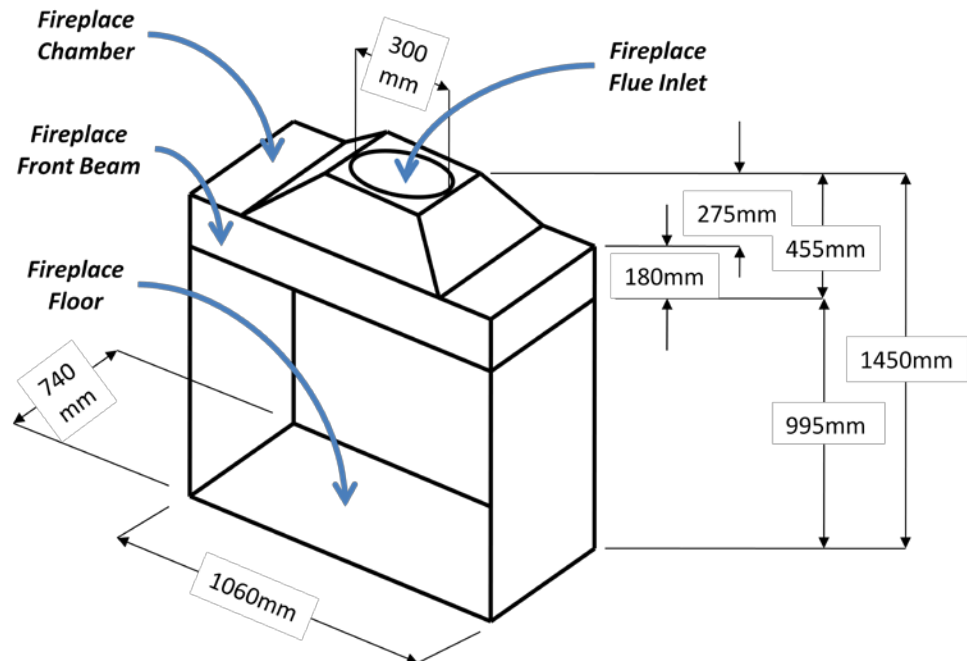


Smoking Fireplace

1) The Fireplace:

Fireplace Dimensions:



Height of the fireplace front beam to the fireplace floor: **995mm.**

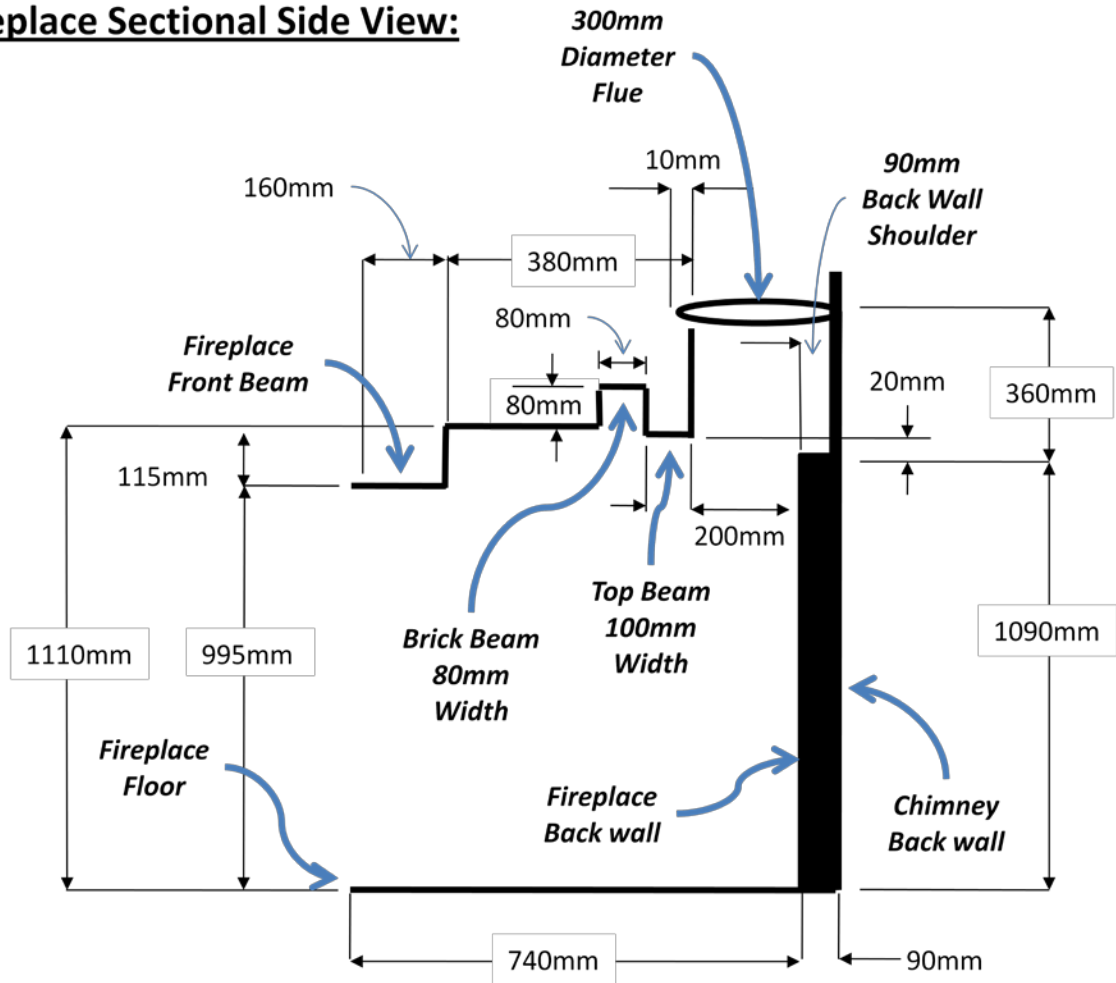
Overall height from the floor to start of flue: **1450mm.**

Fireplace width: **1060mm.**

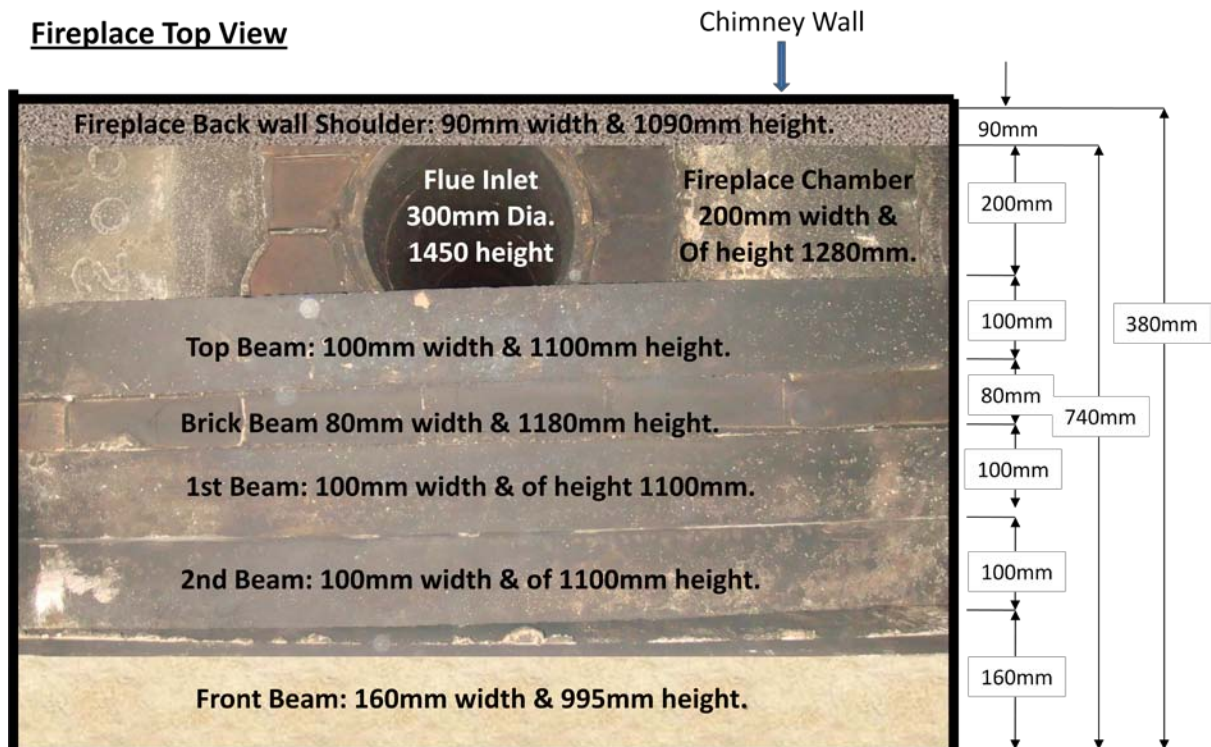
Fireplace depth: **740mm.**

The flue inside diameter: **300mm.**

Fireplace Sectional Side View:



Fireplace Top View



All heights are measured in mm from fireplace floor



Fire Basket and Back Plate measurements:

- The Basket**

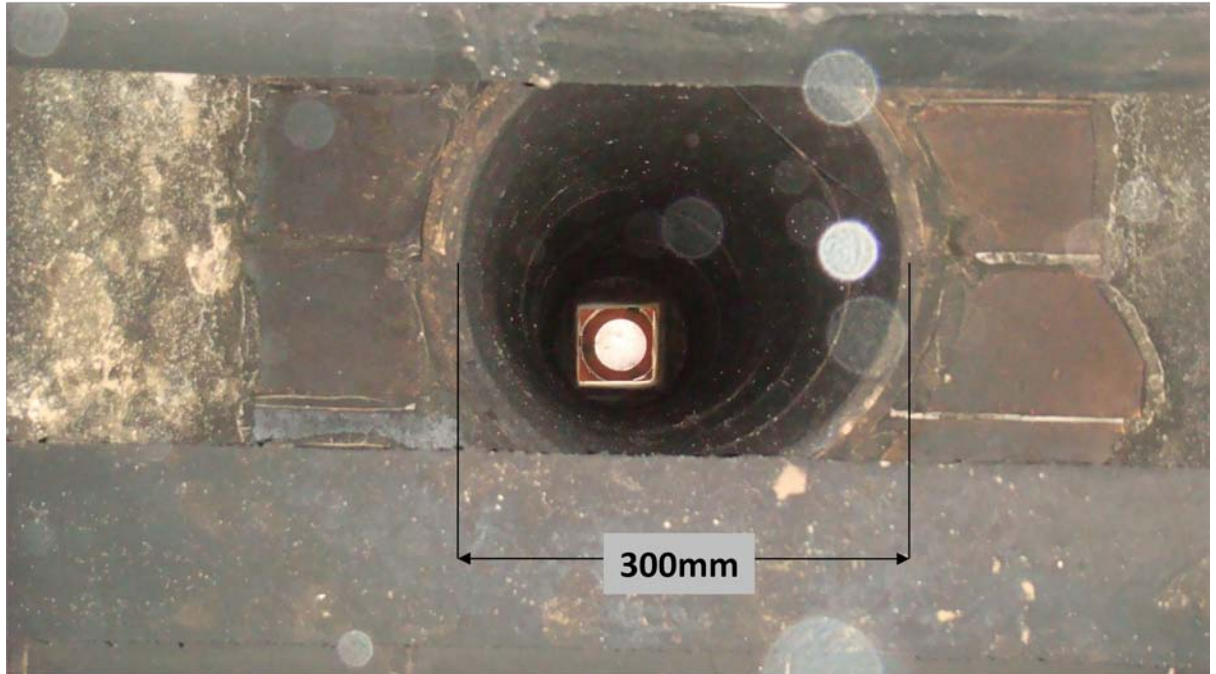
1. Width: **1000mm.**
2. Depth: **500mm.**

- Back Plate**

1. Top corner height from the fireplace floor: **740mm.**
2. Shoulder height from the fireplace floor: **650mm.**
3. Width: **740mm.**

- 2) **Internal Flue:** The flue is circular with inside diameter of **300mm**. The cross sectional area of the flue is **707** square cm.

A circular vertical Flue with 300mm diameter and of length of 5000mm from the fireplace chamber to the Pot inlet.

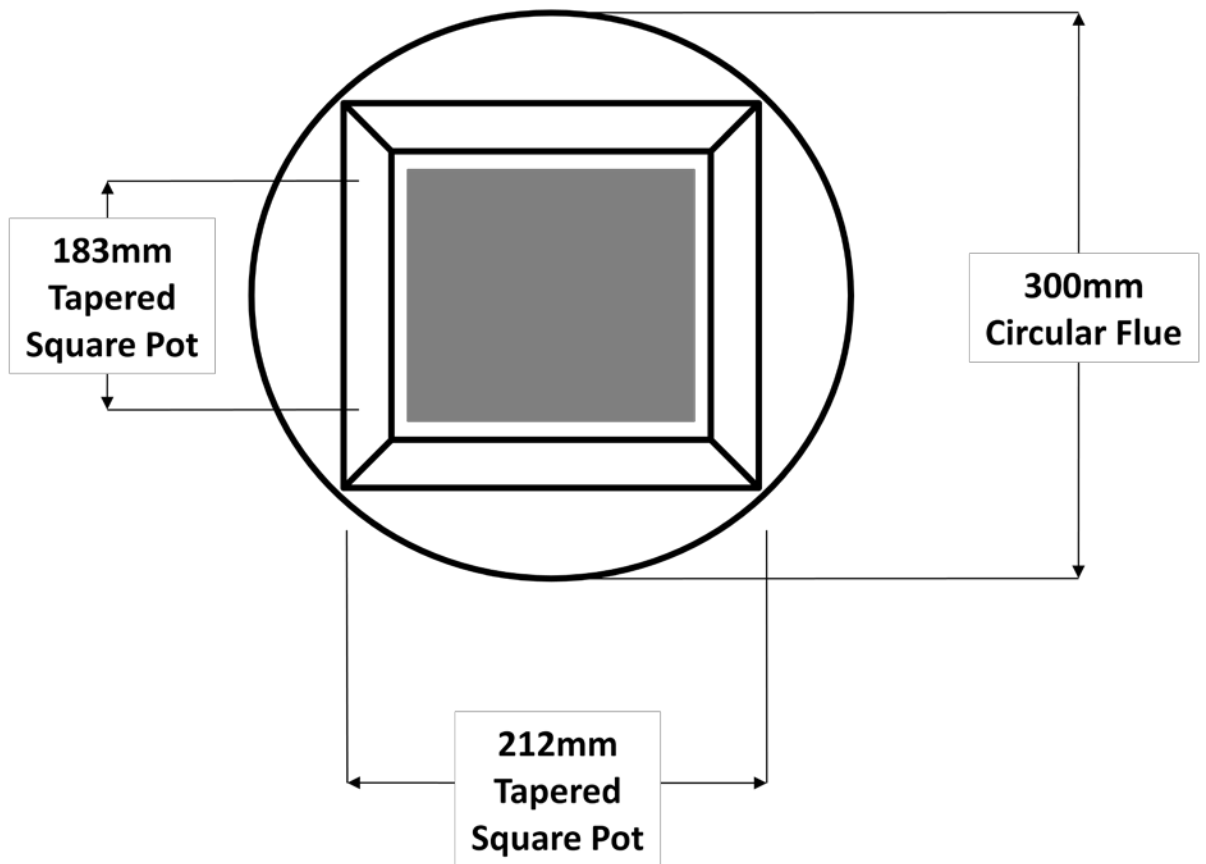


- 3) **The Pot:** The square pot of **206mm** inside length. The cross sectional area of the pot is **424** square cm, it forms **60%** of that of the flue.

The Square Pot

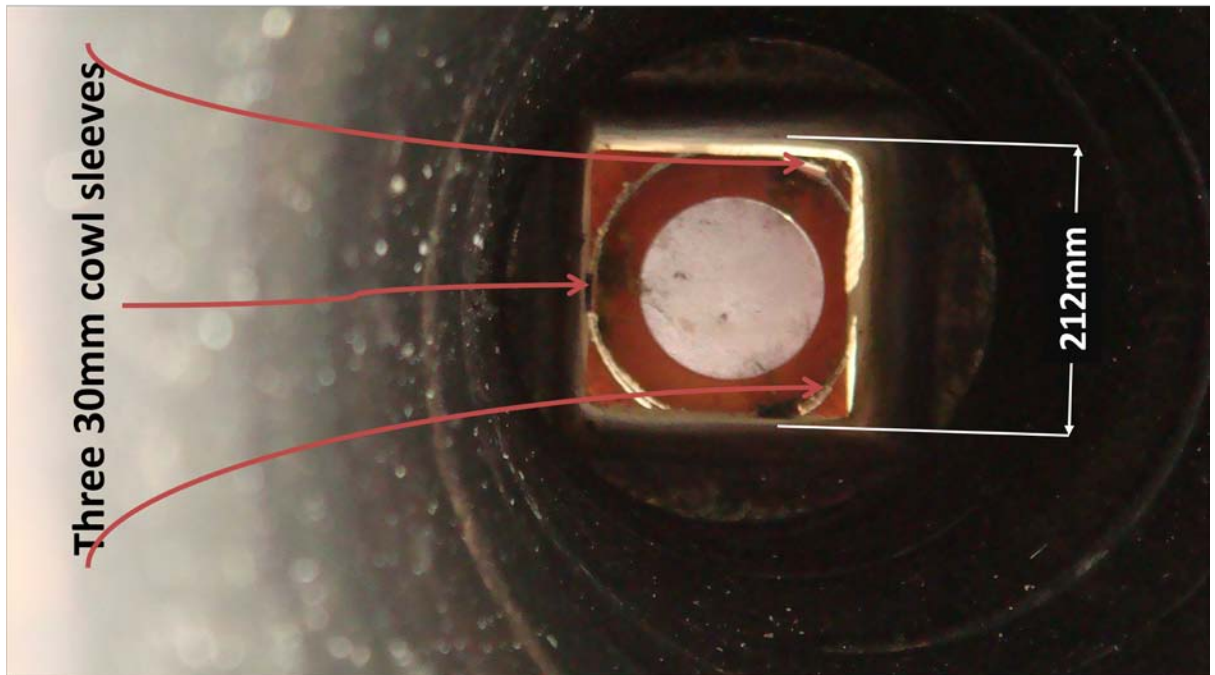


Unsuitable Pot:



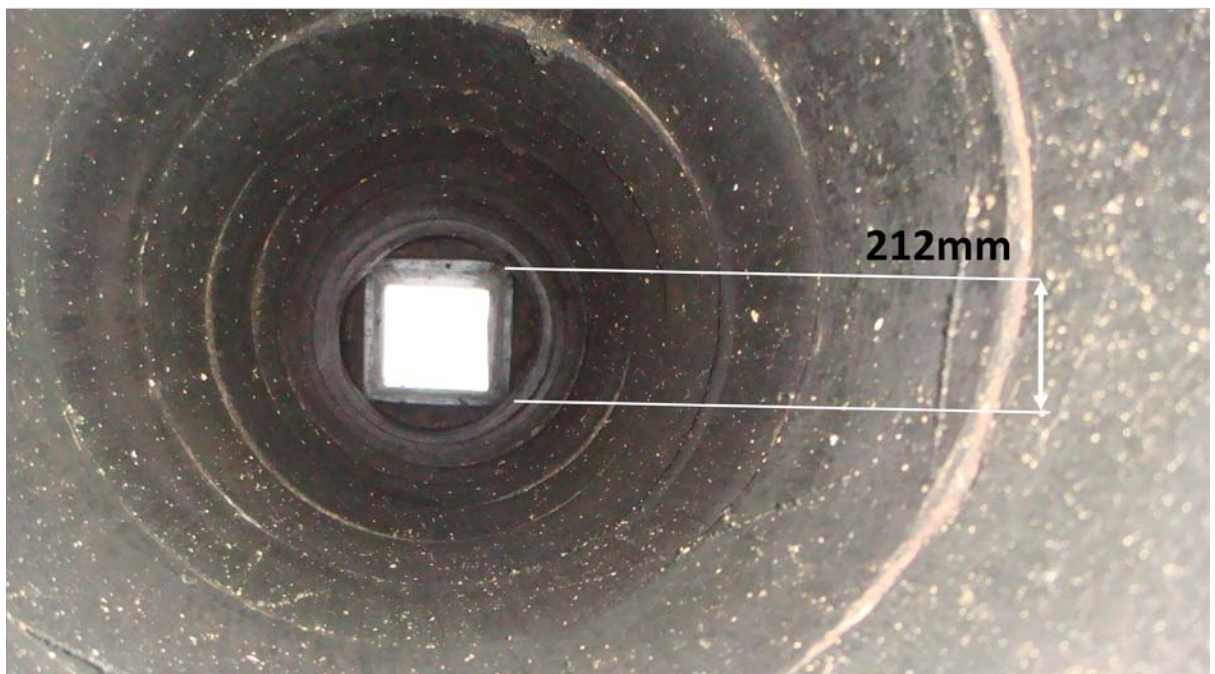
- 4) **The cowl:** The pot is fitted with a standard bird guard and rain-hat cowl. The bird guard mesh form a cylinder of **206mm** diameter and **85mm** height, fixed by three vertical sleeves of **30mm** width. The surface area of the mesh minus of that of the sleeves is **500** square cm; it forms **71%** of that of the flue.

The flue, square pot and rain-hat cowl



Photos of the flue is taken from the fireplace floor looking upward.

The flue and the square pot. Without the rain-hat cowl

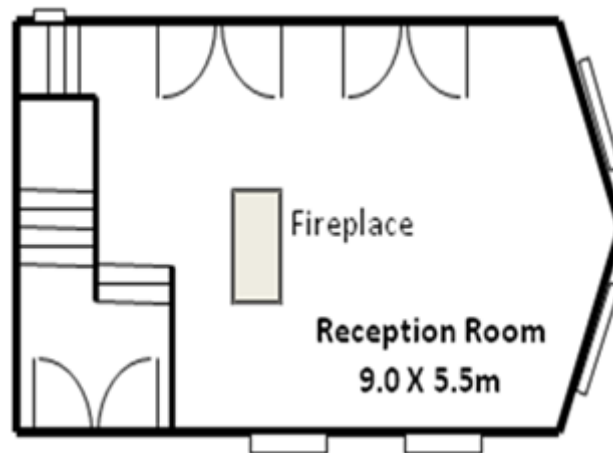


Photos of the flue is taken from the fireplace floor looking upward.

- 5) **Chimney Height:** The chimney height from the fireplace floor to the pot outlet is approximately **5.5m**.



Ventilation: The fireplace is situated in 9.0m X 5.5m reception hall with vaulted ceiling and triple aspect with twin French doors opening into outside. Opening the doors to outside did not stop or affect the downward flow of the smoke. There are no extracting fans in the room.



6) Peculiarities:

- a. Dwindraught smoke does not appear at all times.
- b. The house is on gentle hill, surrounded by high trees.
- c. When the wood log fire has a high flame, the amount of dwindraught is minimal.

The “Bed Sheet” experiment: (<http://www.argylecanopies.com/smoking.html>)

A bed sheet taped into the top of the fireplace front beam and left to hang loosely touching the fireplace floor, the following observation are noted.



- 1) The sheet was sucked inwardly into the fireplace and made healthy sag. It looks like a sail filled with air. See the above photo.
- 2) Friday afternoon/evening, 5th November, Gentle wind with occasional low to medium wind speed:
 - a. At most of the times, the sheet maintains a steady position with healthy sag.

- b. Between now and then, it buffed out, however, at all times, kept small inward sag into the fireplace. It never puffed outward beyond the perpendicular plain across the fireplace face, the sheet never buffed out completely or uniformly, it gently bubbled in some places.
 - c. I could not establish a synchronisation between the sheet movement and outside wind speed changes.
 - d. The slight movement of the sheet is infrequent, and independent of the outside trees movement with the wind.
 - e. Opening and closing doors and windows, throughout the house, did not have any affects on the sheet position. Also ventilators switching on and off did not have any effects too.
- 3) Saturday 6th November, no wind, very calm day.
 - a. The sheet stays stationary in its position, without any movement, maintaining good healthy sag. Possibly the sag is greater than Friday afternoon. The attached photo is taken on Saturday morning.
 - b. No changes have noted; the sheet looks like a rigid structure, curved inwardly to the fireplace in some places, touching the bars of the fire basket, which is at least 40 to 50cm from the perpendicular plan across the face of the fireplace.
- 4) Sunday 7th November: The weather conditions are similar to Saturday; no movement of the sheet is noted. The position of the sheet described in section 3, items a, and b are applicable.
- 5) Monday early morning 8th November: South East wind with speed of 20 to 46 MPH, raining heavily. Unexpectedly the sheet is as steady and motionless as on Saturday and Sunday. The position of the sheet described in section 3, items a, and b still applicable. It is possible that the wind direction on Monday morning 7th November is different from that on Friday 5th November.

Initial conclusions:

A) No problem areas:

1. Under normal calm weather conditions, the chimney seems to operate correctly.
2. No ventilation problems as opening doors and/or windows have any effects on the position of the sheet.
3. No competition problems with other air flow systems such as ventilation pipes, cooker hood, air extractor, doors and windows.
4. The chimney height of 5.5m probably on the critical side. Any increase in height will be an improvement.

B) Possible problem areas:

1. The chimney pot
2. Air turbulent
3. Fireplace opening size
4. inside/outside pressure difference

Remarks:

- I. The slight movement of the sheet on Friday without apparent synchronisation with wind speed may be due to (the normal changes of the negative pressure at the chimney pot with wind speed) and /or the subsequent generated air turbulent. However, the wind speed on Monday is as high as and possibly higher than Friday, no movement of the sheet is noted then, this may indicate that the change in the negative pressure at the chimney is depending on the wind direction and is tolerant to wind speed.
- II. The air turbulent may due to one or more of the combinations of the following factors:
 1. The surrounded high trees.



2. The position of the house on a hill.

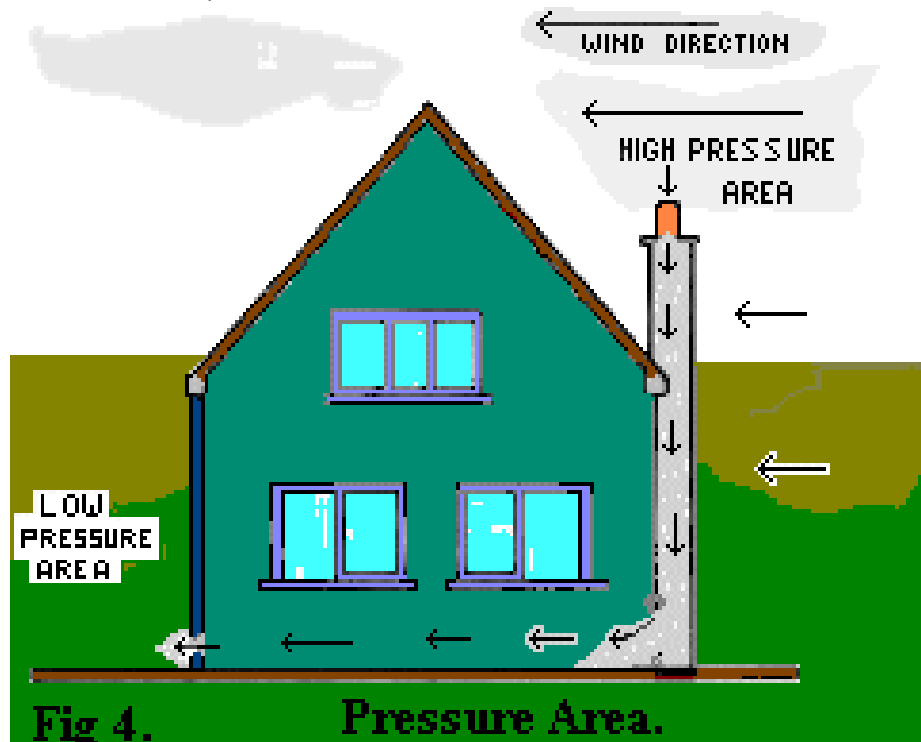
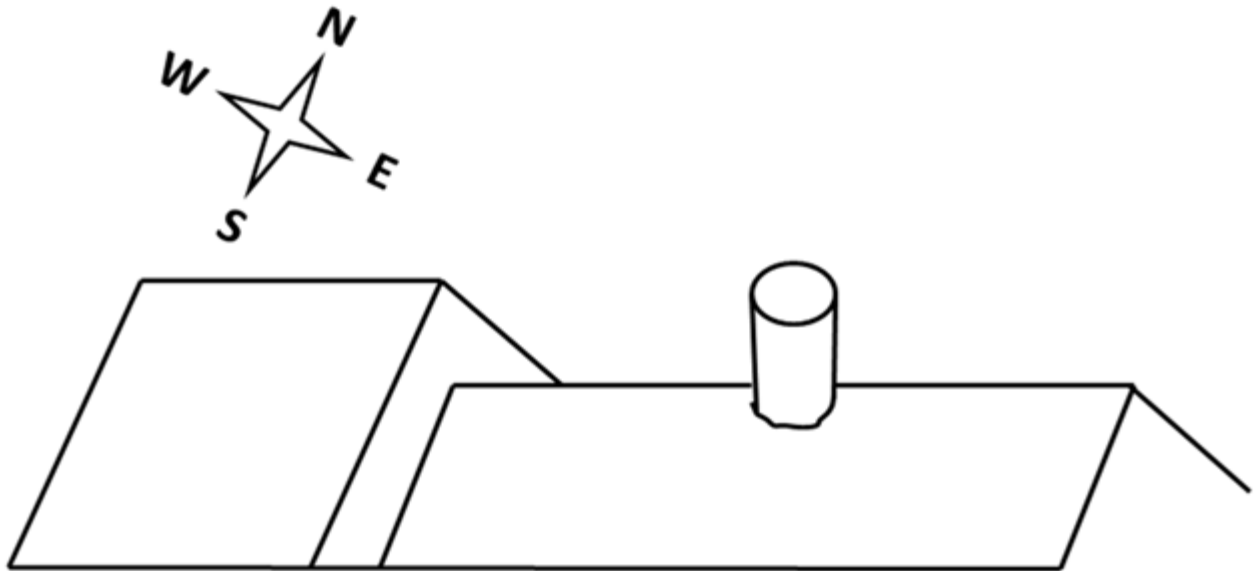


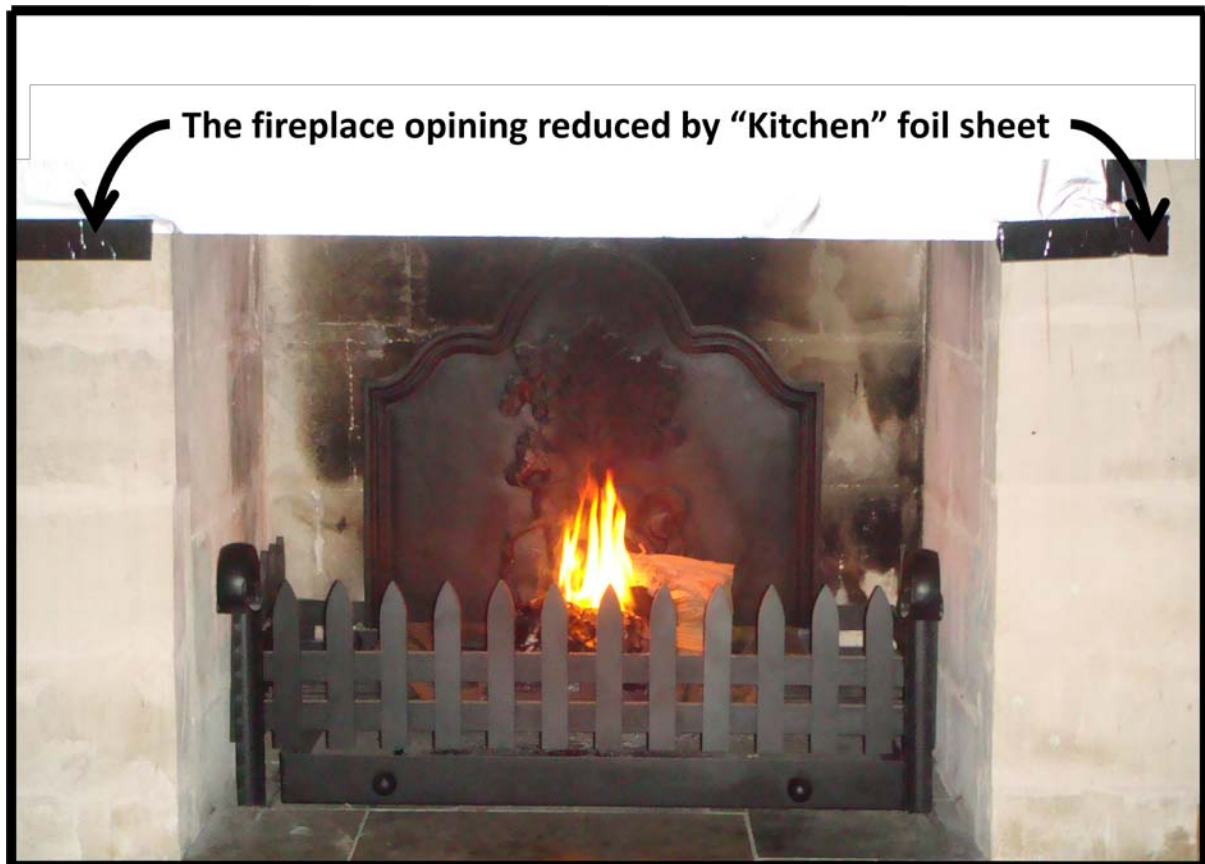
Fig 4. Pressure Area.

3. The house roof has two levels structures, the chimney positioned at the lower level; please see the diagram below. It is likely that the two roofs structure with unfavourable wind direction is the dominant factor.

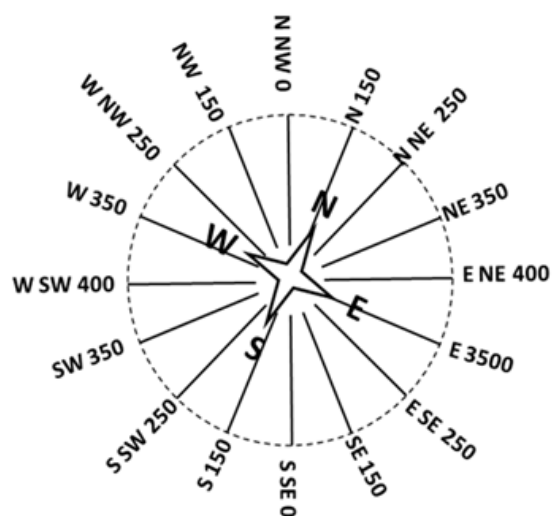


- III. The fireplace Opening: As a rule of the thumb, the fireplace opening should be less than eight times of the cross sectional area of the flue:
- The 30cm flue has cross sectional area of 707 square cm. Therefore, the maximum allowable cross sectional area of the opening is 5,656 square cm.
 - The existing opening area is 10,000 square cm, which is about twice of the maximum allowable opening.
 - A canopy/smoke panel of 100cm width and 55cm depth, (with area opening of 5,500 square cm) may result in more acceptable ratio.
- VI. Negative pressure from inside to outside the house, this is highly improbable since the chimney work reasonably well at favourable weather conditions.

The “Kitchen Foil” experiment: A kitchen foil sheet is taped into the top of the fireplace front beam to stop the smoke get into the room.



The findings of this experiment are identical to that off the “bed sheet”. The results of the “kitchen foil” experiment can be illustrated in the following polar diagram, which show the wind direction and the length of foil sheet to stop the smoke coming outward into the room. Note the worse direct is alongside the roof ridge.



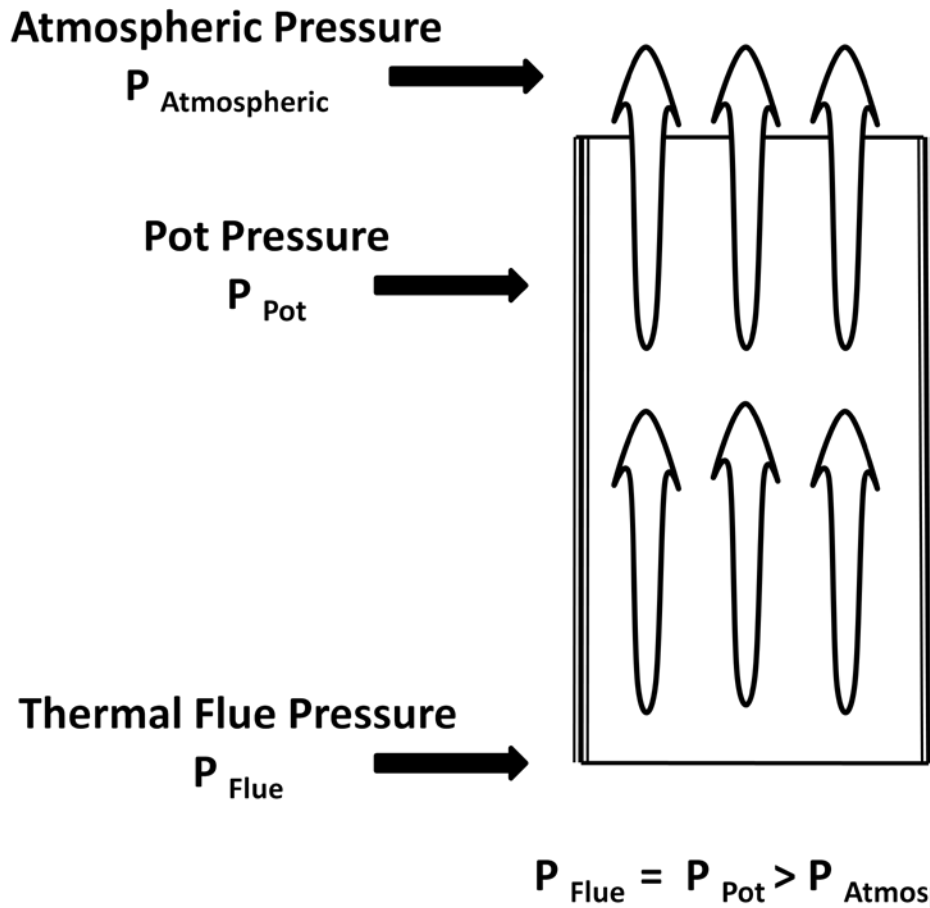
A possible explanation to these finding that, the wind eddy current generated by the two roof structure of the building and by the local topography (the hill and the trees) creates a zone of negative pressure at the outlet of the chimney pot. The magnitude of this negative pressure is again directional and is directly proportional to the “kitchen foil” length needed to stop the smoke get into the room. In some cases the negative pressure is sufficiently high, minimizing the chimney thermal uplift pressure and hence, allows draft to get into the flue, suffocating the fire from air and resulting in smoke getting into the room. The process is additive, as the fire go down the thermal uplift reduces and more and more the smoke will flow into the room.

Remarks:

- I. The wind speed and direction are taken from Bracknell forecast weather station, which is 10 to 15 Miles away from the house; also, the direction of the wind may change during the time of taken measurements. Results is therefore, should not be considered as accurate measurements, however, it is a good general observation of the behaviour of the smoke.
- II. A great difficulty is experienced during the process of determining the minimum length of the foil needed to stop the smoke. The length should again not to be considered as accurate measurement but should be taken as good indictors of the smoke movements.
- III. The polar diagram used to illustrate the results of the experiment may give a force impression of uniform picture of the behaviour of the smoke. Once again these results should present a good general observation than definite measurements.

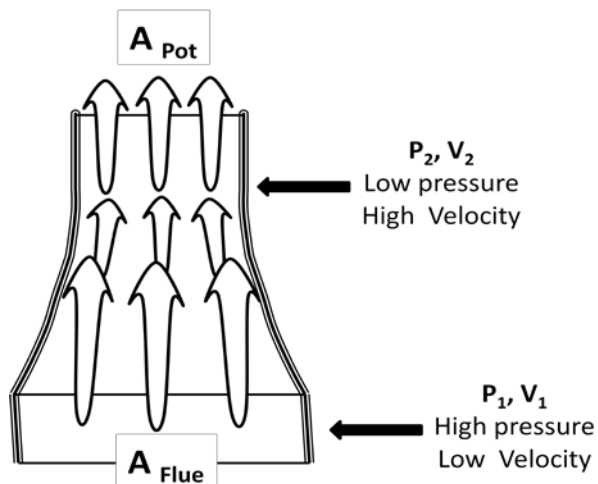
The “Venturi” effects:

- 1) Consider a flue and a pot of the same dimensions:



The chimney will operate normally if and only if the thermal flue pressure is just greater than the atmospheric pressure.

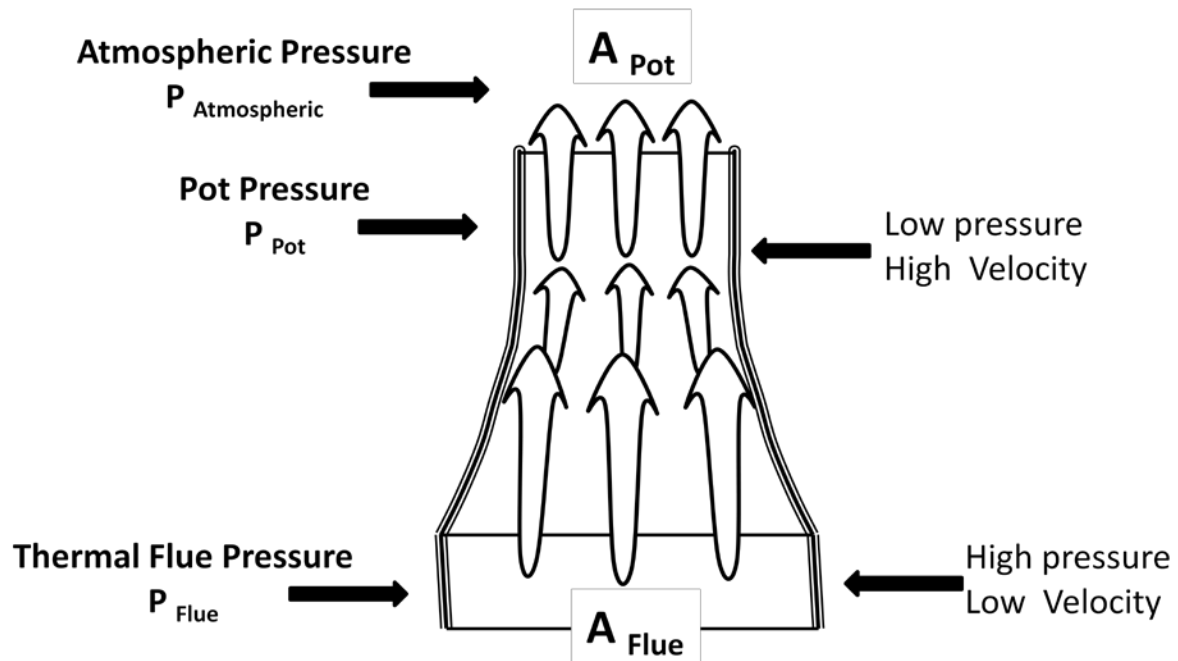
- 2) Consider a flue terminated by a pot of cross sectional area A_{Pot} and the flue with larger cross sectional area A_{Flue} :



The theoretical pressure drop ($p_1 - p_2$) at the constriction would be given by:

$$\frac{\rho}{2}(v_2^2 - v_1^2)$$

Where ρ is the **density** of the fluid, v_1 is the (slower) fluid velocity where the pipe is wider, v_2 is the (faster) fluid velocity where the pipe is narrower (as seen in the figure).



$$P_{\text{Pot}} > P_{\text{Atmospheric}}$$

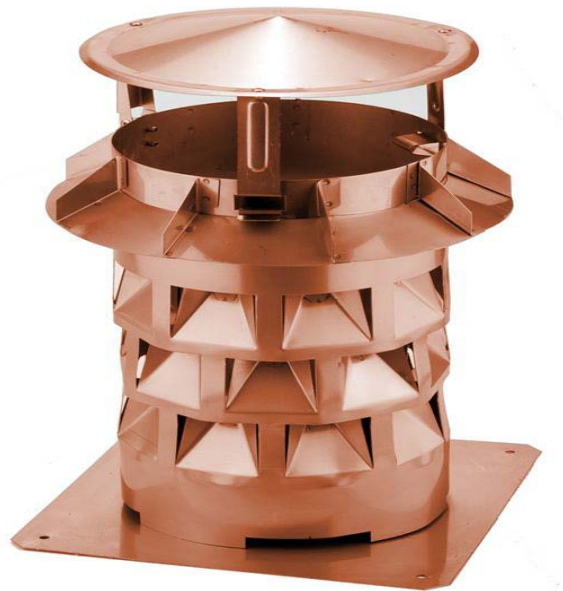
$$P_{\text{Flue}} > P_{\text{Atmospheric}} \sqrt{(A_{\text{Flue}}/A_{\text{Pot}})}$$

$$P_{\text{Flue}} > 1.25 P_{\text{Atmospheric}}$$

The chimney will operate normally if and only if the thermal flue pressure is just greater than **1.25** of the atmospheric pressure. The factor **1.25** is the root square of the ratio of the existing flue to that of the existing pot cross sectional areas.

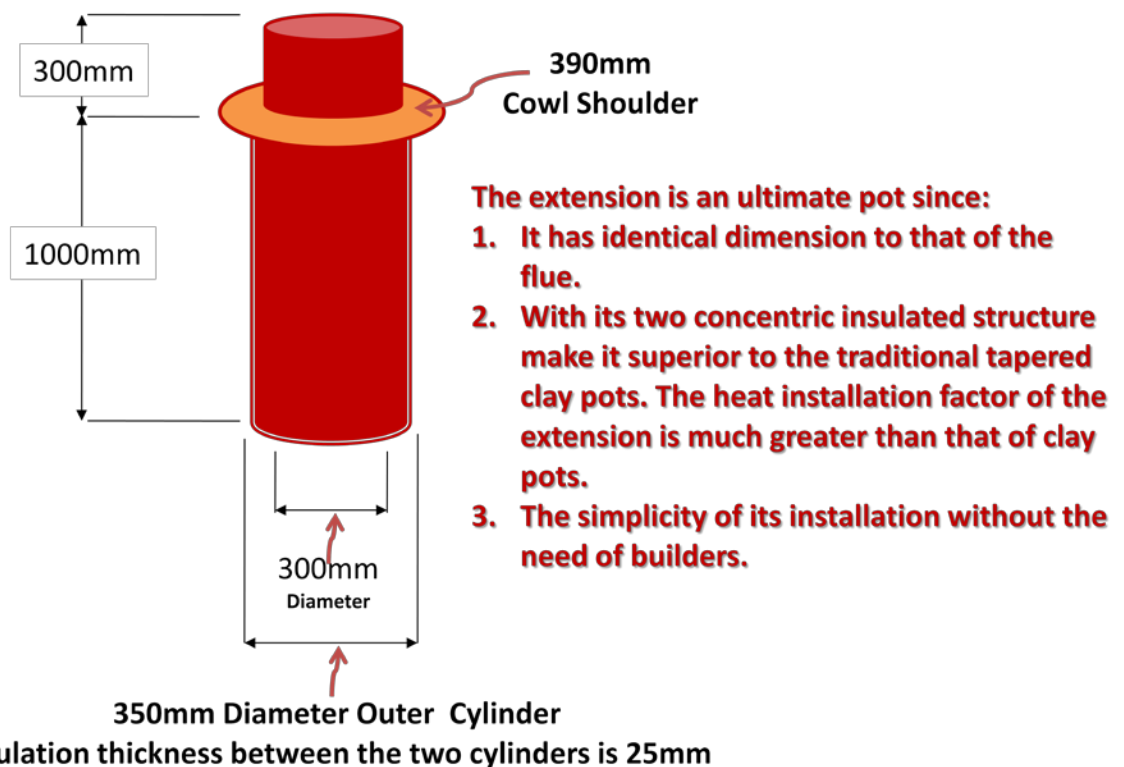
Solutions:

- 1) Fit a static anti-downdraught cowl on the top of the extended pot, such as Windkat Cowl.



- 2) Extending the height of the chimney outlet to the atmosphere by at least 50cm above the highest point of the roof structure, such as 1000mm Windkat extension.

The Ultimate Chimney Pot Two Insulated Concentric Stainless Steel Cylinders



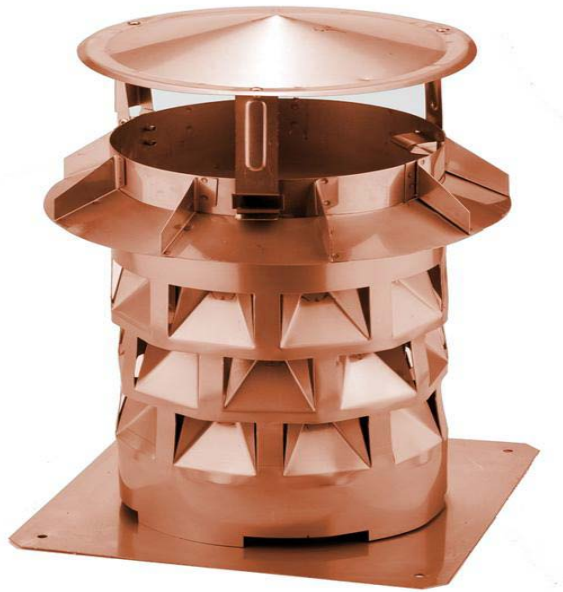
Both one and two may be fulfilled by replacing the square pot by 300mm Windkat cowl with 1000mm pot extension. This will increase the height of the chimney by approximately 20%. Both the flue and pot will be of the same dimensions, smoothing the flow of the smoke and maximising the effective flue cross sectional area. The cowl will prevent the downdraughts due incident wind from surrounding trees, hill side, and the roofs structure. Furthermore, Windkat cowl is the only downdraught cowl, available in the market, capable of maintaining constant uplift pressure relatively independent of wind speed and direction.

3) Halfling the fireplace opening.

This may be achieved by adding an appropriate size smoke panel/guard. A specially designed smoke panel is proposed. The smoke panel manufactured by AMES SMELLIE LTD.

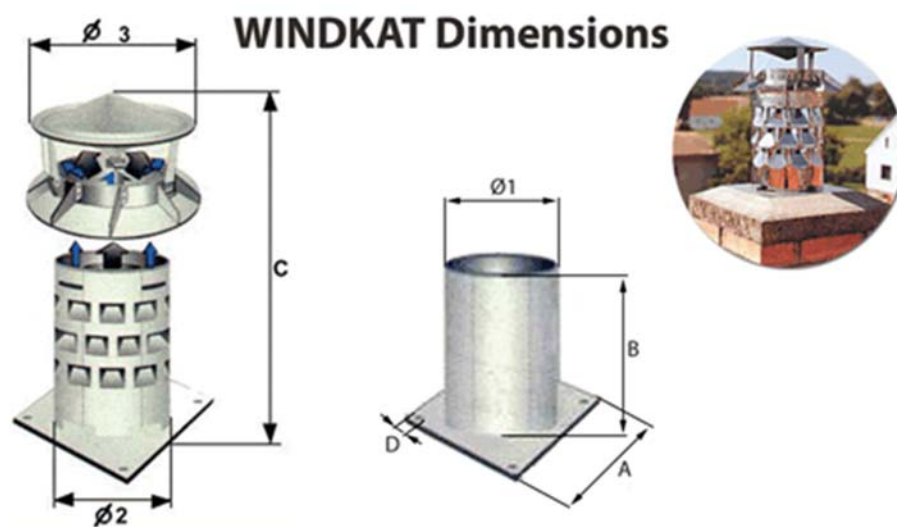
The following is complete description of the Windkat cowl, pot and the smoke panel.

Windkat Base Plate (<http://www.windkatcowls.co.uk/>)



The base plate configuration allows the Windkat anti draught chimney cowl to be easily fitted onto the flat top the chimney stacks after the removal of the existing square pot.

The square base plate may be fastened to the chimney stack with four screws and the cowl simply slots on top **No concrete is needed!**



WINDKAT	A	B	C	D	Ø1	Ø2	Ø3
130	280	240	420	20	130	180	260
150	280	240	420	20	150	205	280
180	350	300	510	20	180	230	360
200	350	300	510	20	200	250	380
250	350	300	510	20	250	300	420
300	500	300	510	30	300	360	480

Windkat 300 is selected with a pot extension of 1000mm; the flue and pot will be of 300mm diameter and a total height of 1510mm.

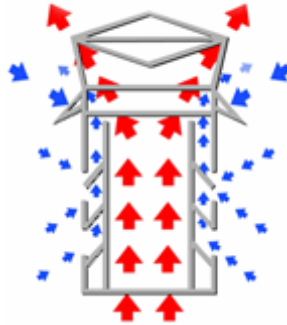
Installation Instructions of Windkat Base plate:

Included in delivery: Windkat 300 base plate, 4 x 6mm wall plugs, 4 screws, and heat resistant sealant

1. Remove the Windkat from the base plate.
2. Place the base plate on the chimney and position it according to the chimney's dimensions.
3. Mark mounting holes on the chimney.
4. Remove the base plate from the chimney and drill the 6mm mounting holes.
5. Insert the wall plugs into the mounting holes
6. Use heat resistant sealant to seal the space between base plate and chimney stack.
7. Secure the base plate with screws into the drilled mounting holes.
8. Place the Windkat back onto the base plate. The Windkat will fasten automatically due to the nozzles. No extra fasteners are required.

How Windkat Works: (<http://www.windkatcowls.co.uk/how-windkat-works.html>)

Windkat uses a system of injection nozzles to maintain constant negative pressure in any flue to which it is fitted and is the most effective anti-downdraught cowl on the market.



The purpose of a flue is to draw exhaust gases, from combustion in fireplaces or stoves, up the chimney and safely out into the atmosphere. There are however certain factors including local topography (hills or trees), building design (low chimneys) and most commonly weather conditions (strong winds or thermal inversions) that can act like a 'cap' on the critical zone where the chimney meets the atmosphere. This creates overpressure and stops exhaust gases from rising and therefore exiting the building.

These factors can lead to the unfortunate scenario of a fire that is difficult to light and/or burns irregularly. But BEWARE, as a poorly functioning flue can also lead to highly toxic exhaust gases backing-up, coming back down the flue (downdraught) and entering your room which can be extremely dangerous and even life threatening.

As well as having your chimney checked regularly by a qualified sweep, the Windkat is the best solution on the market today for avoiding these downdraught problems. But there's even more! Not only does the Windkat stop downdraught, but its unique ability to maintain a steady even draw in virtually all weather conditions leads to greatly increased efficiency in combustion. This means that wood and other fuels are burned at their optimum rate meaning more complete combustion which in turn leads to pollution reduction and financial savings.

Advantages at a glance:

It provides a constant even negative pressure reducing downdraughts and increasing combustion efficiency.

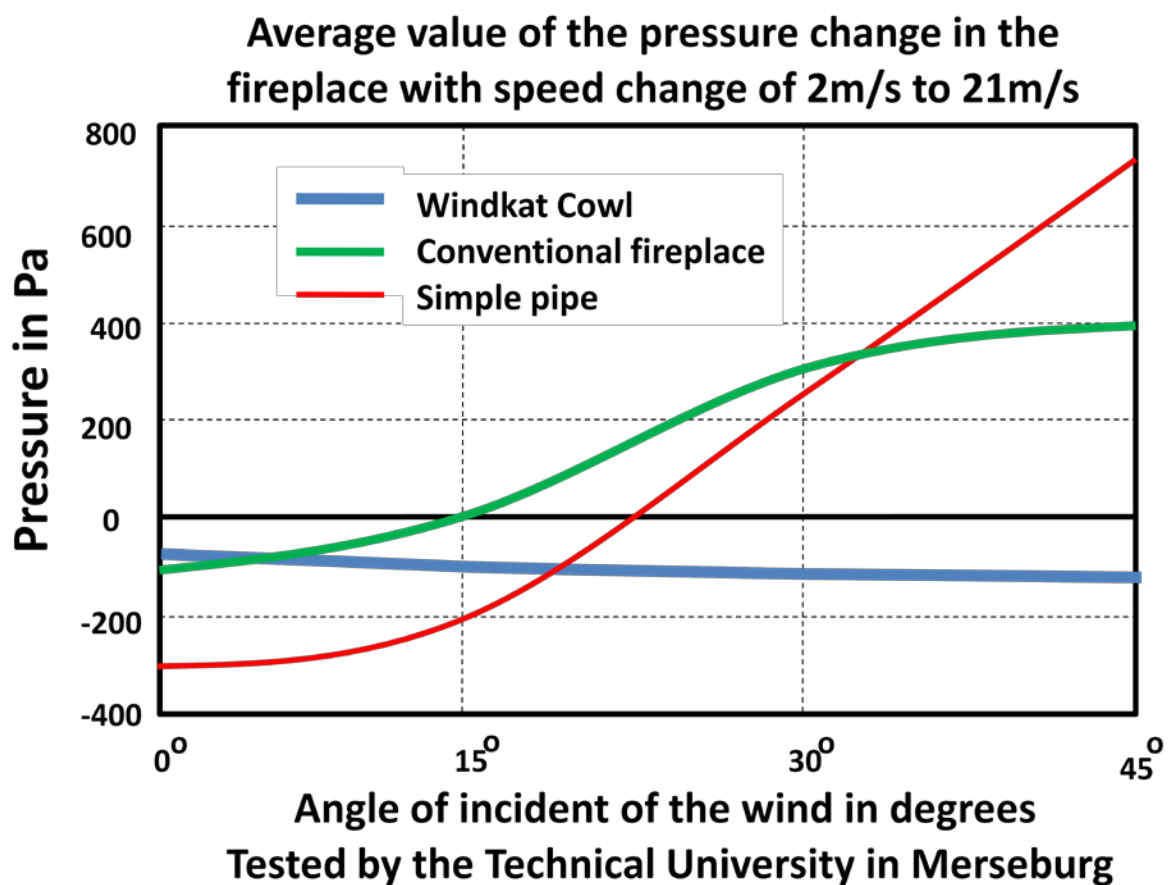
Fits directly and very securely onto the flat top of your chimney stack (base plate configuration) and replaces any existing chimney pot. The Plug-in configuration allows installation directly into single or double walled flue pipes.

Unlike a rotating cowl the Windkat has no moving parts to wear out, won't develop an irritating noise, is effective even in still conditions, won't stop working, and maintains a constant even draw. The Windkat is also far more effective than most other static anti-downdraught cowls.

The hinged top allows for easy cleaning access.

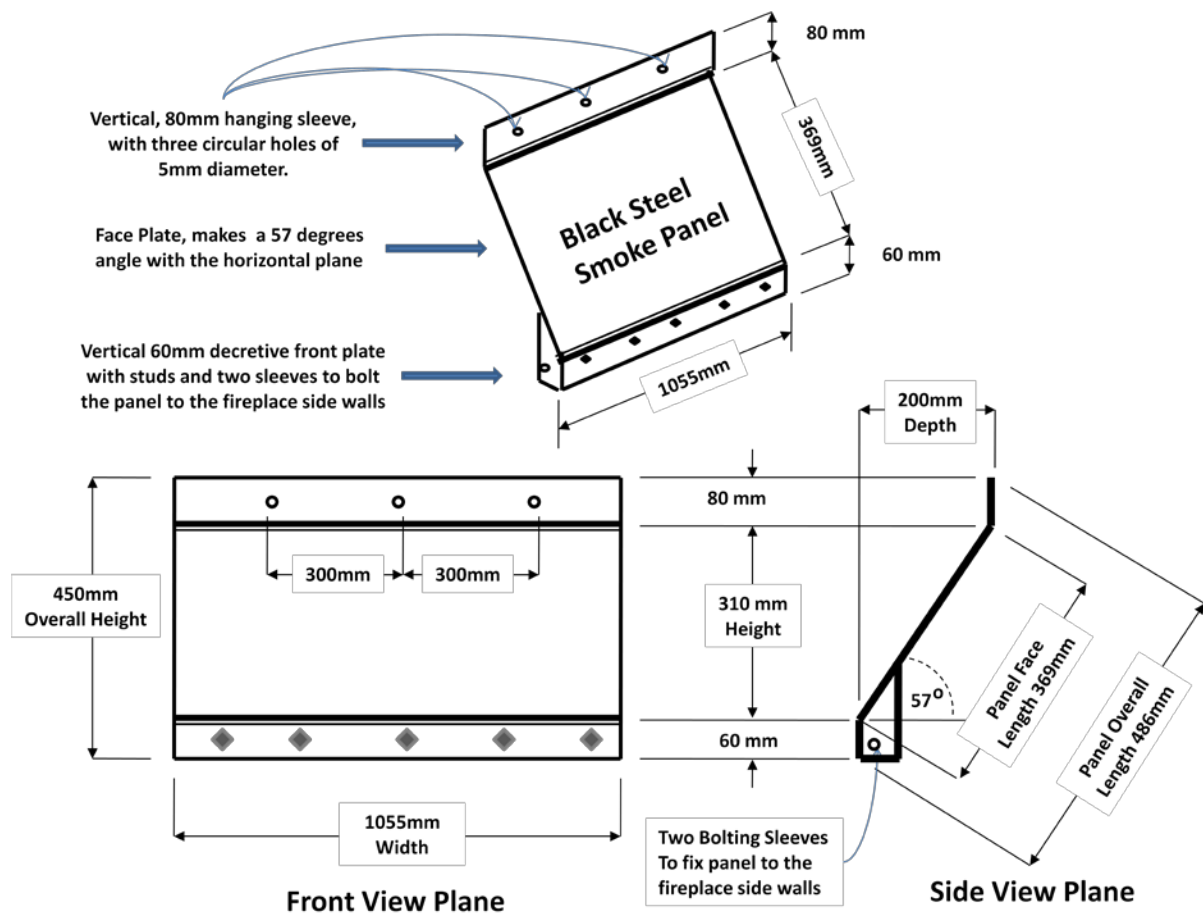
Obstructions including roof ridge higher than chimney

The Windkat is the only cowl to reliably solve draw and downdraught problem in fires with flues that terminate well below the height of the roof ridge. There is however certain situations where local wind conditions coupled with extreme air currents caused by the roof (or other obstructions especially if they are above the height of the chimney) mean the Windkat must be lifted out of the particular problem zone in order to function properly. The addition of the 0.5m meter Windkat extension does this effectively and reliably in the vast majority of cases. The extension does not need to raise the Windkat above the ridge of the roof; its purpose is simply to give the Windkat some distance from the roof which alleviates the sometimes extreme pressure differences that can exist with very close proximity to roofs.

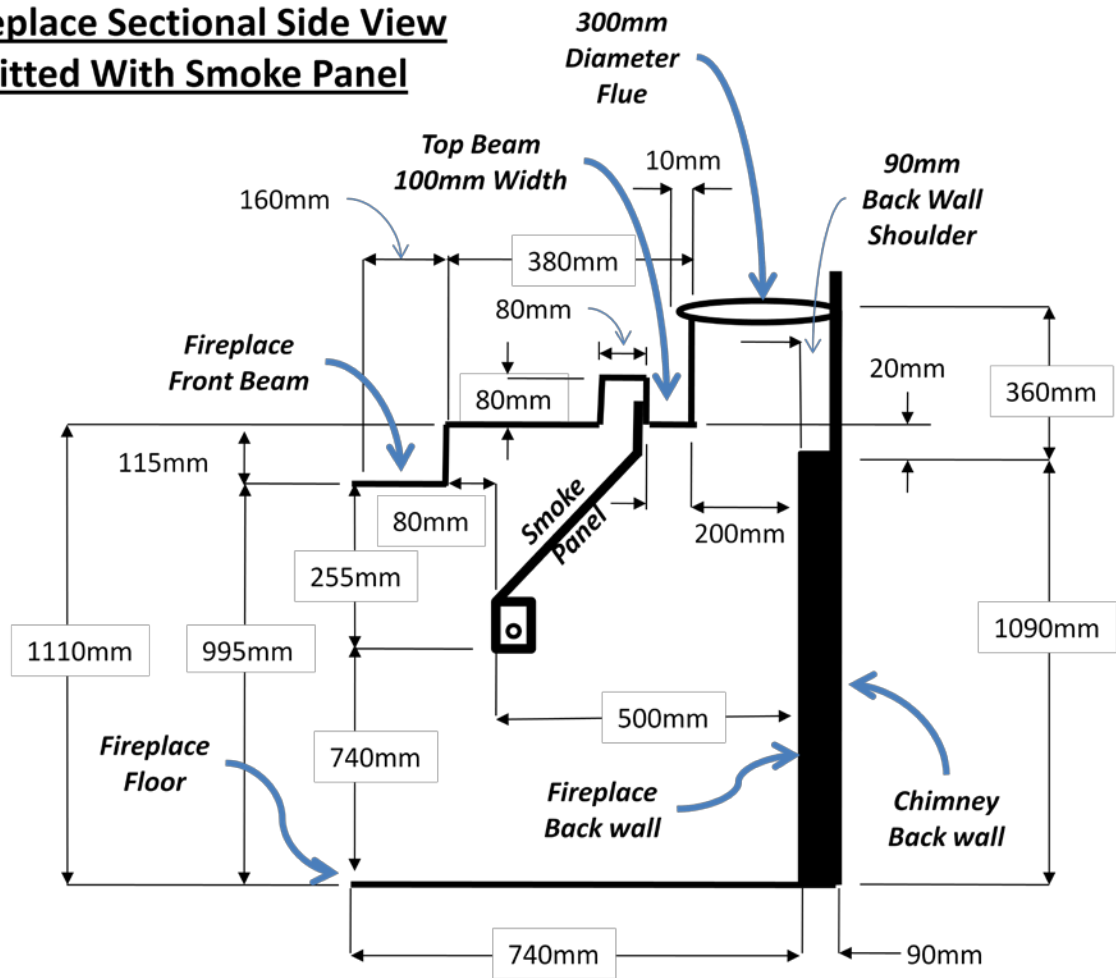


Windkat cowl provides constant even negative pressure which stop downdraught and increase combustion efficiency. Pots without cowl pressure may increase to 400Pa.

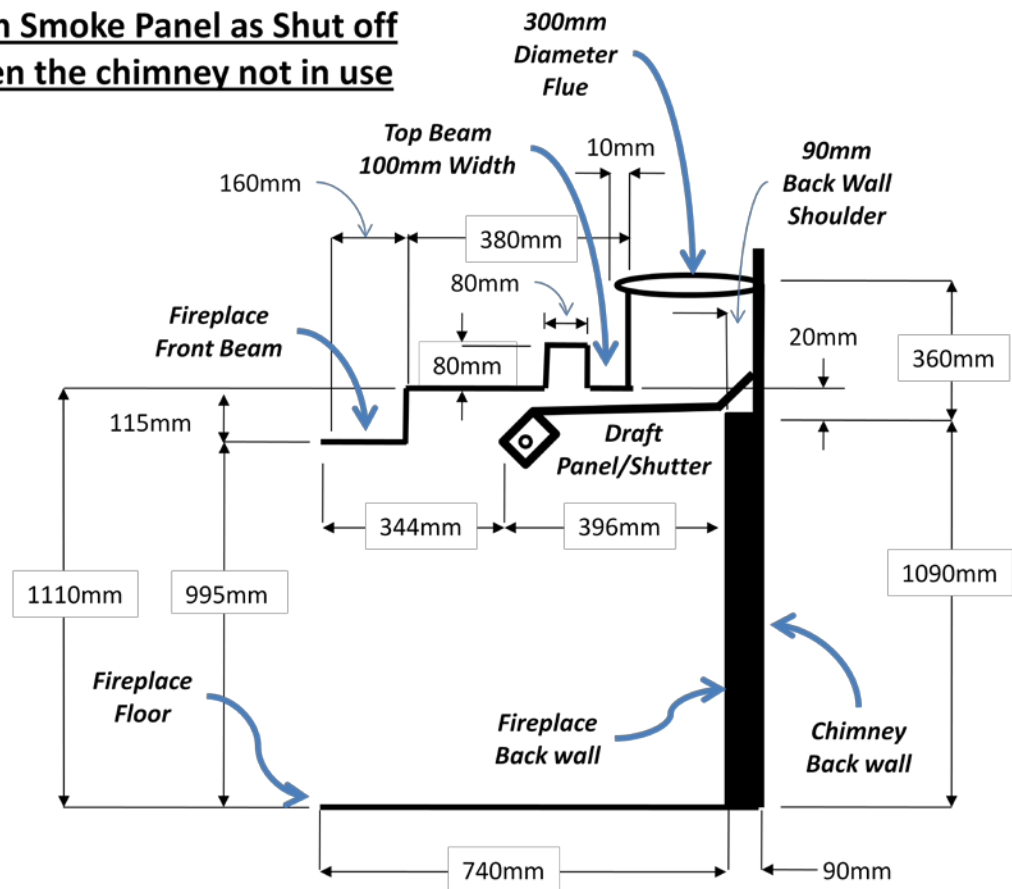
The Smoke Panel



Fireplace Sectional Side View Fitted With Smoke Panel



Fireplace Sectional Side View
Fitted With Smoke Panel as Shut off
Valve, when the chimney not in use



The New Fireplace Opining:

Let R equal to the ratio of the fireplace opining to that flue cross sectional area.

Optimum value of R is given as: **6.7** (15% rule: <http://www.stovesonline.co.uk/fireplace-opening-size.html>), **8** (suggested by: <http://www.firesnflames.co.uk/help-and-information/Help-and-Information/Fireplace-design-and-construction/Fireplace-opening-and-chimney-sizes/menu-id-27.html>), **9** (suggested by chimney builders association, furthermore they suggest that a ratio of **10** is appropriate for a straight vertical flue with new smooth lining; also they refer to the "TARDES" scenario (http://www.chimneysweepcambridge.co.uk/page/fireplace_dimensions)).

Existing fireplace opening and flue:

30cm diameter flue cross sectional area is **707** square cm. opining of **100cm** width & **100cm** height cross sectional area is: **10,000** square cm. $R = 14$

Fire place fitted with the designed smoke panel of **100cm** width, **50cm** depth and **74** cm height:

Cross sectional area is equal to smoke panel (Width X Depth): **5,000** square cm. $R = 7$

Worse case scenarios:

1. Cross sectional area is equal to smoke panel (Width X Height), **7,400** square cm. $R = 10.4$

2. Cross sectional area is equal to smoke panel {Width X (Height - Ash tray height of **7mm**)}, **6,700** square cm. $R = 9.47$

3. The "TARDIS" affect it may be true, only if the fireplace has no side walls, give the cross sectional area as {Width X (Depth + Height)} which result in **R of 17.5**; the man who suggest this is clearly Dr. Who fan, No clear explanation to this effect is given, it is highly improbable scenario.

4. The "TARDIS" effect may be applicable only, to fireplace with no walls, relatively in open space, the cross sectional area according to the "TARDIS" is {(twice the width X (Depth + Height))} which result in **R of 35**.

Acknowledgement:

Thanks are due to Malcolm of Argyle Canopies (<http://www.argylecanopies.com/smoking.html>) for suggesting the two experiments and for his time, and continuous advice and support.

-----End-----

Final Version 21th November, 2010.