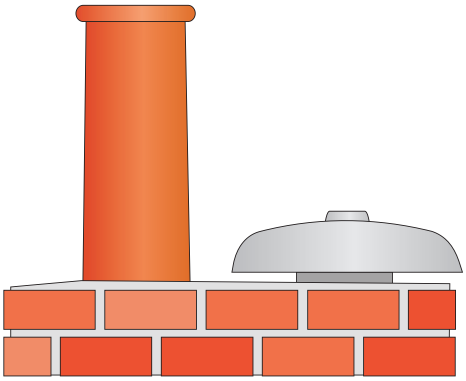
Are there any obstructions?

A cowl must be fitted in an area where there is a free flow of air, outside any high or low pressure zones or turbulance areas and free from any other obstructions. Please refer to the manufacturers instructions regarding the assembly and correct fitting of the cowl. Most cowls have been designed to be fitted to a pot and not directly onto a flat chimney stack.



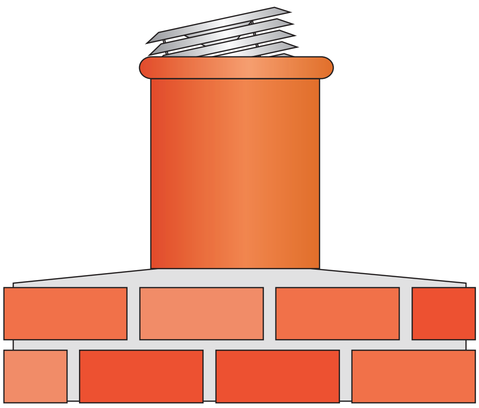
A flexible liner should never be visible or used to support the cowl.

X



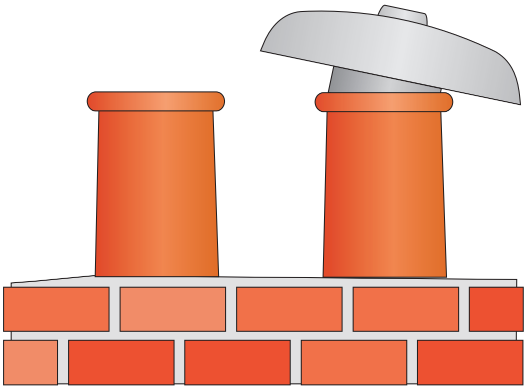
A cowl should not be masked by another flue pot. Or fitted too close to the main chimney structure.

X



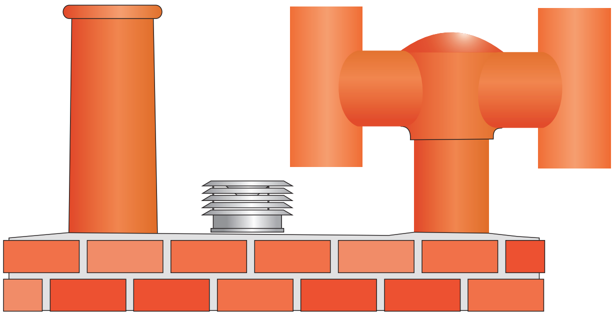
A cowl should not be fitted within the body of a chimney pot.

X



A cowl should be correctly aligned and fitted to the pot securely.

X



A masked cowl would be subject to turbulence and impossible to control.

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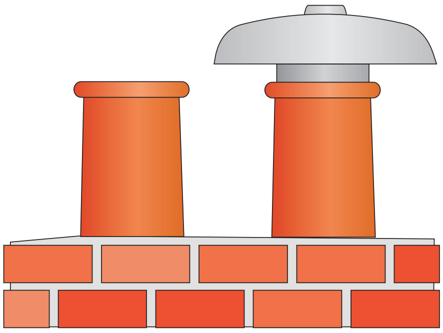
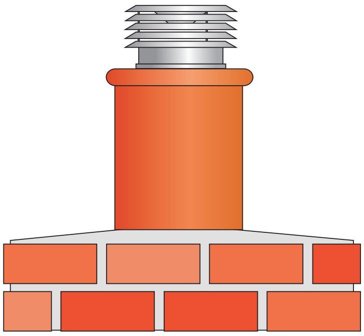


✓

A cowl should be fitted so as to be slightly higher than the pot. Securely fitted to avoid wind damage.



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Make sure your cowl is fitted securely. Far too many cowls have ended up in the next field at the sign of the first breeze. Some cowls have extra secure fittings (i.e. straps and locking bands) available as an optional extra.

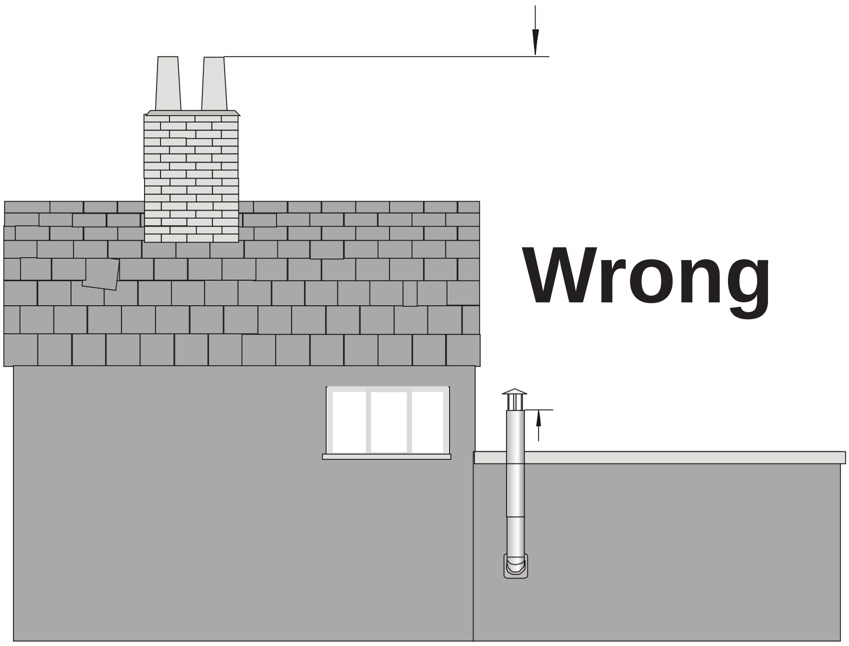
Finally having fitted your cowl, carry out necessary checks to ascertain that the appliance is working correctly. Re-commission the appliance if this is needed.

Installation of Pre-fabricated Flues

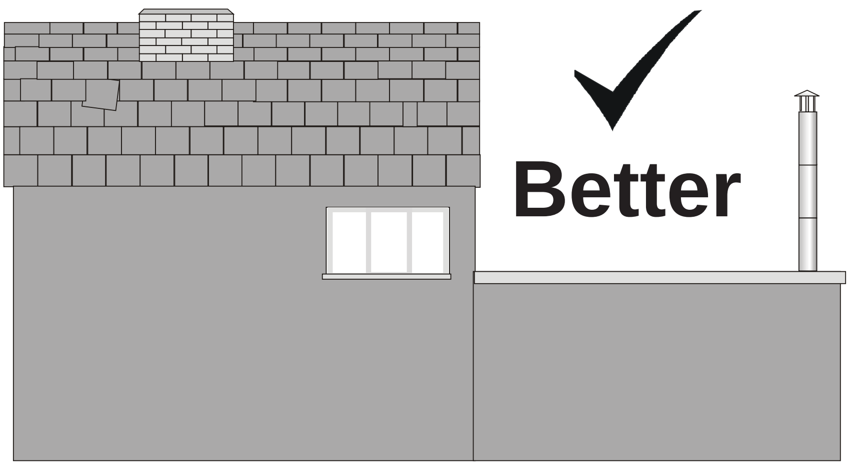
Pre-fabricated Flues

Remember that it is impossible to ascertain exactly how a flue will perform until it has been put up, so many things can effect the performance. In planning the installation of your flue, it is important not to build into it a potential problem, it will help if the following guide lines are followed:-

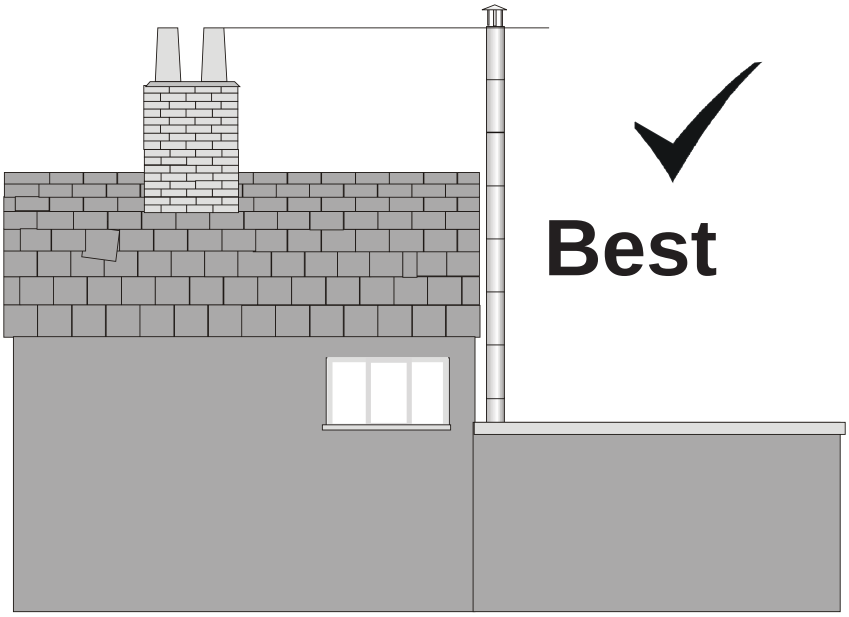
1. Choose the correct materials for the job.
2. Keep the flue as straight as possible.
3. If you have to introduce bends, keep them to an absolute minimum, no angle should be less than 45°.
4. On top exit stoves, ideally the flue should rise vertically 1 meter before the first bend.
5. Avoid a horizontal run of more than 150 mm on a rear exit.
6. Avoid long external runs.
7. The warmer the flue the better it works.
8. Terminate above the ridge, 1 metre is ideal where possible.
9. Fit the correct terminal, and as per the manufacturers instructions.
10. Make sure you have adequate access for sweeping.



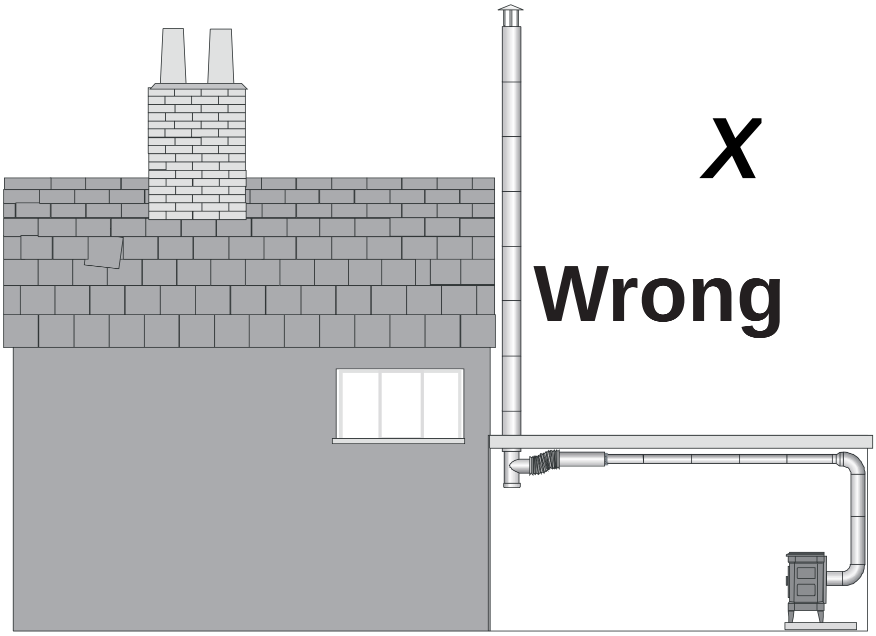
Disparity between the flue heights will cause the extension flue to reverse flow. Apart from the obvious problem of fumes entering the window, the relative heights of the extension flue and the window will also affect the flue when the window is opened. Wind blowing from right to left will cause a high pressure zone around the termination to stall the flue and wind blowing from left to right will subject it to uncontrollable turbulence. The flue is too short to generate sufficient pressure difference.



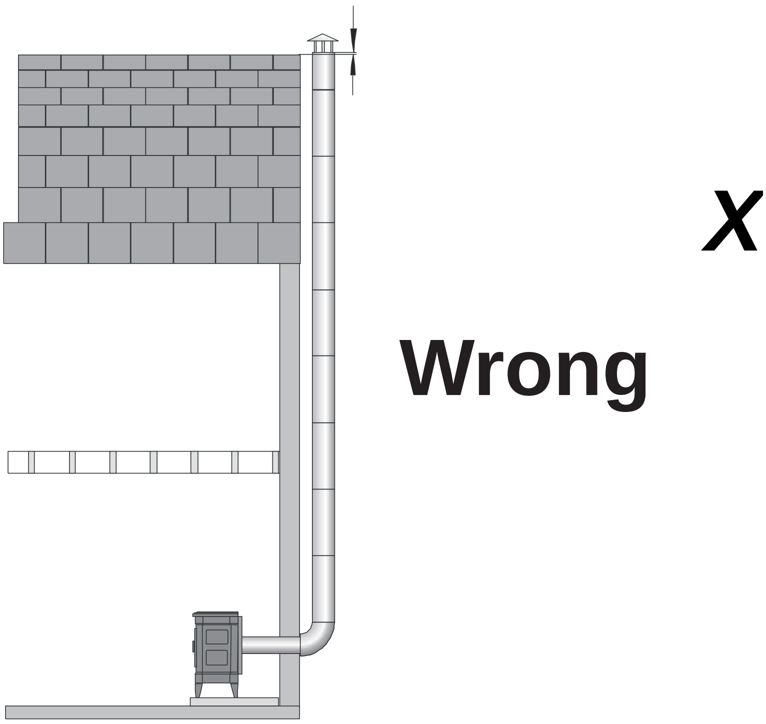
Although this flue is not ideal it has addressed most of the problems highlighted with the previous illustration and will work satisfactorily in most weather conditions.



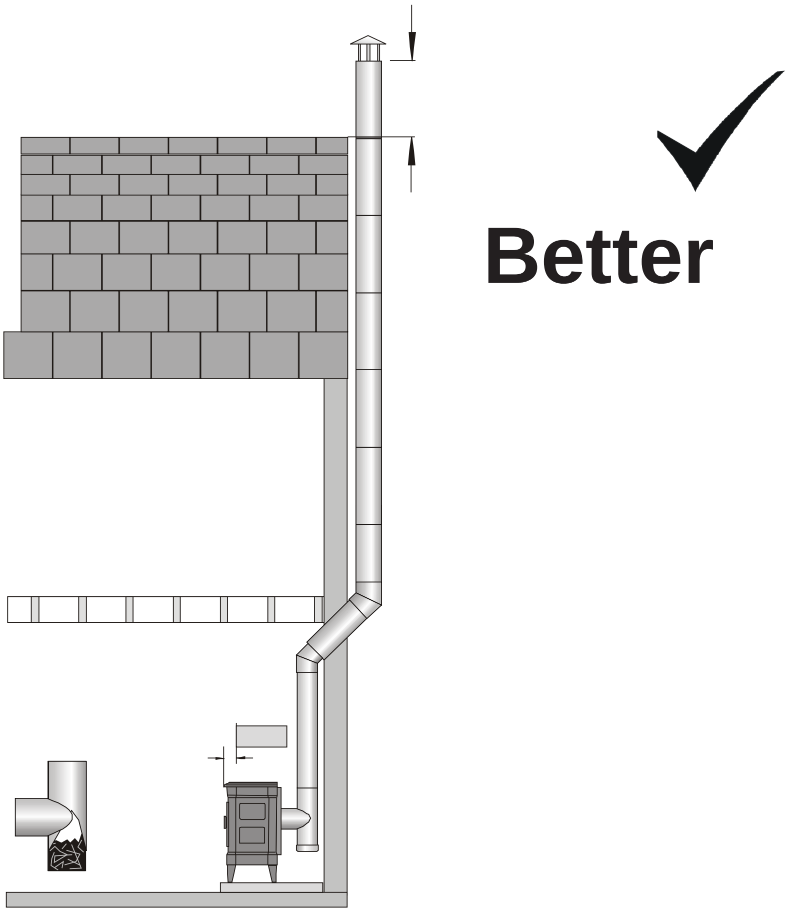
This would be the ideal flue. All flue terminations are of equal height and the extension flue is clear of all potential turbulence and high pressure areas.



If asked to visit a property to "sort out" a stove, always survey the flue, noting any potential problems with its design and any surrounding obstructions which may be causing problems. What may seem to be satisfactory at first sight may become the obvious cause of any problem with a more detailed examination and save you hours of futile stove adjustment.

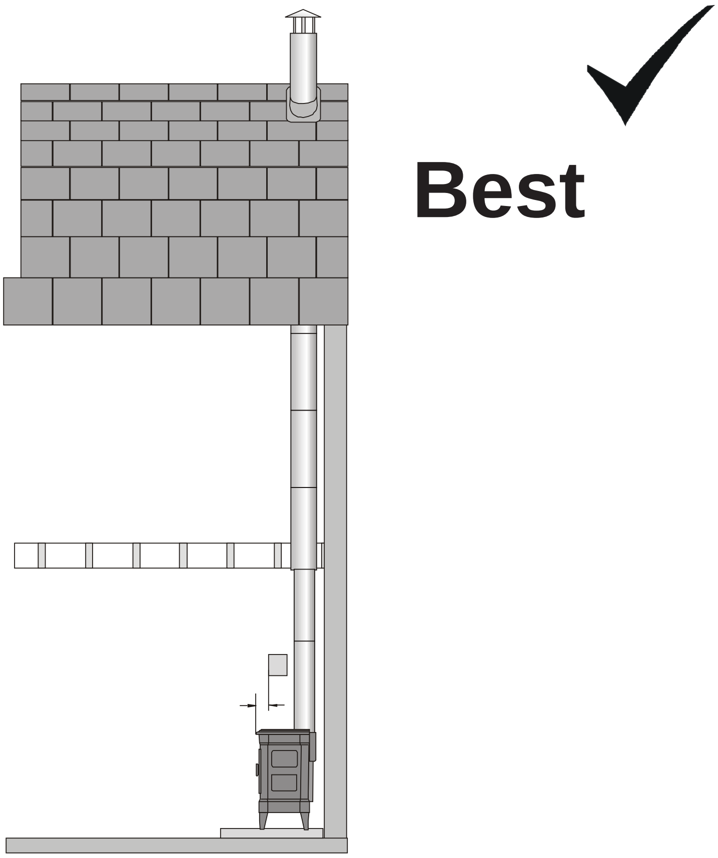


This is an unsatisfactory flue, firstly because the termination is too close to the roof ridge which will subject it to turbulence, and secondly because it has no easy access for cleaning and the right angled bend will accumulate any solids from the stove together with items such as leaves and twigs falling down the flue. The third important failing is the long horizontal run directly from the stove. Expecting the barely warm gases produced when the stove is lit to struggle horizontally rather than vertically upwards is to rewrite a basic law of physics. The reality will be clouds of combustion products issuing from every less than perfect seal on the stove until the flue pipe warms by being in contact with the stove body; this may take a considerable time.



Better

The termination in this illustration is in a satisfactory position and the horizontal run of the “tee” piece is short enough not to cause problems. If the hearth is deep the fitting of a tee at the back of the stove will allow the stove a better position for the room air to circulate around it. Not only does a tee provide good access for cleaning, it also provides a safe reservoir for any rubbish or water falling from the flue.



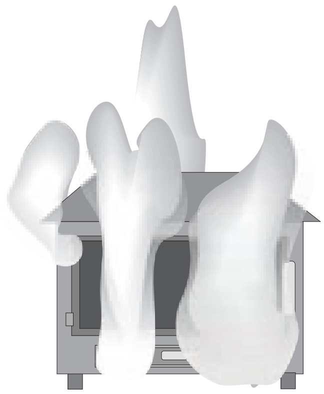
Best

This is an ideal flue with a completely vertical aspect with no bends, no horizontal runs and protected from damage. Particular attention must be payed to any building regulations which may be applicable and you must be aware of any restrictions imposed by the flues use near combustible materials imposed by the flue system manufacturers. Whilst all matter falling down the flue will fall into the stove it should be noted that this will include rain. This is not generally a problem when the stove is operating and the flue gases are hot enough to vaporise incoming water but it can cause severe damage to a cold stove as the water mixes with the acidic products of combustion. Enamel stoves are particularly at risk as any corrosion will cause the enamel to flake off.

Spring and Autumn Syndrome

A additional guide to show the influences of seasonal temperatures upon the operation of a stove and flue system.

Stoves utilize the effect of air current within the flue to both exhaust the products of combustion and to induce air into the stove. Normally, because the air within the house is warmer than the outside air the flue is exhausting air from the stove even when it is not operating.

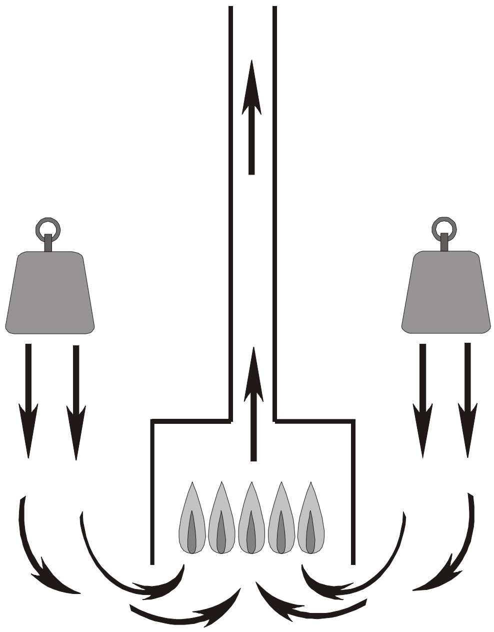


1. A hot flue does not “draw” air into a stove, it is the differences of densities that motivate the lighter gases upwards.

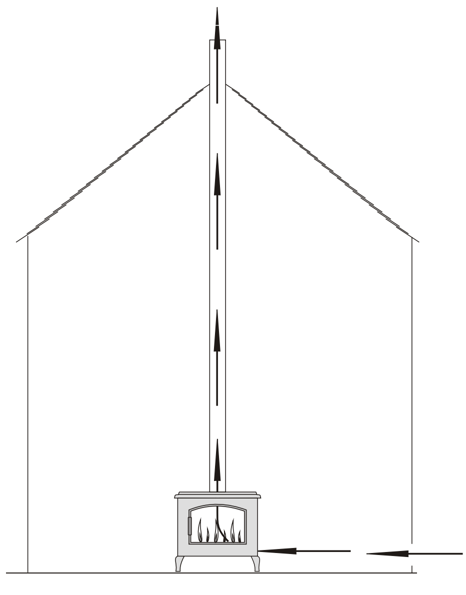
2. The greater the temperature difference between the gases within the flue and the surrounding air, the greater the difference in densities and the greater the motivation.

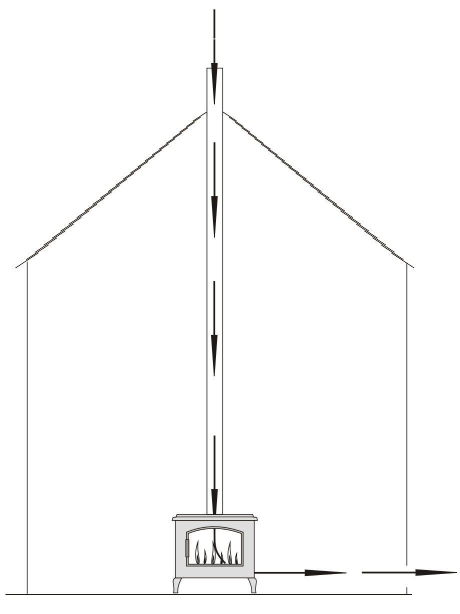
3. The taller the flue, the greater the weight of the equivalent volume of denser air, the greater the motivation.

During the very changeable whether conditions of Spring and Autumn the outside temperature can rise suddenly and become warmer than the temperature within the house. This causes the air within the flue to reverse its normal flow pattern and air travels down the flue. The most obvious outcome of this will initially be a smell from the flue and whilst this is not harmful it may be unpleasant if the flue has not been swept as often as it should have been.



Because of the warmer outside temperature the house will feel colder than it actually is, and the desire to light the stove and at least match the outside temperature will reveal another problem, the stove will not light. If sufficient air is coming down the flue the stove will appear to begin its lighting cycle but smoke will emanate from what are normally air inlets and into the room. The stove may continue to operate in this fashion for a considerable time but because the flue is operating in reverse there is no possibility of any hot air produced by the stove travelling up the flue, to warm it, and reverse the flow.

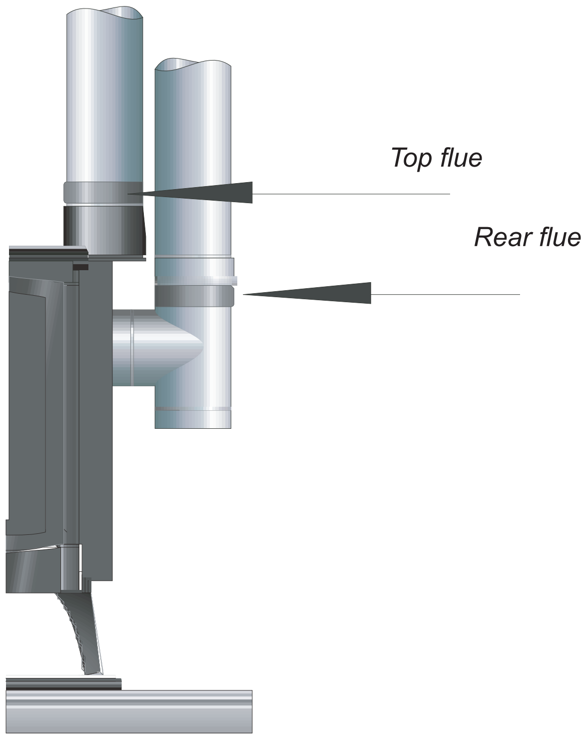




If the house feels colder than the outside temperature do not light the stove without clarifying the that the air is travelling up, rather than down, the flue. As mentioned previously a smell of soot is an indication that the flue is operating in reverse but by opening the stove's door and placing a hand within the stove it should be possible to confirm the air flow.

Leaving the stove door open for a few minutes may allow enough air through the flue to warm its fabric sufficiently to at least stall the air flow which will make lighting possible. If this fails the practice of directing warm air from a hair dryer into the stove is a solution chosen by some, who report it to be effective. However, do not attempt this procedure unless the stove is scrupulously clean and free of all ash, dust and any other debris; the air flow from a hair dryer is surprisingly powerful.

If lighting the stove under these conditions proves to be more than an infrequent irritation you might like to consider purchasing a flue heater band which is permanently attached to the flue pipe and when required heats the flue pipe noiselessly and without dust.



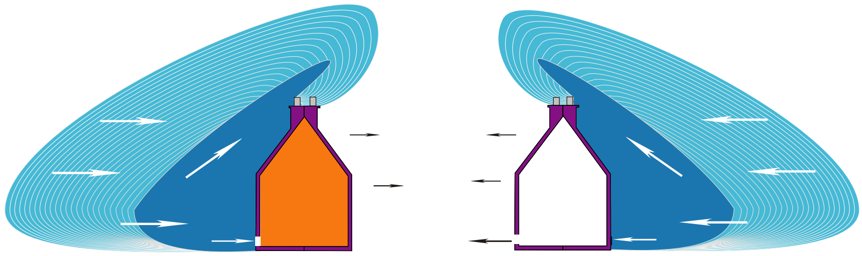
The heater band clamps around the flue pipe close to the stove (see diagram) and plugs directly into a standard electrical socket. Prior to lighting the stove the heater band should be switched on and allowed to heat the flue pipe for a period of time, this will depend greatly upon the flue environment. Heating the flue pipe will introduce heat into the flue so helping to initiate a flue draught. Once the stove is lit the heater band must be turned off as prolonged use may cause damage to the heating element. To control the switching of the heater band the use of a a run back timer (MS 10000) is recommended

Run back timer
MS10000
This switch when activated will allow power to the heater band for up to 4 minutes heating the heater band to its optimum and then switching it off automatically prolonging the life of the heater element.

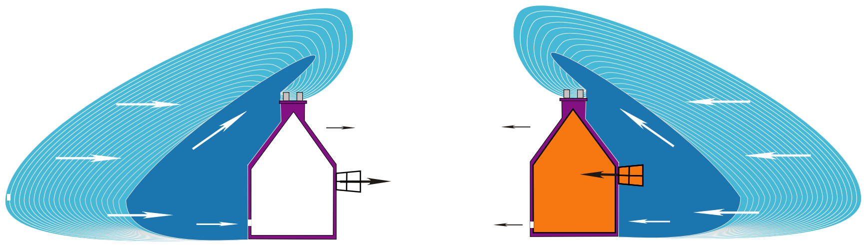
An additional guide to air requirements and vent positions

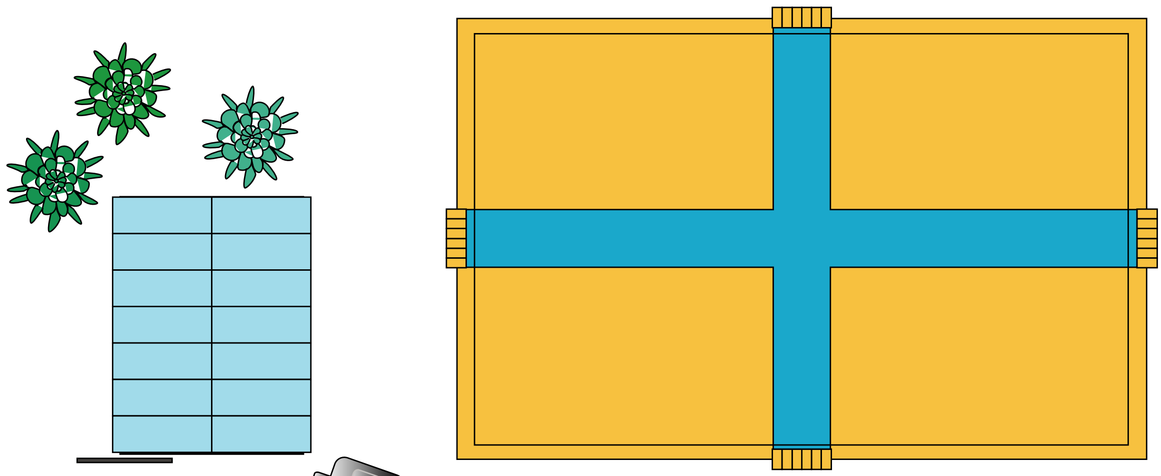
The information that follows is only a guide. In all circumstances the installation must conform to that of building regulations. Approved Document F Means of Ventilation 2006

Any air vent will induce air into the house when the wind is blowing towards it, but will evacuate air from the property when it it down wind.

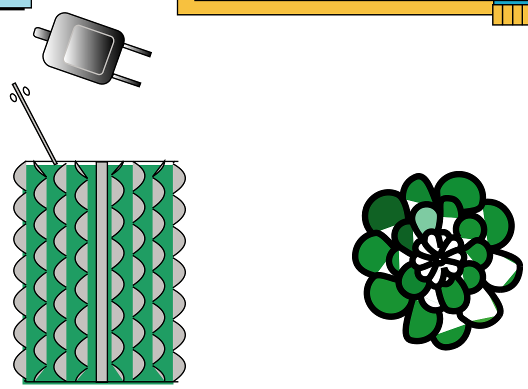


Even when facing the prevailing wind, any opening on the down wind side of greater area will probably result in a pressure drop within the property. The converse is also true as the relationship of the openings to the wind direction are reversed.

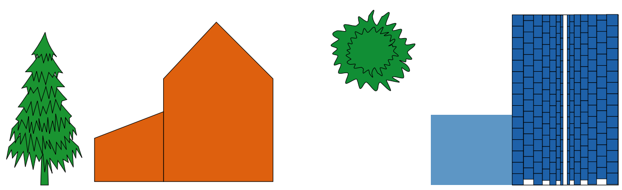


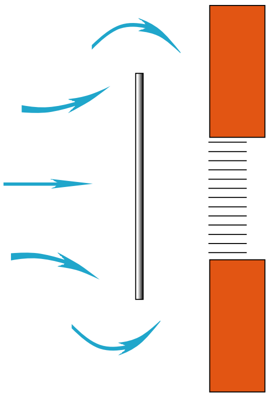


Various attempts to cancel the effects of the winds effects upon air vents have been proposed, one of which being an under floor duct linking vents facing opposite directions, the ventilation to the room being taken from this duct. This scheme presupposes that the property has no outside obstructions such as bushes, garden buildings or other houses nearby.

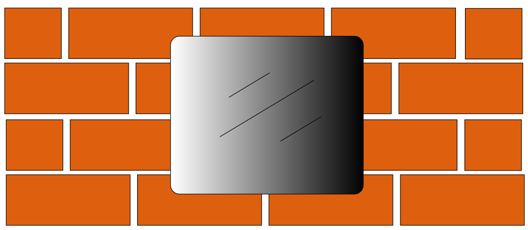


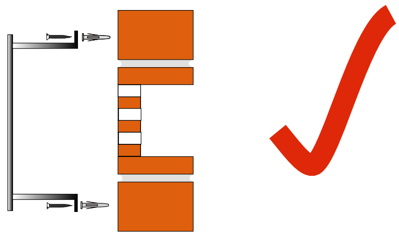
The difficulty in providing consistent ventilation is always more difficult when the property is not symmetrical and especially so when an extension of a different height has been added to the property, or where nearby trees cause wind turbulance to both the vent and flue termination.

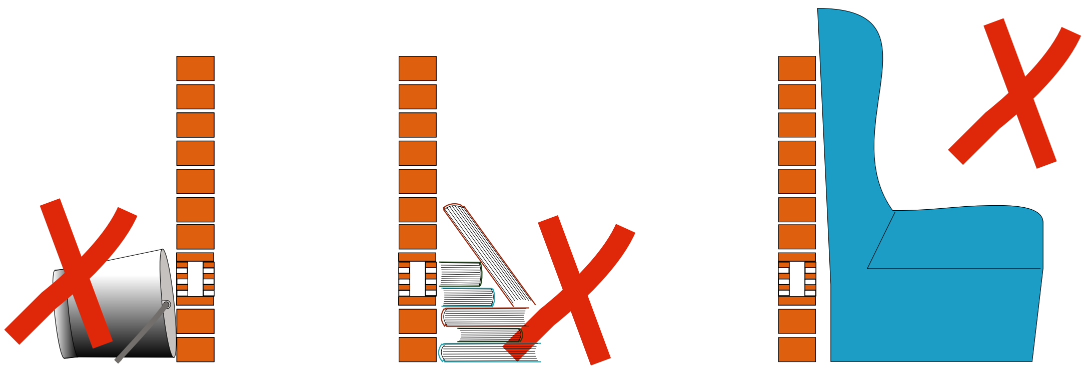




By protecting the vent from direct air flow by positioning a baffle of greater area than the vent the effects of wind can be reduced, but care must be taken to be certain that the total vent area is not restricted and that the baffle is mounted securely and cannot be moved to restrict the vent. This will only reduce the effects as it will not affect the air pressure, only the air velocity. Regular inspection must be carried out to ensure the vent does not become restricted.



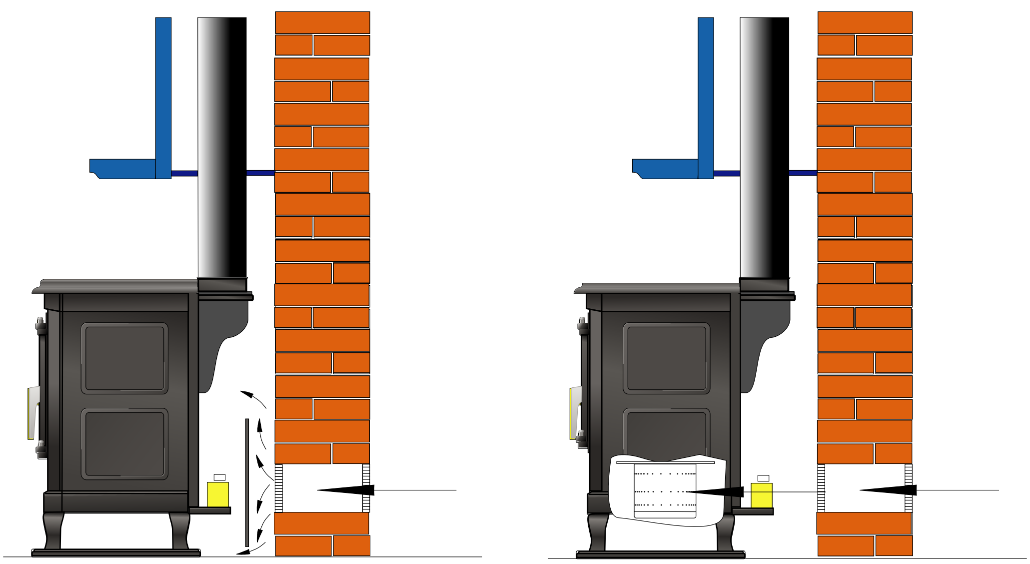




Leaning a baffle plate against the vent, or placing any un measured or movable object to restrict the vent, either on the inside or outside of the vent, is dangerous and must not be done.

Although the ideal position for the air vent inlet is as close to the stove as possible to minimise cold draughts in the room care must be taken to ensure the incoming cold air does not aim directly at the stove. The stove's burner operates by maintaining a temperature high enough to vaporise the oil before it ignites and cooling the pot with a direct stream of cold air may reduce the burner's temperature below that necessary for complete vaporization, which will result in incomplete combustion causing the formation of soot and a loss in the stove's efficiency.

NOTE:
Ventilation cannot be looked at in isolation; it is the other end of the flue terminal. If the property has more than one flue it should be born in mind that ventilators interconnect within the property and no vent can be assumed to be supplying air solely to a specific flue.



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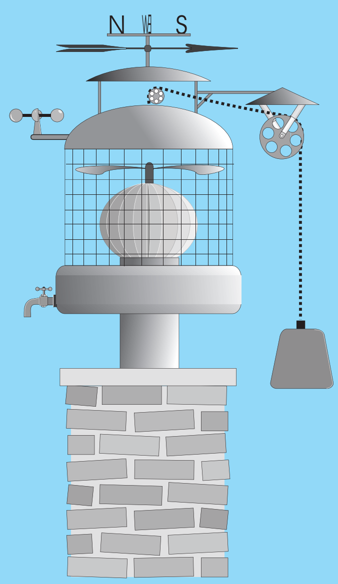

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