Electrolux
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TECHNICAL MANUAL

COOKER HOODS

PRINCIPLES OF INSTALLATION OF COOKER HOODS

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Introduction

The kitchen is increasingly becoming an integral part of the way we live. The time is long past when it was the main workplace of the housewife, the realm of the woman with no interests outside the home.
Kitchen-furniture manufacturers provide a vast range of decorative furniture and nobody today has any difficulty in finding the right object for furnishing the kitchen in a comfortable and above all functional manner.
We have also solved the problem of kitchen ‘mobility’. Unlike the bespoke kitchens of owner-occupied homes, today it’s no problem packing the kitchen fittings along with the living-room furniture when you move house.
Manufacturers of domestic appliances have also played their part by ensuring that all the fine looking kitchen furniture is also comfortable to use.
The domestic appliances have a design that meets all needs and a technology that enables them to adapt to any form of furniture and also makes them easy to handle.
A common trend in modern interior design is the kitchen that is lived in that has been created by removing division between the area for eating and the area for relaxation. The kitchen has thus become a communications centre where the family loves to be together.
Food is prepared, whether a succulent pork roast, a Christmas turkey or mouth-watering cakes for high days and holidays. We all love stopping to savour these delicious smells. But the insatiable human appetite is not even put off by less pleasant smells such as the smells of vegetables, fish and onion-based dishes. At most, after a little time we feel the need to breathe in a little fresh air: we remove the impregnated air but without creating unpleasant draughts that give an unpleasant feeling of cold because of the loss of heat from the atmosphere and we finally try to maintain a level of humidity between 40 and 60% that is bearable for the human body.
Even this is no longer a problem. Today, in almost one home out of two the manufacturers of domestic appliances provide appliances that help keep the kitchen comfortable and therefore healthy: they are extraction hoods. Their technical properties, physical design and differing appearances enable them to satisfy all desires and needs.
We have below set out some tips for buying the right appliance for your needs because making the right choice saves a lot of annoyance later on, and perhaps even a little money.

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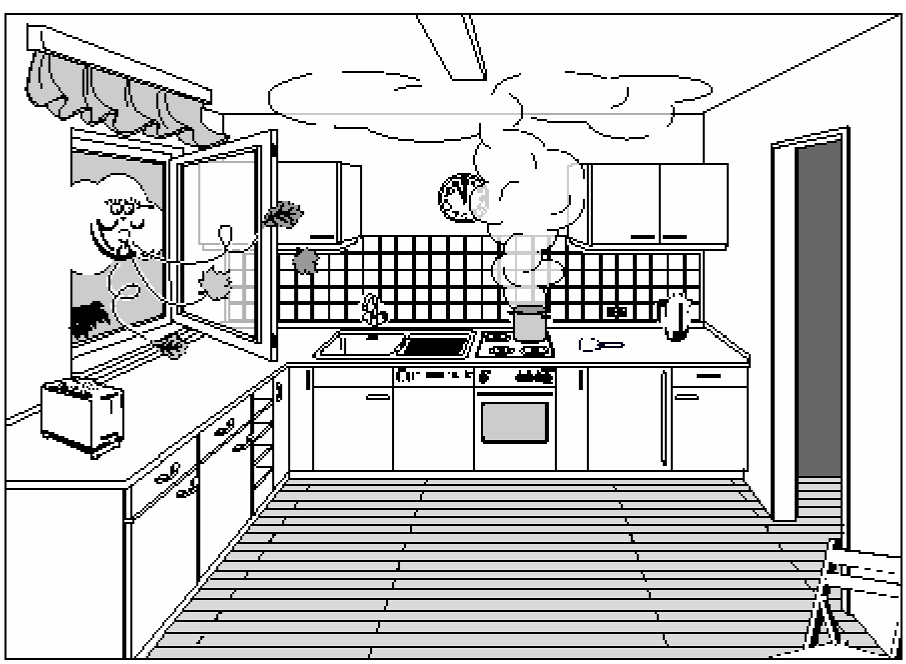
Ventilation Systems

A kitchen can be freed of unpleasant elements in the air in two ways. In all cases, the kitchen must be **ventilated and aerated in a controlled manner.**

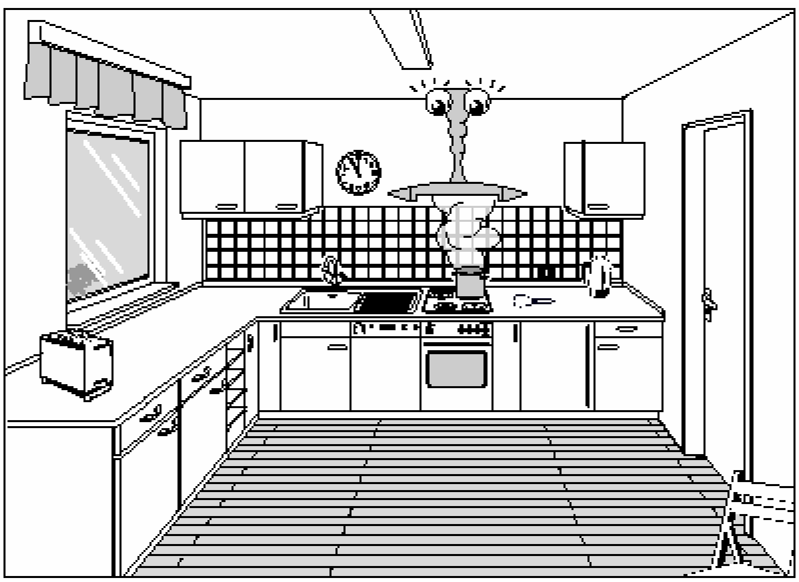
Static ventilation system

If it is cold outside and one opens the window the air change can be easily noticed, but the side effect is that the room starts to get cold. On the other hand, in summer hardly any fresh air gets into the room unless several doors or windows of other rooms are opened at the same time to create a draught.
A connection is thus created with the ‘outside world’ and the effectiveness of aeration depends on atmospheric conditions (direction of the current and atmospheric pressure, air temperature and humidity). Until the legislation on the heat insulation of new buildings came into effect in 1995, there was even a sort of continuous ventilation, but the introduction of almost hermetically sealed doors and windows put an end to it.
But why do we talk of a ‘**static ventilation system**’ in this paragraph?
After all, a certain dynamism is required to carry out continuous procedures such as ‘open the door-close the door’ or ‘open the window-close the door’! Without these physical exercises the air in the rooms **would be stationary,** in other words it would be **static** because the change of air would be too slight.
With this type of ventilation/aeration precious heat is lost and the toxic substances that should be eliminated from the air unfortunately remain in the room and thus contribute to the proverbial ‘stifling air’ in the kitchen.



Dynamic ventilation system

It has been shown that this impregnated air is still sufficiently dense to stay in the place it which it forms, i.e. at the point in which food is prepared. For this reason, the brilliant idea was hit upon of changing air in the kitchen in a deliberate way by means of special devices.
The air has to be forced to move by means of fans located on the walls, in the windows or on the ceiling or in a ‘ventilation recess’ equipped with a fan or by using a much more useful device: an extraction hood.
In this way, a dynamic system is created that uses a few important principles to filter or remove humid vapours from the kitchen in a controlled manner that minimises all the unpleasant side effects and creates a Healthy environment in the kitchen.



Healthy environment/toxic substances

When preparing food we generally tend to provide the body with the bulk (non-absorbable) substances that are required for digestion.
This does not, however, occur with the air in the kitchen because it is full of different types of toxic substances that must be eliminated.

Humidity

A lot of water is used for cooking that turns into steam when it is heated. The innumerable drops of water in the steam are outstanding vehicles for all the fatty substances and odours released into the air. If the air of a room is saturated with humidity the vapour is deposited on the walls, on the windows, on the furniture, on the paintwork and on the walls. At an ambient temperature of 20 °C a kilo of **air** (0.73 m^3) can absorb up to 14.7 g of water. The hotter the air is the more humidity it can absorb. The consequences are deformed and swollen wood, greasy surfaces of furniture and wet walls.

Heat

This is produced from the continuous release of heat from sources such as ovens and hobs, heating bodies such as above all refrigerating units and last but not least the heat of the human body. Together with humidity, heat provides fertile terrain for bacteria and moulds.
People and furniture greatly suffer from it.

Odours

As already mentioned in the introduction, during cooking substances with varying degrees of intensity of odour are released. Initially, the odours may stimulate the appetite but in the long term they become unpleasant if they follow you throughout the house.

Fats

As soon as fats dissolve grease vapours form that are deposited in a thin film on furniture, partitions, paintwork and walls.
This very thin film cannot then be removed from paintwork and walls and creates an ideal environment for bacteria.

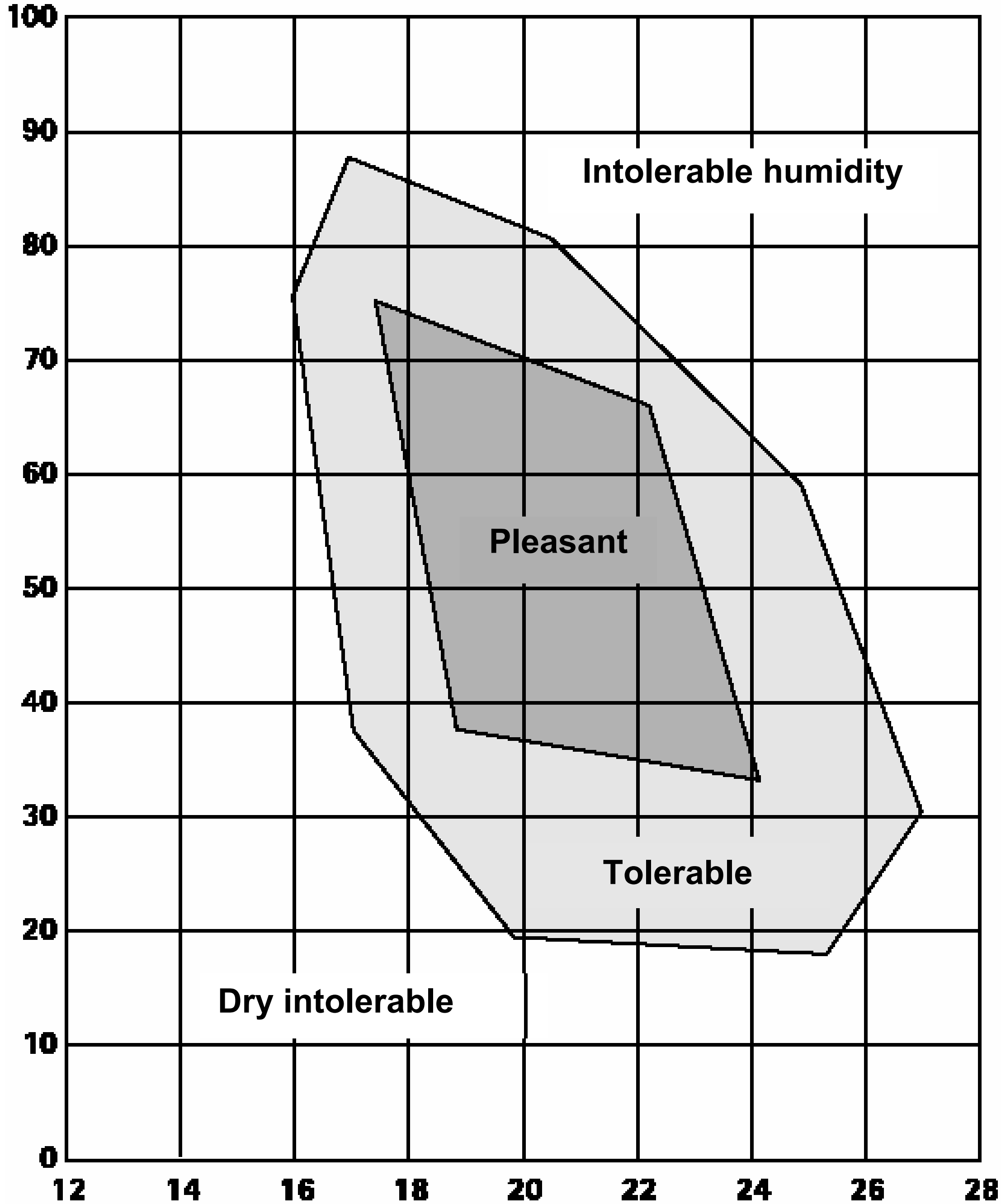
Solid substances

Even when one makes a cake, the flour 'makes dust' and if sugar and cocoa powder is then added for decoration we can appreciate why the kitchen sometimes gets really dusty. If these types of solid substances, together with particles of smoke and fats are heated above smoke temperatures (135 - 240ºC) and also come into contact with all the above substances the air really does become stifling!

Conclusion:

Only after all these undesirable elements have been eliminated from the air in the kitchen without the unpleasant sensation of cold produced by the air currents and only if relative humidity is compatible with an ambient temperature between 18° and 20°C can we talk of a **healthy environment.**

The objective must therefore be to take appropriate measures to extract or filter unclean air that is full of wet vapours.



Environmental comfort curve

Safety regulations

Even when the purchaser acquires an apparently simple extraction hood he must meet certain legal obligations. There intention is solely to ensure that the user passes many happy years with this appliance.

Constructional standard for façade

Before opting for this undoubtedly more effective form of ventilation make sure that your neighbour does not object to the **external motor**. This is required but it certainly does not add to the system's appearance. The objection to the external motor might not only be on aesthetic grounds but also on 'olfactory' grounds, especially if it directly faces the neighbour's bedroom! Or if the row of houses creates currents of air that could take the smells of the kitchen towards other houses further along.
Local planning-permission authorities should be consulted.
There might also be a local 'directive' that prescribes the installation of a hollow body for evacuating fumes that must be placed in a visible position on detached or terraced houses up to an extraction opening height at a given number of metres above ground level! There just might be some regulation of this sort.

Regulations on devices powered by sources of energy other than electric power

Also in this case regulations vary at a regional level and basically state that it is forbidden to **use** extraction hoods and appliances powered by energy other than electric energy (solid-fuel, oil and gas stoves) that extraction into the same **flue** or only if negative pressure greater than 4 Pa (=0.04 mbar) cannot be generated in the flue in which they extraction.
A **sufficient supply of fresh air** must always be provided.
This means that common use without hazard is possible only if the premises in which these devices are located can be aerated from the exterior by an suitable **aeration opening** of about 500 - 600 cm².

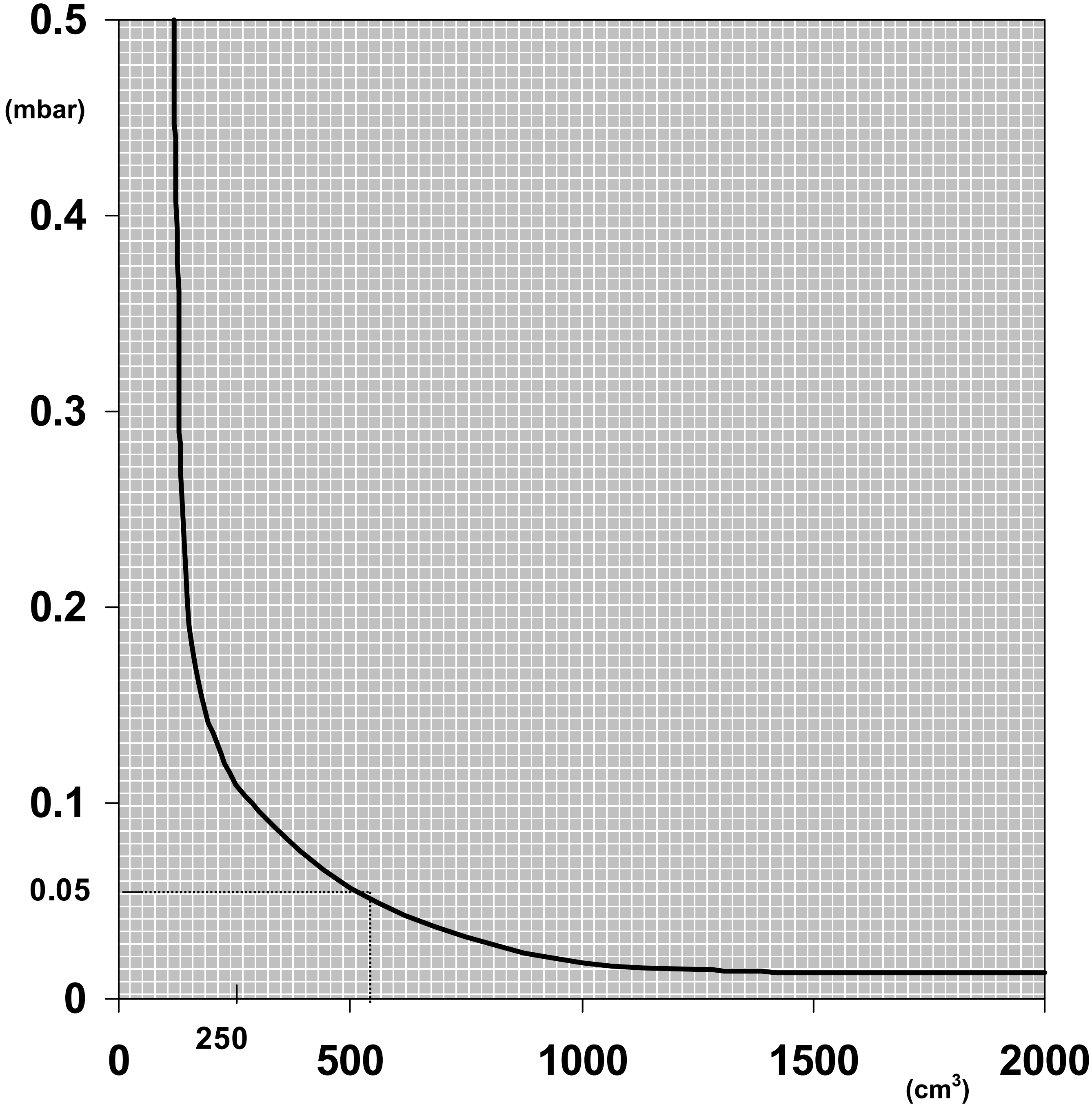
If one remembers what happens when **oxygen** is removed from a naked light we will understand why these paragraphs talk about prudence. If the supply of fresh air is insufficient a window must be provided between a touch switch to enable a current of the air to reach the hood only when it is opened. On the other hand, when the window is closed the hood cannot be actuated.

In general, permitted negative pressure is measured by a qualified flue and chimney technician. If the values do not fall within permitted limits the appropriate steps must be taken.

We certainly cannot require the manufacturer to provide written confirmation that a given extraction hood does not exceed 4 Pa.
Too many environmental factors that the manufacturer cannot envisage determine negative pressure.

Flue regulations

Stale air must on no account be discharged into the smoke or fume flue cap and neither can it be discharged into the recess used for ventilating appliances that are not powered by electric power.
Before inserting the stale air into a smoke or exhaust fume flue cap that is no longer in use the approval of a qualified flue technician authorised to work in the territory in question must be obtained.
Fume evacuation must comply with legal regulations!



Negative pressure in the kitchen extraction fan operating and relative dimensions of aeration hole.

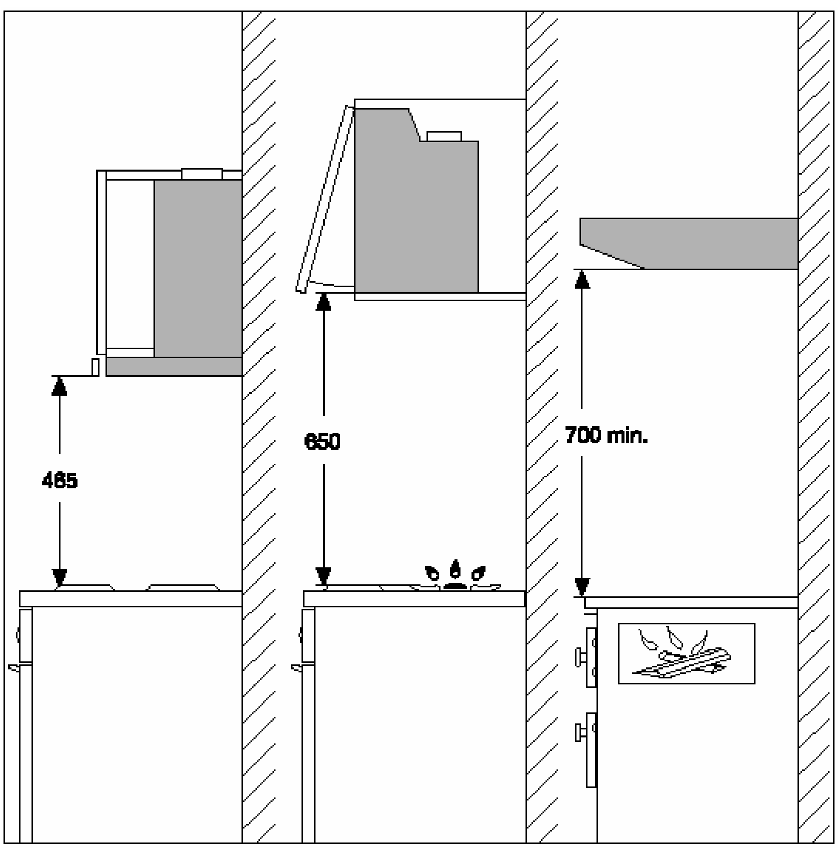
Safety regulations

Minimum distance
When fitting the extraction hood, take care to comply with the set safety distance that has to separate it from the hob underneath. If this distance is not maintained the structural elements of the appliance that are sensitive to heat may be damaged. If the **minimum distances** are exceeded the **extracted current** may also become instable (but **extraction power** is not diminished!). Each hood model is tested and approved on this basis.

General regulations on the distance between the bottom edge of the extraction hood and

an electric hob: 650 mm
a gas hob: 650 mm
an oil/coal stove: 700 mm

Exception: 465 and 470 mm for hoods with a double extracting surface and hoods with a flat screen that satisfy technical constructional requirements. In other cases, the relevant assembly instructions apply!



Wiring
Before wiring up the appliance make sure that the voltage specified on the rating plate corresponds to actual **mains voltage.**
If the appliance has a plug it must be connected to an easily accessible **socket** that is fitted in compliance with legal wiring regulations. If a socket is fitted directly above the sheet metal covering the hood flue or on the adjacent wall-mounted element there is the advantage that it is not visible and if necessary the plug can be easily pulled out.
If a fixed connection is required wiring must be carried out only by a qualified electrician authorised by the utility supplying the electric power.
For the installation a circuit breaker must be provided that has a contact opening of at least 3 mm. Suitable circuit-breaking devices include, for example, switches, fuses, overload cutout switches and relays with an opening of the contacts that is greater than 3 mm.

Recommendations on user safety
• In order not to overload the extraction hood, if possible put a suitable lid on the cooking vessels (saves energy!).
• On no account use naked lights near fuel such as oil, gas and coal!
Always remove heat by running the extraction hood above the cooking vessels.
• Exercise extreme caution when **frying** underneath the hood! Never leave the fryer running unattended! The grease/oil in the fryer could ignite spontaneously. Impure oil tends to ignite even sooner!
• **Flambé** cooking is always forbidden underneath the hood!
• When carrying out any kind of work on the hood always remove the plug from the hood and turn the master switch to the ‘Off’ position.
• Adhere to the set schedule for cleaning and **replacing filters** because if these elements are impregnated with grease/oil they may form a resin and catch fire in the event of overheating although they are made up of metal. Resinated filter material cannot be recleaned!

Warning: these safety instructions must be complied with! In the event of non compliance not only may the user suffer harm but he will also lose all his warranty rights!

Operating modes: recirculation or extraction

Up until now we have mainly talked about the extraction of waste air. The waste air is impregnated with many different impurities and is discharged into the outside atmosphere after it has been properly purified. Much talk has been wasted about how to manage the expense or which measures to take to ensure correct disposal.
But we have not asked what should be done in cases in which the construction or regulations or limitations imposed by the authorities, including objections raised by neighbours, do not allow such a system of ventilation or make it unreasonably expensive.
The following rough summary illustrates the basic **differences and characteristics of both types of aeration.**

Requirements	**Extraction**	**Recirculation**
External motor	- size of connection same as size of extraction opening of hood	- not required
Air extraction/ air delivery conduit	Air-delivery conduit - Diameter the same as the hood and the external motor - Diameter as large as possible - pipe as short as possible - internal pipe wall smooth - as few bends if possible - avoid sharp bends - do not alter the diameter - condensate collected as appropriate - heat insulation collected as appropriate - correctly sized fresh-air supply - in certain circumstances, follow the instructions on appliances that are not electrically powered	- only inside the flue - only inside the wall-mounted element
Air filter	- metal grease filter or - filter grille in non-woven fabric	- metal grease filter or - filter grille in non-woven material plus active-carbon filter
Noise	- if the above instructions have been correctly followed, little noise, silent	- more noisy because of additional filters
Performance	- good	- satisfactory

Hoods that extract are naturally more demanding than hoods that recirculate air.
A recirculation hood is constructionally economical but the additional **active-carbon filter** that absorbs odours must be changed **about every three months or every 120 hours of operation,** depending on cooking habits. Over a year or the entire life of the appliance running costs become rather high.
The first **washable active-carbon filters that can be regenerated several times** are now available on the market. They can be washed using the dishwasher's heavy-duty programme and can then be dried and then regenerated in the oven at a temperature of about 100°C: the useful life of a filter of this type is about three to four years before it loses its effectiveness
Using the active-carbon filter increases the fan's extraction resistance, the flow is reduced in favour of greater air speed and the small diameters increase the noise of the current of air.

Recirculation of air

Dimensions of room

Before dealing with the question of aeration, the dimensions of the premises in question must first be considered. The air inside the latter must be recirculated several times over a set period of time. However, by so doing the humid vapours are kept moving (they are rotated in a vortex) and finally reach the hood where they are eliminated. **A small room requires greater recirculation of air than a large one.** In a small room the air gets saturated rapidly whereas in more spacious rooms there is more space for transporting humid vapours.

Experience has shown that if recirculation of the air in an hour is six to twelve times the volume of the room air currents cannot be perceived.

When calculating the volume of the room (base by height of the room) the **furniture** and objects in the room must not be subtracted as if they diminished volume because this figure provides a safety margin and is a conservative estimate of the air-change index.

Air flow Q

The calculated **volume** V multiplied by the bottom **air-change index** f = 6 and by the top air-change index f = 12 gives the minimum and maximum operating **air flow** Q in m^3/h. This value enables and appliance with the correct **power** to be selected.

It is always better to choose an appliance of the next power class up because this ensures that you will be able to set the fan to run with little noise both in normal and continuous operating mode.

$$Q = V \times f$$

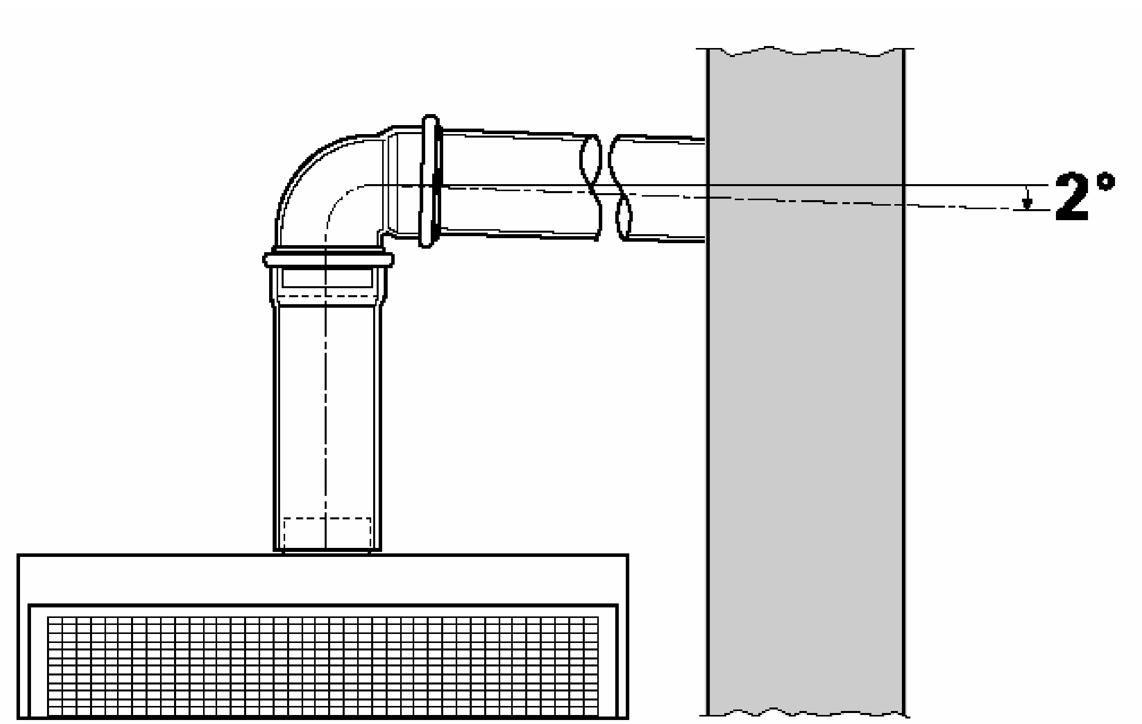
Example of calculation:

A kitchen has to be ventilated that measures 16 m² in area and 2.50 metres in height.
What air flow is required?
Solution: Q = V x f. V = surface of kitchen x height of kitchen:
Q_{min} = 16 m² x 2.50 m x 6/h = 240 m³/h
Q_{max} = 16 m² x 2.50 m x 12/h = 480 m³/h
For this kitchen a hood is therefore required whose minimum operating power is 240 m³/h and whose maximum operating power is 480 m³/h.
Even at lower power levels quiet continuous operation is ensured.

Extraction of fumes

After the air has circulated a few times it must be purified and eliminated. If constructional circumstances do not allow it to be discharged outside a hood must be used that recirculates air. The properties are set out in the chapter ‘Types of operation’.
The importance of the fume-extraction pipes must not be underestimated because otherwise **grave design errors** may make the investment in a very powerful extraction hood totally absurd.
The **air-extraction pipe** must be **low resistance**. It must lead **directly** to the **correctly dimensioned** opening in the wall and must **on no account** have elements that **reduce its diameter.** Neither must it have numerous **90°-bends**. Also the characteristics of the **inner wall** not only affect flow but also to a large extent the silent operation of the appliance.
However, all too often during **renovation** work the existence of a prior **external motor** is not taken into consideration. We know that there is one but when we have to connect the new more powerful extraction hood we all too often find that the connecting pipes are too small in diameter.

Newly constructed hoods are more powerful than the older models.
This is certainly due to changes over the last decades in furnishing materials. But in order to make the most of the power the **sufficiently large air-extraction diameters must also be available.** This means that the diameter of the extraction pipe of an older less powerful hood is certainly smaller and that the pipe continued to the outer opening/to the external motor!
We have now learnt that the **air-extraction pipe** must protrude at an angle of **no more than about 2°, but with a tilt of about 2°**. ‘Before’ it was believed that in this way one could extraction used air more easily from the extraction system but it was forgotten that any condensate will accumulate in this part of the wall because it is subject to different temperatures in the section towards the kitchen.



Tilt of the extraction pipe

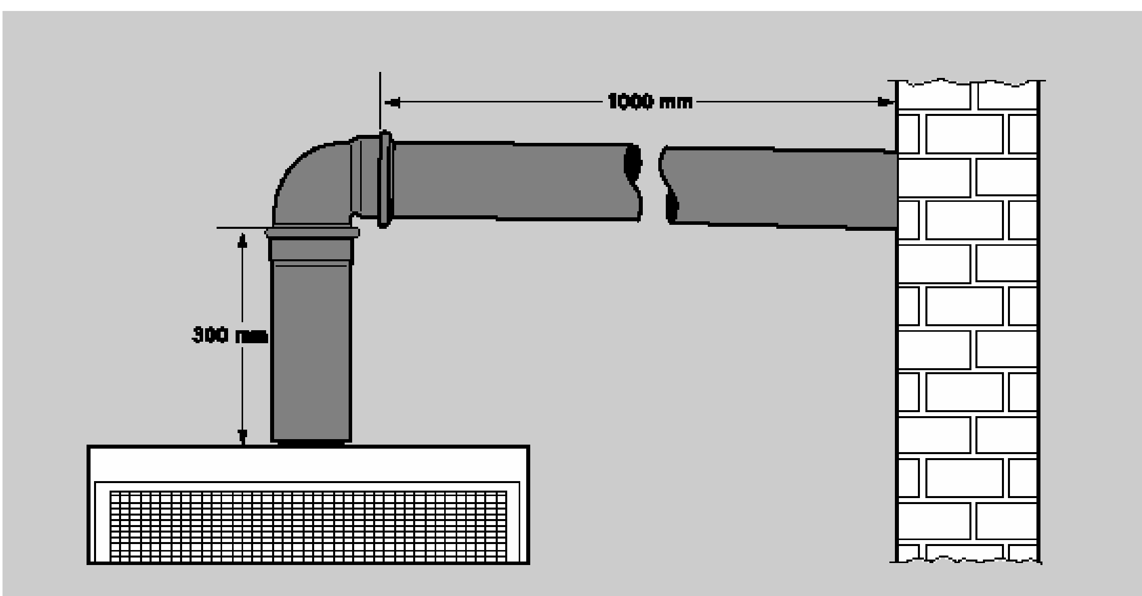
Air change index

DIN 44 971 or free blowing

In the chapter ‘Recirculation of air’, we calculated the **air change index** (air flow) required for a given kitchen in order to be able it to be aerated adequately. But we did not consider the method of aeration required. In order to apply the same criteria to this matter a DIN standard DIN 44971 has been drawn up. This prescribes the method for measuring the **power** of an extraction hood. In this case the sensor for calculating actual power must no longer be placed at the hood fan outlet (free-blowing) but only at a distance of 30 cm vertically above the outlet of the fan. A 90°-bend and a 1-m horizontal pipe is connected to the sensor. This roughly corresponds to an extended length of 4 metres! We can readily appreciate how much power is ‘swallowed up’ in a bend of this type.

Conclusion:

When comparing hoods of different manufacturers always ascertain whether the **power rating** refers to ‘**free blowing’** or are **measured according to standard DIN 44 971** (and perhaps also according to standard DIN EN 61591)!



Measuring method according to standard DIN 44 971

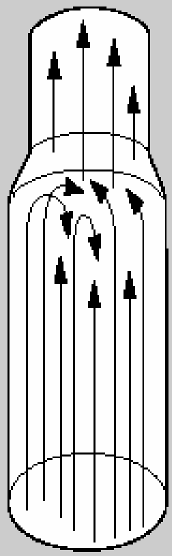
Losses

90º-bends
The ideal method according to standard DIN is rarely carried out in practice. In general, during the design phase an infinite series of variations are studied that above all depend on constructional realities.
The first ‘escape’ in the loss zone occurs in this bend. About 15% is lost from just one of these bends, so we can readily imagine the losses if there were not just a second but also a third or even fourth bend!

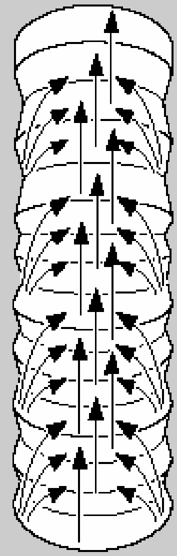
Air-extraction pipe

For the installation technician it is a blessing to be able connect the hood to the extraction in the wall using a series of hoses that overcome all obstacles. They also enable corners to be negotiated without having to use ‘rivets and joints’. However the pleasure of silent and powerful fan operation will be considerably reduced.

The drawn corrugated hose is a source of great problems for draught technology. Even when it is bound with clips and similar devices **it does not enable air to be conveyed without attrition.** The relatively large corrugation hinders a free laminar current. Air vortices (turbulence) are created and if at least the central currents are lucky they manage to reach the end of the section without encountering obstacles. But with partial currents the kitchen cannot be effectively ventilated. **All** the air must be able to pass!



Loss due to reduction of diameter



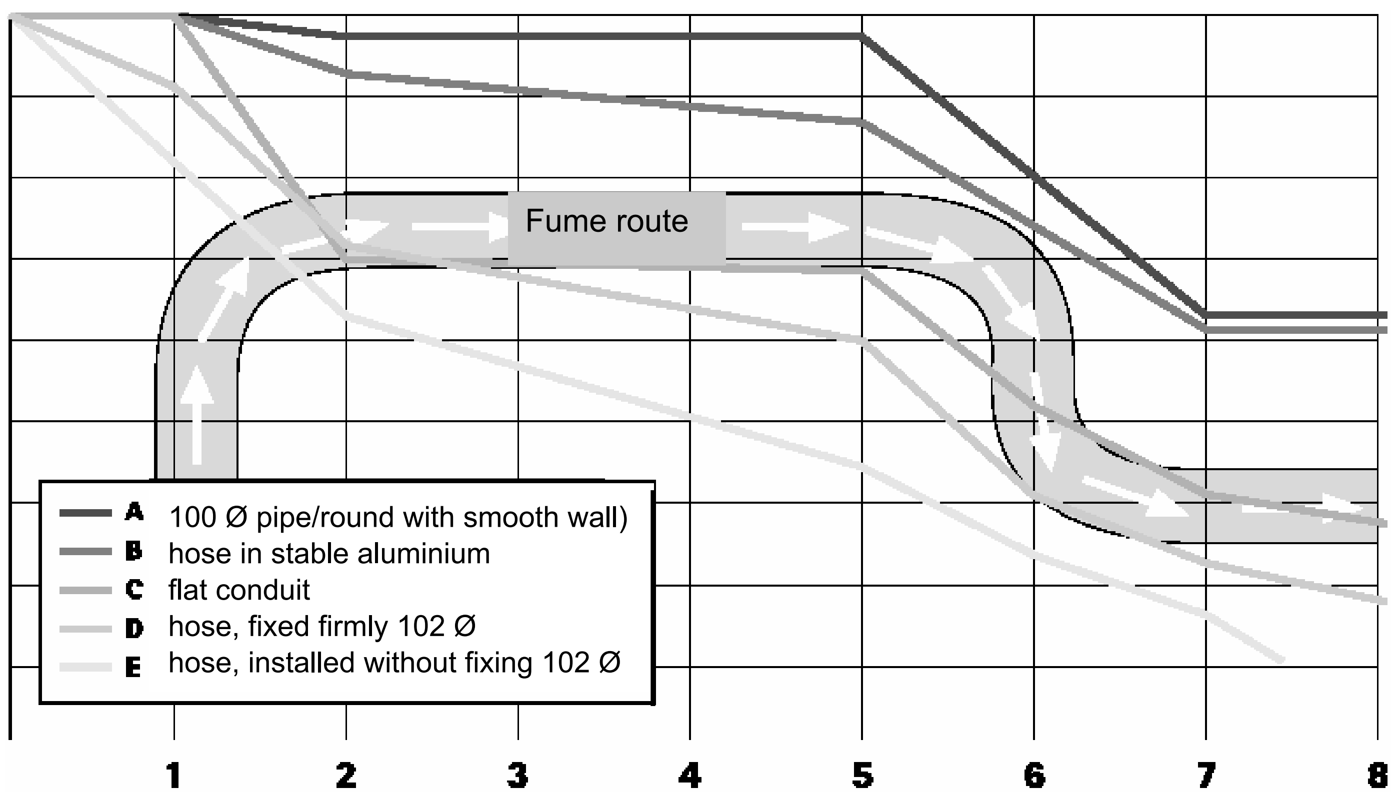
Loss due to air turbulence (vortices)

Power killers: reduction of pipe section and corrugated hoses, turbulence

In order to have **a much greater flow**, it may be useful to use just one **pipe with a smooth internal wall**. This provides not only a stable laminar current but also problem-free assembly because temperature does not make the pipe bend or twist.

But why do we need a smooth-walled **air-extraction pipe** that is as stable as possible if for technical and visual reasons the hood requires a **flat conduit**? The discharged air should therefore be expected at the latest at the transition from round to flat (of the hood valve), which makes for turbulent travel. At the end the discharged air current would calm down again but it must then be discharged outside beyond the external motor. But the external motor normally has only a round fitting, so the diameter changes again.

A subsequent comparison of different types of pipe (see following page) shows how losses of current depend to a large extend on the type of material used.


Fume route
A 100 Ø pipe/round with smooth wall)
B hose in stable aluminium
C flat conduit
D hose, fixed firmly 102 Ø
E hose, installed without fixing 102 Ø
1
2
3
4
5
6
7
8

Counterpressure

If a fan vane has to convey from A to B pressure falls unless the air has to **circulate** only in the immediate vicinity. The flow volume is compressed in the extraction system. The narrower and longer the conduit, the greater the compression. **In the most unfavourable case or in cases in which the extraction pipe is very long the flow stops or can even return** if the air column starts to vibrate. In such a case even quite a powerful fan is no longer effective.
Under similar extreme conditions the fan motor can no longer perform its original task and if the user of the appliance thinks he can 'give it a hand' by setting it at maximum or intense level he is making a great mistake and will in fact only make matters worse. The **pipe resistance** in fact typically acts as a second-degree function that doubles flow volume, i.e. the resistance of the **extraction conduit** is quadrupled (see also the chapter 'Models and specification sheets').
In such unfavourable circumstances the fan still tries to perform its task by compensating the loss by increasing power intake: it increases 'revs' but very noisily. A further consequence it that the entire system starts to 'pump', which pushes the fan unit well beyond its designed capacity. As a result **the appliance's working life is shortened.**
The conclusion is therefore that **the least possible resistance** should always be sought in order to maintain designed counterpressure.
This is achieved in the following manner:

- by using piping with as large diameter as possible (150 mm ø current standard),
- by not modifying the diameter along the entire route of the pipes
- by making the pipe route as short as possible
- by using a pipe with a smooth internal wall for the extraction
- by using as few bends as possible
- by never making sharp bends but rather shallow bends (shock resistance).

Additional fans

It is widely believed that the conditions mentioned above can be ignored and that power can be increased by installing an additional fan. However, this is certainly not the case:

each fan has its own original characteristics that can be read on its 'birth certificate', i.e. by its characteristic curve. When interacting with environmental conditions such as the geometry of the impeller vanes the system supporting the axis of the starter motor and of the fan vane, differing operating settings, different pipe resistance, etc, **a theoretical work point** can be obtained on a so-called **diagram of characteristic curves** (see chapter on 'Models and specification sheets').

Is it in this area that another fan has to be 'planted' with its own special characteristic? It is already a problem that it cannot obviously be placed in the same place. This fan must therefore be positioned a little further forwards inside the flow volume and must deal with what is left by its 'predecessor'. Even if we suppose that the impossible may occur, i.e. that the second fan has the same characteristic curve as the main fan the disturbance factor of the 'distance between the two' and therefore the no-longer identical ratios between delivery and extraction would in itself be a cause of unsynchronised operation. The two fans would deliver and extract continuously in such a way that **overall performance is not increased but reduced.**

Another problem would also be the common electric actuation, which should logically start with the same hood-switching element. The printed circuits are certainly not designed for similarly increased current loads.
In no case should such a system be recommended!

Air delivered

We have until now talked about how to evacuate stale air. However, if something is removed something must be put in its place or be added. Where does the air therefore come from that is in the end taken away from the extraction system? Do we need it? This question can be answered very briefly.

Discharging air requires an air intake!

This statement can be very easily demonstrated with the help of a hair dryer. If the air inlet is kept closed the hair dryer first of all gets very noisy and then only a very small stream comes out from the outlet and this outflow occurs only because the air inlet has not been hermetically sealed. Warning: the appliance becomes too hot to handle if it has been switched on after setting it on 'Hot air' and may therefore overheat!

This demonstration can undoubtedly also be applied to the extraction hood and is the proof that an extraction hood needs a supply of fresh air that is as great as the maximum amount of air that it is able to extract. On the other hand, the extraction hood must not be supplied with too much fresh air because otherwise the regular operations that are conducted underneath the hood would be damaged by **uncontrolled vortices** and extraction efficiency would be diminished because it would be extracting too much 'clean' air.

The air supply can be ensured in different ways:

- the best way is via an **external extraction/delivery motor** through which the stale air is expelled outside and at the same fresh air is delivered inside by means of its incorporated **check valve** (see chapter on 'Accessories from A to Z'). The check valve opens proportionally. In other words, it opens in proportion to the increase in blowing pressure so that **the correct quantity of air is delivered to the kitchen at all times**. This device is required only if there is a direct connection with the room to be aerated and the air is not conveyed through adjacent rooms (e.g. a storeroom);
- through a separate air-delivery conduit if the external motor is in an adjacent room;

- through a **window,** which must be protected by **electric interlock** with the hood if in the same room there is an oil, coal or gas-powered appliance with its own flue (see also the chapter on ‘Safety regulations, paragraph on ‘Regulations governing appliances powered with energy other than electric power’!).
  The hood can therefore be started up only if the window is tilted open; make sure that no uncontrolled turbulence occurs near the hood if, for example, an air current forms!

- through **adjacent rooms** that are not separated by a lockable door. Large rooms always have sufficient **self-ventilating properties** to create a sufficient draught. In such cases, there is another advantage: not only is the room ventilated but the air in the kitchen is ‘pre-heated’ and is therefore more able to absorb impurities.

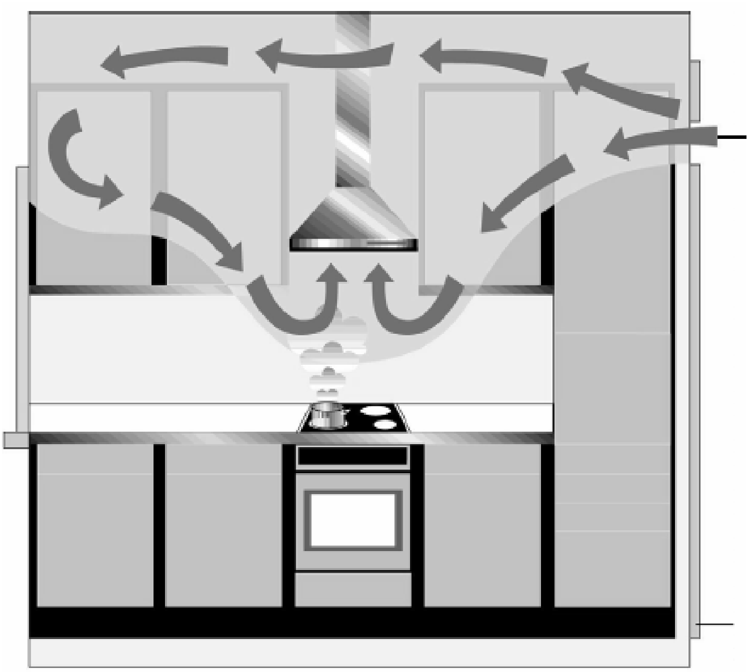
Note:
The external motor can also be positioned without any difficulty directly behind the flue of a hood. This is the optimal position from a technical point of view for creating draughts. Using the external extraction/delivery motor the incoming fresh air can enter the room through the extraction outlet incorporated in the side of the flue metal.
Caution: with low winter temperatures outside condensation may form that will seek the fastest route along the inside wall of the flue metal along the body of the hood towards the bottom in the direction of the cooking vessels! In this case good **thermal insulation** in the air-intake zone is very helpful.
During the design phase, allowances must be made for a larger external motor for a connection measuring 150 mm in diameter.

Alternative:
If the possibility described above is not feasible supplying air through a **grille in the top part of the kitchen door** can be considered. A **ventilation grille** at floor level would have no sense because only the kitchen floor would be aerated and the user’s feet would feel cold.
It should also be remembered that kitchen vapours tend to remain suspended **high up,** near the ceiling!

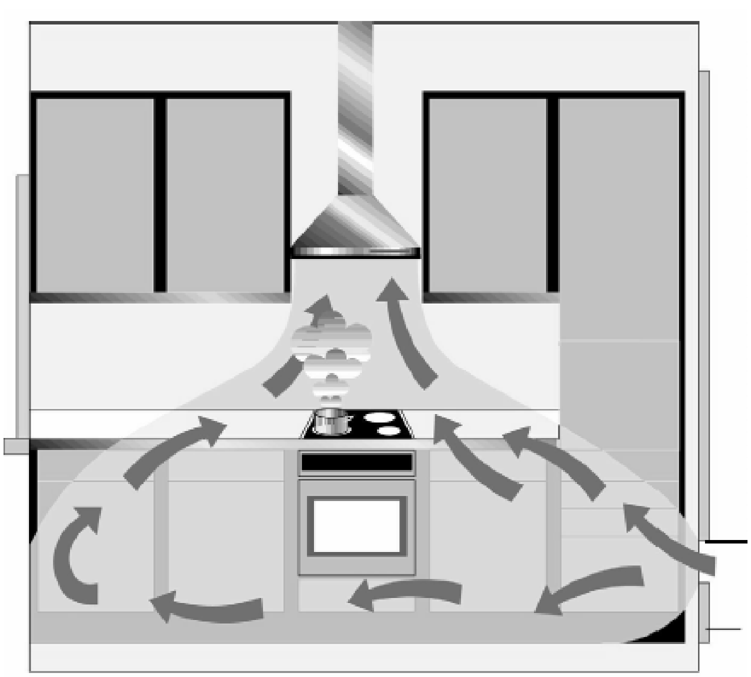
Conclusion:
If none of the possible solutions listed above can be considered an **air-recirculation hood** must be used. In this case the air to be purified must by regenerated by means of an **active-carbon filter** and be returned to the kitchen (see chapter on ‘Fan types’).

The extraction hood Delivered air

Aerated ceiling zone (vapour zone)



Aerated floor zone



Noise level

Where movement is produced, noise is also produced. In general, the faster the movement the greater the noise. For this reason, after work has finished the kitchen extraction hood is left to run for another 15 minutes at maximum to ensure complete extraction.
In this way the hood is exploited to the full, obviously with the corresponding 'musical accompaniment'. This function can even be programmed in such a way that the fan switches off only after a set time. This is also a way of avoiding the unpleasant noise.

In addition, noise can be drastically reduced by careful design. The measures to be taken to ensure that the hood fulfils its proper role when the fan start switch is pressed have been amply described.

When we come to the question 'but how noisy is this appliance?' the salesperson shrugs his shoulders, especially if one asks more precise questions and is even 'means' enough to ask what measuring method has been used to calculate the noise of the appliance.
This subject is certainly not so easy to understand.
As a general rule the set characteristics and proprietors of the extraction hood are tested and the extraction hood is then subjected to approval inspection. Physics is everywhere and cannot be deceived. Nevertheless, there are different ways for reducing the noise of the domestic appliances, namely through so-called

active or passive soundproofing.

This always depends on the room in which the appliance that causes the noise is placed. A room that is furnished with furniture and carpets certainly reduces noise better than a room with a tiled floor and little furniture. And a recessed appliance can operate much less noisily if it is in a room that is full of furniture rather than being installed between hollow bodies that act as amplifiers (loud speakers).
If a changed in cross-section (from round to flat) was unavoidable or if the cross-section even had to be reduced (smaller diameter), such reductions were made near the external motor, with the resulting increase in noise (and power loss) that they incurred. But in this way a 'needle's eye' was created that had the counterproductive side effect that an extremely sensitive column of used air was created that might easily collapse in on itself. If such reductions have to be carried out, locate them directly at the extraction hood's outlet.

Active soundproofing

This term simply means that the soundproofing tries to separate the source of the noise from the surrounding environment. As we have already said, **there must not be any hollow bodies in the immediate vicinity** that will unit with the hood to form a single unit. The actuating units should be fitted on oscillating bearings in such a way their oscillations and vibrations are transmitted to the body of the appliance only in an attenuated form.

Very intense work on similar solutions is being carried out because there is little point in having the quietest dishwasher in the world, an oven that softly murmurs, a fridge that one does not even hear if a monstrous extraction hood is fitted to the wall or the ceiling that is as noisy as the other appliances are silent.

Today’s living conditions require more powerful extraction hoods and that is the challenge that faces technicians and engineers: harnessing this concentrated force.

Passive soundproofing

Underneath the engines of today’s cars there are nearly always glued **insulating layers.** They consist of pressed textiles or of bituminous substances and are cut to measure.
In this case, passive soundproofing is used and it is this that is partially used inside extraction hoods and their flues. The relatively thin sheet-metal casings thus oscillate less and thus become ‘soundproofed’.

The knack with this type of insulation consists of cladding the right points of an appliance but without forgetting hygienic considerations because deposits of dirt must be prevented from collecting in corners and additional joints.
The flow conditions must not be harmed by artificially produced turbulence because this not only leads to loss of power but also causes an unpleasant noise.
The perceived noise of a domestic appliance is becoming an increasingly important purchasing factor because, as we have already said, the kitchen that is also a living room has become very fashionable. Unfortunately however, information on noise levels is virtually impossible or very difficult for both the layman and the expert to understand. The following pages attempt to throw a little light on this subject.

Acoustic power and acoustic pressure

The human ear unable to perceive all tones in the same way.
The highest and the lowest tones are, for example, heard less clearly. This sensation is technically recreated by the so-called A weighting.
We therefore say:

'A-weighted' acoustic power L_{WA} in dB (re 1 pW).
Where the letters have the following meanings:

L :	logarithmic scale,
W :	reference to acoustic power,
A :	evaluated by analogy with hearing (A weighting),
re 1pW :	power at 1 Picowatt
	= 0.000 000 000 001 W = 10^{-12} W

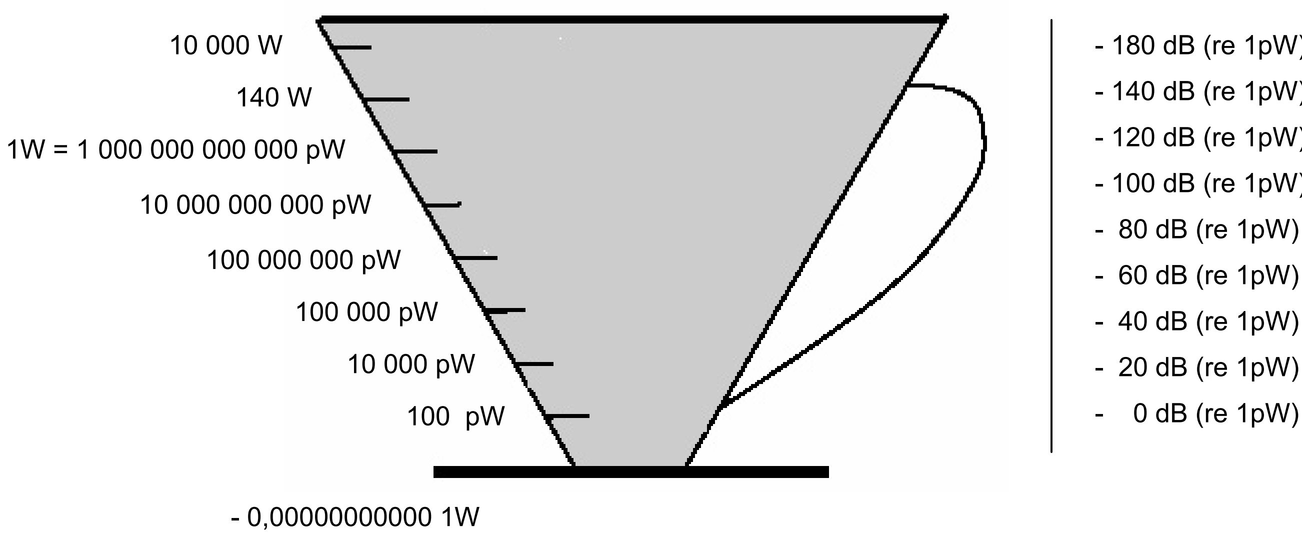
Acoustic power :

Acoustic power cannot be measured directly. However, as it is closely connected to the acoustic pressure in the room, **it can be extrapolated from measurable acoustic pressure**.

Different levels of acoustic power must not be simply added up because otherwise gigantic figures would be obtained. In fact, the operating noise produced by two clocks that each ticked at 40 dB would rapidly become greater than the noise produced by a vacuum cleaner of the old generation. However, logarithms show that the total noise produced by the two clocks amounts to only 43 dB, which is little more than the amount of noise produced by just one clock.
Just as the power of a bulb does not define the luminosity of a room the subjective noise level cannot be deduced from an appliance's acoustic power. A large room with furniture, carpets and light-absorbing shutters is darker than a small room with bright furnishings lit by an equally powerful bulb. This comparison can be used for the noise produced by an appliance, which seems to be greater in a small bare room than in a larger room that is full of furniture and carpets.

Acoustic power

Level of acoustic power



Acoustic pressure:

The level of acoustic intensity is defined by its own parameter, i.e. by **acoustic pressure** or by the **perceived level of acoustic pressure** that can be clearly represented by a logarithm. The physical unit of measurement is called dB (A), where A again stands for ‘A-weighted’.

The similarities between the concepts confuse even the greatest experts. **The index and the unit must always be borne in mind.**

Level of acoustic power LWA in dB (re 1pW)
Level of acoustic pressure LA in dB (A)

Relation between acoustic power and acoustic pressure

The ‘conversion factor’ between acoustic power and acoustic pressure depends to a large extent on the distance of the measuring microphone and just as much on the cleanness of the room. In a measuring laboratory that is soundproofed 100%, the influence of the room is precisely known.

Note: in the case of a measurement according to standard DIN 45 635, the **level of acoustic pressure** measured at a distance of 1 m is **12 dB less than the level of acoustic power** of the appliance.

The greater the so-called ‘reverberation’ of a room the greater the level of acoustic pressure measured at the same level of acoustic power. In small tiled kitchens the level of acoustic pressure may even be greater than the level of acoustic power. As it is really very difficult to evaluate the influence of the environment it is practically impossible to measure the acoustic power of an appliance in a normal room in the home.

As the level of acoustic pressure is greatly influenced by the room it is not a suitable way of describing sources of noise. By contrast, acoustic power does not depend on the environment or on measuring conditions.

How noises are heard

Noises are classified by 'nuisance levels' that differ according to the perceptive capacity of the human ear. Also in this case the comparison with a source of light is very appropriate, not to say illuminating.
The intensity of a bulb tells us nothing about the colour of the light produced. The light may vary from blinding to warm without indicating it actual intensity. In the same way, the level of acoustic power says nothing about the tone of the noise. Two equal levels of acoustic power may be unpleasant in different ways and may also be judged differently by different people. **The level of acoustic pressure cannot therefore be measured objectively.**

Conclusion:

- The operating noise of the appliances is defined by the 'A-weighted' level of acoustic power. It is very costly to determine this parameter and can only be done in a special noise-measuring laboratory.
- Information on apparently very low noise must be investigated very critically to decide the measuring dimension used: dB(A) or dB (re 1pW).
- The purchaser has no choice but to believe in the data supplied by the manufacturer and by the relative test institutes.
- A subjective comparison 'by ear' makes sense only if the appliances are very close to one another; otherwise the influence of the room's acoustics is too great and any comparison is misleading.

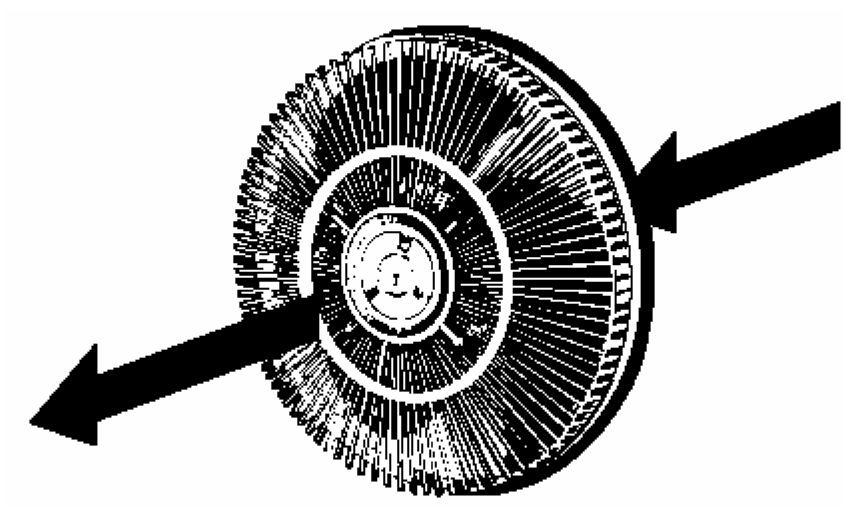
Fan types

In ventilation technology the conveyed air must not be compressed, or must only be slightly compressed. Different types of fan are used that fall into two main categories: **axial fans and radial fans.**

Axial fans

Axial fans are mainly used where a **large quantity of air needs to be moved over short discharging distances with large diameters** such as for example underground garages, tunnels, etc.
These fans are similar to turbines and aspirate the air parallel to the rotation axis of the motor-fan unit and also expel it parallel to the other end. The direct contact of the conveyed air with the moving fan vane shifts the air flow in a kinetic movement. As a result, power is diminished, but this can be amply compensated by switching the direction of the vanes.

However, minimal pressure is generated. Furthermore, large volumes of air can be moved only at a relatively high rate of **rpm** and the unit becomes very noisy.
The most common example of this type of miniature fan is the fan inserted into domestic extraction pipes. Owing to its reduced dimensions and compact structure it is often fitted in the **air-extraction pipe** to aerate lavatories.

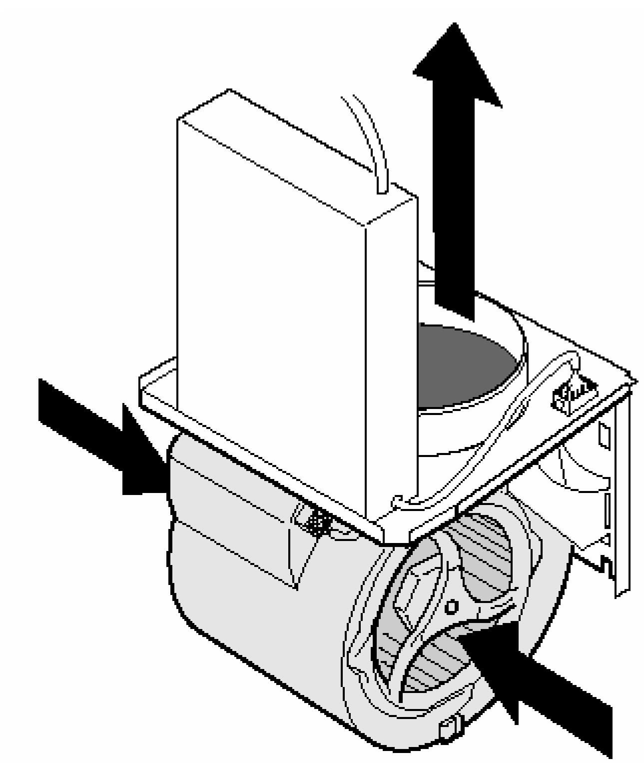


Radial fan

For **longer extraction routes and smaller diameters** radial vanes are used. They generate the potential pressure required to remove air but compared with axial fans they can be used only for **limited flow volumes.**

Also in this type of fan the air enters in an axial direction, as in the case of the axial fan. However, in this case the air flow exits vertically in relation to the impeller's rotation axis. The centrifugal force of the fan's rotating elements gives the air flow a further accelerating thrust that is further increased by the fan casing, the outlet diameter of which is narrowed.

Radial fans generate relatively high usable pressure. The constructional form of the casing greatly influences the flow volume that is set and also the noise generated. **Radial fans are the preferred constructional model for technical applications in kitchens.** This type of fan enables flow volumes between 250 and 800 m³/h to be achieved with noise levels that are still very acceptable.



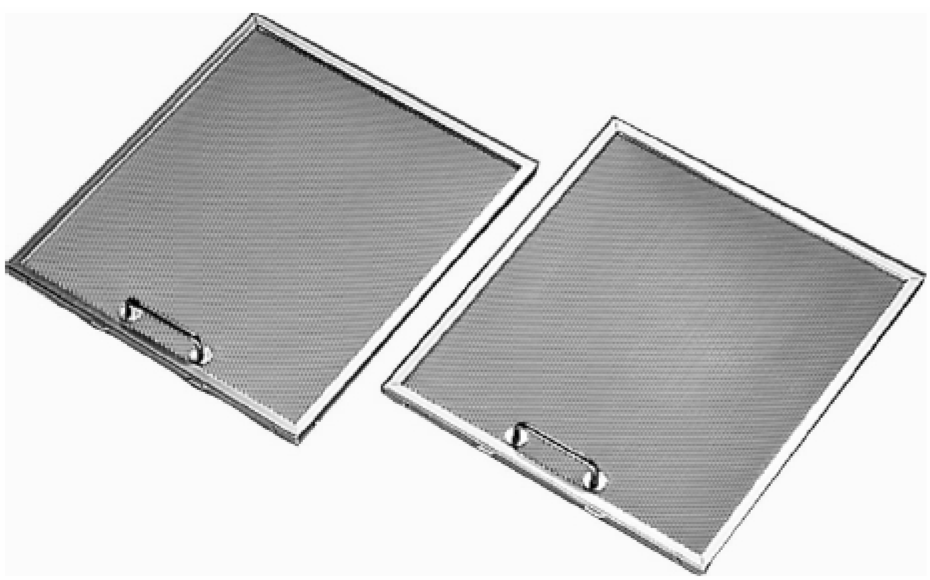
Types of filter

Grease filters

The task of the grease filter both for recirculation and evacuation hoods is to absorb grease and dust particles and also humid vapours. Different models and materials are used and if they are new or are cleaned regularly in the proper manner they are not flammable or are very rarely flammable and have self-extinguishing properties. The most commonly used filters of the ones described below are metal filters, disposable paper filters and active-carbon filters.

Metal grease filters

They are typical **long-life filters** and consist of layers whose depth varies from manufacturer to manufacturer. One might think that a deeper layer will separate much more grease than a thinner layer but this is not the case because the filter diameter decreases and aspiration pressure therefore increases. The power of the fan decreases and the items to be filtered are no longer held back. Furthermore, the noise of the extraction hood will increase. This problem is solved **by carefully choosing the right filter depth for the fan.**



Metal grease filters in frames

Metal filters are used as shaped ‘inserts’ or are inserted into frames. In all cases, after about 30 hours of use they can be washed in the dishwasher using the intensive programme (at least 65 °C), **without** washing sensitive pans or delicate glasses together (because of grease deposits in pans or accumulated food residue in the filter fabric!). The filter may change colour (light grey, opaque), depending on the composition of the metal or the detergent used.
Changes in colour are due to oxidation, a chemical process that is accelerated on the one hand by the corrosive acid components of oils and fats and also by the detergent. If cleaning is anticipated, worse problems can be avoided.

Filters in non-woven fabric
They are made of manmade fibres that are about 10 mm thick and are **long-life filters**.

Labyrinth filters
Another **long-life filter** is the so-called labyrinth filter. This consists of synthetic or metal material. The grease and dust particles break against the ‘bars’ that are staggered in different rows one behind the other in such a way that the grease and also the humidity of the kitchen vapours can flow from them.
Owing to this shock effect, they are also called **impact collectors**.
The separated substance is collected in a grease-collection tray.

Paper filters
This type of filter belongs to the category of **‘disposable’ filters**. It cannot therefore be regenerated or washed once it is saturated. In general, it consists of a mixed layer of wood (cellulose) and manmade material (polyester, rayon) and has great capillary and adhesive properties. The depth is limited to about 1 mm to obtain an effective result.

Odour filters (active-carbon filters)

This filter is used **only for air-recirculation hoods** (filtering version). It consists of active-carbon granulate normally consisting of 3 or 4-mm grains. The inside of one of these grains of granulate consists of an exceptionally thin labyrinth of channels on the walls of which all the passing odours are deposited that the grease filter upstream does not manage to absorb. Thanks to this property the carbon filter has a high absorbent capacity. Materials such as fossil carbon, lignite or carbon coke are used, the thin pores of which are made available only through a coking process during which the parts containing tar are eliminated. The thin pores increase the surface that can absorb the filter odours. Just 8 g of **active carbon** correspond to a football pitch!
The load of the active carbon package must be determined on the basis of the fan's aspiration power. The **flow speed** of the aspirated air must not exceed 0.6 or a maximum of 0.8 m/s. Too high a flow speed prevents the odours from being deposited in the granulate.

Using a new filter
To obtain good performance right from the first startup or after a new filter has been inserted, the following conditions must be met:
• after removing the **granulate** from the packing cardboard or the protective film, it must be distributed in a uniform manner in the frame of the filter, by shaking if necessary

• The **filtering element** must stick to the fan's aspiration side.
If there are non-airtight points the extracted air will be returned to the room without being filtered.

• It always used to be recommended to stir the water vapour of a boiling saucepan for about 10 to 20 minutes on the carbon filter in order to open the pores of the thin granulate and thereby ‘activate’ the filter load to absorb the odours.
Laboratory tests, have, however, completely invalidated this assertion. **According to the manufacturer’s data the filter is ready for use without any particular preparation** as soon as it is taken out of its protective film. But at the end of the cooking process it must operate for another 10 to 20 minutes in order to dry or ‘evaporate’.

• The extraction hood should have been switched on a few minutes (up to about 15 min.) before starting to cook. This creates the turbulence required to extract the **smog** in the room.

• Replace **the carbon filters regularly** and regularly clean the grease filter placed first in order to ensure regular ventilation operation. A saturated grease filter can dramatically reduce the efficiency of the active-carbon filter (thickening of granulate pores, sticking of granulate). The frequency of cleaning depends to a large extent on the user’s habits. For this reason it is difficult to give precise indications. In all cases, follow the

Manufacturer’s instructions.
The decision on whether to replace the filter can be assisted by a visual signal that depends on the appliance. A light may for example switch on after about 120 hours of operation, regardless of the intensity of cooking up until that moment or the hours may be counted as if only water had been heated without any need for an odour filter.
A completely effective indication can be obtained only by measuring the difference in pressure, i.e. by measuring the pressure before and after the filter, but this cannot be achieved at the moment.

Conclusion:
The performance of an extraction hood can be maintained only if filters are regularly and carefully changed.

Constructional forms of appliances

The range of commercially available extraction hoods differ widely in terms of constructional form. Such a choice should enable nearly all needs to be met. Nevertheless, in order to avoid subsequent problems the designer must be provided with detailed information on the place in which the appliance is to be installed.

Wall-mounted appliance (flat hood)
It is positioned underneath a corresponding wall-mounted element that is 60, 90 or even 100 cm wide. The hood is fixed underneath the base of the wall-mounted unit: the air is discharged through the wall-mounted unit downwards, through the wall by extraction or it is returned to the room above the wall-mounted unit through an adjustable grille by means of air-recirculation. This type of switching is known as ‘summer/winter’ switching and enables heat to be saved during the cold periods of the year. In this case a carbon filter must be used!

Recessed appliance that can be hung between wall-mounted units and can be integrated.
These appliances are fixed into an element built around them, or simply between two wall-mounted elements. The front side is 'clad' with a front panel that matches the overall visual appeal of the unit.

Recessed appliance underneath a shortened wall-mounted element; alternatively with a flue.

Fan module

Wall-mounted extraction hood (extraction hood con flue)

Hood for island

Miscellaneous

The program is completed by special constructional models that refer to appliances that can be lowered directly near the hob that are fitted with telescopic motor-driven pipes that can be manually adjusted. The **external blowing units** should also be mentioned, whose task is basically to banish the source of noise from the ventilated room to outside or to another room. These constructional models will not, however, be discussed in detail here.

Accessories from A to Z

Deposit collection grille
Certain hood models are supplied with a grille for collecting deposits that is situated between the two wall-mounted elements or directly on the wall in the flue zone or on the assembly plate of the hood body. It is useful for collecting the deposits and as an aesthetic element (maximum load 3 kg).

External motor for extraction
If possible, it is installed fixed to the outside of the building on the side that is less exposed to atmospheric agents. A drain must prevent the conveyed extraction vapours from leaving marks on the wall.
In the case of **a combined external extraction/delivery motor,** the diameter of the air-intake inlet must be less than that of the outlet. The air intake must acquire great speed thanks to this narrowing so that it can make the **vapours** suspended near the ceiling circulate and make them flow towards the hood.
A built-in valve always regulates the correct ratio between air intake and discharged air at every respective load level.

Make sure that the top edge of the unit does not impinge on the air intake and shut off the air flow!

Air-extraction conduit
If it is not suitable the operating efficiency of an extraction hood in perfect working order may be considerably impaired. **Use therefore always just one type of piping** (with smooth inner wall **and use only that type of piping** as far as the external motor without adding elements that increase resistance!

Air-extraction fitting
The fitting is located on the fan outlet and in certain types of hood a clip-on reduction unit or ‘converter’ transforms its shape from rectangular to round so that it can be adapted to the rest of the conduits system.

Extension of air-extraction pipe
As the manufacturer does not know how the extraction hood will be used sometimes only the aluminium hose pipe is supplied that is required for recirculating the air without any extension going beyond the hood zone. A set of extensions is available that with the help of a connecting ring and clips for the hoses enables a multiple extension to be obtained. However, a word of caution must be given here: **increasing the length of the air-extraction pipe** also increases piping resistance and therefore **diminishes hood power!**

Flat conduit
This type **air-extraction conduit** is not popular with fitters because the **change from a round to a flat cross-section** that may become round again at the external motor causes **significant losses** (up to more than 30 %). Nevertheless, it remains an essential element in the construction of furniture because it can be 'hidden' much more easily above the kitchen furniture than can a round pipe of the same diameter (see also the chapter 'Air change index').

Cable extension
In certain types of hoods (fan modules) the control model can be dismantled and be refitted in another place chosen at will. Cable extensions that can be easily installed exist for this purpose.

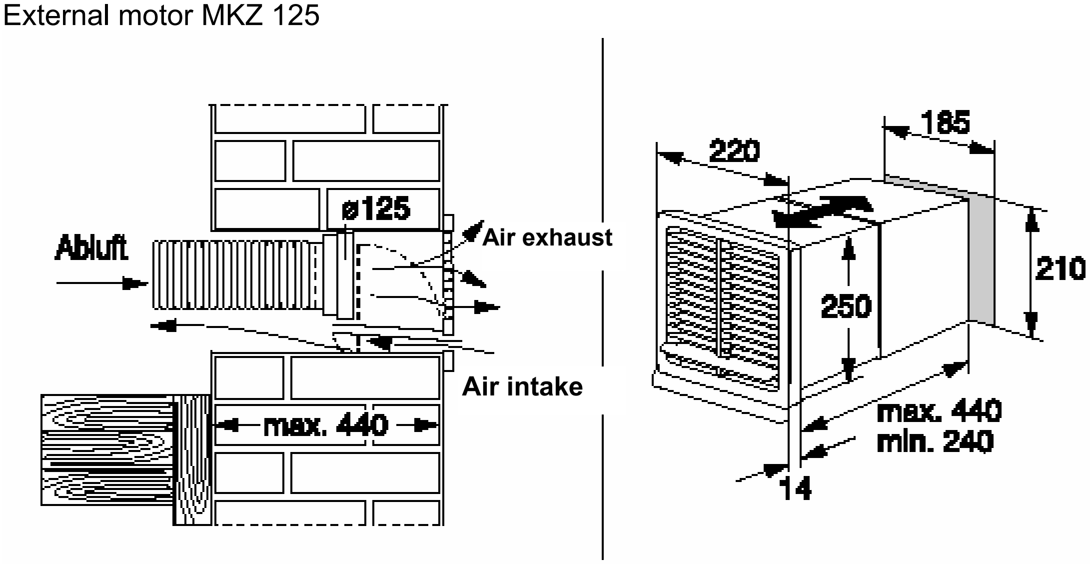
Condensate separator
If for constructional reasons the **discharged air has to be extracted through rooms at different temperatures, condensate formation** in the colder zone must be considered. This unpleasant side effect can be counteracted by the evaporation principle by conveying the condensate into a receptacle filled with sand (with a very large evaporation surface) or by returning it in the form of thin vapour to the extraction system through a condensate collection basin with a circular space with a thin wall. It is sometimes sufficient to efficiently insulate the coldest section.

External motor
During extraction an external motor must provide aeration. Depending on specification, this may be telescopic or may be adapted without steps to the thickness of the masonry. **The best assembly place is the external wall of the building that is the least exposed to atmospheric agents** (see also the chapter 'Ventilation systems')
The variations in extraction/delivery always ensure that there is the correct air intake for the room to be aerated regardless of the level at which the extraction hood is running. An insert between the inlet and the outlet prevents stale air from being aspirated. In addition, a drain above the outlet edge prevents the condensate that is accumulated from getting deposited on the wall of the house.

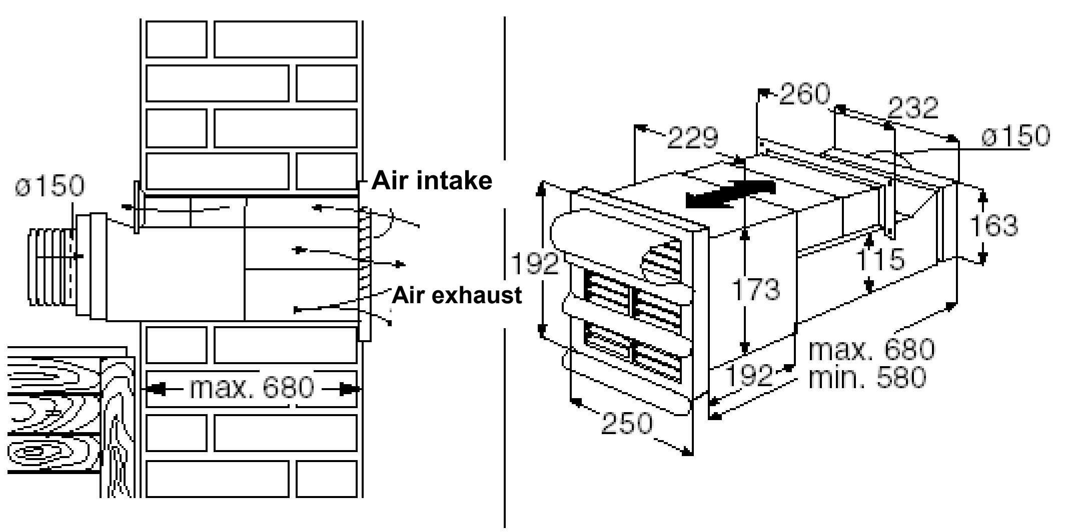
The external motors are available in three main connection sizes:
– for 125 mm nominal width
– for 150 mm nominal width
– for 200 mm nominal width

An external motor with a nominal width of 125 mm can be adapted to diameters that are immediately below 120 and 100 mm using a reduction unit.
In both cases the dimensions are provided with clip-in inserts or fixed measurements.
Modern extraction hoods with two motors with **separate discharges must on no account be connected by means of a so-called three-way Y joint**. In theory, the extension pipe should have a diameter of almost 200 mm in order to be able to evacuate both partial flows without greater resistance. Specialised shops therefore provide special external motors whose modular construction enables separate air-extraction conduits to be connected.
Alternatively, it would be possible to fit **two 'smaller' external motors located next to one another or one above the other.** A common covering frame would improve visual appeal somewhat (as well as complying with the 'constructional standard for the facade').

External motor MKZ 125



External motor MKZ 150



Frame

In most cases the extraction hoods are supplied with a support frame (and instructions on frame) for the active-carbon filter. This frame must be assembled in the chamber of the filter in the body of the hood for the recirculating operation.
(All too often however, this frame is thrown away together with the packing material!).

Check valve/stagnation valve

To prevent a return of odours from adjacent units or of the air current when the motor stops these types of valve are often used. They are also used in several different appliances that work as part of an overall system. These valves nevertheless have the disadvantage that they **'knock' in the presence of uncontrolled air currents.**

Care and maintenance

The extraction hood will operate reliably only if it is sufficiently well looked after. If the user of the hood follows the advice and recommendations that follow he will certainly avoid a few call-out fees for visits from maintenance engineers.

- Before carrying out work in or near the extraction hood always disconnect it by **pulling out the plug from the socket and switching off the master switch.**
  - To **clean the casing,** the control items, the lamp covers and the filter frame never use corrosive or abrasive agents or hard cleaning objects (brushes, etc). Always use soft clothes and delicate detergents, regardless of whether the surface is painted or is in steel alloy or aluminium.
  - **Steel alloy surfaces:** the Customer After Sales Service has a special detergent for chromed and steel surfaces. It has conserving properties that make it much easier to look after the product over a given period of time.
- Also inside the appliance, behind the filtering elements the hood can be easily cleaned. The very thin vapours of the kitchen always reach even the most inaccessible parts and after a little time they will certainly become deposited even in these points.
- Take the utmost care not to damage the motor/fan unit or the current cable with **pointed sharp objects.**
- At least every four weeks (depending on the intensity of cooking!) clean the metal grease filter. Soften it for about an hour in hot water with a detergent to dissolve the grease and then rinse with hot water or clean in the dishwasher using the heavy duty programme (the dishwasher must not contain any other objects!). Once the filter is dried, refit it.
- After three or a maximum of four months, again depending on cooking intensity, the **active-carbon filter** must be replaced (only for recirculation mode). Other types of filter can be cleaned and regenerated. In all cases, follow the manufacturer's instructions.

- If the fan operates irregularly and makes a whining noise the problem normally ceases when the motor reaches nominal rpm. Nevertheless, if irregular operation at all levels is observed after years of service this may due to grease that has accumulated on the fan vanes and has caused imbalance because the filter has been replaced incorrectly. In such cases the extraction system is no longer completely free and the increasing piping resistance also leads to a loss in power. The **Customer After-Sales Service** will have to be called out!

Models and specification sheets

The properties and characteristic elements of an extraction hood are described in sales brochures available in the specialised store.
By way of example, a description of an extraction hood with flue now follows.
The **diagram of characteristic curves** is particularly important. It provides particularly significant explanations of the operating behaviour of an extraction hood when it is actuated at different operating levels or is fitted with a fitting for air extraction with a non-standard diameter. There is always power loss when the counterpressure ratios are changed because of the reduced dimension of the extracted air outlet.
At the same time, on the noise axis, all the variations of perceived noise intensity can be followed.
The **characteristic blowing curves** are created at the moment that the appliance is 'born'.
We already know at what moment which motor-fan combination is used, how the motor impeller and fans (ball or radial bearings) are supported, and the **geometry** of the mobile vanes of the airscrew. The geometry of the housing is also known down to the measuring method specified by DIN standards but we know nothing about what happens **after** the issuing of the measuring regulations.
That is why these characteristic curves are plotted according to a comparable unified method.
The entire system is completed by the 'small attachment' that must not be underestimated, i.e. the air-extraction conduit. The parts that are required to make it such as bends and hoses to the external motor all have their own autonomous **characteristic.** In this case we speak of the **characteristic conduit curve**, which describes overall resistance. It provides the basis for calculating the flow volume in function of the respective static pressures and clearly shows that it is based on a second-degree function. This simply means that doubling flow volume quadruples resistance in the **air-extraction conduit**.
Depending on its design, each extraction hood has one or more **operating points** (also known as **work points**). They are the intersecting points of the two characteristic curves of the **fan and air-extraction conduit**, which were put together in a diagram. At these points the **index of stale air change** is exactly determined.

Diagram of characteristic curves

A diagram (shown in simplified form by way of example) of the characteristic curves provides ample explanations of the behaviour of an extraction hood under different operating conditions.
Curves A, B and C are the **theoretical characteristic pipe curves** that are normally found in air-extraction pipes measuring 100, 125 and 150 mm. They become steeper the smaller the diameters but also the poorer the quality of the pipe (corrugated plastic house, variation in diameter, many bends, etc.).
Curves X, Y and Z are the **actually calculated characteristic fan curves**, in this case for all three load levels. They clearly show that in an ideal situation, i.e. with counterpressure of zero Pascal, best fan performance is achieved at about 265, 360 and 460 cbm/h. Unfortunately, the ideal situation does not always occur because the flow is normally braked by the 'foreign bodies' such as pipes, bends and external motors. The intersection points (work points) of the characteristic curves concerned show how powerful the 'braking' process can be just by reducing the diameter from 150 to 100 mm:

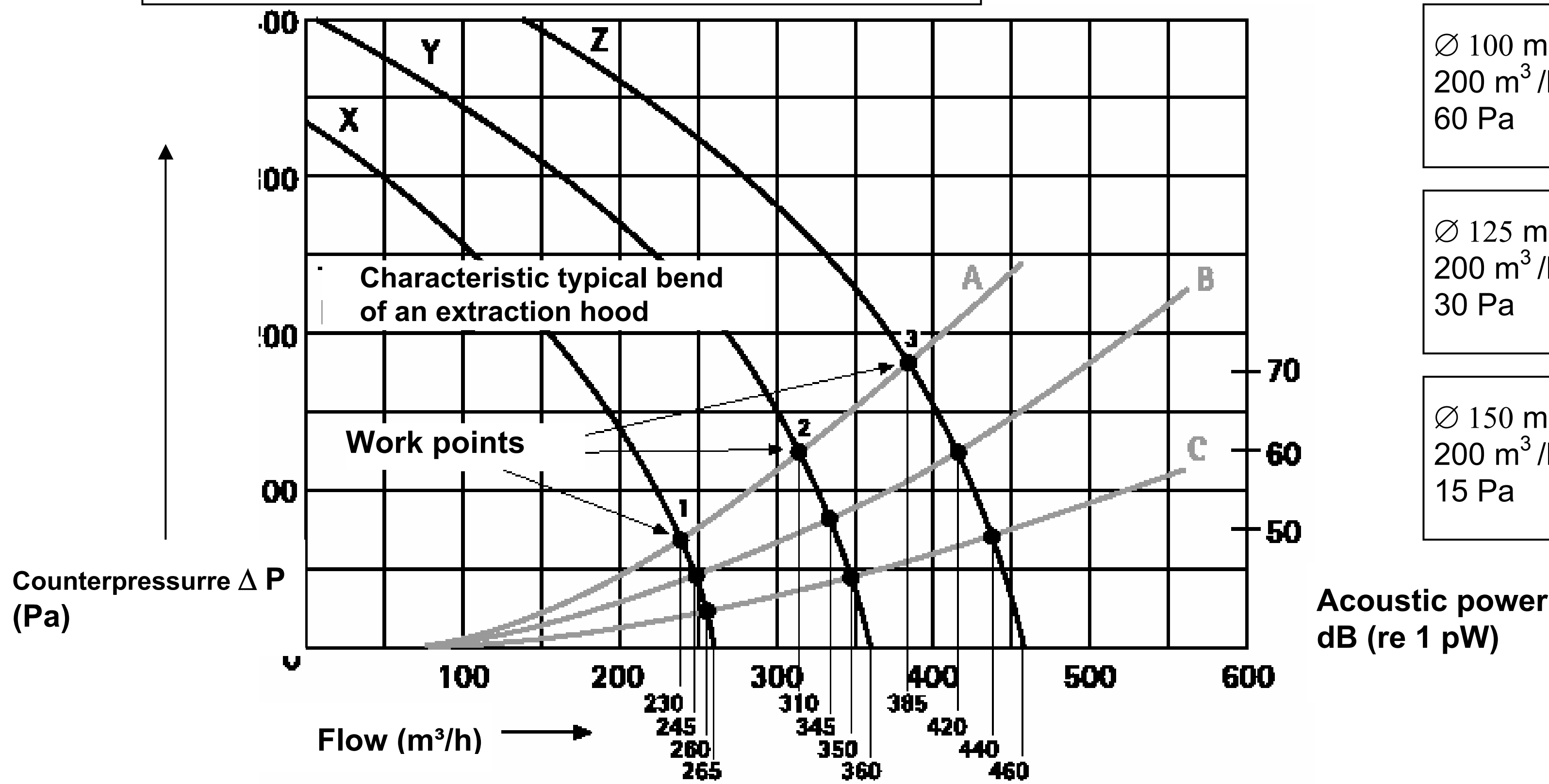
Work point diameter flow	**Air-extraction pipe mm**	**min./norm./max. cbm/h**
1/2/3	100	230/310/385
1/2/3	125	245/345/420
1/2/3	150	260/350/440

If we consider only cases in which the maximum nominal volume of 460 cbm/h (corresponding to level 3 and a diameter of 150 mm, with noise of only 49 dB, virtually a whisper) has to be 'crushed' by an external motor (that may still exist) with a system of pipes measuring 100 mm in diameter, there is a sudden power reduction of about 13% and the noise level is about 70 dB.
If this system of air extraction, which diverges from the almost ideal constellation, is subjected to heavy duty by using elements that increase resistance, in an instant said 13% losses increase by 30% or even by 60% or even more (see page 4, 'Comparison of different types of pipes')!
The curve characteristic clearly shows that any further attempt to obtain greater power at the same high operating level is doomed to miserable failure. Only greater loss and increased noise would be achieved.
CONCLUSION: a high flow rate requires as little resistance as possible in the pipe (see page 19, 'Air extraction' and page 22, 'Losses').

Diagram of characteristic bends

Actual characteristic bend of an extraction hood X. Y, Z (load level 1, 2, 3)

Characteristic theoretical bend of conduit



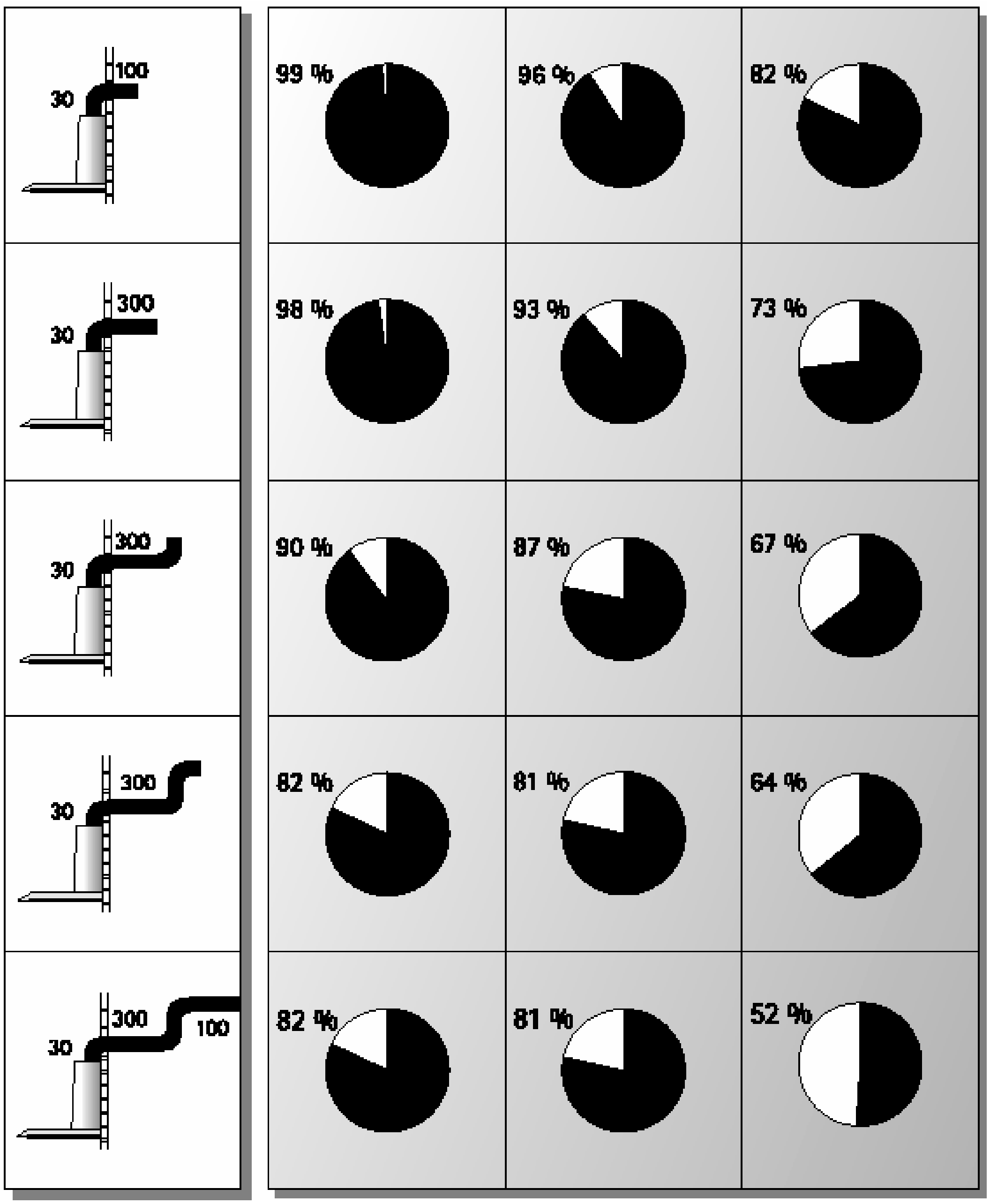
∅ 100 mm
200 m^3/h
60 Pa

∅ 125 mm
200 m^3/h
30 Pa

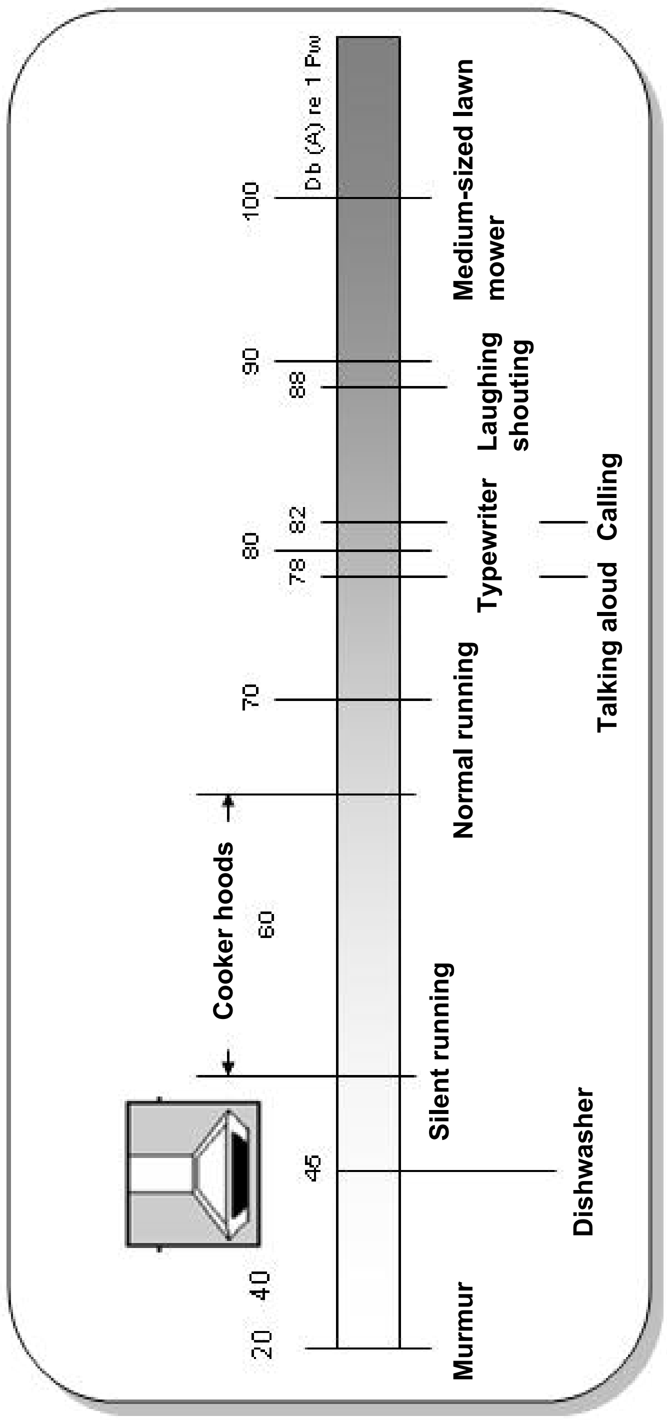
∅ 150 mm
200 m^3/h
15 Pa

Assembly situation

	Plastic discharge	Aluminium hose	Corrugated hose

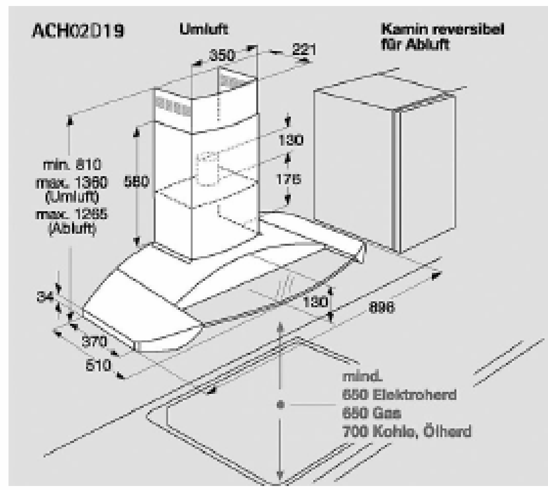


With growing power (greater pipe resistance) and smaller pipe diameters, losses increase proportionally.


Db (A) re 1 Pw
20
40
45
60
70
78
80
82
88
90
100
Cooker hoods
Murmur
Silent running
Dishwasher
Normal running
Typewriter
Talking aloud
Calling
Laughing
shouting
Medium-sized lawn
mower

Example taken from a sales document

Model: 2060 D-m	Constructional form: wall-mounted extraction hood
Variations: steel alloy	Type of operation: air extraction



Specification

Material	steel alloy
Number of motors/fans	1
Weight	21.4 kg
Extraction hole	nominal diameter 150/125 Ø mm
Operating voltage	220-240 V
Total maximum power intake	215 W
- motor	135 W
- lighting	4 x 20 W
Bulbs	halogen

Index of air change in aspiration version (extraction)

Conforms to DIN EN 61591	Min.: 200 m³/h
	Max.: 348 m³/h
	Intensive: 535 m³/h

Free blowing: 574 m³/h

Equipment characteristics

- Grease filter	2 pieces / metal
- Control elements	short-stroke switches on front
- Power adjustment	4 levels (3 + intensive)
- Control regulation	5/15 minutes
- Filter saturation indicator	optical

The diagrams of the characteristic curves are available on request from AEG.

Design checklists

First information that needs to be obtained

• Layout of kitchen with position of cookers
• Could the extraction hood be bigger than the cooker?
• Calculate the volume of the room (base x height) ---> power reserves (without calculating volume of furniture)!
• Recirculation or extraction?
• External extraction/delivery motor: visual appearance of facade (permission from neighbours/planning permission required)
• What constructional form is required?
• Detached house, owner-occupied or rented accommodation?
• Arrangement/number of doors and windows
• Building's extraction system
• Other ventilation systems and aeration of premises (ventilation recesses, wall-mounted fans, etc) ---> if necessary, obtain authorisation from a qualified flue and chimney technician for your area.
• Are other heating appliances connected to the flue (oil/coal stoves, heating stoves, gas water heaters, etc)? (see Regulations governing appliances powered with energy other than electric power!)
• Other domestic appliances present (microwaves, oven, dishwasher, refrigerator, washing machine, etc)
• Cooking habits (user cooks a lot/a little, boils/roasts/fries
• Expectations of hood
• ....
• ....
• ....
• ....

Replacement requirements

• Supplier of previous appliance (kitchen furniture manufacturer, specialised market, second hand, etc)
• Information on previous extraction hood (age, size, power, operating mode, brand)
• Connection system (material, diameter, length, number of bends)
• Cooking habits/frequency of previous use
• Intervals/frequency of filter replacement
• Reason for new purchase (what was wrong with the previous purchase?)
• Frequency of faults in the previous hood (after-sales call-outs, reasons)
• Were special permits required?
• ....
• ....
• ....
• ....

Basic questions

(For the solutions, see page 62)

The finest and most expensive extraction hood will not be worth the money you paid for it unless you follow certain basic rules of ventilation technology! Here are some questions on these rules.

1. What is the ‘conversion factor f’?

2. What minimum and maximum power in m³/h must be provided by an extraction hood to effectively aerate and ventilate without draughts a kitchen that is 2.50 metres high and has a surface area of 8 metres? What is the calculation formula?

3. What % reserve is required to calculate fan power? Why?

4. List at least seven points that ensure silent operation of the extraction hood!

5. How are the minimum distances from the hobs defined? Who sets them and what do they depend on?

6. What happens when an extraction hood recirculates air?
a) It runs much more quietly because a much thicker active-carbon filter has been inserted instead of the metal grease filter (damping effect).

b) It becomes noisier because of greater resistance to aspiration that arises after the active-carbon filter is inserted?

c) Power is improved because it does not have to convey air to an extraction pipe.

d) A small amount of power is lost because an extra carbon filter is inserted.

7. The degree of filtering of an active-carbon filter increases if the hood is switched on 10 to 15 minutes before starting cooking. Is this true? Why?

8. What should be the appearance of an 'air-extraction' section in a hood with a flat screen? What does it consist of?

9. If other appliances using naked lights are running at the same time (boilers and water heaters with open chambers, oil/ceramic heaters, etc) as a hood that recirculates air must the regulations regarding appliances powered by energy other than electricity be strictly followed?

10. What do the regulations for appliances powered with energy other than electric power state?

11. Can active-carbon filters be cleaned and regenerated? If so, how and how often?

12. What kind of operating mode is advisable if the design characteristics allow it?

13. What are typical errors that my arise during the design phase?

14. What is active and passive soundproofing?

15. Can a second fan that is installed in the same ventilation system increase the stale air change index? Which characteristic tells us something about this?

16. Can the rotation direction of a fan motor vary during operation? If it can, what additional steps must be taken?

Solutions:

1. This indicates how often in an hour the air must be recirculated in a room so that it is sufficiently changed. The empirical values range from a minimum of 6 to a maximum of 12. The minimum value ensures continuous silent operation and the maximum value also ensures extraction of the strongest odours.

2. Flow Q in m^3/h = volume of room V x conversion factor f (Q = V x f)
Q_{min} = 2.5 m x 8 m^2 x 6/h = 120 m^3/h
Q_{max} = 2.5 m x 8 m^2 x 12/h = 240 m^3/h

3. When determining hood power, a power reserve of about 20% must be calculated because during the design phase in most cases we do not yet know the exact composition of the air-extraction pipes. Power may therefore be diminished by, inter alia, the following characteristics:
• air-extraction pipe too long
• change of pipe from round to flat
• decrease in diameter of air-extraction pipe
• more than two 90°bends
• use of plastic hoses.
In the example indicated in point 2 the power requirement should be defined between approximately 280 and 290 m^3/h.

4. • Air-extraction pipe with smooth internal wall
• air-extraction section as short as possible
• no more than two 90°bends
• instead of one 90°bend, two 45° bends should be inserted
• do not change from round to flat conduit
• there must be no ‘needle eye’ at the end of the air-extraction section (external motors too small)
• use of double-grooved fans
• extraction fan with two motors (can run more slowly and therefore more silently)
• if the power reserve is sufficient, operation is more silent in the bottom sector
• The discharged air needs to be replaced by a sufficient quantity of delivered air (in a slightly lower quantity in order to achieve faster air speed).

5. In general:
Electric and gas hobs: 650 mm
Coal and oil: 700 mm
The exact distances depend, however, on the respective type of extraction hood. They are defined by the manufacturer on the basis of the components used and are given in the relative assembly instructions.

6. Answers b and d

7. Yes, absolutely right! The granulate of the active-carbon filter may expand under the action of the humidity and of the heat of the air flows into the room and ‘activate’ the pores so that they open. The odours can thus be deposited in the pores as soon as they have been produced by the cooking process.

8. The air-extraction pipe must pass through the wall-mounted element and the outlet must be fitted with an adjustable grille whose front part faces away from the ceiling and the rear wall. Very often, the adjustable grille is not fitted, so that the flow of extracted air knocks ‘indirectly’ against the ceiling. Apart from the dirt, the greater dynamic pressure diminishes the power of the extraction hood.

9. No, not if the air is recirculated! Unlike evacuation operations, in this case there are no differences in pressure that might affect the naked light (removal of oxygen!).

10. In the case of contemporary operation of an extraction hood and other appliances powered by a naked light (gas, coal, oil, etc) in the same room negative pressure must not exceed 0.04 mbar.
This can be prevented by making a fixed opening in the room measuring about 500 – 600 cm². Authorisation from a qualified flue and chimney technician for your area must be obtained.

11. Normally no. Exception: those marked in the sales documents. This can be regenerated and reused for about three years provided that it is regularly cleaned, i.e. twice a month. It is washed in an (empty) dishwasher at 65°C and is dried in an oven for 10 minutes at 100°C.

12. Extraction because the air can be cleaned more thoroughly by extracting undesirable impurities from the air.

13. • Reduction of the diameter of the air-extraction pipe
• too many bends (max. two if possible); 90°bends instead of 'gentle' bends (1 bend ---> loss of 12 – 20%!)
• 'cheap' materials (plastic hoses)
• air-extraction routes too long
• change from round to flat pipe (loss up to 32%!)
• power requirement incorrect or has not been calculated at all (Q = V x f)
• too much or too little air delivered

14. • Active: separation of noise between 'source of noise' and casing.
• Passive: gluing of soundproofing on parts of casing.

15. No! It would be a mere coincidence because each fan has its own 'individual' characteristic bend. In practice, this can never coincide with another one because of the different constructional elements such as, for example, motor winding, type of impeller support, geometry of vanes and composition of the material. By doing so, the continuous 'give and take' would result in very poor performance and would create a very instable ventilation system. Only completely identical characteristics could increase power.

16. No! Fan rotation direction cannot be changed but the direction of air extraction can be changed. This incredible phenomenon may occur, especially when using cheap extraction pipes or too high a pipe resistance, the oscillation of the air column resonates with the column of the air-extraction system. The flow direction may thus suddenly change so that the air flow is pushed back into the hood through all the fissures. The motor continues to run at reduced power. In such cases never switch the polarity of connection clamps of the three-phase motor! The air-extraction system must therefore be stabilised (stiffer pipes such as hoses in aluminium or plastic extraction pipes).

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