



**DO YOU HAVE PROBLEMS
WITH THE CHIMNEY?**



The modern appliance for solid fuel like every other item of household equipment work satisfactorily, when they are properly selected and correctly connected. Then it is little probable any sort of problems to appear. There are occasions when the problem of the smoky fire presents itself.

Smoke problems and bad draught are caused by poor design and construction of the chimney – insufficient dimensions and an unfavorable site conditions.

The purpose of this brochure is to describe the possible causes and to explain what can be done for their removal. It is possible for the brochure describing mistakes and improvements to create a wrong impression for the degree of severity of the problems described in it. In order to be comprehensive in reasonable limits, however, it is desirable to cover the cases which rarely happen as well as the simple ones.

HOW DOES THE CHIMNEY WORK?

The chimneys aren't too complex but most of the people really don't understand the way of their function. The knowledge of the flue makes it possible to obtain a good and safe fire and to avoid the problems connected with the chimneys.

Each kind of chimney has its advantages and restrictions. Chimneys constructed of bricks are traditionally more beautiful, which many owners wish. Chimneys made of metal tubes are easier to fix and usually are at a lower price.

To determine the best chimney for you requires a complete picture of the appliances maintained by the chimney (stoves, fireplaces, boilers etc.) and the necessary ventilation section, which requires each one of them.

If you intend to build a new chimney, first study what passage section the appliance, which you use, needs. If you install a new appliance (or used one in another place) to an existing chimney, do the same. Don't accept in principle that your chimney is suitable. Check it out.

The chimney is a vertical tube intended to draw the products of combustion from the heating appliance out and to emit them in the atmosphere outside the limits of the abode.

There are one or more vertical passages located inside the chimney called flues. Each appliance connected to the chimney requires its own flue. The chimneys made of brick can have some flues. The metal chimneys, of course have only one in its inside pipe.

The upward draught or "pull" in a chimney is a result of the combination between its height and the difference in temperature between the flue gases and the air outside. It is very simple – the column of hot flue gases in the chimney has smaller weight than an equivalent column of cold air outside, so that the pressure in the lowest part of the warm chimney is less than the air pressure outside. This quite

small difference in pressure creates the draught. The warmer and taller is a chimney the better the draught and the less risk of condensation.

The hollows and the narrows, the rough surfaces and the sharp bends are resistances to the flow of the gases and reduce the draught, so that as far as possible they must be eliminated.

Air leakage leads to cooling the flue gases and consequently reducing the draught.

In certain circumstances it may be desirable to reduce the excessive draught by introducing "dilution" air, but this should only be done in a controlled way, not by allowing accidental leakage.

Wind at the top of the chimney may have positive or negative effect on draught, depending on the surroundings and the position of the chimney top in relation to the roof.

The bad draught may also arise with a too weak combustion process as a result of the low temperature of the flue gases.

DIAGNOSTIC PROBLEMS

When the smoke escapes into the room, the most probable reasons are:

- A. Insufficient draught to carry away all the smoke;
- B. There is no upward draught at all;
- C. The chimney terminates in high pressure zone;
- D. Down-draught.

The smokiness can be a consequence of variety of causes, several of which could operate together, therefore it is not always simple matter to diagnose the cause of the problem, nor there is an universal means of its determination, and therefore each case has to be treated depending on the concrete symptoms.

In order to be able to cure smokiness, first of all it must be known why it occurs, and since there are a great number of possible reasons, not all of which are evident, it is expedient a sequence of operations to be done in a consecutive order.

The first step is to read through this brochure, because sometimes the problem can be recognised immediately from a description of it and removed without any need for a lengthy investigation. If, however, the cause of the problem isn't evident, the next step is to check the symptoms, the most common of which are:

SYMPTOM A

A part of the smoke and the fumes but not all, escape into the room without any sign of being blown back by the wind. Smokiness is constant irrespective of the climatic conditions, although the wind may have some effect in either worsening or improving matters. This usually means insufficient draught.

SYMPTOM B

There is no up-draught at all, irrespective of whether wind blows outside or not.

SYMPTOM C

Intermittent blowing back through the chimney with the wind from a definite direction. The degree of smokiness varies with wind strength.

SYMPTOM D

The draught decreases or reverses with wind from a definite direction. The draught returns when the wind ceases or changes its direction.

Finally, when one or some simple tests have been carried out, their results will usually indicate the cause of the smokiness. It is not unusual for two or maybe three different tests to give positive results – this means that there are several causes, operating together. For example, the case with the back draught can be combined with air starvation, or a bad construction of the chimney – with a partially blocked flue.

To cope more quickly with the possible causes of smokiness the methods of testing and offered remedies are indicated as A.1, A.2, B.1, C1 etc. in connection with the symptoms described above.

A.1 “AIR STARVATION”

All appliances for solid fuel need an air flow into the room, as some of them, for example those for open fire need more air. An additional air flow can pass through special openings in the appliance over the flame. For a closed appliance 15-30 cu. m per hour are necessary, whereas with a fireplace with open fire this value can reach 250 cu. m. and even more per hour.

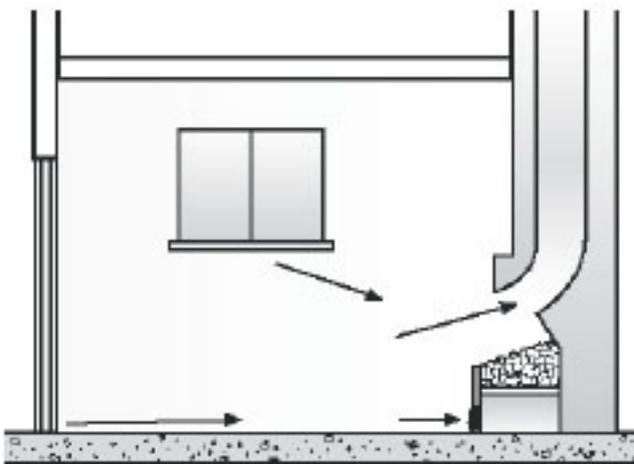


Figure 1

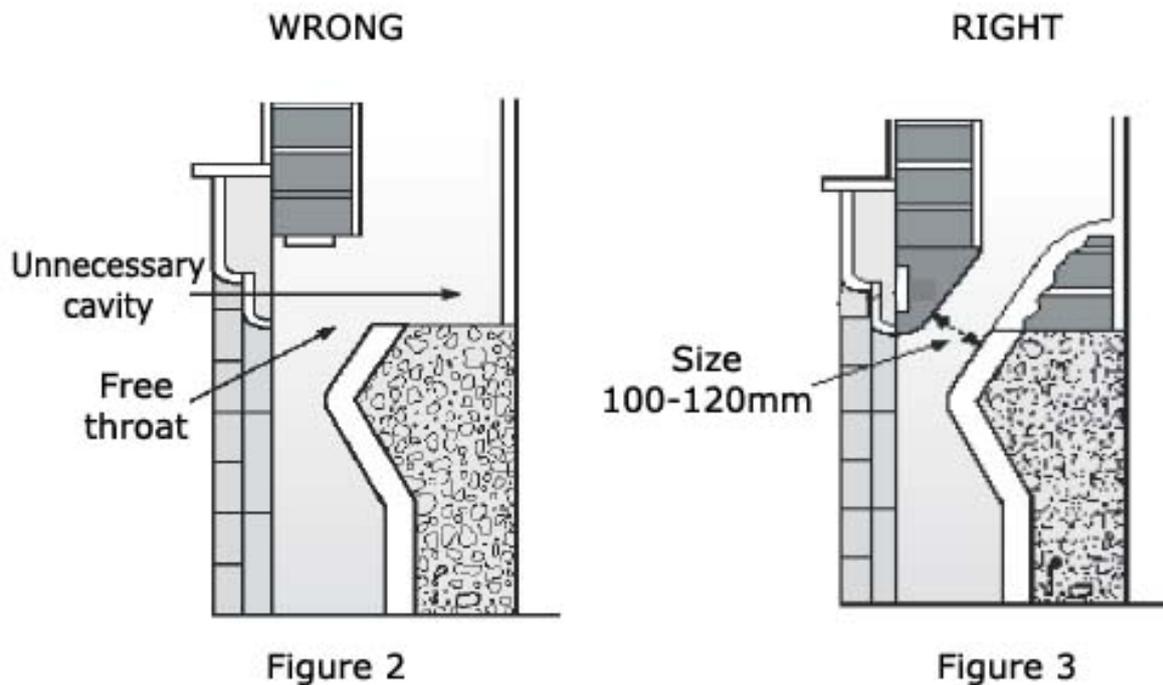
Using solid fuel in a room insulated very well (fig. 1) leads to two results:

1. If the oxygen is insufficient, the result is incomplete combustion. With a complete combustion the products are carbon dioxide and water vapour. However the shortage of oxygen will lead to formation of carbon oxide CO, which is very poisonous gas without smell.
2. There is not sufficient air available to substitute the air, which

together with the highly poisonous carbon oxide.

TEST: Open a door or a window, preferably when there is no wind outside. If the smoking into the room ceases, the cause of it is usually “air starvation”.

REMEDY: It is necessary to allow more air into the room but sometimes this can lead to an unpleasant draughts. The first step is to see whether it is possible to reduce the volume of the air flowing to the chimney, so that the “demand” for air is less. An inspection of the throat over the fire may reveal a large throat without any sign of natural draught and even larger voids at the sides - see Fig.2.



The void should be filled in and the throat – reduced, so that there is a smooth streamlined entry into the chimney flue, as it is shown in Fig.3. If the throat opening can be made adjustable for size, it will be better, with a minimum amount of opening when the chimney is hot and a maximum opening for relighting when the chimney is cold.

The heating appliance must not enter into competition with other appliances, which throw air away from the house such as aspirations etc. Their action can lead to a shortage of air and smokiness.

A.2. FIREPLACE OPENING TOO LARGE

The flow of gases through the chimney flue is limited by its size and the constructional details of that flue. When the fireplace opening is too large, this flow increases and it needs a bigger draught, so that it is drawn up. At the same time the gases are cooled by the entering fresh air, the draught decreases and the smoke eddies into the room.

TEST: What can be done is the section of the chimney to be compared with the size of the door. If the section of the open door is more than 8 times than the section of the flue, there is a likelihood of smokiness. With a short chimney flue (for example on the top floor flat) this ratio must be reduced to 6:1.

REMEDY: Increase the size of the chimney, where is possible, although it is difficult and expensive.

A.3. "SIPHONAGE EFFECT"

This trouble occurs if the inside barrier between two neighbouring flues is destroyed (there is a break in it.) and one flue isn't used at the moment. On insufficient ventilation in the room with the heating appliance the smoke is sucked downwards through the unused flue. (Fig. 4).



Figure 4

TEST: Open a door or a window and watch the smoky fire. Check the entirety of the flues through an inspection or a smoke test.

REMEDY: Remove the break between both flues. Improve the ventilation in the room, where the appliance is working, so that the pressure increases.

A.4. "HOUSE – CHIMNEY"

The movement of the air in the building must not impede the work of the chimney. For example, when a house has an open window on the floor above (Fig. 5), the warm air goes out through the open window and the whole house begins to work like a big chimney. An air flow starts from below upwards in order to substitute the air gone out through the window, reducing the pressure of the floor below, where the heating appliance is. If the effect is strong enough, it will overcome the draught of the chimney and will pull the gases downwards back in the house. The badly insulated roof and ceiling, the staircases leading to them can cause the same phenomenon.

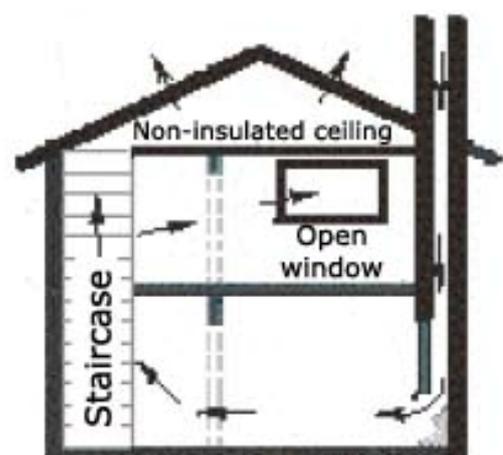


Figure 5

REMEDY: The insulation on the floors above shall be improved and it shall be

ensured an outside access of air to the heating appliance on a level as low as possible.

A.5 HORIZONTAL PASSAGES

Usually flues are vertical but sometimes horizontal displacements are necessary. Sometimes these sections are low, with sharp curves and a big length – the result is a poor draught and a smoky fire.

TEST: An inspection of the configuration of the flues is done, as, if it is necessary it is thrust with a flexible rod.

REMEDY: The main features of a good passage are indicated on Fig. 6.

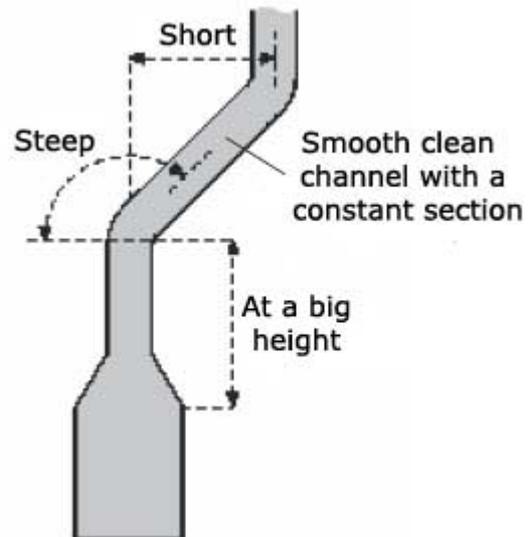


Figure 6

A.6. PARTIAL BLOCKAGE OF THE FLUE

It may be due to a bad workmanship or there is a foreign substance or soot accumulation. A banal example is shown on Fig. 7, where the mortar fallen during the construction and has caused a partial blockage.

TEST: The sweep's brush often reveals the availability of such obstructions and sometimes it leads to their removals. Another method of checking for obstructions is to lower a metal ball on the end of a rope down the flue, which shall have a clearance not more than 25 mm next to the walls. Through ticks on the rope, when the ball gets stopped, will determine the position of the blockage, and sometimes it may be dislodged.

REMEDY: If the blockage cannot be removed by other means, the flue at that point will have to be opened for clearing.

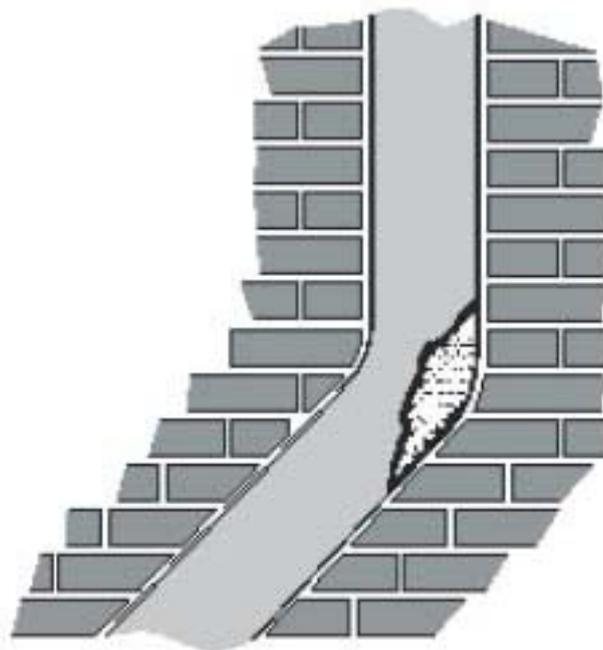


Figure 7

A.7 UNSUITABLE SIZE OF FLUE

The conventional brick chimneys, although not ideal, are generally suitable for all types of domestic heating appliances. The small section leads to increasing resistance and thence – to smoky fire. On the other hand the too big size leads to difficult warming and again to reducing the draught.

TEST: Measure the size of the flue

REMEDY: Use flues with a section suitable for the respective heating appliance.

A.9 BAD FIXING OF FLUES

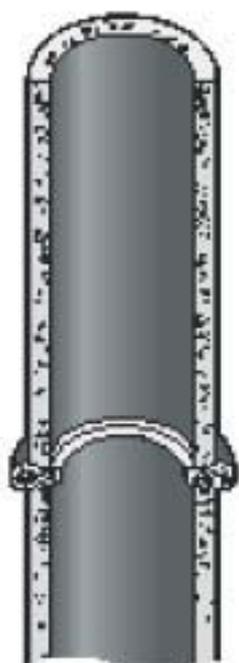


Figure 8

Some flues have plain ends and a butt joint, others are overlapped. A fault often found is a protruding ring with cement which should have been removed during construction – Fig. 8. In other cases the flues have no jointing between the liners and brickwork omitted.

TEST: Scraping in the place of the joints indicates if there is a problem. A smoke test described at the end of the brochure may indicate by visible smoke the extent of leakages.

REMEDY: If the trouble is due to a cement ring, it sometimes can be removed by careful scraping. With overlapping flues in graver cases it may be necessary to break off the brickwork and even to change them.

A.9. UNSUITABLE CHIMNEY POT

In some cases, a round-base chimney pot is fitted to a square flue by placing small pieces of tile across the corners to protect. The four obstructive ledges, added to the other eventual problems, may turn out the “last straw”.

TEST: By inspection

REMEDY: A square-based pot s with parallel sides in its lower part shall be used.

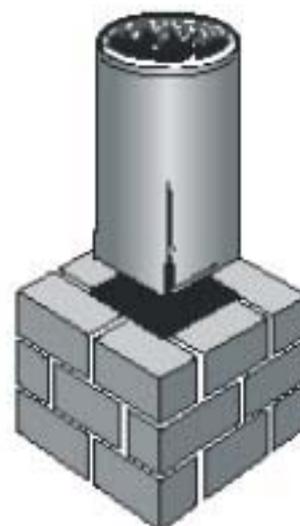


Figure 9

A. 10. PARTIALLY BLOCKED CHIMNEY POT

When smoke flows through a flue, the particles of soot are attracted to cold surfaces inside of the chimney pot, mainly on the top of the chimney, especially if there is a chimney pot as the shown in Fig.9. Usually the soot is removed by the sweep's brush, but if a fuel with high tar content is used, only a hammer and a chisel may be necessary to be used.

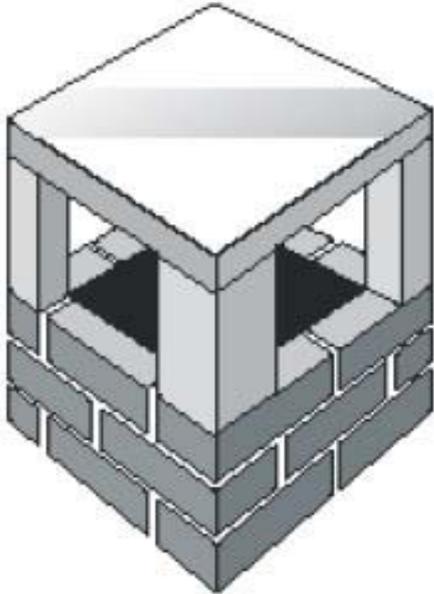


Figure 10

TEST: Cleaning with a sweep's brush reveals if there is such a trouble.

REMEDY: If the trouble is recurrent, change the fuel for a fuel with lower tar content. The variant shown in Fig.10, which is intended for protecting from rain and wind, can also replace the used square or circular termination. The combined area of the four openings should not exceed twice the area of the flue.

A.10. BAFFLING OF FLUE GASES

On fig.11 -14 it is shown how some of the faults, which most often result in poor draught can be fixed. In all the examples the pipe projects too far into the flue so that the free flow of gases is hindered.

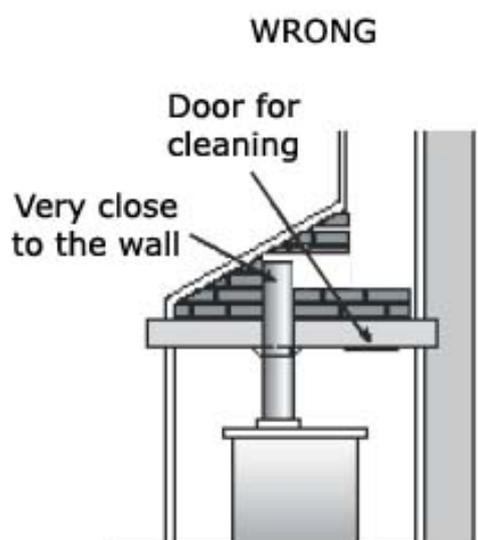


Figure 11

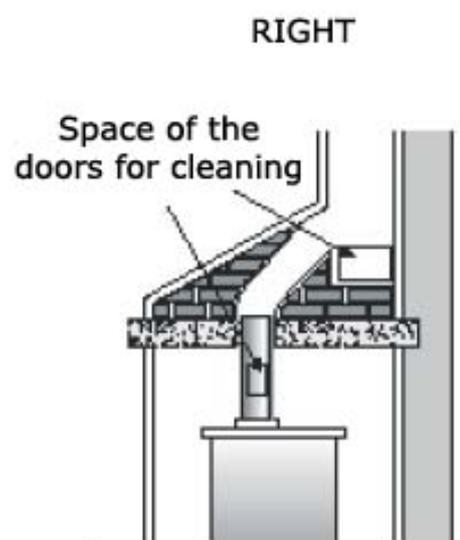


Figure 12

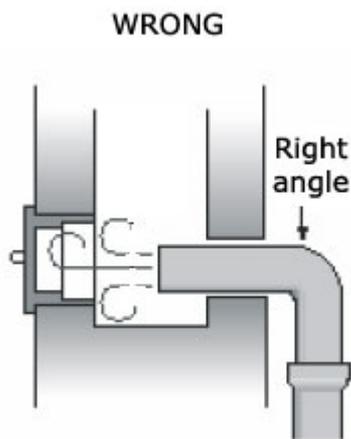


Figure 13

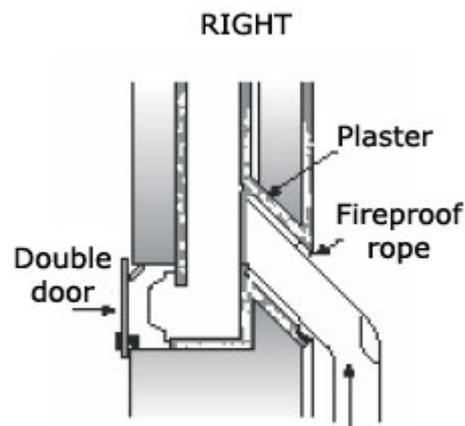


Figure 14

TEST: By inspection

REMEDY: Sharp changes in direction of the flue gases should be avoided. The pipes should be projecting into the brick flue via bends of 135°. The brick flue should be plastered smoothly, and the pipe – caulked with a fireproof rope.

The soot cleaning door must be double to avoid excessive cooling of the gases. It should also be slightly below the entry of the flue pipe so that the hot gases not impinge on it and so a space to be ensured to avoid the blocking of the pipe by the fallen soot.

A.11. AIR LEAKS

The cold air which is leaking into the flue naturally cools the gases and decreases the draught, because of which it is very important that the chimney should be airtight. The most usual points of air leakage are around the register plate where the pipe projects into the brickwork; in the joints around flue pipes and the soot cleaning doors. It is possible to leak air if the plaster of the brick flue are badly filled or have cracked. In the described cases it is possible that potentially dangerous outward leakage of the fumes rise.

TEST: Inspection usually is done with a lighted match or a candle. If the flame is drawn, it is a certain evidence for the leakage. The determination of the leakage through the brick work is done by a “smoke test”, described in the end of the brochure.

REMEDY: All faulty flue pipe joints shall be discovered and repaired. The cement setting compound shall not be liable to crack. Soft gaskets such as heat-resisting ropes or tapes shall be used.

B.1 COMPLETE BLOCAGE

If the flue is not kept properly cleaned, soot deposits in time will completely stop the draught; the same thing can happen when pieces of the chimney pot, slate or bricks etc. fall down the flue.

TEST: Put a sweep's brush through and it will reveal whether there is a blockage.

REMEDY: Try first with a hard rod or a wire. If this doesn't help, lower a metal ball tied with a rope through the top of the chimney. Even if this turns out unsuccessful, it will allow you to find the exact position of the stoppage for opening the flue. Regular cleaning remains the most certain prevention.

B.2 COLD FLUE

An uninsulated chimney cools the gases more rapidly and respectively the draught can't be as good as when it is well insulated. Besides, when the fire has been out, or the flue damper of the heating appliance has been closed for several hours, the draught may be reduced sufficiently to cause smokiness.



Figure 15

Uninsulated metal one-layer pipes should never be used as a chimney outside a house. The severe chilling of the flue gases, particularly when the appliance is burning slowly, not only results in unsightly condensation but also seriously reduces the flue draught so much that dangerous fumes may be emitted from the appliance, because there is no draught to carry them away.

TEST: Insert a lighted piece of newspaper in the flue. After a brief delay, the smoke should be carried up the flue.

REMEDY: Insulation of the flues

C.1 CHIMNEY TOP BEING IN A HIGH-PRESSURE REGION

Fig. 16 shows a chimney lower than a nearby object, in this case the roof and on the windward side. This is a region of high wind-pressure. On the other side (in the lee) underpressure turns out. That means that the air tends to be drawn out of the house on the leeward side and to be blown in on the overpressure side. This can affect the chimney, as a counteraction of the draught, and if the underpressure is high enough, causing a down-draught.

As this condition occurs only with the wind in a certain direction, the situation of the chimney in relation to the roof indicates the cause of trouble. Furthermore, smokiness occurs when there are open doors and windows on the lee side but not on the high-pressure side.

TEST: Open a door or a window on the windward side. This should equalize the pressures and restore the draught.

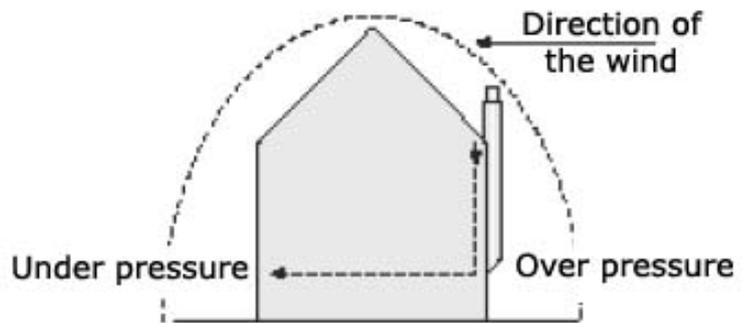


Figure 16

REMEDY: If possible, the chimney should be extended beyond the region of high pressure. In most cases with a height 0,5 – 1 m higher than the ridge of the roof or other object, causing the overpressure, no trouble occurs.

Metal uninsulated pipes should not be used as permanent extensions, because they chill the gases and may cause further troubles.

If the possible extension is insufficient, probably the only alternative is to prevent the air being drawn out of the house towards the lee side. This can only be done by making the doors and the windows airtight on the lee side and if possible closed.

D.1 DOWN DRAUGHT DUE TO ROOM INLETS (DOORS, WINDOWS, VENTILATORS) BEING IN A LOW-PRESSURE REGION.

This trouble occurs mainly with short chimneys. Suction in the room, although normally associated with the condition described in C.1. can cause smokiness regardless of chimney position. Fig. 17 shows a situation, which is difficult to cure.

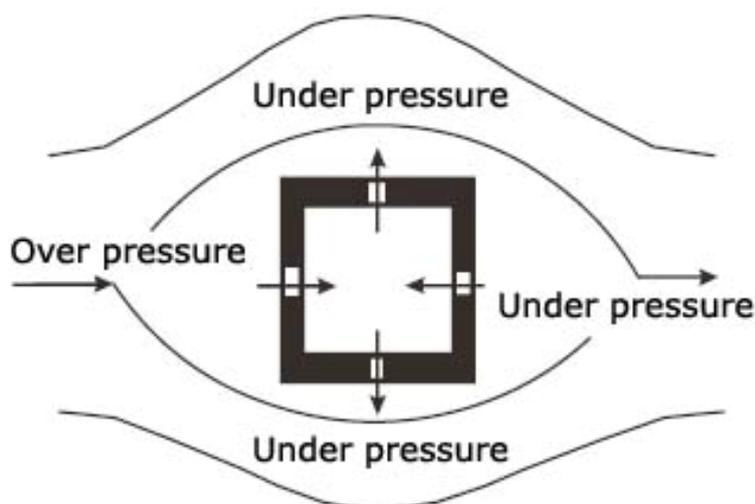


Figure 17

The flow of air around the house creates regions of high and low-pressures, which may cause down-draught if the disposition of doors and windows is such that the underpressure created in the room is low enough.

TEST: Light aromatic sticks and follow with your eyes the movement of the smoke; usually it drifts towards doors and windows, to the other side where the pressure is reduced, thereby indicating from where air is

being drawn out of the room.

REMEDY: Some possibilities can be tried to restore the normal up-draught.

- fitting chimney draught-inducing cowls to increase up-draught, as the indicated ones on Fig. 18;
- restricting the throat over the fire (Fig.3) to increase the temperature in the flue;
- draught-proofing doors and windows, which are adjacent to the low-pressure area.

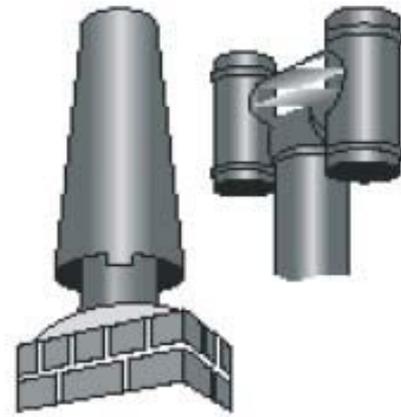


Figure 18

D.2 DOWN DRAUGHT DUE TO WIND CURRENTS

Very often the chimney top is exposed on air turbulence, caused by drawing the wind upwards or to the sides by some adjacent object (Fig. 19) – a building, a tree, or the chimney on the lee slope of a hill.

The air occurs in the vicinity of the chimney top in direction from above downwards and blows the smoke back. This usually is related to a wind from a definite direction and a definite speed.

TEST: Observe the position of the chimney in relation to adjacent higher objects such as buildings and trees and in respect of surrounding land contours.



Figure 19

REMEDY: Try to raise the chimney terminal out of the turbulent zone. If this is impossible, protect it in one of the ways indicated in Fig. 10 or Fig. 18.

If a cluster of chimney pots close together on the same stack, it is possible as a result of the down-draught smokiness to be caused by one working chimney through the adjacent unused flue in a room where no heating appliance works. In such case it is better the unused flues to be temporarily capped in a way that the flue can be opened if needed later.

CONDENSATION

Water vapour is one of the products of combustion produced when any kind of fuel is burnt. Fuels with relatively high hydrogen content produce more water vapour than others. As long as the water remains in its vapour state until it leaves the flue, no problems arise, but when the flue gases are cooled below a certain level, moisture

will condense on the surfaces of the flue. Unfortunately, condensation often combines with sulphur compounds in the flue gases and with sulphates in brick work to form weak acids, which over a period of time, attack brickwork and mortar joints. In some cases condensation may cause staining the walls in the rooms, particularly on upper floors. Other causes contributory condensation are flues too large for the heating appliance and using wet fuels. The remedy is to use a flue with an appropriate diameter which is insulated.

METHOD FOR CHECKING THE SOUNDNESS OF A CHIMNEY BY SMOKE TEST

- The heating appliance should not be alight.
- Arrange for access into all the spaces of the building through which the chimney flues run, and to the roof.
- When a chimney stack is shared by two or more houses or flats, make sure that there is no other heating appliance connected to the stack will be in use during the test.
- Warm the flue by burning some paper at the bottom of it.
- Have available suitable means to seal off the top and the bottom of the flue after it has been filled with smoke. For example a plastic bag and sealing tape is useful for “capping” the chimney pot.
- Light a smoke cartridge in the bottom of the flue.
- As soon smoke issues from the chimney pot immediately seal it off, leaving the smoke cartridge to burn out and fill the flue with smoke.
- Observe all parts of the chimney for smoke leakage.
- Observe whether smoke issues from any other flue in the same stack.
- Any smoke test should continue for at least 10 minutes.

