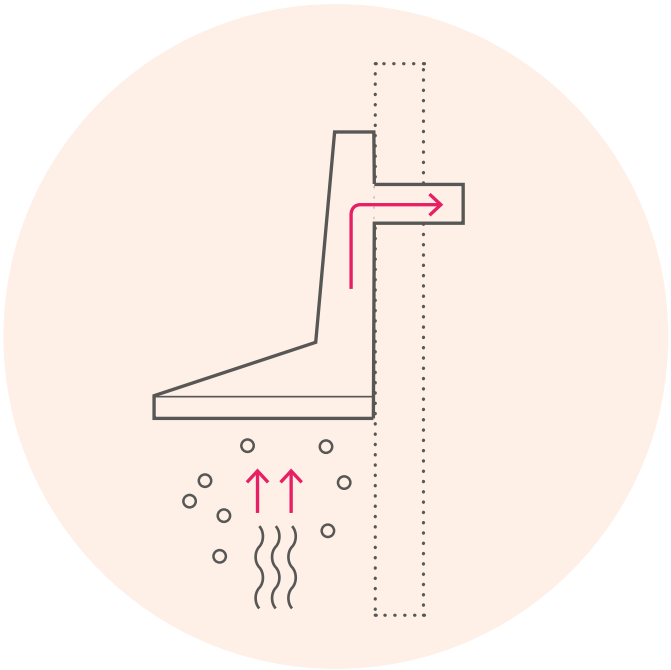
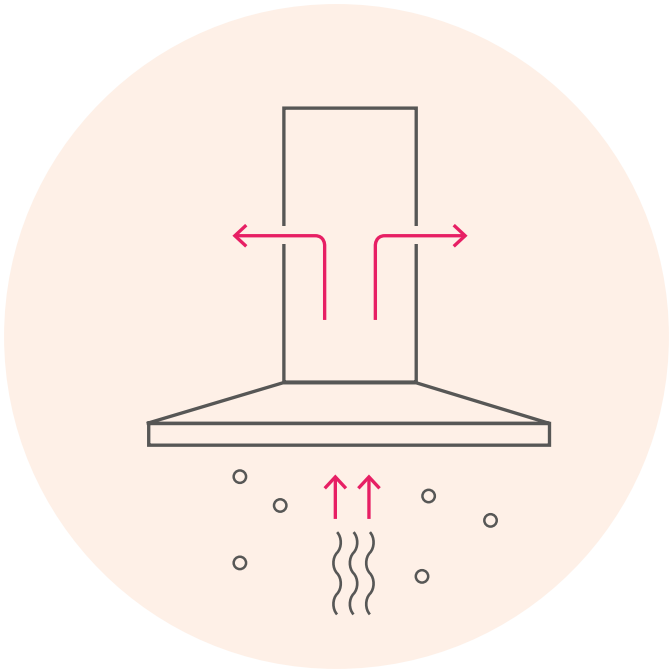
Guide to extractor systems for kitchens





Recommendations for planners, consultants and users

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Ventilation technology

Implementation of extractor systems—safe, efficient and convenient planning

Guide to extractor systems for kitchens

The entire package matters

Odors, grease and moisture produced during cooking should not make their way to the living room. To remove or neutralize these as completely as possible, a powerful kitchen ventilation system alone does not suffice. Too many factors determine the efficiency and performance of the overall system. After all, moving air is a special medium. To define the optimum for users of modern kitchen technology against the background of current and future building standards, the authors of this research have carried out a large number of studies, researched the fundamentals and made calculations. This brochure summarizes the main results and includes some surprising ones. In summary, they provide important information that can be used to plan and implement all types of kitchen hood and vent systems in an efficient, energy-saving and convenient way.

The Institut für Holztechnologie Dresden and the ITG Dresden Institute for Building Systems Engineering as well as the Passive House Institute, Darmstadt, which was also responsible for project management, were involved in the study. The technical partners included Naber GmbH, a manufacturer of kitchen accessories, a supplier of kitchen ventilation systems and a manufacturer of kitchen furniture.

Projectpartners

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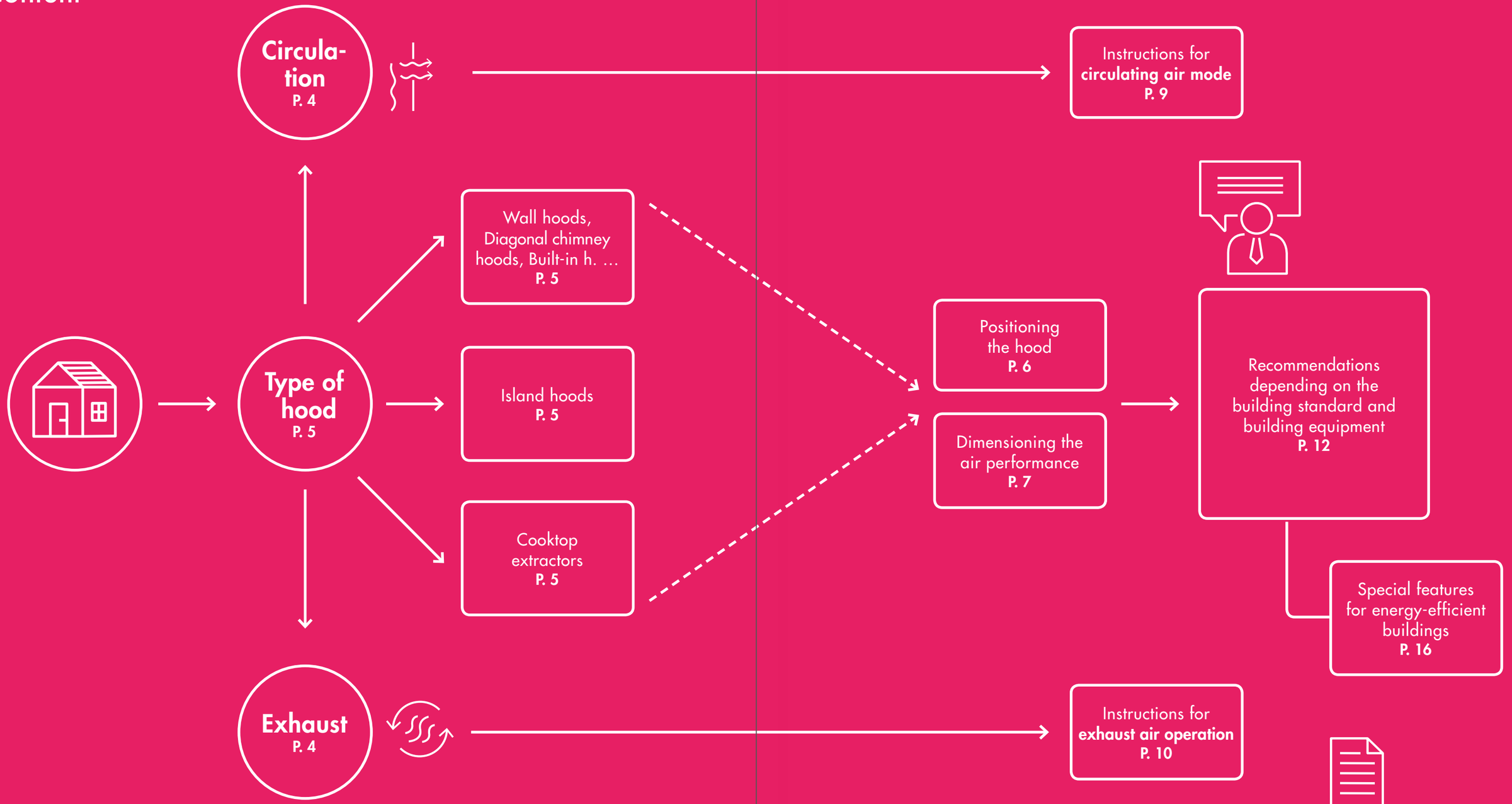
Overview Content



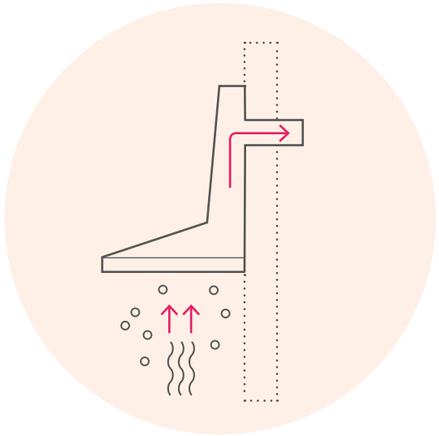
Guide to extractor systems for kitchens

1 Overview of available extractor systems

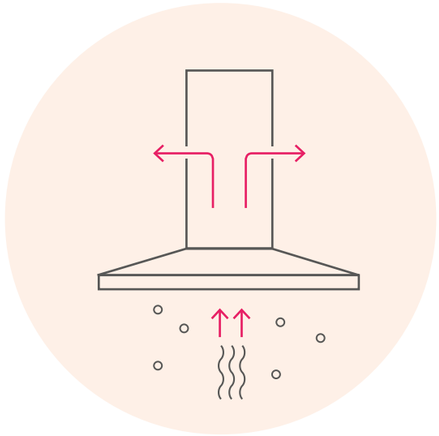
Exhaust vs. Circulation

Most extractor systems can be operated either as circulating or exhaust air units. The recommended operating mode depends on various criteria, which will be discussed in the following sections.

EXHAUST AIR OPERATION



CIRCULATING AIR MODE



• The extracted vapour* incl. moisture and odours is led to the outside.	• The extracted vapour is filtered and returned to the room.
• The air volume flow has to be returned to the room by means of suitable measures.	• Moisture is not taken away, so this extraction system should provide a basic air exchange in the kitchen.
	• The removal of odours depends on the efficiency of the filter system, the maintenance condition and the type of domestic ventilation.

* Cooking vapour from water vapour, aerosols and fats

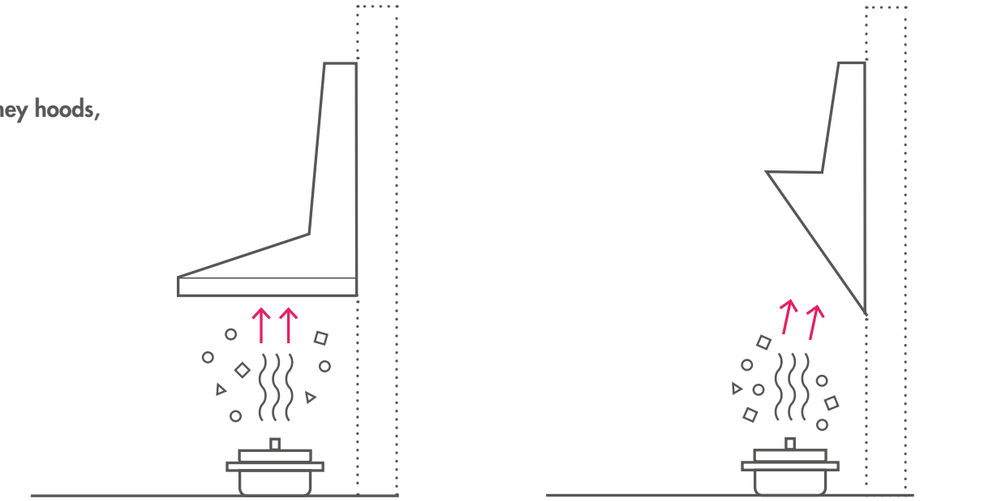
The different designs of extractor systems

In addition, different types can be distinguished. The choice is largely determined by the available space, but also by design ideas and cooking habits.

DESIGNS IN COMPARISON

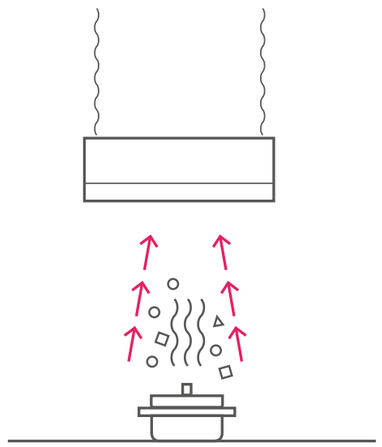
A

Wall hoods, diagonal chimney hoods, built-in hoods



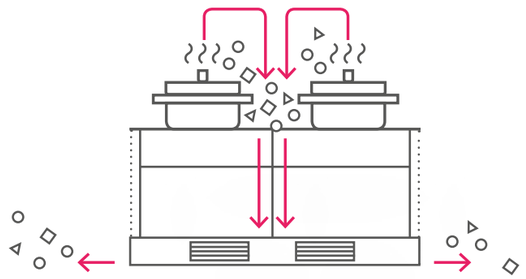
B

Island hoods

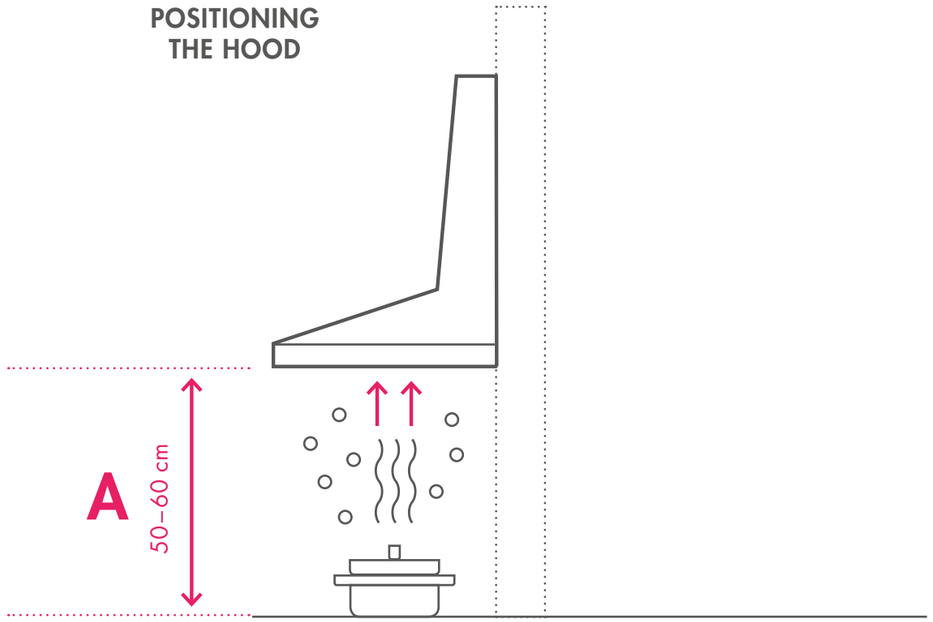


C

Cooktop extractors



2 General planning information



1. The lower edge of the hood is usually mounted at a distance H of 50–60 cm (65 cm in combination with a gas hob) from the upper edge of the hob. **Larger distances should be avoided** as these increase the required exhaust air volume flow. Even a 20 cm higher arrangement of the extractor hood can increase the required captured air flow rate by 20 %*.

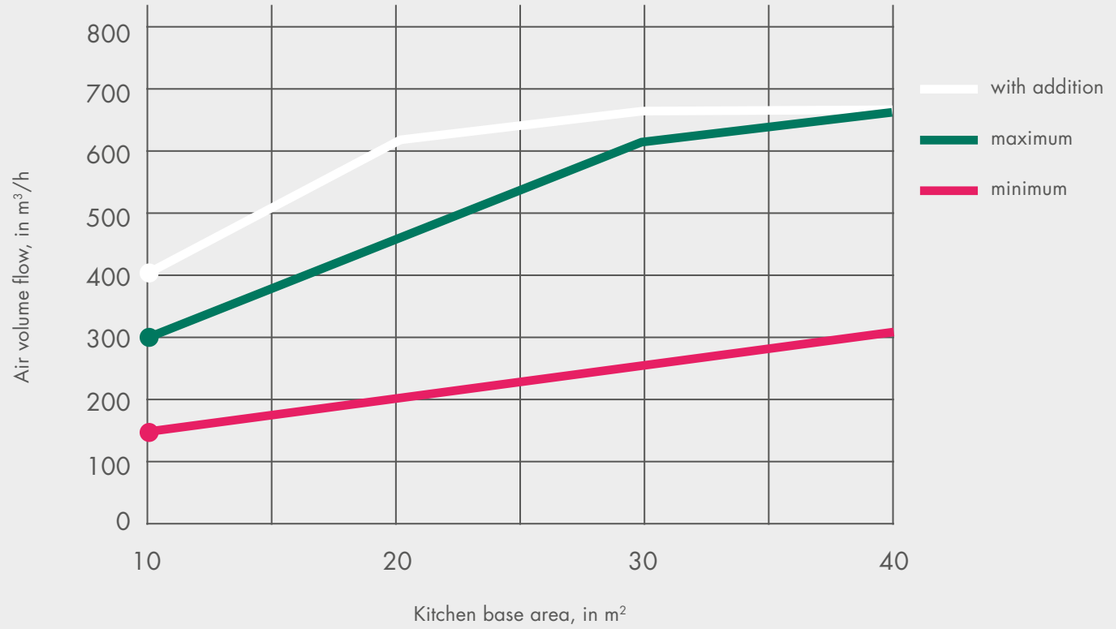
2. **Wall-mounted hoods are preferable to island hoods where possible**, as the capturing of vapours is more stable and effective. With the same capturing, the volume flow of hoods mounted on a wall can be selected approx. 40 % lower*.

3. A **distance** to adjacent furniture according to manufacturer's specifications is recommended to prevent moisture damage to adjacent furniture.

4. **If possible, island or wall hoods are to be preferred to cooktop extractors**. Initial investigations in [BewDunst] (P. 20) showed that the capturing of vapours above the hob is more effective.

* Estimation according to [VDI 2052] (P. 20)

Determination of the air volume flow of extractor systems according to AMK-008, draft 04/2018



Air volume flow (q in m³/h)

A (Kitchen base area), in m²	$q_{COOKZONE}$, in m³/h		
	min.	max.	
	100	150	with addition
	n, in 1/h		200
	min.	max.	with addition
	2	6	8
10	150	300	400
20	200	450	600
30	250	600	650
40	300	650	650

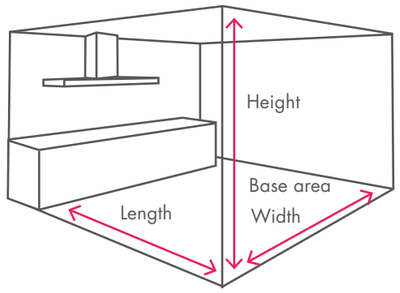
* The addition is recommended to compensate for loss of performance. e.g. by odour filters and if the exhaust air routing is not optimal.

assumption h=2,5 m

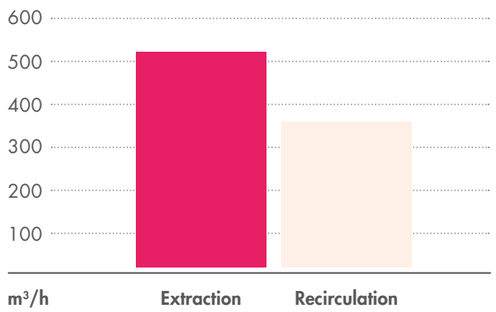
Dimensioning the air performance

Usually, the air volume flow for the extractor system is dimensioned according to the floor area of the kitchen or according to the room volume and the resulting air change, see illustration [AMK] on page 7. In larger kitchens with large dining areas or open kitchens, the process inevitably leads to very high-volume flows, since the process is oriented towards reducing odours in the room, whereby it is assumed that odours enter the room as a result of cooking.

The primary goal, however, is a good capturing of the cooking vapour in order to minimise the spread of odorous substances into the room as far as possible. A good capturing of kitchen vapours is therefore essential in order to effectively reduce the room air pollution caused by cooking processes. The capturing of vapours is largely independent of the floor area of the kitchen, but is significantly influenced by room air flows.



Maximum air flow with the same devices

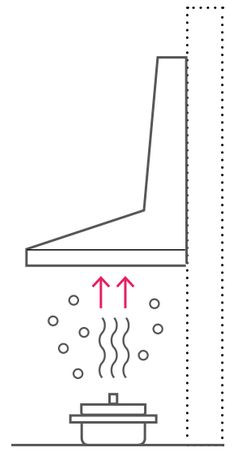
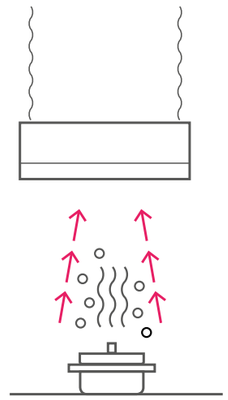


The volume flow required for a good capturing of vapours is rather determined by the position of the extractor hood in the room and the design of the extractor hood. Other decisive factors for exhaust air systems are the length, adapted cross-section and aerodynamic design of the exhaust air duct.

Rough calculations (cf. table on page 9) show that the actual required captured air flow rate for hood systems with good collection can be significantly lower than for designs of the air performance according to the kitchen floor area (cf. table on page 7). Here, the capturing is mainly influenced by the arrangement of the hood in the room and the sensitive heat output of the hob. Current measurements confirm this [BewDunst] (P. 20).

Relative estimation of the required captured air flow rate as a function of the arrangement of the hood in the room and of the hob

based on [VDI 2052]

Hob	Hood arrangement			
	Height H above hob [cm]	Wall hanging 	Freely suspended (island solution) 	Required capture air flow as a percentage of reference value[1]
Gas / electric	80		×	100 %
	60		×	80 %
	80	×		65 %
	60	×		50 %

1 Reference value for the required captured air flow rate = 350 m³/h for gas cooker: 2 hobs in operation with 2 × 2 kW power, height H above hob 80 cm, freely suspended, complete capturing of the thermal flow, no cross-flow

Would you like to view the topic of exhaust/circulating air from a completely different perspective?

Then follow the Steinmeiers through the world of cooking—from the Stone Age until today! Our video is a lot of fun and gets to the point of kitchen ventilation.

The video guide:
www.compair-flow.com/correct-and-safe-planning-of-extractor-systems

Instructions for circulating air mode

Additional hygienic air exchange required

No moisture loads are taken away in the circulating air mode. According to [DIN 1946-6], an exhaust air volume flow of 40 m^3/h is recommended to prevent moisture damage. Depending on the size of the kitchen, this corresponds to an air exchange of approx. 0.5 to 2 $^{h-1}$. This can be ensured by a centralised or decentralised ventilation system. If such a system is not available, the basic change has to take place via manual opening of the windows.

Follow-up time

A follow-up time of 5–10 minutes for drying the hood system (especially the activated carbon filter) is generally recommended.

Energy efficiency

In contrast to exhaust air systems, circulating air systems do not require an energy efficiency class. Initial investigations indicate that the quality of the activated carbon filter has a major influence on the energy efficiency of circulating air systems.

Special features of cooktop extractors

- In case of a cooktop extractor, the vapour is extracted downwards by the system and fed into the base area of the base unit.
- To prevent moisture damage, it is recommended that the circulating air is led out of the base area in a closed air duct system. The circulating air outlets (grilles) must not be obstructed or blocked.
- The recirculation of air into the base area without ducting to the outside of the piece of furniture is expressly not recommended here to potential moisture and mould damage.

Maintenance/degree of odour reduction

To ensure that the recirculation filters function properly, they have to be regenerated or replaced at regular intervals in accordance with the manufacturer's recommendations. Users should be informed of the need and follow-up costs.

Used circulating air filters have lower degrees of odour reduction. The investigations indicate considerable differences in the activated carbon filter systems [BewDunst].

Pressure losses/ noise emission

Circulating air filters represent a high flow resistance and therefore lead to an increased pressure loss. Comparative investigations showed a reduction of the effective volume flow at the hob of up to 25% [BewDunst] (P. 20).

Instructions for exhaust air operation

Additional flow

Sufficient additional air flow has to be ensured, otherwise an inadmissible negative pressure may occur in the kitchen. The additional air flow can be reached by:

- Opened window (manually opened or via window contact coupled to the extractor system)

- Controllable outdoor air apertures

- Intake air wall-box frame

- Exhaust-air-supply-air-wall-box

To avoid odour transmission, additional air flow should not be allowed from adjacent rooms (e. g. air from bath/WC).

Channel length / pressure drops

The flow cross-section and the length of the duct have an influence on the pressure losses and thus on the effective air volume flow. In the case of high pressure drops, the indicated volume flows are not achieved. The following points have to be observed:

- Shoring of a 150 mm cross-section (Ø 150 mm or equivalent rectangular cross-section)
- Channel length as short as possible with few changes of direction
- Wall-box frame/outdoor air apertures with a large free flow cross section
- Aerodynamically optimised canal systems should be used especially for high-performance systems.

Wall-box frames/ external air diffusers

Wall-box frames/outdoor air apertures should automatically close tight when the extractor system is not in active operation and should not lead to any leakage volume flow. Additional insulation also offers an advantage.

Common operation with ventilation systems

The integration of the extractor system into the domestic ventilation system cannot be recommended for the following reasons:

- Fire protection: possible transmission of fire and smoke, applicable fire protection regulations have to be observed.
- Hygiene: Fat deposits in air ducts
- Design: Domestic ventilation systems are usually designed for air volume flows in the order of 100 to 200 m^3/h, for extractor systems air volume flows of up to 650 m^3/h are permissible and common.
- If the exhaust air extractor system without additional air flow is operated simultaneously with the supply/exhaust air system without additional air flow, heat recovery deteriorates.

Common operation with fireplaces

In principle—especially in modern, high-density buildings—the use of room-air-independent fireplaces is recommended, which have a separate combustion air supply and are therefore less sensitive to negative pressures in the room (maximum 8 Pa negative pressure permissible).

The joint operation of an exhaust air extractor system and a fireplace (in particular depending on the room air) is relevant to safety, as an impermissibly high negative pressure in the installation room of the fireplace can cause flue gases to escape into the room.

DIN 1946-6 Bbl. 3 and Bbl. 4 requires a maximum permissible negative pressure of 4 Pa and the installation of suitable safety devices for the joint operation of ventilation systems or exhaust air extractor systems with room air-dependent fireplaces:

- Ensuring an exclusively reciprocal operation
- Common operation with differential pressure monitoring or position monitoring of the supply air opening

3 Recommendations depending on the building standard and building equipment

What kind of building is concerned?

- ○ New construction in accordance with current energy-saving legislation (EnEV, GEG)
- ○ New construction as an energy-efficient or passive house
- ○ Outstanding amounts

Tendency: In principle, both exhaust air and circulating air extractor systems are permitted for all building standards. **There are no legal restrictions** on the use of a particular type of extractor depending on the building standard.

For buildings with a very low heating requirement (e.g. passive house and efficiency house 40) it is nevertheless recommended to opt for circulating air extractor systems, as the energetic influence of exhaust air extractor systems is relevant, especially for small residential units. The next section shows under which boundary conditions exhaust air extractor systems are possible.

Is a room air-dependent fireplace available or planned (chimney, gas boiler)?

- ○ Yes
- ○ No

Tendency: If a room air-dependent fireplace is present, it has to be ensured that no negative pressure is generated in the installation room of the fireplace which would allow toxic flue gases to escape. Since a circulating air extractor system does not cause any pressure changes in the building, it can be easily installed in the building. In the case of an exhaust air extractor system, additional technical measures have to be taken to ensure that the negative pressure is limited to 4 Pa. These include e.g.:

- Differential pressure switch for common operation
- Automatic supply air opening (position monitor) during common operation
- Alternate operation (safe operation by switching off or optional mode where the system cannot be activated if the room air-dependent fireplace is in operation).

Hint: In buildings with a very low heating requirement, a comfort fireplace of any type is not energy-efficient unless it is the main heat supply system. **Therefore, this point can be neglected in this type of building.**

Is there a ventilation unit?

- ○ Yes, a supply air system
- ○ Yes, an exhaust air system or a ventilation system in the bathroom
- ○ Yes, a supply/exhaust air system
- ○ No

Tendency: The additional supply air flow for the exhaust fume extraction system has to be independent of the presence of a ventilation system. For reasons of fire protection and hygiene, the kitchen exhaust air extracted via the exhaust air extractor system should not be integrated into an existing exhaust air duct. With systems generating a negative pressure (exhaust air system or ventilation system in the bathroom or exhaust air extractor system), the safety-relevant aspect in combination with a room air-dependent fireplace has to be absolutely observed.

How much do the annual ventilation heat losses increase due to the use of exhaust air extractor systems?

For domestic ventilation, a distinction is made between operation with and without heat recovery (heat recovery efficiency 80 % or 0 %). In ventilation systems with heat recovery, the relative increase in annual ventilation heat losses due to the operation of the exhaust air fume extraction system is much greater. In absolute terms, the annual ventilation heat losses increase by 156 kWh/a to 657 kWh/a due to the operation of an exhaust fume extraction system regardless of the size of the apartment and the presence of heat recovery. This is equivalent to additional heating costs of approx. 11 €–46 € per year. In the circulating air mode, moisture and non-neutralised odours have to be removed via permanent basic ventilation or window ventilation.

With circulating air extractor systems, on the other hand, additional costs for regular filter changes have to be taken into account. The total costs of both variants are therefore of a comparable order of magnitude.

If **energy-efficient and tight-closing heat retention systems** are used instead of the conventional backwater flaps when using an exhaust fume extraction system, **heat costs are significantly reduced**.

What is the size of the opening for the additional flow in exhaust air systems so that no critical negative pressures can occur in the room?

Extractor systems in the exhaust air mode require an additional air flow, as otherwise negative pressure is created in the kitchen, which is not permitted in conjunction with a room air-dependent fireplace and can lead to critical situations even without fireplaces, e. g. through doors in the air system that can no longer be opened. In general, safety requirements are understood to mean the possible opening of an escape door as a measure against the pressure difference. Critical door opening forces occur in case of a pressure difference higher than 75 Pa. It should therefore be ensured that this value is not exceeded in everyday life. The following minimum cross-sections are required for the additional flow in airtight buildings ($n50 < 0.6^{h-1}$) in order not to exceed a safety-relevant negative pressure of 75 Pa[1]* [BewDunst]:

Size of the usage unit	Exhaust air volume flow	Required diameter of free opening area[2]
20 m²	250 m³/h	130 mm
	500 m³/h	180 mm
	650 m³/h	210 mm
100 m²	250 m³/h	100 mm
	500 m³/h	160 mm
	650 m³/h	190 mm
200 m²	250 m³/h	100 mm
	500 m³/h	160 mm
	650 m³/h	190 mm

1 Safety-relevant limit value for opening doors. In the case of joint operation with fireplaces, stricter requirements apply with regard to the maximum negative pressure (cf. joint operation with fireplaces).

2 Depending on the design of the after-flow damper and additional pressure losses through the damper blade and cover, the required cross-section may also be significantly higher.

Herd or flock: Is the building listed as a historical monument or are there local building regulations?

- ○ Yes
- ○ No

Tendency: In the case of listed buildings (preservation order for external façade) or local building regulations that expressly prohibit the alteration of façades (approval required), a circulating air fume extraction system can be installed without further steps. The installation of an exhaust air extractor system has to be approved by the relevant authorities. Discreet exhaust air blinds, some in the colours of the buildings, are available on the market.

Herd or flock: Have moisture or mould damages already occurred in the building?

- ○ Ja
- ○ Nein

Tendency: In order to reduce the moisture content in the room air through cooking processes, an exhaust air extractor system is recommended, as this transports the sucked-in moist air to the outside. Recirculating air systems, on the other hand, remove odours through the recirculating air filter, depending on the device, partly to predominantly, but the moisture remains in the room.

Conclusion: In the current version of the Energy Saving Ordinance and the Renewable Energies Heat Act there are no references to a ban on extractor systems, particularly in new buildings with high thermal insulation. Similarly, the electricity requirements of the extractor systems are not currently taken into account in the energy balance for the issue of an energy certificate.

Which type of cooker hood is more suitable depends essentially on both the structural boundary conditions and the user behaviour itself.

4 Special features for energy-efficient buildings

In buildings with a very low heating requirement, such as passive houses and efficiency houses, the use of an exhaust fume extraction system can increase the heating requirement of the utilisation unit.

For example, the following criteria apply to passive houses:

Annual heating requirement < 15 kWh/(m²a)

The increase in the heating requirement is not only due to the ventilation heat losses during operation of the extractor hood system: if they are not airtight,

Air tightness of the building envelope n50 < 0,6 $^{h-1}$

the exhaust air dampers and the air intake dampers, in particular, can show significant infiltration losses. Airtight sealing products are available on the market.

Recommendations for buildings with very low heating requirements

e. g. passive house and efficiency house 40

Circulating air extractor systems	Exhaust air extractor systems
are to be preferred from an energetic point of view, taking into account ventilation heat losses and fan power consumption.	are possible. The following points have to be observed:
	• Solutions for the additional flow are to be provided. The exhaust air opening or air vent opening has to be provided with tightly closing closures. Simple non-return valves are not sufficient.
	• Impairments with regard to comfort cannot be ruled out. The aim should be to find solutions that allow the fresh air flowing in to the hob to be introduced in the immediate vicinity of the hob.
	• Extractor systems should be used which limit the running time and reset the max. flow rate after a time interval (automatic).
	• Preference should be given to systems with moderate exhaust air volume flows to ensure a sufficient capturing. As investigations of capturing of vapours have shown [BewDunst], there are considerable differences between the individual products. The air flows required for capturing a defined quantity of vapour differed by up to 60 % in the investigated systems.
	• In small apartments, the additional ventilation heat loss significantly increases the heating demand and also the heating load. Extractor systems should therefore not be used in such types of buildings if the average size of the flat is less than 90 m².

FURTHER INFORMATIONS

Product information as well as maintenance and care instructions from the manufacturers:

Federal Association of the Chimney Sweep Trade Central Guild Association (ZIV)
www.schornsteinfeger.de

Building regulations of the federal states in Germany
www.bauordnungen.de/html/deutschland.html

AMK Arbeitsgemeinschaft Die Moderne Küche e. V.
www.amk.de

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[BewDunst] **Final report of the "Study on the technical, energetic and economic evaluation of exhaust and circulating air extractor hoods in kitchens in energy-efficient buildings",** December 2018

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The responsibility for the content of the report lies with the authors.

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Naber – the original

All the major manufacturers of extractor systems worldwide rely on Naber ventilation systems and components. With Naber, kitchen professionals find solutions for almost every planning and installation task. The in-house development department regularly devises technically and creatively ground-breaking products that make kitchens the world over a little better, more comfortable and more efficient.

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