MAICO VENTILATOREN

Practical guide for comfort ventilation with heat recovery

Information, planning information, sample planning

www.maico-ventilatoren.com

“AIR@HOME” app for iOS and Android

“AIR@HOME” WEB TOOL (www.air-home.de)

VENTILATION CONTROL AND ADJUSTMENT

The browser-based air@home web tool provides the user with smart access to one or more controlled domestic ventilation units[1].

Facility managers, tradesmen or end-users can all have convenient access to controlled domestic ventilation units via tablet or PC. State-of-the-art technology and smart operation.

1 Units with controlled domestic ventilation.

CONVENIENT OPTIONS FOR TENANTS AND HOME OWNERS

For example, residents can also flexibly monitor and control their ventilation unit using the iOS app/Android app and their smartphone.

- Select and set various functions, such as operating mode, ventilation level, weekly time program, summer/winter operation
- Adapt the individual room air quality by setting parameters for the sensor limit values (humidity + air quality)
- Depiction of temperature, humidity and air quality trends and the energy recovered

MORE ADVANTAGES

- Smart handling of the ventilation system by smartphone
- Depiction of the current air quality
- Ensuring an optimum room climate, even when no-one is at home
- Documentation as proof of correct ventilation
- App usage with unlimited end-devices

ADVANTAGES FOR HOUSING COMPANIES

- Simple and flexible unit setting with the web tool
- Support to help the tenant find the right ventilation strategy (for example: usage of home by a single person or by a family of five)
- Perfect control over multiple systems
- Interventions when incorrect ventilation is identified

ADVANTAGES FOR TRADESMEN

- Simple and flexible unit setting with the web tool
- Remote service option

MORE SECURE THAN OTHER SOLUTIONS

All the data transferred with air@home is encrypted. The app never communicates directly with the ventilation unit, but via the secure MAICO server. Should a smartphone be lost or the tenant/end-user change, access to the ventilation units is easy to block and re-issue.

Table of contents

1 Healthy room air quality in homes

A pleasant room climate and hygienic room air quality are essential for healthy living and well-being. And this is the main job of domestic ventilation.

Unpolluted outside air sets the standard for “good air”.

Pollution of room air comes from various sources, including harmful substances which enter the room with the outside air, the persons themselves, as well as construction materials, fittings, home furnishings, heaters, cookers, pets, plants, textiles, foods and household chemicals emit a number of substances.

The most important substances include:

- **carbon dioxide (CO_2)**, that is produced by human metabolism or combustion processes (gas stove, candles, smoking).
- **water vapour**, some of which comes from people and some of which is produced from water evaporated by plants, when cooking, washing, showering etc. A humidity level of between 40 % and 60 % is considered comfortable.
- **odours** from human perspiration or domestic activities.
- **toxic gases and vapours** (nitrogen oxide, hydrocarbons, aldehydes, solvents), which escape from objects and materials or are produced from combustion processes.
- **micro-organisms**, such as bacteria, viruses, mould spores or house dust mites.
- **radioactive substances** from construction materials and the earth.

Achieving a good room air quality requires emissions in the building to be mostly prevented, efficiently removed and adequately diluted.

Research into humidity, CO_2 and odours has found that **30 m³ of fresh air an hour per person is a good guide for the volumetric flow needed to achieve good** hygiene levels.

This figure is also based on DIN 1946-6 “Ventilation for residential buildings”. Depending on the size of living space per person, this means air exchange rates[1] of between 0.3/h and 0.8/h.

Taking into account the unavoidable amount of indoor air pollution from construction materials and furnishings as well as the fact that many materials buffer water vapour and odours, requires a minimum volumetric flow to be designed depending on the size of the home.

If the air volume of a home is used as the gauge for this, the air exchange rate should not fall below 0.3/h.

Controlled domestic ventilation is currently considered to be the only way to ensure a hygienically adequate air exchange, with the sealed building envelope design prescribed by law.

MAICO Ventilatoren develop and produce very efficient and smart ventilation systems with heat recovery at the company’s headquarters in Villingen-Schwenningen, southern German - **“Made in Germany”**.

1 The air exchange rate is the ratio between the exchanged volume of air per hour and the total room volume.

Ventilation in line with the relevant standards

DIN 1946-6

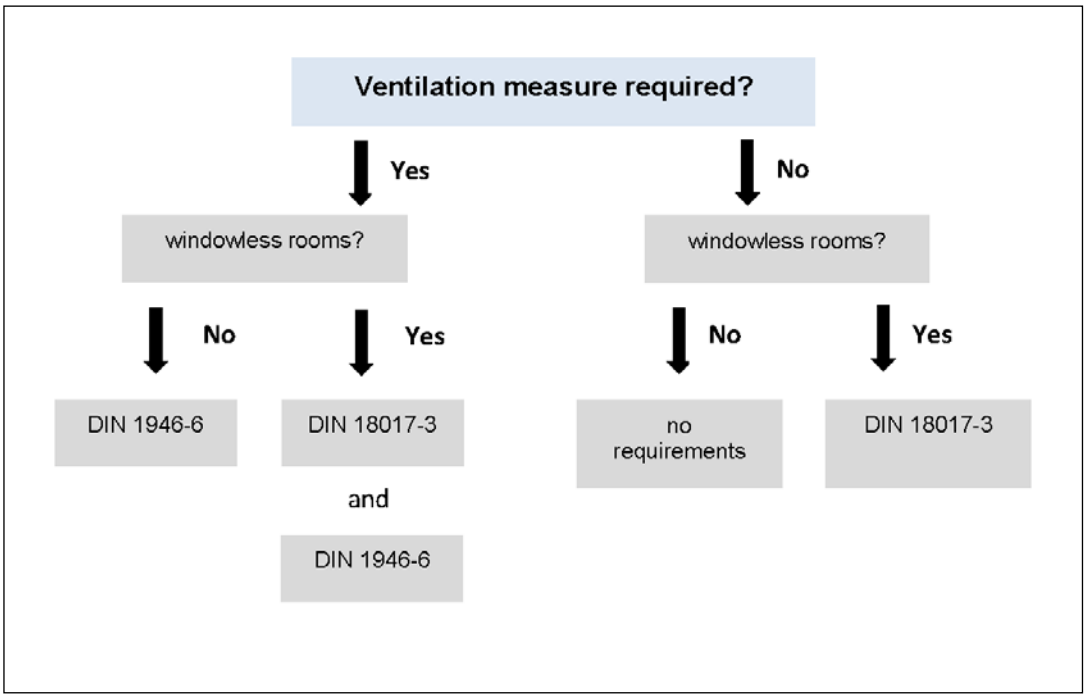
DIN 1946-6 is the ventilation standard of relevance to the design of domestic ventilation systems.
It lays down the planning requirements for:

- equipment for free ventilation and
- fan-assisted ventilation systems.

A **ventilation concept** should always be produced for new buildings or buildings, which are being modernised. This involves working out whether ventilation measures are needed. To do this, the volumetric flow of outside air needed to protect the building or residential unit from humidity is determined and compared with the volumetric flow of outside air resulting from natural infiltration.
If the volumetric flow needed for humidity protection is not reached, ventilation measures are needed. If a home has interior bathrooms or toilet rooms, **DIN 18017-3** should be observed in addition to DIN 1946-6.

DIN 18017-3

DIN 18017-3 applies to fan-assisted extraction systems in bathrooms and toilet rooms without an outside window, in homes and similar occupied areas.
This standard therefore lays down the requirements for how windowless rooms are designed and operated.
A flow of outside air appropriate for the volumetric flow of exhaust air must flow into the living rooms and day rooms from outside through infiltration and, if necessary, through extra suitable outside air openings across the building envelope.
The corresponding flow of supply air is supplied to the exhaust air rooms via suitable overflow air openings in the interior rooms.
In accordance with DIN 1946-6, a ventilation measure is complete when, for example, if providing ventilation in windowless rooms in accordance with DIN 18017-3, the volumetric air flow needed for humidity production is reached and all rooms in the housing unit therefore have an adequate and even flow of air.
If the ventilation concept is planned in accordance with DIN 1946-6, DIN 18017-3 will be satisfied at the same time.



Ventilation concept

Free or fan-assisted systems are available for venting and extracting air from rooms in housing units.
The choice of appropriate system depends on the general and specific requirements.

General requirements include

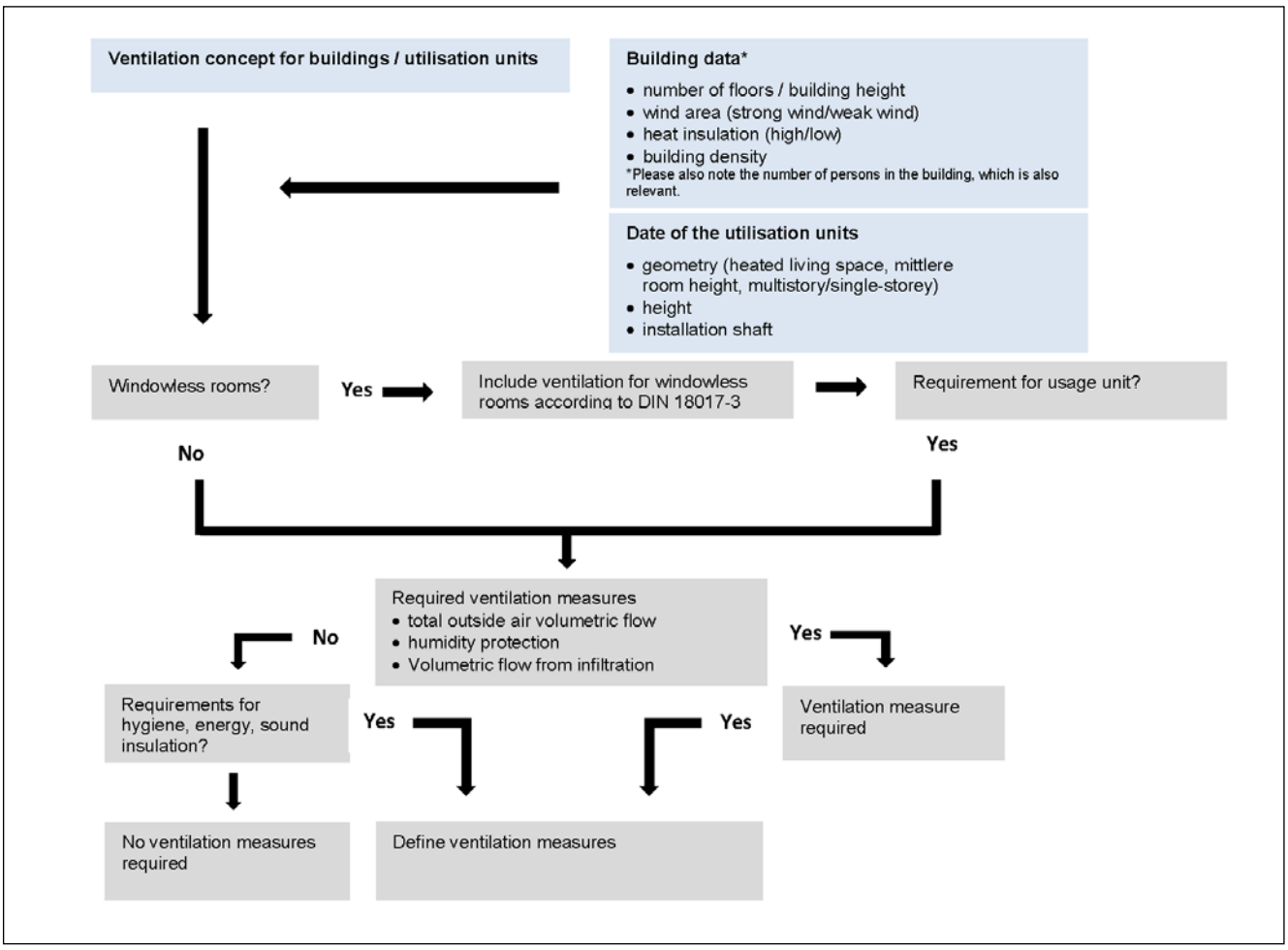
- specifications in ordinances and guidelines, which ventilation systems need to observe;
- technical fire protection and sound insulation requirements in the building;
- requirements relating to how living rooms and day rooms are used (comfort) or volumetric air flows in special rooms.

Specific requirements

- may apply to one housing unit;
- require volumetric air flows to be achieved in specific rooms and if necessary in living rooms and day rooms;
- place more stringent demands on the room air quality (hygiene);
- place more stringent demands on the energy efficiency and/or sound insulation.

In accordance with **DIN 1946-6,** a **ventilation concept** should always be produced for new buildings and existing buildings undergoing modifications of relevance to ventilation (e.g. replacing the windows).
This checks whether sufficient protection against humidity can be ensured by the natural exchange of air through leaks in the building envelope (infiltration).
If the calculated infiltration volumetric air flow is less than the minimum volumetric air flow needed for humidity protection, ventilation measures are essential.

Creating a ventilation concept



MAICOairplan – the configuration software

Simple planning at the highest level

airplan
MAICO

1. High-quality planning tool in accordance with DIN 1946-6
2. Free for existing MAICO customers and potential customers of MAICO heat recovery units simply download from the MAICO website (currently only available in German language)
3. Intuitive operation without any time-consuming instruction
4. Time-saving analysis of a residential unit to determine the necessity of ventilation measures (ventilation certificate in accordance with DIN 1946-6)
5. Convenient recording of all rooms in the residential unit
6. Automatic creation of an offer and, if required, specifications
7. Different output formats (PDF, GAEB and many others)
8. Individually configurable output documents (ventilation certificate, DIN report, volumetric flow overview, ducting plan and many others).
9. Data protection – MAICOairplan is not an online tool, i.e. 100% of your customer and project data is stored on your computer

2 Basis for planning

2.1 Function of a comfort ventilation system with heat recovery

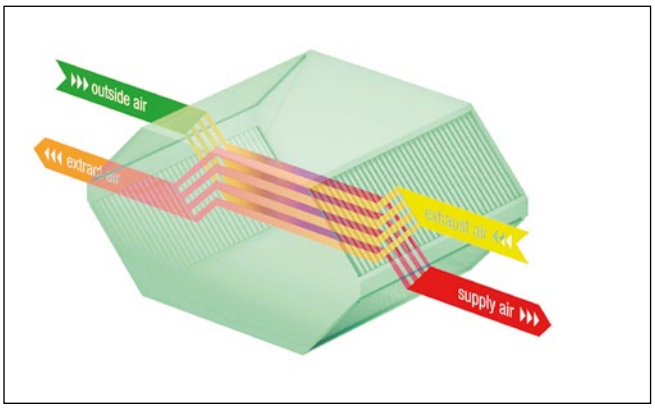
At the heart of controlled domestic ventilation lies the **centralised heat recovery unit**. Fans, air filters, heat exchangers, control and sensors are integrated in this unit.

Warm used air from rooms with high odour and humidity levels, such as kitchens, bathrooms and WCs, is extracted here via a ventilation duct system and passes via the heat exchanger. At the same time, fresh cold outside air is drawn in via the ventilation duct system and also passes the heat exchanger. Up to more than 96 % of the heat of the exhaust air is supplied to the outside air so that this air flows as pre-heated supply air at roughly the same temperature into the living rooms and day rooms, again via a duct system and supply air valves.

2.2 Types of heat exchangers

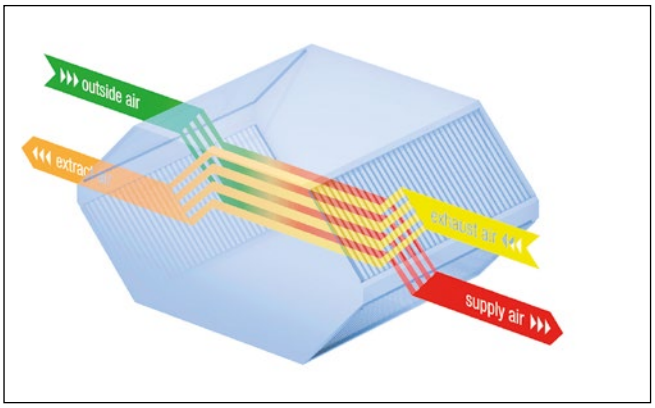
2.2.1 Crossflow heat exchangers

Crossflow heat exchangers transfer energy in the form of heat. The exhaust air (used air) and outside air are fed past the exchanger separately from one another. The warm exhaust air, which flows to the outside via thin channels within the heat exchanger, heats the cold outside air via the quadratic channels arranged in the plastic plates in parallel (crossflow principle).



2.2.2 Enthalpy heat exchangers

The enthalpy heat exchanger is able to transfer moisture from the exhaust air into the fresh flow of supply air. This latest-generation humidity heat exchanger is a special enthalpy exchanger with an integrated polymer film and/or polymer membrane, which separates the flows of supply and exhaust air.

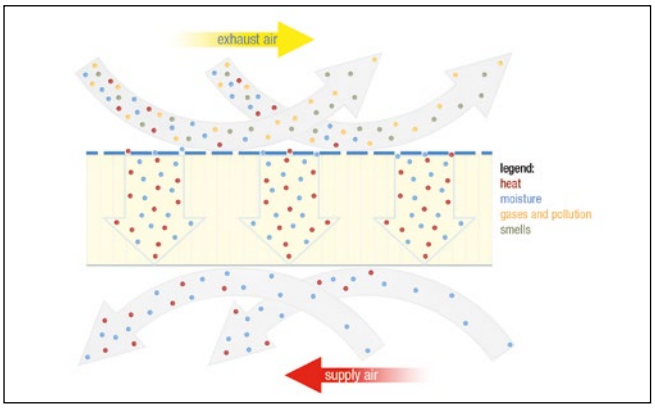


How the enthalpy heat exchanger works

The principle of osmosis is used to transport humidity through the pore structure of a special polymer membrane.

Water molecules of the extracted room air settle on the transfer surfaces of the heat exchanger, from where they migrate through the membrane (osmosis). Thanks to a special coating, the polymer is impermeable to all kinds of microbes. Hygiene is therefore ensured in homes even if exhaust air from kitchen and sanitary areas passes the heat exchanger.

Compared with a standard heat exchanger, the degree of heat provision of the sensitive heat transfer falls slightly, but the energy stored in the water vapour produces an improved overall energy balance for heat recovery in ventilation units with an enthalpy exchanger.



Facts about enthalpy heat exchangers

- Significantly more pleasant environment because both humidity and heat are recovered. The enthalpic degree of heat provision is up to 120 %, 60-70 % of humidity can be removed in the process.
- High levels of sensitive and latent transfer performance.
- Gases and impurities are not transferred.
- Anti-microbial properties of the polymer film (polymer membrane). It is resistant to mould and bacteria.
- Can be washed using water.
- Frost and heat tolerant.

2.3 Air filters

Reasons for using air filters in centralised ventilation units:

- **Fine filter for the outside air**: Filtering takes place regardless of outside pollution and air enters living rooms free from pollution. The heat exchanger and supply air fan therefore remain clean. This results in "pollen filtering", much lower levels of fine dust and therefore much better air quality in interior rooms. Coupled with the controlled air exchange, this helps prevent illness.
- **Coarse filters for exhaust air:** Used to prevent the heat exchanger and exhaust fan from becoming too dirty and thereby to extend their service lives.

Air filter classification

In 2018, **DIN EN ISO 16890** superseded the former DIN EN 779. This European standard evaluates the effectiveness of air filters to various fine dust fractions in PM (Particulate Matter).

Class	Fine dust	Example of particles	Deposition of particles
ISO ePM_1	Up to 1 µm	Viruses, combustion particles, nano particles	Enter the alveoli and blood stream
ISO $ePM_{2.5}$	Up to 2.5 µm	Bacteria, fungus	Enter the lower respiratory tract
ISO ePM_{10}	Up to 10 µm	Pollen, dusts, large particles	Enter the upper respiratory tract
ISO Coarse	Large dust particles	Sand, hairs, fluff	-

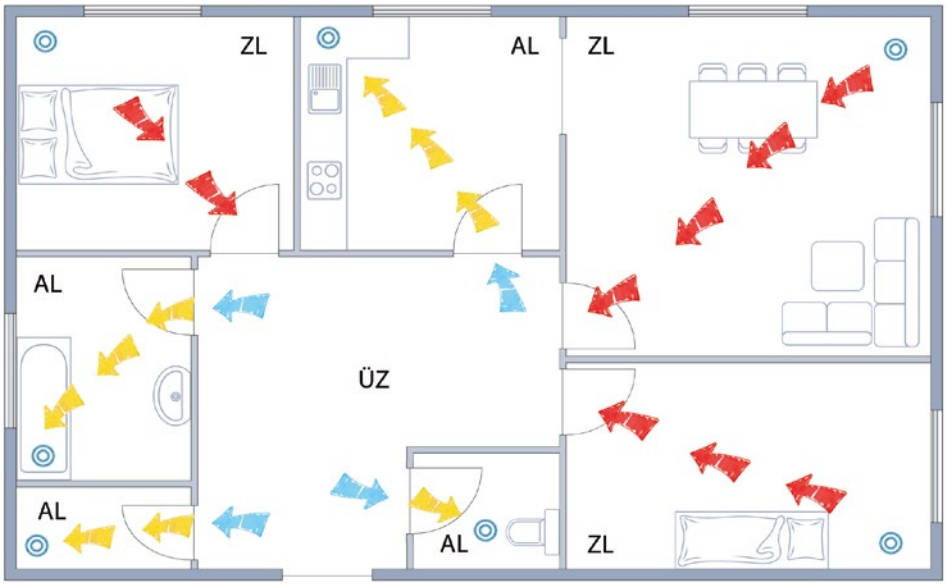
The new filter classification was introduced because over the last few decades a lot more research has been done on the effect of fine dust on human health. It was discovered that fine dust is a serious risk to health and contributes to and may even trigger complications in the respiratory tract and cardio-vascular diseases.

Filter classes according to DIN EN 779 compared with filter classes according to DIN EN ISO 16890

Filter class in accordance with EN 779	Filter class in accordance with ISO 16890
G2	ISO Coarse > 30%
G3	ISO Coarse > 45%
G4	ISO Coarse > 60%
M5	$ePM_{10} \geq 50\%$
M6	$ePM_{2.5} \geq 50\%$
F7	$ePM_{1} \geq 50\%$
F8	$ePM_{1} \geq 70\%$
F9	$ePM_{1} \geq 80\%$

2.4 Cross-ventilation principle

The principle of what is known as “cross ventilation” is usually used around the clock and reduces the thermal losses of ventilation in buildings with controlled domestic ventilation units by up to more than 96%. Fresh air is supplied to the living rooms, flows very slowly over the overflow areas to the exhaust air rooms where it is removed directly as used exhaust air with high humidity and odour levels.



AL: Exhaust air room ZL: Supply air room ÜZ: Overflow area

2.5 System configuration

The installation of a comfort ventilation system requires very careful planning to ensure functional reliability.

If correctly planned/implemented, there are no draughts and no unpleasant smells.

Important points to consider when configuring the ventilation include:

- Calculation of duct cross-sections and air speeds (recommendation: max. 2 m/s for supply air; max. 3 m/s for exhaust air).
- Use of duct and/or channel sound absorbers.
- Application-specific air apertures.
- Laying of the ventilation ducts in line with relevant specifications.
- Correctly calculated amount of air.
- Correct settings for supply air and exhaust air valves.

For reasons of comfort, we would recommend configuring the ventilation system to deliver an air exchange rate of around **0.3-0.8 [1/h]**.

2.6 General notes

Centralised ventilation units with heat recovery should only be used for sealed housing units. Semi-detached houses need one centralised unit per residential unit or each residential unit must have the option of individually controlling the volumetric flows of supply and exhaust air (e.g. VAV systems[1]).

A specified, constant amount of outside air is filtered in the centralised ventilation unit and supplied to the individual rooms.

The same amount of air is removed, e.g. from kitchen, bathroom / WC. Appropriate overflow openings (e.g. door cut-outs of approx. 7-33 mm or door ventilation grilles) should be provided in doors into overflow areas (usually corridors).

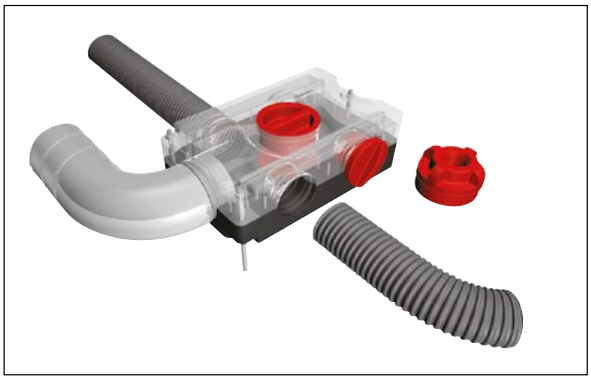
Pay particular attention when planning living rooms with fireplaces. The air in these rooms may only be ventilated or extracted under certain conditions (for more information, consult chapter 3.13).

1 Variable Air Volume

Other points to note:

- The assembly instructions provided with the system should be observed.
- Appropriate overflow openings must be provided.
- The details provided by manufacturers of firing and gas devices should be observed.
- There must be scope for modifying the ventilation duct system by removing disk valves, disconnecting connections on the unit and cleaning openings.

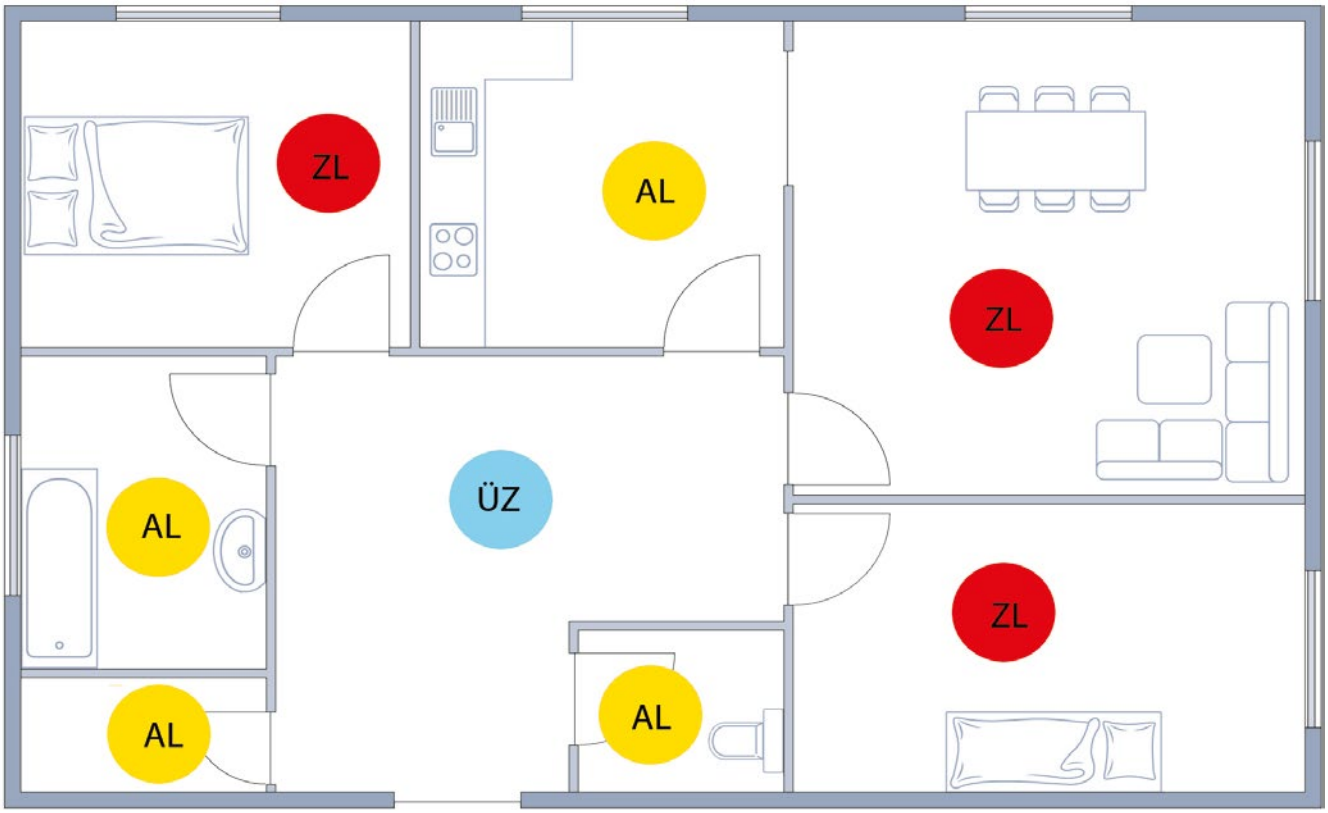
- When laying flexible, round ventilation ducts (MAICOFlex) in ceilings, the structural analysis should be noted along with sound insulation and, if required, fire protection. **This requires coordination with the architect and/or structural engineer.**



- Ensure that the ducts are insulated in line with the relevant standards. To prevent condensate from forming, especially in outside air and outgoing air ducts carrying cold air inside heated rooms, the insulation must prevent vapour diffusion and/or duct systems with protection from vapour diffusion (MAICOTherm) should be used.

3 Practical planning

3.1 Defining supply air, exhaust air and overflow areas



AL: Exhaust air room ZL: Supply air room ÜZ: Overflow area

3.2 Determining volumetric air flows

When configuring the room air system, the criteria of **room air quality** and **room air humidity** should be taken into account. This considers the volumetric air flow in m³/h. The supply air volumetric flow depends on the number of people in the living space. To ensure a good quality of room air, we would recommend a minimum outside volumetric flow of **30 m³/h per person** (configuration for sleeping areas according to DIN 1946-6).

DIN 1946-6 and DIN 18017-3 also contain recommendations regarding outside air volumetric flows in line with the planning. DIN 1946-6 recommends using nominal ventilation (NV) when configuring ventilation systems.

Air volume calculation

The air volume calculation is based on DIN 1946-6. This states that controlled domestic ventilation is needed if the amount of air needed to protect against humidity exceeds the volumetric flow provided by infiltration. Four ventilation operating levels are defined.

- Ventilation for humidity protection (HPV)
- Reduced ventilation (RV)
- **Nominal ventilation (NV)**
- Intensive ventilation (IV)

The air volume is calculated for the **nominal ventilation** operating level.

Total exhaust air volumetric flow $_{v,total,R}$ with fan-assisted ventilation for individual rooms with or without windows. Including effective infiltration

	Total exhaust air volumetric flow[a] qv,total,R,exhaust (in m³/h)			
Room	**Ventilation for humidity protection HPV**	**Reduced ventilation RV**	**Nominal ventilation NV**	**Intensive ventilation IV**
Housework room Cellar room (e.g. hobby room)[b, f] corridor (optional) WC[c]	0.3-0.4 of NV	0.7 of NV	25[d]	1.3 of NV
Kitchen, kitchenette[c] bathroom with/without WC[c] shower room			45	
Sauna / Fitness room			100[e]	

a including effective infiltration

b heated and inside the thermal envelope

c intensive ventilation of windowless rooms: The general building guideline demands 200 m³/h for kitchens without windows

d if required for the housing unit's ventilation concept, the corridor can also be planned with an exhaust air volumetric flow of 25 m³/h.

e and/or according to the anticipated humidity level

f a separate approach is needed for rooms which are used in a way which produces high humidity/pollution levels.

Ventilation for humidity protection (qv,total,HPV)

Ventilation dependent on user, which aims to prevent damage to the building from mould and humidity (minimal operation) depending on the building's level of thermal protection under usual usage conditions (humidity levels, room temperatures).

Reduced ventilation (qv,total,RV)

Ventilation not dependent on user, which meets the minimum requirements of room air quality under usual usage conditions (humidity and pollution levels).

Nominal ventilation (qv,total,NV)

Ventilation needed to ensure preservation of the building and hygienic and health requirements when a housing unit is used as planned (normal operation).

Intensive ventilation (qv,total,IV)

Increased ventilation required for short periods to reduce peaks in pollution (load operation).

1. Determining total outside air volumetric flow

To calculate the total outside air volumetric flow needed, you first need to determine the maximum value for volumetric flow needed by living space, exhaust air rooms and occupation according to planning.

qv,total = max (qv,area; qv,exhaust air; qv,person) – qv,inf

qv,total	total outside air volumetric flow with nominal ventilation
qv,area	volumetric air flow by living space
qv,exhaust air	volumetric air flow from sum of exhaust air rooms
qv,person	volumetric air flow by number of persons
qv,inf	volumetric flow from infiltration:

Use the tables below to determine the total outside air volumetric flow.

Total outside air volumetric flow by living space qv,area

Living space in m²	Volumetric flow in m³/h
≤30	55
50	75
70	95
90	115
110	135
130	155
150	170
170	185
190	200
210	215
230	230
250	245

Total outside air volumetric flow by total exhaust air rooms qv,exhaust

Exhaust air rooms	Volumetric flow in m³/h
Kitchen	45
Bathroom	45
Shower/WC	45
WC	25
Utility room	25
Hobby room	25
Corridor (exhaust air optional)	25

Calculation: qv,area = -0.001*A-total2 + 1.15 *A-total + 20

Total outside air volumetric flow by number of persons qv,person

Person headcount	Volumetric flow in m³/h
1	30
2	60
3	90
4	120
5	150
6	180

Also refer to Table 5 - Minimum values for total outside air volumetric flows qv,total,HU in m³/(h · HU) for housing units (HU) on page 31 of DIN 1946-6:2009-5.

Volumetric flow from infiltration

Every building envelope has certain leaks. When a natural differential pressure arises, this results in the infiltration (and also exfiltration) of outside air.

$$q_{v,inf} = f_{inf} * V$$

qv,inf	volumetric flow from infiltration:
fInf	infiltration factor (table)
V	building volume to be vented

Defined factors can be used to determine this infiltration air volumetric flow via the building volume.

Infiltration factors f_{inf} (assumptions)

Type of supply air	Building location low wind	Building location high wind
Centralised supply air	0.053	0.084
Decentralised supply air	0.059	0.059
Decentralised supply air (Chimney dependent on room air)	0.037	0.037

Applies to a new detached house up to 15 m in height in a normal building location.
Building location with high winds: Annual average wind speed > 3.3 m/s
Because infiltration results in a permanent, natural exchange of air, the total outside air volumetric flow to be brought in through the ventilation unit can be reduced by the infiltration air volumetric flow.

2. Determining supply air volumetric flows

The calculated total outside air volumetric flow is split into the individual supply air rooms using the supply air factors from the following table:

Supply air factors $f_{supply\ air}$ according to DIN 1946-6

Type of use	Supply air factor
Living	3.0 (±0.5)
Eating	1.5 (±0.5)
Sleeping	2.0 (±1.0)
Child	2.0 (±1.0)
Working	1.5 (±0.5)
Guests	1.5 (±0.5)

For each room, the associated factor must be divided by the total of all factors defined for the building. This quotient is the equivalent of the share of the total outside air volumetric flow.

qv,supply air,room = (fsupply air,room / Σfsupply air) * qv,-total

Building-specific peculiarities can be taken into account using the specified tolerance ranges of the individual factors.

Determining fan levels

The volumetric flows for the individual fan levels can be calculated from the total outside air volumetric flow.

Type of ventilation	Formula for volumetric air flow
Ventilation for humidity protection (new build)	qv,HPV = 0.3 * qv,total
Reduced ventilation	qv,RV = 0.7 * qv,total
Nominal ventilation	qv,NV = 1.0 * qv, total
Intensive ventilation	qv,IV = 1.3 * qv,total

Intensive ventilation can also be ensured with the help of the user (window ventilation).
It is not absolutely essential that this is done by the ventilation unit.

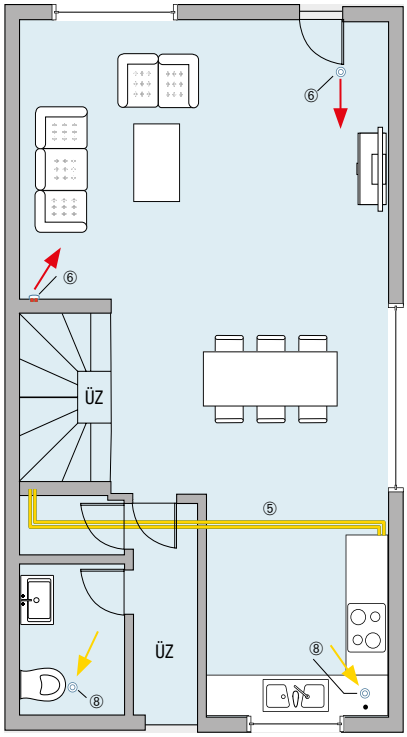
Example of air volume calculation

The procedure for calculating the total outside air volumetric flow and the amounts of supply air and exhaust air for the individual rooms is shown below on the basis of a sample building.

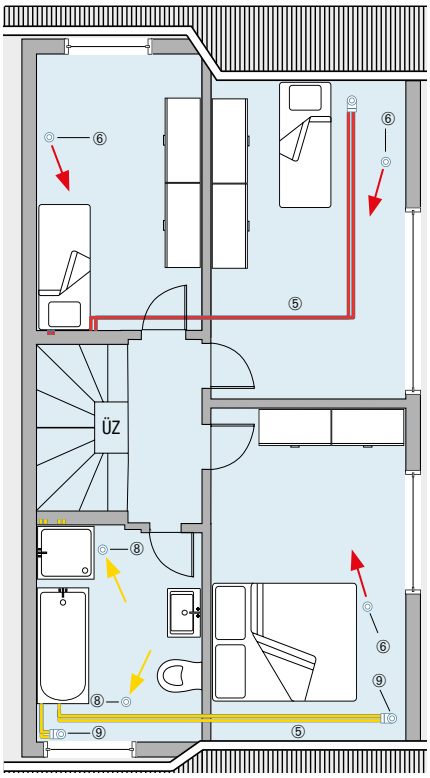
Building data (example only):

- Free-standing detached house
- New build, location with low winds
- Ventilated living space (EG + OG): approx. 115 m²
- Occupied by 4 people

Ground floor (EG)



First floor (OG)



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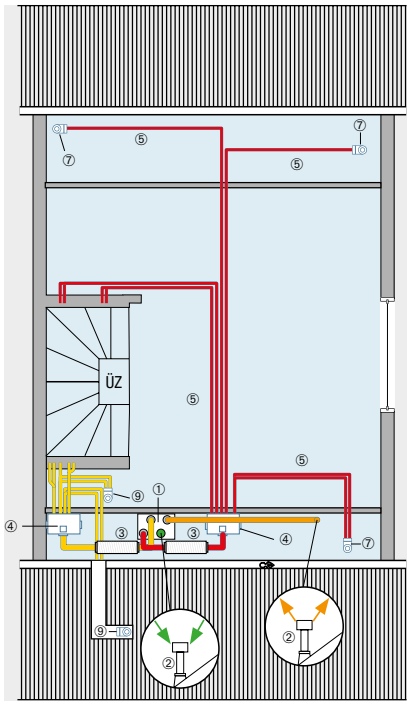


■ Supply air ■ Exhaust air ■ Outside air ■ Outgoing air

① WS 170 L ventilation unit
② Outside and outgoing air connection with Therm duct
③ Tubular sound absorber
④ Air distributor
⑤ Flexible duct
⑥ Supply air valve
⑦ Bracket and adapter for supply air valve, ground floor
⑧ Exhaust air valve
⑨ Bracket and adapter for exhaust air valve, ground floor/first floor

In accordance with DIN 1946-6, the utility room is an adjoining room. Adjoining rooms should only be included in the ventilation and air extraction if high levels of humidity and/or pollution are anticipated. For this reason, the utility room is not ventilated in our example. To calculate the total outside air volumetric flow, you first need to determine the amounts of air needed by living space, exhaust air rooms and number of people.

Volumetric air flow by living space

A-total = 115 m²
qv,area = -0.001*(115 m²)² + 1.15 *(115 m²) + 20 = **139 m³/h**

Volumetric air flow by total exhaust air rooms

Kitchen	m³/h	45
WC	m³/h	25
Bathroom	m³/h	45
qv,exhaust air	**m³/h**	**115**

Determining volumetric air flow by number of people

4 people (amount of air per person 30 m³/h)
qv,totalpersons = 120 m³/h
The estimated maximum value for the sample building comes from the living space.
max (qv,area; qv,exhaust air; qv,person) = 139 m³/h
To finally determine the volumetric flow for configuration, the natural outside air volumetric flow from infiltration should be deducted from the figure calculated because this does not have to be provided by the ventilation unit.

Determining volumetric flow from infiltration

Centralised supply air, location with low winds
A-total = 115 m², room height = 2.5 m
f_{inf} = 0.053 (see table)
qv,inf = 0.053 * 115 m² * 2.5 m = **15 m³/h**

Determining total outside air volumetric flow

qv,total = max(qv,area; qv,exhaust air; qv,person) – qv,inf
qv,total = 139 m³/h – 15 m³/h = **124 m³/h**

Determining supply air volumetric flows

Depending on type of use, the appropriate supply air factor according to DIN 1946-6 should be assigned for each supply air room and the total of all supply air factors then calculated.

	$f_{supply\ air}$
Living	3.0
Sleeping	2.0
Child	2.0
Guest	1.5
Total $\Sigma(f_{supply\ air})$	**8.5**

The share of the total outside air volumetric flow can be determined for each room using the quotients from supply air factor and total of supply air factors.
qv,supply,living = (3.0 / 8.5) * 124 m³/h = 44 m³/h
qv,supply,sleeping = (2.0 / 8.5) * 124 m³/h = 29 m³/h
qv,supply,child = (2.0 / 8.5) * 124 m³/h = 29 m³/h
qv,supply,guest = (1.5 / 8.5) * 124 m³/h = 22 m³/h

Determining exhaust air volumetric flows

The exhaust air volumetric flows can be taken from the corresponding table according to DIN 1946-6 depending on the how the room is used. Check whether the total of all exhaust air volumes matches the total outside air volumetric flow determined. If this is not the case, the exhaust air volumes should be adjusted accordingly.

Kitchen	m³/h	48
WC	m³/h	28
Bathroom	m³/h	48

qv,total = Σ(qv,exhaust) = **124 m³/h**

Operating levels of ventilation unit

If the total outside air volumetric flow (nominal ventilation) is known, the associated volumetric flows for all four operating levels can be determined:

Ventilation for humidity protection:

qv,HPV = 0.3 * 124 m³/h = 37 m³/h

Reduced ventilation:

qv,RV = 0.7 * 124 m³/h = 87 m³/h

Nominal ventilation:

qv,NV = 1.0 * 124 m³/h = 124 m³/h

Intensive ventilation:

qv,IV = 1.3 * 124 m³/h = 161 m³/h

Air distribution systems

Air distribution systems are a key element of the ventilation system. They should be planned and implemented with care and consideration. Modifications at a later date usually entail a sizeable amount of work and incur related costs.

In order to minimise pressure losses and installation work, aim for as short a line feed as possible. We would recommend a system designed in the shape of a star. This means that the total outside air volumetric flow of the ventilation unit is spread over several ducts by centralised valve units, thereby supplying the individual rooms.

Laying procedures

In new builds, the favoured approach is usually to lay ducts on the unfinished floor (in the screed) or within the concrete ceiling. An installation in lightweight construction walls is also possible. Laying in suspended ceilings and in the attic have proven a success, particularly, when redeveloping buildings.

Here the main distributor from the ventilation unit should preferably use a folded spiral-seams duct. Because of the larger cross-section surfaces, higher volumetric flows can then also be achieved with little pressure loss and low speeds.

Application area

When configuring the ventilation system, the maximum volumetric flows for supply and exhaust air depending on distribution system and nominal size should always be observed. If exceeded, there is a risk of noise developing and increased pressure losses.

3.3 Selecting ventilation unit and determining installation site

The factors to consider when selecting an appropriate ventilation unit are:

- The determined total outside air volumetric flow (a reserve of approx. 30% should be available for increased ventilation).
- The cubage of the unit (hanging on wall, ventilation unit hanging from ceiling or wall).
- Heat recovery with or without additional humidity recovery (enthalpy heat exchanger).
- Scope for removing any condensate produced in the domestic drainage system (a condensate drain is not needed for enthalpy units of the MAICO WS series).

Installation site of the centralised domestic ventilation unit:

The centralised domestic ventilation unit must be installed at a site which meets the following conditions:

- Observe assembly/installation instructions inside the building (e.g. cellar, refrigerator, loft floor, etc.).
- In the vicinity of the outside and outgoing air openings.
- Connection to waste water system (removal of condensate). A condensate drain is not needed for enthalpy units of the MAICO WS series!
- Take into account accessibility for maintenance and repair work.
- If mounting in a damp room, this room will require additional air extraction to protect the unit from corrosion.
- The unit should be installed in a frost-free location.
- Max. ambient temperature of 40°C.

Potential installation sites

Attic

\+ Easy installation

\+ Short line lengths

\+ Simple line feeds from outside and outgoing air

\- It may not be possible to install the unit and lay the condensate drain somewhere free from frost.

\- There may be insulation issues

Cellar

\+ Location is maintenance-free

\+ Covers involve little work and incur low costs

\- It may not be possible for the outside air to be drawn in directly

\- Line feed for supply air and exhaust air may be more complicated and more expensive

Living area

\+ Frost-free unit installation and condensate drain possible

\+ If laying in the concrete ceiling, the line feed for the supply and exhaust air will not be compli cated

\- Appropriate space must be available

\- There may be insulation issues

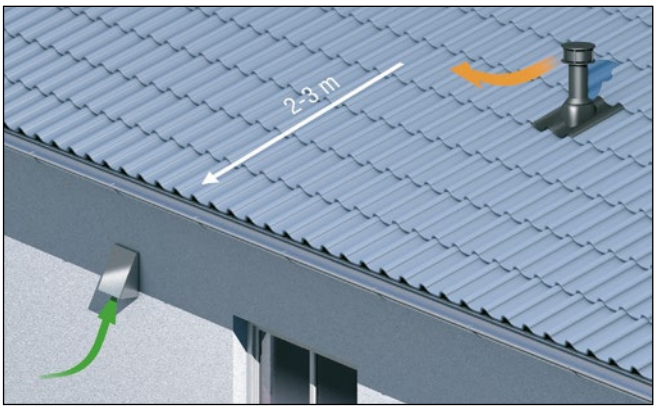
\- The line feed for outside and outgoing air may be problematic

3.4 Planning outside and outgoing air openings

The openings for outgoing and outside air can be fitted on both the roof and wall. Ensure an adequate cross-section, depending on the volumetric flows calculated:

Recommendation: max. 5 m/s air speed (note the Formulary for more details).

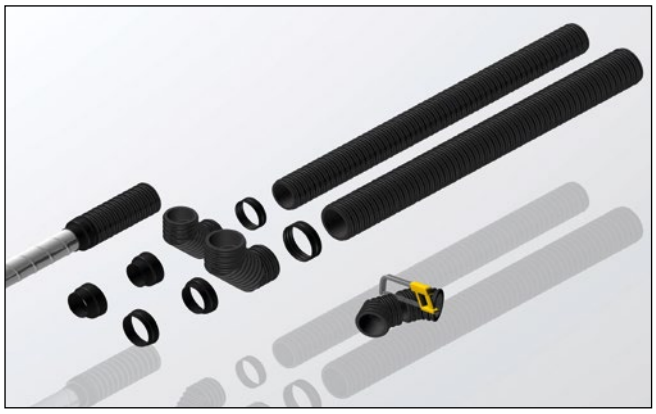
The outside and outgoing air openings should be fitted at least 2 - 3 m away from one another to avoid “short-circuit effects” between the outgoing and outside air. KWH combi-wall connections can also be used.



3.5 Defining thermal insulation / vapour diffusion insulation

3.5.1 Outside and outgoing air lines

Ensure that the ducts are insulated in line with the relevant standards. To prevent condensate from forming, especially in outside air and outgoing air ducts carrying cold air inside heated rooms, the insulation must prevent vapour diffusion and/or duct systems with protection from vapour diffusion (MAICOTherm) must be used. See figure on right.



Thermal insulation of ventilation ducts in accordance with DIN 1946-6

Air type		**Minimum thickness of insulation at ambient air temperature** (λ 0.038 W / (m*K)			
		Outside the thermal envelope, within the building			Inside the thermal envelope
Minimum temperature		**< 0 °C** Attic without thermal insulation to the outside mm	**0 °C to 14 °C** Attic with thermal insulation to the outside or cellar mm	**14 °C to 18 °C** Cellar room with waste heat from heating installation mm	**> 18 °C** mm
Outside air	Sealed against vapours	≥ 8	≥ 20[c]	≥ 32[c]	≥50[d]
Supply air	with heat recovery without humidity recovery	≥ 50[d]	≥ 50[d]	≥ 20[d]	0
Supply air	with heat recovery with humidity recovery	≥ 80[a]	≥ 50[d]	≥ 20[d]	0
Supply air	Exhaust air heat pump	not permitted	≥ 80[a]	≥ 80	≥ 50[b]
Supply air	Air heating	not permitted	≥ 80[a]	≥ 80	≥ 50[b]
Exhaust air	with heat recovery and/or exhaust air heat pump	≥ 80[a]	≥ 50[d]	≥ 20[d]	0
Outgoing air	sealed against vapours with heat recovery and/or exhaust air heat pump	≥ 20[a]	≥ 20[c]	≥ 32	≥ 50[d]

Insulation levels: 8 / 20 / 32 / 50 / 80 / 120 mm

Individual line: Supply/exhaust air line for a single living space.

[a] If central lines are > 6 m and individual lines are > 2 m, mathematical verification or up to twice the length, next highest level of insulation

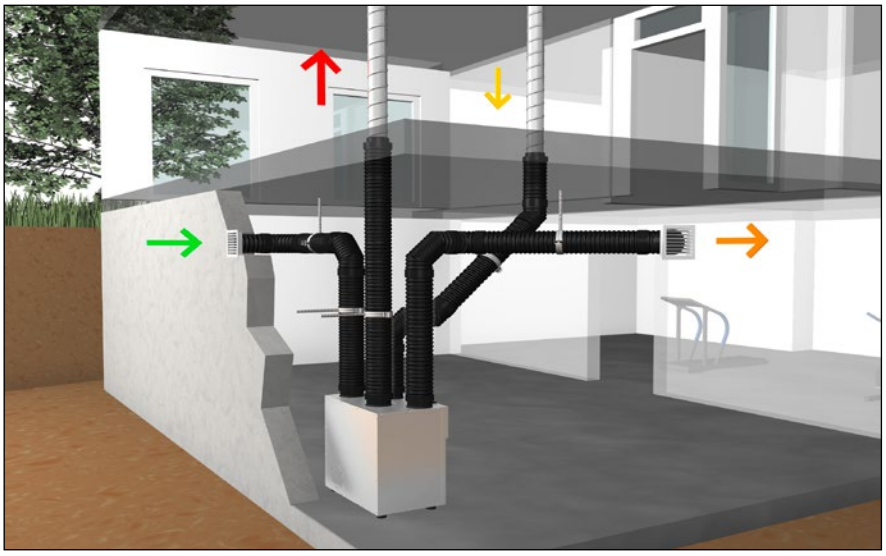
[b] May be reduced in the room to be supplied.

[c] For lines with a metallic surface (ε < 0.7) next level of insulation

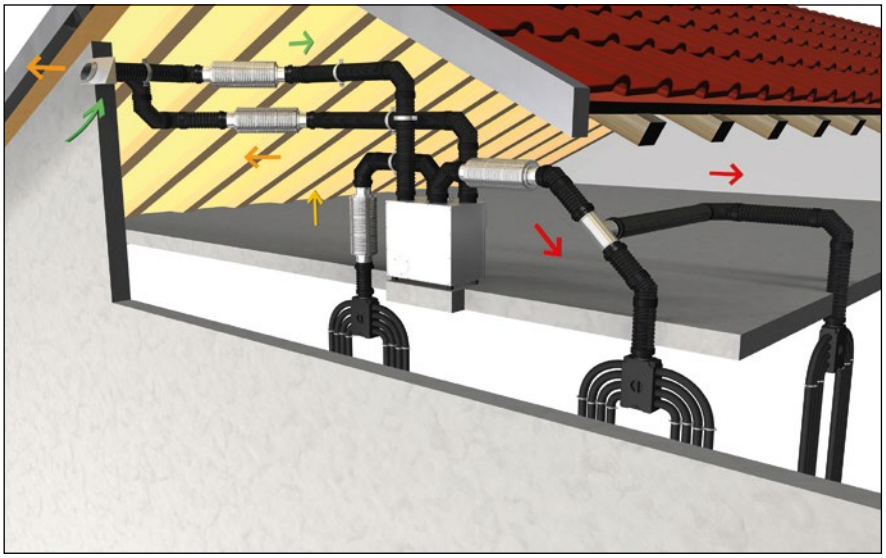
[d] For centralised domestic supply/exhaust air units, line length of up to 2 m: ≥ 32 mm

3.5.2 Configuration of outside and outgoing air lines

- To prevent condensate from forming, design outside and outgoing air lines with the heat-insulated MAICOTherm ventilation duct system or folded spiral-seams duct (with sufficient insulation).
- Route over roof with roof cowls (DF... + DP...) or over outside walls with grilles.
- Feeds through the sealed building envelope should be professionally sealed.
- We would recommend a minimum spacing of 2 m between the outside and outgoing air openings or the use of combi-wall connections (KWH ... L/R).
- Ensure fire protection (minimum spacing, ...) if necessary. See Building Codes of the individual German states (LBO) and Specimen Guideline on fire protection requirements pertaining to ventilation systems. If in any doubt, contact an expert.
- Use sound absorbers in the outside and outgoing air if air is drawn in/blown out in areas sensitive to noise (balcony, terrace, etc.).
- Outside air intake
  - in the shade wherever possible (cool air in the summer)
  - not in places affected by bad odours (garage, compost etc.)
  - as high as possible, > 2 m (to ensure air is free from dust and odours)
  - not on the side affected by the weather
- Outgoing air openings
  - not opposite neighbours' windows
  - > 2m (out of reach of children).



Outside and outgoing air lines with the heat-insulated MAICOTherm ventilation duct system.



Use of a KWH ... L/R combi-wall connection as an outside and outgoing air opening.

3.5.3 Supply air and exhaust air lines

Temperature losses along the duct system reduce the degree of heat provision. The exhaust and supply air lines should therefore be laid fully inside the heat-insulated body envelope.

In places where this isn't possible (e.g. on uninsulated loft floors), the exhaust and supply air lines should be insulated with insulating mats, roughly 50 mm thick. This should prevent condensation, especially inside the exhaust air line.

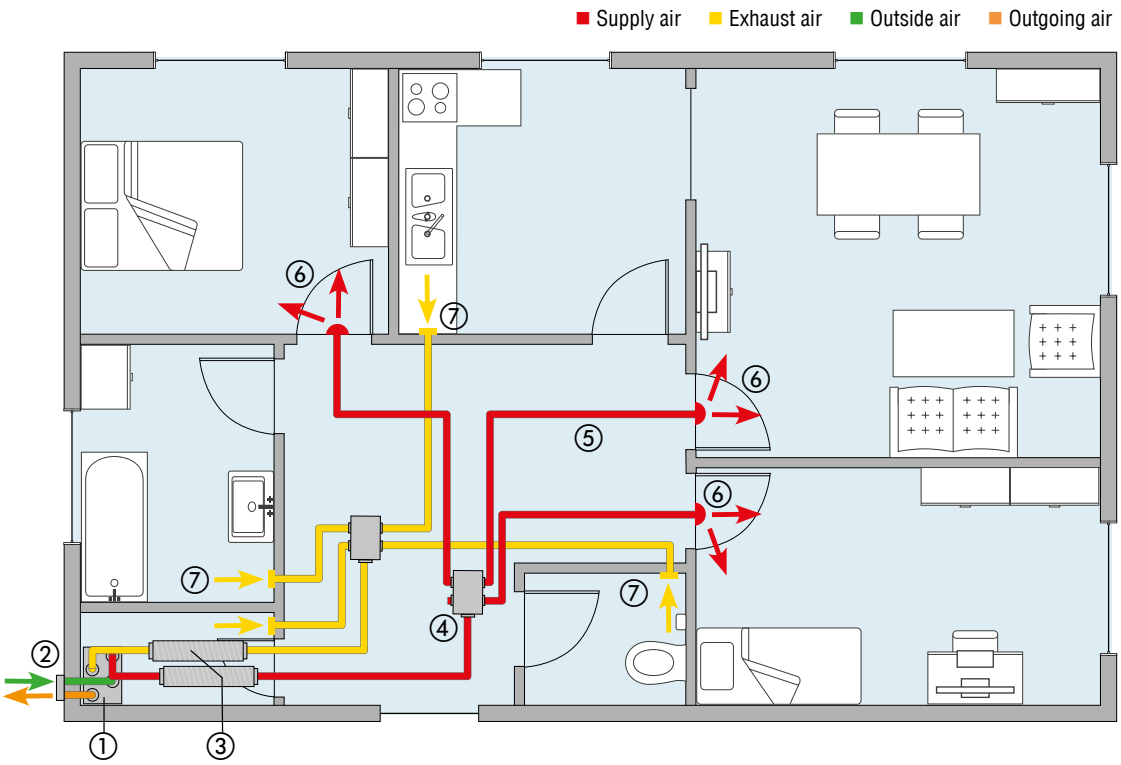
3.6 Defining position, quantity and size of supply air and exhaust air valves and overflow openings

Supply air elements

- Not directly above areas occupied by people, beds or seats, maintain gap of 1m.
- Not behind curtains, cupboards or other construction elements and/or fittings, which hamper the air inlet.
- The preferred option is floor outlets coupled with underfloor heating.
- It is essential that maximum volumetric flows are noted, especially for supply air valves.
- Ceiling and wall spacing of approx. 50 cm.
- Wherever possible, above radiators.
- Blower nozzles at max. 20 cm from ceiling.

Exhaust air elements

- Position as high as possible. Ceiling and wall spacing of approx. 20 cm.
- As close to the source of humidity or odour as possible.
- Not directly above radiators.
- If greases are present (kitchen), use FFE 10 grease filter element in combination with TFA 12 DN 125 disk valve.
- Position as far as possible away from the door to achieve a good flow through the room.



① WS 170 R ventilation unit
② Outside and outgoing air connection with Therm duct
③ Tubular sound absorber
④ Air distributor
⑤ Flexible duct
⑥ Supply air valve
⑦ Exhaust air valve

Maximum volumetric flows

To minimise flow noise, we recommend the following max. volumetric flows for living areas:

Diameter (mm)	Air direction	Max. volumetric flow (m^3/h)
100	Exhaust air	30
100	Supply air	30
125	Exhaust air	50
125	Supply air	50

Overflow area

Overflow areas define the space between two rooms in a home. Because of the difference in pressure, air flows from the supply air area to the exhaust air area. Appropriate measures should be taken to ensure that the air flows as described. For example, this can be achieved with the following measures:

- Shorten the door leaves in the lower part of the door
- Use appropriate air grilles in doors or walls.

Overflow openings in accordance with EN 1946-6

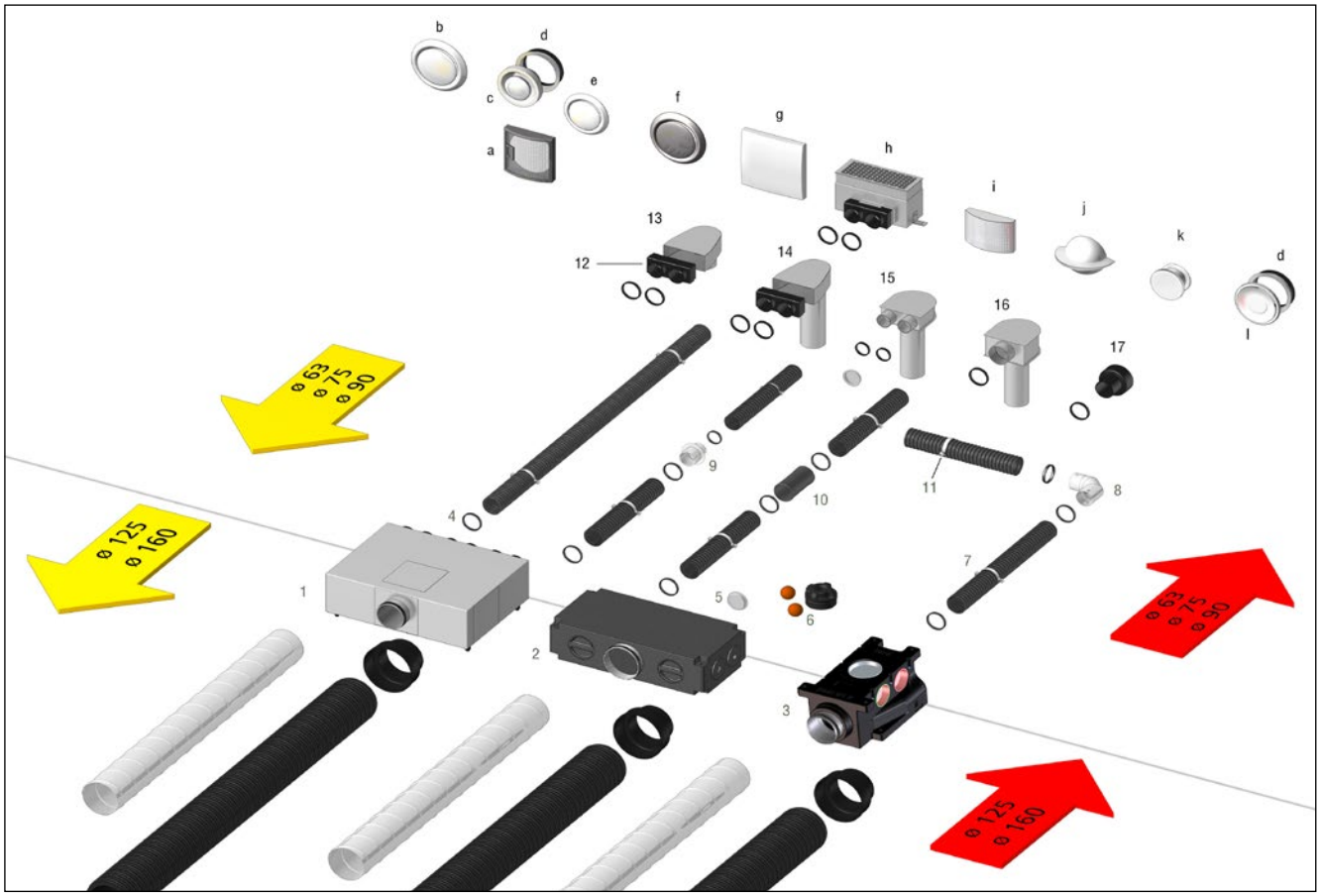
Amount of air Door with sealing	m^3/h	10	20	30	40	50	60	70	80	90	100
Overflow area	cm^2	25	50	75	100	125	150	175	200	225	250
Shortening measurement	mm	3	6	8	11	14	17	20	22	25	28

Amount of air Door without sealing	m^3/h	10	20	30	40	50	60	70	80	90	100
Overflow area	cm^2	0	25	50	75	100	125	150	175	200	225
Shortening measurement	mm	0	3	6	8	11	14	17	20	22	25

Details in accordance with EN 1946-6:
The shortening measurement states the number of millimetres by which a 89-cm door leaf needs shortening.

3.7 Defining line dimensions, line feed as well as quantity and positioning of air distributors

Air distribution with flexible MAICOFlex ventilation duct system



General notes

- Select the flexible duct diameter suitable for your application based on planned volumetric flow (see table on right).
- The installation height available for the flexible duct.
- Structural analysis and fire protection during concrete installation (see next section).
- Select the system components suitable for the selected flexible duct diameter from those shown above.
- Connect up one or two flexible ducts per valve and/or slide-in adaptor depending on the planned volumetric flow.
- Do not route lines through cold areas without insulation. Insulate if necessary.
- Line lengths of up to 15 m.
- The same or similar line lengths guarantee an even distribution of air.
- Note minimum bend radii. Use MF-B sheet metal elbows to achieve this.
- Determine line diameter and number of connection ducts per valve depending on volumetric flow calculated and using the following table:

MAICOFlex diameter (mm)		Bend radius	We recommend
outer	inner	(mm)	V_{max} (m³/h)
63	53.5	150	20
75	64	150	30
90	77.5	350	50

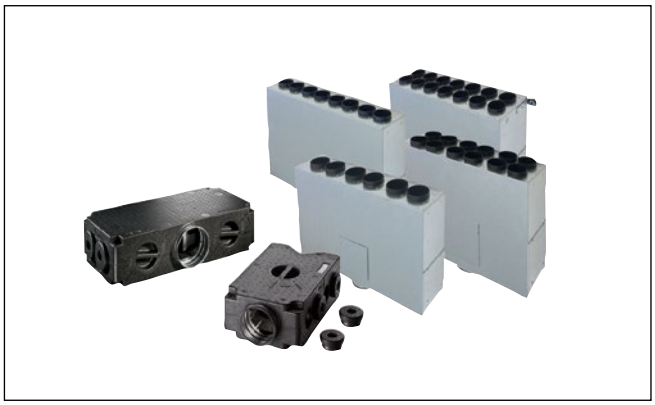
- Seal ducts during the construction phase

MAICOFlex / ventilation components/air distribution system

Abbreviation	Article	Connection diameter of air distributor DN 125			Connection diameter DN 160 air distributor		
	Ventilation duct system MAICOFlex	Connection diameter of flexible duct **DN 63**	Connection diameter of flexible duct **DN 75**	Connection diameter of flexible duct **DN 90**	Connection diameter of flexible duct **DN 63**	Connection diameter of flexible duct **DN 75**	Connection diameter of flexible duct **DN 90**
1	Air distributor box made of sheet metal	MF-BV63-125-8	MF-BV75-125-6	MF-BV90-125-5	MF-BV63-160-14	MF-BV75-160-12	—
2	Air distributor made of plastic (EPP)	MF-V63	MF-V75	MF-V90	—	MF-V75-8	MF-V90-8
3	Air distributor made from sound-insulating plastic	—	—	MF-VK90-7	—	—	MF-VK90-7
4	Gasket	MF-FDR63	MF-FDR75	MF-FDR90	MF-FDR63	MF-FDR75	MF-FDR90
5	End plug	MF-FST63	MF-FST75	MF-FST90	MF-FST63	MF-FST75	MF-FST90
6	Cleaning set	MF-R63	MF-R75	MF-R90	MF-R63	MF-R75	MF-R90
7	Flexible duct	MF-F63	MF-F75	MF-F90	MF-F63	MF-F75	MF-F90
8	90° sheet metal elbow	MF-B63	MF-B75	MF-B90	MF-B63	MF-B75	MF-B90
9	Reducer	MF-RZ75/63	MF-RZ75/63 MF-RZ90/75	MF-RZ90/75	MF-RZ75/63	MF-RZ75/63 MF-RZ90/75	MF-RZ90/75
10	Insertion sleeve	MF-FSM63	MF-FSM75	MF-FSM90	MF-FSM63	MF-FSM75	MF-FSM90
11	Mounting clamp	MF-S63	MF-S75	MF-S90	MF-S63	MF-S75	MF-S90
12	Slide-in adaptor	MF-WE63	MF-WE75	—	MF-WE63	MF-WE75	—
13	Brackets	MF-W100 80/150	MF-W150 80/200	—	MF-W100 80/150	MF-W150 80/200	—
14	Brackets	MF-WL100 80/150 MF-WL125 80/150	MF-WL100 80/200 MF-WL125 80/200 MF-WL150 80/200	—	MF-WL100 80/150 MF-WL125 80/150	MF-WL100 80/200 MF-WL125 80/200 MF-WL150 80/200	—
15	Brackets	MF-WLF100/63/63	—	—	MF-WLF100/63/63	—	—
16	Brackets	—	—	MF-WLF100/90 MF-WLF125/90	—	—	MF-WLF100/90 MF-WLF125/90
17	Valve adapter	MF-A63	MF-A75	MF-A90	MF-A63	MF-A75	MF-A90
	Transition piece flat/round	—	FFS-Ü90/75		—	FFS-Ü90/75	
	Other components						
MT	MAICOTherm						
FFS	MAICOFFS						
WF	Folded spiral-seams duct*	Folded spiral-seams duct*					
a	Grease filter element for exhaust air •	FFE 10					
b	Disk valve, Plastic ••	TK 10 TK 12	TK 10 TK 12 TK 15	TK 10 TK 12		TK 10 TK 12 TK 15	TK 10 TK 12
c	Metal, disk valve •	TFA 10 TFA 12	TFA 10 TFA 12 TFA 15	TFA 10 TFA 12	TFA 10 TFA 12	TFA 10 TFA 12 TFA 15	TFA 10 TFA 12
d	Mounting frame for TFA/TFZ ••	EBR-D 10 EBR-D 12	EBR-D 10 EBR-D 12 EBR 15	EBR-D 10 EBR-D 12	EBR-D 10 EBR-D 12	EBR-D 10 EBR-D 12 EBR 15	EBR-D 10 EBR-D 12
e	Disk valve, metal •	TM 10 TM 12	TM 10 TM 12 TM 15	TM 10 TM 12	TM 10 TM 12	TM 10 TM 12 TM 15	TM 10 TM 12
f	Stainless steel disk valve ••	TM-V2A 10 TM-V2A 12	TM-V2A 10 TM-V2A 12	TM-V2A 10 TM-V2A 12	TM-V2A 10 TM-V2A 12	TM-V2A 10 TM-V2A 12	TM-V2A 10 TM-V2A 12
g	Exhaust and supply air valve	AZV 100					
h	Floor and wall outlet	MF-FBWA63	MF-FBWA75	—	MF-FBWA63	MF-FBWA75	—
i	Supply air valve •	ZWVQ 10 ZWVQ 12					
j	Blower nozzle •	WD 10 W					
k	Blower nozzle •	WD 10 D					
l	Metal disk valve •	TFZ 10 TFZ 12	TFZ 10 TFZ 12 TFZ 15	TFZ 10 TFZ 12	TFZ 10 TFZ 12	TFZ 10 TFZ 12 TFZ 15	TFZ 10 TFZ 12

• for supply air • for exhaust air *procurement and insulation by the customer

Air distributor



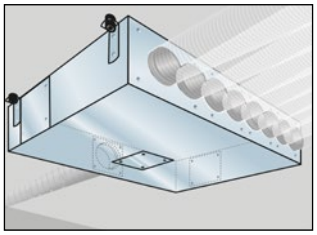
Selection

From the air distributors available, select the one suitable for your application, depending on

- the diameter of the flex line to be laid;
- the quantity of flex lines to be laid;
- the max. volumetric flow of the air distributor;
- the space available to install the air distributor;
- the direction from which the lines to be connected to the distributor meet the distributor.

Air distributor	Material	Quantity Connection socket	Connection diameter Ventilation ducts (mm)	Connection diameter Ventilation unit (mm)	Dimensions W x H x D (mm)
MF-BV63-125-8	Sheet steel, galvanised	8	63	125	650 x 150 x 450
MF-BV63-160-14	Sheet steel, galvanised	14	63	160	650 x 200 x 500
MF-BV75-125-6	Sheet steel, galvanised	6	75	125	650 x 150 x 450
MF-BV75-160-12	Sheet steel, galvanised	12	75	160	650 x 200 x 500
MF-BV90-125-5	Sheet steel, galvanised	5	90	125	650 x 150 x 450
MF-V63	Plastic EPP	8	63	125	435 x 150 x 270
MF-V75	Plastic EPP	4	75	125	435 x 150 x 270
MF-V90	Plastic EPP	4	90	125	435 x 150 x 270
MF-V75-8	Plastic EPP	8	75	160	710 x 185 x 350
MF-V90-8	Plastic EPP	8	90	160	710 x 185 x 350
MF-VK90-7	Plastic EPP	7	90	125	300 x 490 x 220

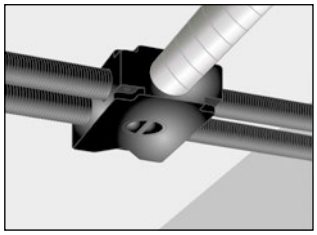
Connection options



MF-BV63-125-8
MF-BV63-160-14
MF-BV75-125-6
MF-BV75-160-12
MF-BV90-125-5

Alternatively, **connect ventilation unit using one of the revision openings**.

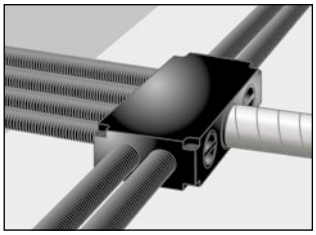
One of the revision openings is used for the MF-R cleaning set.



MF-V63
MF-V75
MF-V90

Alternatively, **connect ventilation unit using one of the revision openings**.

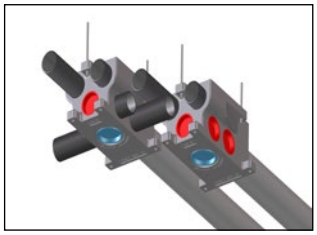
Another of the revision openings is used for the MF-R cleaning set.



MF-V75-8
MF-V90-8

Ventilation unit connection **on the wide side**.

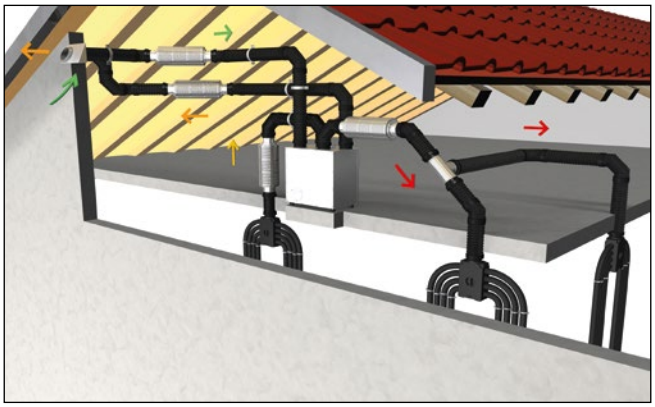
The two revision openings on the right and left of the connection socket are used for the MF-R cleaning set.



MF-VK-90-7

Ventilation unit connection **on the face side**. DN 125 feed duct with SVR 125 plug connector or DN 160 with folded spiral-seams duct.

The innovative design allows the distributors to be positioned right next to one another.
The revision opening is used for the MF-R cleaning set.



■ Supply air ■ Exhaust air ■ Outside air ■ Extract air

Installation

- Use the mounting holes and/or screws/threaded rods to secure the air distributors to the ceiling, wall or floor.
- Connect the MF-F flexible ducts tightly to the air distributors. Note the installation instructions. You do not need any sealing rings for the MF-V distributors.
- Seal unused openings with the MF-FST end stops provided.
- Connect ventilation unit and air distributor with the heat-insulated MAICOTherm MT ventilation duct system as shown on left.

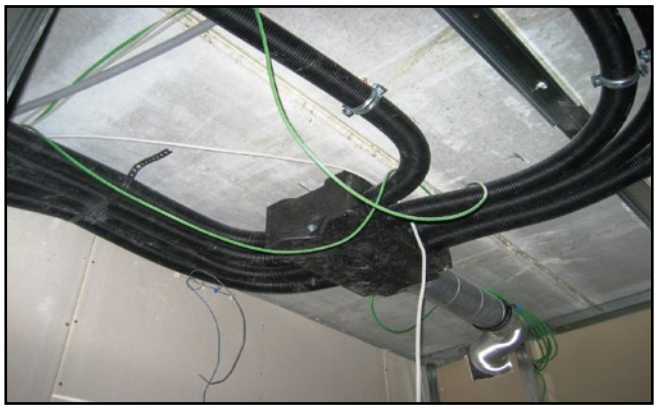
3.8 Laying MAICOFlex ducts

When laying the network of ventilation ducts, the following conditions must be met:

- Short and symmetrical ventilation ducting.
- Lay ventilation ducts in as straight a line as possible.
- Ventilation duct diameter depends on volumetric flows calculated.
- The ducts laid between the roof spars and in the back walls should be located under the insulation (in the warm area) and/or insulated against cooling and the formation of condensation.
- If laying in concrete ceilings, the ducts must be secured to prevent them from floating up.
- Avoid tight flexible duct bend radii to minimise pressure losses.
- To avoid large differences in pressure between the supply and exhaust air, ensure that the ventilation ducts are of roughly the same length.
- The maximum flow velocity in the ventilation duct system should be 2-3 m/s (recommendation: max. 2 m/s for supply air; max. 3 m/s for exhaust air)
- Revision openings provided should be kept fully accessible.

3.8.1 in suspended ceilings

- Ducts can be laid in suspended ceilings with all nominal flexible duct sizes (63, 75, 90 mm).
- Suspend the ceiling by min. 180 mm (MF-V63 / MF-V75 / MF-V90) or 215 mm (MF-V75-8 / MF-V90-8).
- Use MF-S75 mounting clamps to secure at a distance of 75 cm in each case.
  Insulate mounting clamps to prevent the formation of condensate.
- Provide revision openings in the ceiling to access the distributors.



3.8.2 in concrete ceilings

Whenever laying in a concrete ceiling, the structural engineer must be consulted.

If flexible ducts are inserted into ceilings with fire protection requirements, minimum ceiling thicknesses and/or minimum thicknesses above and below the inserted parts must be take into account. The precise installation situation should be clarified with the local site engineer based on the fire protection concept for the building. Also refer to DIN 4102-4 3.4 Tables 9 and 10.

The fire protection requirements depend on the building class and therefore the building height. The building classes are defined in the German Model Building Code and are as follows:

Building class 1	Free-standing building with a height[1)] of up to 7 m and no more than two housing units with a total area of no more than 400 m² and free-standing building used for agricultural or forestry purposes.
Building class 2	Building with a height[1)] of up to 7 m and no more than two housing units with a total area of no more than 400 m².
Building class 3	Other building with a height[1)] of up to 7 m.
Building class 4	Building with a height[1)] of up to 13 m and housing units with an area of no more than 400 m².
Building class 5	Other building including underground building.

[1)] Top edge of finished floor of uppermost day room in relation to the average site level.

Depending on the Building Code of the individual German state, the details provided in metres and even the fire protection class requirements may differ slightly.

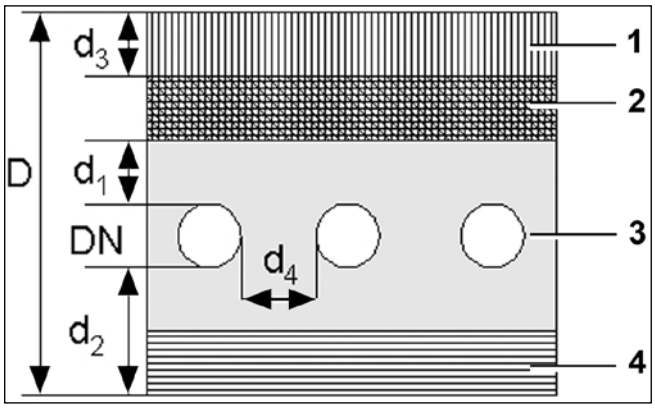
The minimum thicknesses for concrete slabs with cavities filled with combustible materials (e.g. MAICOFlex), are covered in DIN 4102 Part 4, Chapter 3.5, Tables 9 and 10. These details also apply to in-situ concrete ceilings.

In special applications, it is absolutely essential that the measures described are checked by a structural engineer and fire protection specialist to ensure that they are correct and feasible. If necessary, adjustments must be made to suit the prevailing conditions.

Extract from DIN 4102 Part 4

Minimum thicknesses of steel concrete and reinforced concrete slabs made from normal concrete with cavities (in our case, ventilation ducts)

Cross-sectional view of a ceiling



1 Screed 2 Insulation 3 Concrete slab with ventilation duct
4 Filigree flooring

Details such as screed film and floor covering are not taken into account.

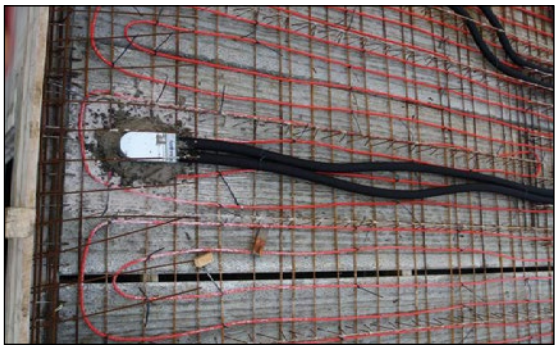
	Building class 1 F30	Building class 2 and 3 F30-A	Building class 4 F60-A	Building class 5 F90-A D
D	The total thickness of the ceiling depends on the thickness of insulation, the flexible duct selected, the empty electric ducts and the actual screed thickness.			
DN	63 or 75 mm			
d_1	50 mm	80 mm	80 mm	100 mm
d_2	50 mm	80 mm	80 mm	100 mm
d_3	min. 25 mm			
d_4	> DN			

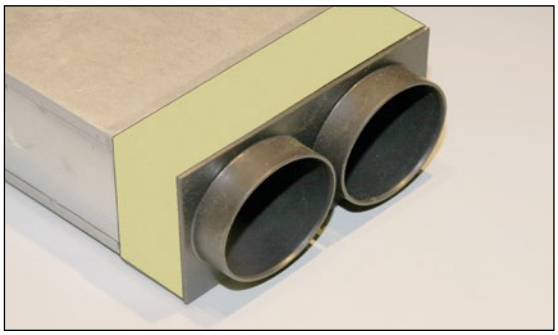
- The details shown here on the left refer to the German Model Building Code and may vary depending on the Building Code of the individual German state.
- Ceilings in cellars of class 1 and 2 buildings must be fire-retardant (F30). In class 3 to 5 buildings, they must be fire-resistant (F90).

Undertaking the installation

Step 1:

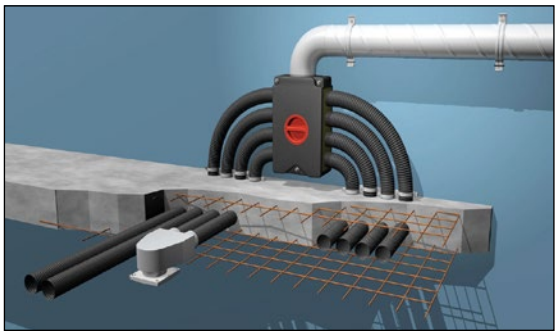
- Lay the flexible ducts on the filigree flooring and fix them to the iron cross beams with cable ties. The KT supports must not be damaged!
- When casting in the ducts in concrete ensure that the ducts on the filigree flooring are securely fastened to the iron cross beams to prevent them from floating up.



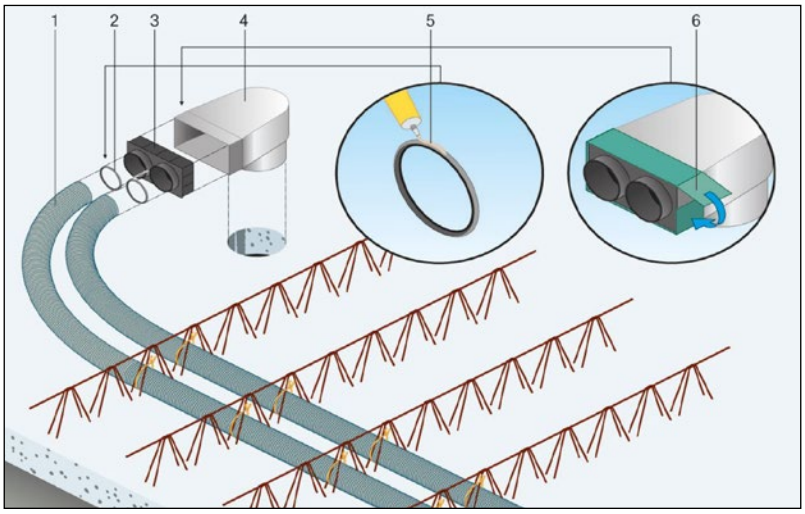


Step 2:

- Drill the core holes for the brackets, fix the MF-WE slide-in adaptor (3) in the MF-W... brackets (4) and mount these on the filigree flooring. If necessary, PU foam should be used to seal the bracket in the core hole.
- Connect the MF-F flexible ducts (1) with the MF-WE slide-in adaptors (3). When casting in concrete, MF-FDR gaskets (2) must always be used to establish a watertight connection*. A suitable lubricant (5) can be used to give the mounting situation more ease of movement.
- Connect the MF-WE slide-in adaptor (3) with the MF-W bracket... (4) by sticking down with adhesive tape (6).
- Any openings not used should be sealed with a sealing plug. (The plug is included in the scope of delivery for the slide-in adaptor!).
- Label the flexible ducts so they can't get mixed up.
- Before casting in, check the ventilation duct system for damage.



* does not apply to EPP distributors



Lubricant should be used when fitting the MF-FDR gasket. The MF-WE slide-in adaptor should be affixed to the MF-W bracket using adhesive tape.

1 MF-F flexible duct
2 MF-FDR gaskets
3 MF-WE slide-in adaptor
4 MF-W bracket
5 Lubricant
6 Adhesive tape

3.9 Observing sound-reduction measures

DIN 4109 “Sound insulation in buildings” stipulates a noise level of < 25 dB(A) in living rooms and bedrooms. Sound insulation measures should therefore be planned and implemented with an appropriate level of care.

The following measures are needed for sound insulation:

- Sound-deadened unit installation.
- Installation of tubular sound absorbers on the unit’s supply and exhaust air connections upstream of the air distributors so that fan noise is not transferred into the rooms.
- Installation of tubular sound absorbers in the outside and outgoing air too if there are terraces or balconies close to their outlets.
- Compliance with max. volumetric flows and minimum bend radii of the flexible duct.
- It is essential that maximum volumetric flows are noted, especially for supply air valves.

Types of sound insulation:

Telephony sound

- The transmission of sound from one room to another via the duct system is known as telephony sound.
- There is no need for a telephony sound absorber if the flexible ducts are laid in a star shape and if a minimum length of 5 m/flexible duct is observed.
- Thanks to the way in which folded spiral-seams ducts are laid, telephony sound can be prevented by design if telephony sound absorbers are planned in between rooms.
- For greater comfort, sound absorbers (e.g. the channel sound absorber) with a connection dimension of 80/150 or 80/200 can also be used here.
- However, there are then no guarantees that you will still be able to clean with the cleaning set.

Unit sound

- The transmission of sound from a unit itself via the ventilation duct system into the rooms is known as unit sound.
- Sound absorbers should be installed between the central unit and distributors (as close to the unit as possible) to prevent the unit sound from spreading into the home. These sound absorbers should be fitted in both the supply air line and exhaust air line.
- If noise is a problem (at the outside air or outgoing air opening), we would recommend installing sound absorbers. When installing the central unit, ensure acoustic insulation.

Structure-borne sound

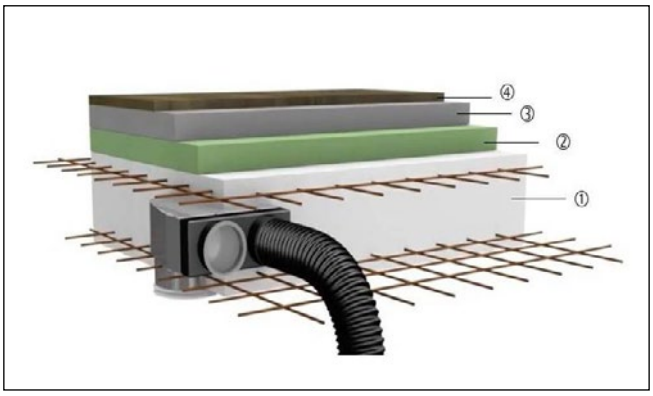
- Structure-borne sound is the sound transferred above a solid body at a frequency of more than 15Hz.
- It can be converted into airborne sound if radiated off surfaces, which makes it audible.
- Structure-borne sound may be transmitted depending on the structural circumstances. For example, if concrete ceilings run all the way through terraced houses or if units have been badly or unprofessionally installed.

Airborne sound

- Airborne sound is the dispersion of sound waves in the air.
- Airborne sound can be minimised through the use of solid walls and concrete ceilings.

Footfall sound

- Footfall sound is a special kind of structure-borne sound.
- It includes noises, which are produced under a ceiling through the excitation of structure-borne sound.
- Footfall sound insulation can be improved by increasing the mass per unit area of a ceiling but in most cases requires flexible floor coverings to also be added or floating floor sub-structures to be fitted on the slab.



① Concrete ceiling ② Footfall sound insulation ③ Screed
④ Floor covering

Planning and conditions for the installation site

When installing the ventilation unit in a room, the following conditions should be met:

- Frost-free room.
- Floor with with sufficient load-bearing capacity.
- The base must be horizontal, level, solid and permanent.
- It must be ensured that operation of the second ventilation unit is not impaired.

Flow noises

- Flow noises generally only arise above certain flow velocities. The greater the velocity, the more noise is produced. Flow velocities should not therefore exceed **3 m/s**. (Recommendation: max. 2 m/s for supply air; max. 3 m/s for exhaust air).
- Valves should also be properly planned in so that there is as little flow noise at the valve as possible.
- Footfall sound insulation should be noted when laying in the floor.

Sound insulation for neighbouring rooms at installation site

- When operating units, sound which is perceived as annoying in adjoining rooms may be emitted. This applies especially if the installation room is next to living rooms or bedrooms.
- Preventing annoying levels of sound requires sound absorption measures, e.g. more stringent sound-deadening requirements are placed on the interior wall. Duct fastenings and wall feedthroughs should be insulated against structure-borne sound.

3.10 Commissioning the ventilation system

Before regulating, check that

- all filters and valves are inserted correctly;
- all overflow openings are in place;
- the electrical connection has been undertaken correctly;
- ventilation ducts are correctly insulated;
- the condensation connection has been fitted correctly and all shutters, controllers and potential fire protection shutters are open.

Regulating the ventilation unit requires an appropriate unit for measuring the air volume, such as a hydrometric vane with a measuring funnel.

- Observe tolerances of measuring unit and measurement inaccuracies.

Regulation procedure:

- Set level 2, nominal operation.
- Set fan levels in unit to calculated air volumes. (Note the installation and operating instructions for the unit.)
- Open all valves all the way or preset valves on the basis of planning and valve data.
- Start the regulation procedure with the valves furthest away from the central unit.
- Check measurement for all valves.
- Regulate the valves until the desired amount of air is reached.

All calculated and set data should be documented. The operator must keep the installation and maintenance instructions. The company responsible for regulation may offer a maintenance contract service.

3.11 Maintaining the ventilation unit

You will find detailed information about maintenance work and how to perform it in the respective ventilation unit operating instructions.

Pay particular attention to the safety instructions in the respective instructions.

The following maintenance should be undertaken at the specified intervals:

Maintenance interval	Maintenance work to be undertaken
Quarterly	▶ Check the filters. Depending on the level of contamination, replace if necessary.
Annually	▶ Replace all filters. ▶ Depending on the level of contamination, we recommend cleaning the heat exchanger. ▶ Depending on the level of contamination, we recommend cleaning the inside of the unit.

3.12 Cleaning the flexible MAICOFlex ventilation duct system

Cleaning set

The cleaning set comprises a vacuum cleaner adapter and two cleaning balls. It is available in three different diameters to match the flexible ducts.

Procedure for cleaning

Working from the air distributor, a cleaning ball is inserted in the duct branch and sucked out from the other end using a vacuum cleaner. The cleaning ball exits along with any remaining dirt.

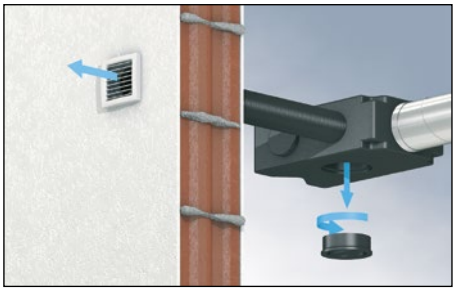
Safety instructions

- Keep the instructions.
- Once cleaning is complete, ensure that there are no cleaning balls left in the duct system.

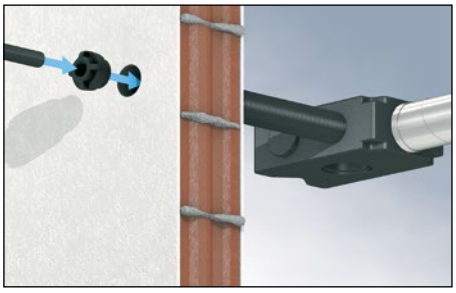
Cleaning

- Clean ventilation ducts as required. Cleaning should be undertaken at as low an air humidity as possible.
- If possible, use an industrial vacuum cleaner.
- Undertake cleaning procedure several times on each duct branch.
- In large building complexes, have the exhaust air and supply air pipes cleaned by a caretaker.
- Clean dirty cleaning balls with a standard rinsing agent.

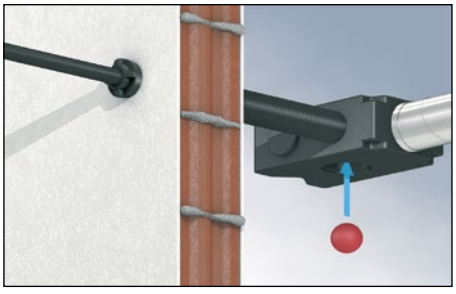
Cleaning a duct branch



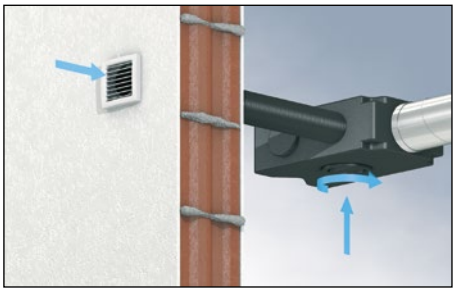
- Remove revision closure (bayonet closure, 45 °) from air distributor, also see “open/close” inscription on housing.
- (Depending on installation situation, the DN 125 revision closure will be at the front, top or bottom.)
- Remove internal grille or disk valve from other end of duct branch.



- Insert cleaning adapter.
- Place vacuum cleaner hose in connector funnel of cleaning adapter so that the hose seals tightly.



- Switch on vacuum cleaner.
- Place appropriate cleaning ball inside air distributor in the duct branch requiring cleaning.
- The cleaning ball is drawn in until it reaches the cleaning adapter.
- Take off cleaning adapter.
- Switch off vacuum cleaner.
- Take out cleaning ball.



- Remove dirt from duct branch.
- Clean cleaning ball.
- Undertake cleaning several times for each duct branch.
- Fit internal grille or disk valve and revision closure.

3.13 Combining a ventilation system with fireplaces

What should I note when operating ventilation systems with fireplaces?

Air-extracting equipment, such as a ventilation system, a central vacuum-cleaning system, an outgoing air cowl in a kitchen or an exhaust air clothes dryer, may produce a dangerous vacuum in the building if there is not a sufficient supply of combustion air from outside. This may cause the waste gases from the fireplace, fatal carbon monoxide in particular, to be drawn into the living room.

There are two ways of operating fireplaces with ventilation systems:

Joint operation

This option usually requires an additional safety device (vacuum monitor). Note that the DIBt approval for air-ventilated fireplaces states a max. permissible vacuum from the room side Situations exist where this permissible vacuum is greatly exceeded and the fireplace approval therefore ceases to apply (approval limitation). In this situation, the fireplace is considered dependent on room air.

The following vacuum situations are possible:

- supply air fan shutdown to protect the heat recovery unit (electric or pump hot water preheating register / brine EHE or air EHE) from frost;
- failure of the supply air fan on heat recovery units without the exhaust fan shutting down at the same time;
- extreme filter contamination;
- air EHE full of water;
- exhaust fans running at the same time;
- exhaust air operation in eco mode.

Alternating operation

When operating the fireplace, the ventilation system is switched off automatically, e.g. by temperature sensors in the fireplace's waste gas pipe.

The regional master chimney sweep must always be consulted during the planning phase!

The criteria for assessing joint operation of fireplace, ventilation system and range hood are shown below:

Ventilation units may only be installed in rooms, apartments or housing units of a comparable size, in which air-ventilated fireplaces are installed if:

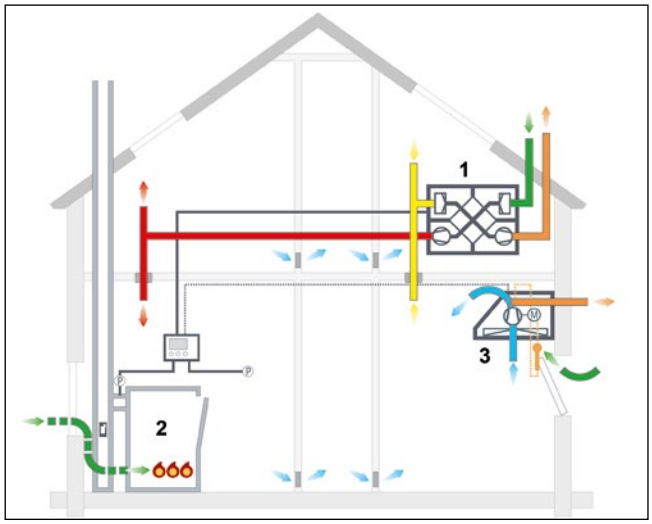
- a parallel operation of air-ventilated fireplaces for liquid or gaseous fuels and the air-extracting equipment can be prevented via safety devices, or
- the extraction of exhaust gas from the air-ventilated fireplaces is monitored by special safety equipment. In the case of air-ventilated fireplaces for liquid or gaseous fuels, the fireplace or the ventilation system must be switched off if the safety device is triggered. In the case of air-ventilated fireplaces for solid fuels, the ventilation system must be switched off if the safety device is triggered.

Ventilation units must not be installed if there are air-ventilated fireplaces in the housing unit that are connected to exhaust gas systems, which themselves have multiple connections.

In order to permit the intended operation of ventilation systems equipped with the central ventilation units with heat recovery, it should be possible to shut off any combustion air ducts or exhaust gas ducts from air-ventilated fireplaces.

For exhaust gas ducts of fireplaces for solid fuels, the shut-off device may only be operated by hand. It must be possible to identify the position of the shut-off device from the setting of the operating handle. This is considered to be fulfilled if a soot blocking device is deployed.

Air-ventilated fireplace with safety device

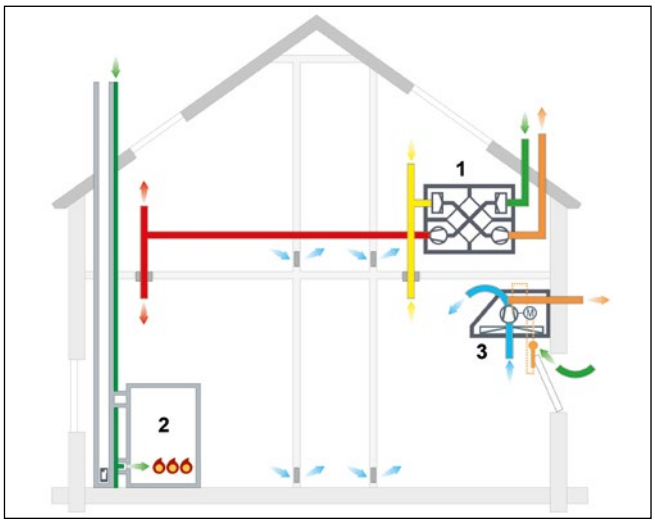


1 Ventilation unit positioned centrally, for the entire apartment, supply and exhaust air unit with or without heat recovery
2 Fireplaces
3 Range hood

Air types
- Outside air
- Supply air
- Extract air
- Exhaust air
- Circulating air

Safety device*
Vacuum monitoring (P)

Air-ventilated fireplace taking the example of an air-waste system, safety device not needed



* **Explanations of safety devices**
The safety device is checked for electronic and functional safety using the safety objectives of DVGW VP 121. A product standard based on this exists in the form of DIN 18841:2005-12.
A) Joint operation
During joint operation, a tested safety device should ensure that dangerous vacuums cannot arise. In case of malfunction, the safety device switches off air-extracting equipment and/or ventilation system or a fireplace which can be rapidly controlled from the heating gas side.
B) Alternating operation
A tested safety device (e.g. based on vacuum or temperature measurement) should be used to ensure that the ventilation system and fireplace are not operated at the same time. The processing of signals must satisfy this safety philosophy. The power supply may be shut down and this is sufficient.

3.14 Technical background knowledge

Terms relating to ventilation

Air exchange
Air exchange is understood as the exchange of air in closed rooms.
The exchange is measured as the air exchange rate.

Air exchange rate
This states how often the total volume of room air is exchanged for fresh air in a particular period. The air exchange rate tells you how frequently the air is exchanged per hour. A single air exchange rate means that the air in the room is “replaced” once an hour.

Outside air
Air that is drawn in from the outside.

Outside air rate
When calculating the personal air volume, the number of people continually present in the room is taken into account. Guide: 30 m³/h per person.

Supply air
The air flowing into the room.

Exhaust air
The air drawn out of the room.

Outgoing air
The air given off to the outside.

Volumetric air flow
Amount of air needed over a certain period [m³/h].

Air opening
Opening in the room (wall, ceiling or floor), through which air can exit or enter (e.g. grille, disk valve or blower nozzle).

Overflow opening
Opening through which the air overflows from one room to another depending on the flow direction.

Degree of heat provision
Heat recovery parameter (thermal source: exhaust air), including the amount of energy gained from potential condensation. The heat from other sources, entering the flow of supply air (e.g. waste heat from motor in flow of supply air) is included too.

Terms relating to ventilation

Formulary

circular area	$A = r^2 \cdot \pi = \frac{d^2 \cdot \pi}{4}$	pipe friction	$\Delta p_R = l \cdot R$
volume flow	$\dot{V} = A \cdot v \cdot 3600\ s/h$	pressure loss	$\Delta p_{ges} = l \cdot R + Z + \Delta p_{installation}$
rate of flow	$v = \frac{\dot{V}}{A \cdot 3600\ s/h}$	continuity law	$\dot{V}_1 = \dot{V}_2 \quad v_1 \cdot A_1 = v_2 \cdot A_2$
		heat quantity	$Q = m \cdot c \cdot \Delta\vartheta$
air exchange	$LW = \frac{\dot{V}}{V_R}$	hydraulic diameter	
dynamic pressure	$p_{dyn} = \frac{\rho}{2} \cdot v^2$	- for any cross-sectional shape	$d_h = \frac{4 \cdot A}{U}$
individual resistances	$Z = \Sigma\zeta \cdot p_{dyn}$	- for rectangular form	$d_h = \frac{2 \cdot a \cdot b}{a + b}$

A	=	surface in (m²)
r	=	radius in (m)
d	=	diameter in (m)
v	=	rate of flow (m/s)
LW	=	air exchange
$\dot{V}$	=	volume flow in (m³/h) (in the pipe or valve)
V_R	=	room volume in (m³)
p_{dyn}	=	dynamic pressure (Pa)
ρ	=	density of medium (kg/m³)
Z	=	pressure loss due to individual resistances (Pa)
ζ	=	coefficient of resistance without unit
Δp_R	=	pressure loss due to pipe friction (Pa)
l	=	pipe length (m)
R	=	pressure loss (Pa/m)
Δp_{ges}	=	total pressure loss (Pa)
$\Delta p_{installation}$	=	pressure loss due to internals (Pa)
Q	=	heat quantity
c	=	specific heat capacity (Wh/kg x K)
$\Delta\vartheta$	=	temperature difference (K)
D_h	=	hydraulic diameter

Duct cross-section calculation

Nominal size (mm)	Cross-section A (m²)	Maximum volumetric flow V (m³/h) at flow velocity V: v = 3 m/s	v = 2.5 m/s	v = 2 m/s	v = 1.5 m/s
MAICOFlex		**(m³/h)**	**(m³/h)**	**(m³/h)**	**(m³/h)**
63 (inner: 54 mm)	0.0022	24	20	**16**	12
75 (inner: 64 mm)	0.0032	35	29	**23**	17
90 (inner: 78 mm)	0.0047	51	42	**34**	25
MAICOFFS		**(m³/h)**	**(m³/h)**	**(m³/h)**	**(m³/h)**
52 x 132	0.004	45	36	**29**	22
Folded spiral-seams duct		**(m³/h)**	**(m³/h)**	**(m³/h)**	**(m³/h)**
100	0.008	**86**	72	**58**	43
125	0.012	**130**	108	**86**	65
150	0.018	**194**	162	**130**	97
160	0.020	**216**	180	**144**	108
180	0.025	**270**	225	**180**	135
200	0.031	**335**	279	**223**	167
224	0.039	**421**	351	**281**	211
250	0.049	**529**	441	**353**	265
280	0.062	**670**	558	**446**	335
300	0.070	**756**	630	**504**	378
315	0.078	**840**	700	**560**	420
355	0.099	**1070**	890	**710**	540
400	0.126	**1360**	1130	**910**	680
450	0.159	**1720**	1430	**1145**	860
500	0.196	**2120**	1760	**1410**	106
MAICOTherm		**(m³/h)**	**(m³/h)**	**(m³/h)**	**(m³/h)**
125	0.012	**130**	108	**86**	65
160/150 (inner: 170 mm)	0.022	**238**	198	**158**	119

Maximum volumetric flow for the **exhaust air**, should not be exceeded for comfortable operation.

Maximum volumetric flow for the **supply air**, should not be exceeded for comfortable operation.

Formulas	Calculation formulas	Key
	$A = d^2 \times \pi / 4$	V (m³/h)
	$A = V / (v \times 3600s)$	A (m²)
	A x v x 3600s	v (m/s)
		d (mm)

4 Sample planning

Better system-based ventilation - all from one source

- Centralised ventilation units for a huge range of different housing sizes
- The MAICOFlex duct system with all supply air and exhaust air routing components
- The heat-insulated MAICOTherm duct system for outside and outgoing air flow
- Various sound absorber models

■ Supply air ■ Exhaust air ■ Outside air ■ Extract air

① Ventilation unit
② Sound absorber
③ Air distributor
④ Therm duct
⑤ External grille
⑥ Flexible ducts
⑦ Supply air valve
⑧ Exhaust air valve

Sample planning for flats and semi-detached houses, detached houses and bungalows

The benefits in detail

- Ten real-life sample plans: apartments up to 140 m², bungalows up to 140 m², semi-detached houses and detached houses up to 450 m² of living space
- Consistent and clear
- Show typical model options
- For quick orientation and overview
- Typical installation locations of MAICO ventilation units
- Correct placement of inlets and outlets
- Sensible routing of ducts

Trio

Central ventilation for flats with heat recovery

- The supply air rooms are the children's rooms, bedrooms and living room
- The exhaust air rooms are the bathroom and kitchen
- Disk valves for supply and exhaust air in the respective rooms
- Air flows from supply air rooms to exhaust air rooms via door ventilation grilles or door cut-outs
- Revision openings on the air distributors ensure that the ventilation ducts can be cleaned with the cleaning set if necessary

Incl. RLS 1 WR control unit

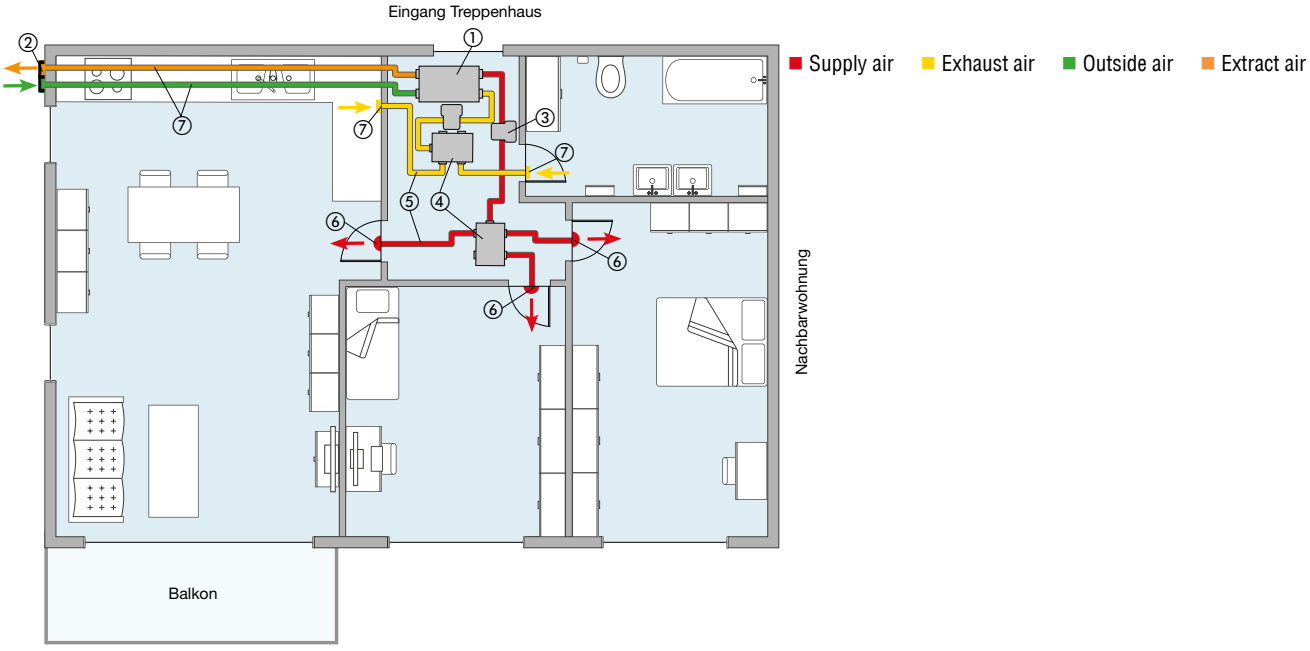
Optional RLS T1 WS with touchscreen

Description of property

- Installation of ventilation unit and air distributor as well as all ventilation ducts in suspended ceiling in corridor
- Outside and outgoing air flow through heat-insulated Therm ducts and combination wall connections on the external wall
- Control via 4-step switch, home network, app or as an option via a touch panel or KNX

enocean @home AIR Modbus® KNX

① Trio ventilation unit
② Outside and outgoing air connection with Therm duct
③ Sound absorber box
④ Air distributor
⑤ Flexible duct
⑥ Supply air valve
⑦ Exhaust air valve



The ventilation unit is fitted in the corridor's suspended ceiling

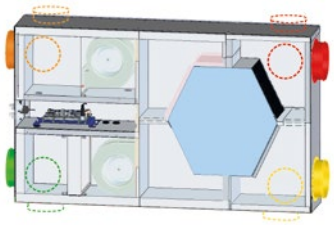
Flat

Trio

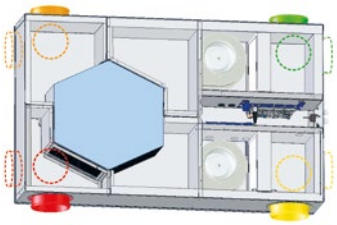
Central ventilation for residential units of up to 80 m²

If necessary, other positions can be selected for the sockets and/or the unit can be turned to the appropriate position. The illustrations show the units from above. The service side is at the bottom.

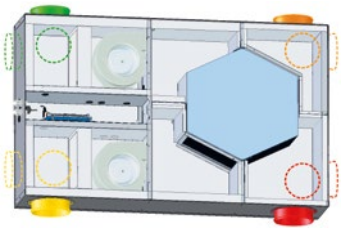
■ Supply air ■ Exhaust air ■ Outside air ■ Extract air



Trio Variant LZ



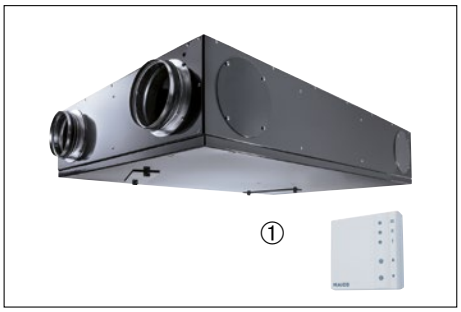
Trio Variant QZ-AR



Trio Variant QZ-AL

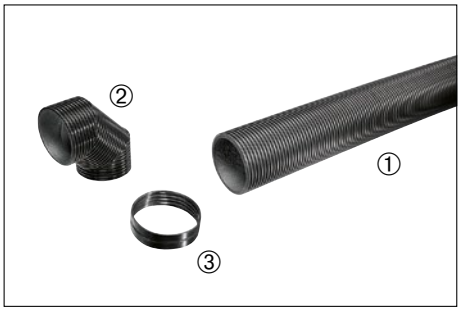
MATERIAL PER RESIDENTIAL UNIT (example)

Ventilation unit with heat recovery including control unit Trio with energy-efficient EC motors	ART. NO.	CONTENT/ QUANTITY
① Trio LZ	0095.0124	1
Trio QZ-AR	0095.0122	optional
Trio QZ-AL	0095.0120	optional



- Max. 120 m³/h at 190 Pa
- Dimensions W x H x D: 600 x 213 x 1070 mm

INDIVIDUAL COMPONENTS FOR THE OUTSIDE AND OUTGOING AIR FLOW WITH INSULATED DN 125 DUCT	ART. NO.	CONTENT/ QUANTITY
① L-duct, insulated, MT-R 125 (1 item = 2 m)	0059.0981	8
② Elbow, insulated, MT-B 125 90/45	0059.0983	11
③ Connector, MT-V 125	0059.0985	22

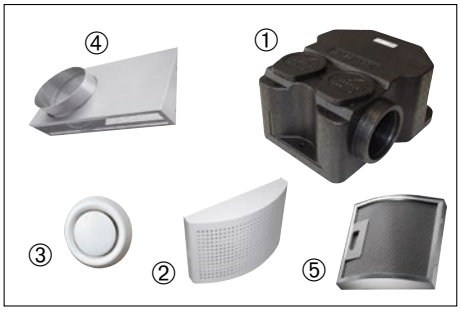


MAICOTherm – appropriate installation solution for tight installation situations

INDIVIDUAL COMPONENTS FOR SUPPLY AND EXHAUST AIR DN 90 FLEXIBLE DUCT	ART. NO.	CONTENT/ QUANTITY
① Flex duct MF-F 90 (Roll = 50 m)	0055.0095	1
② Air distributor MF-V 90	0059.0968	2
③ Gaskets MF-FDR 90 (Set = 10 pieces)	0175.0263	1
④ Valve adapter MF-A 90	0059.0963	5

Das MAICO*Flex* duct system – the optimum installation solution in terms of speed

MORE INDIVIDUAL COMPONENTS	ART. NO.	CONTENT/ QUANTITY
① SB 12/16 sound absorber box	0059.0995	2
② Supply air valve ZWVQ 10	0152.0064	3
③ Exhaust air valve TK 10	0151.0192	2
④ Combi-wall connections for outside and outgoing air Right-hand version, KWH 16 R	0152.0060	1
⑤ Grease filter for kitchen, FFE 10	0092.0506	1



The MAICO accessories – appropriate individual components

WS 160 Flat

Central ventilation with heat recovery for apartments and detached houses

- The supply air rooms are the living and work rooms as well as bedrooms and children's rooms.
- The exhaust air rooms are the bathroom, kitchen and utility room
- Supply/exhaust air valves in respective room
- Air flows from supply air rooms to exhaust air rooms via door ventilation grilles or door cut-outs
- Revision openings on the air distributors ensure that the ventilation ducts can be cleaned with the cleaning set if necessary

Incl. RLS 1 WR control unit

Optional RLS T1 WS with touchscreen

Description of property

- Unit installation in ceiling in utility room, can also be installed elsewhere (no condensate drain needed)
- Ventilation ducts for supply and exhaust air fitted in suspended ceiling in corridor
- Outside/outgoing air via heat-insulated Therm ducts

- Control via 4-step switch, home network, app or as an option via a touch panel or KNX

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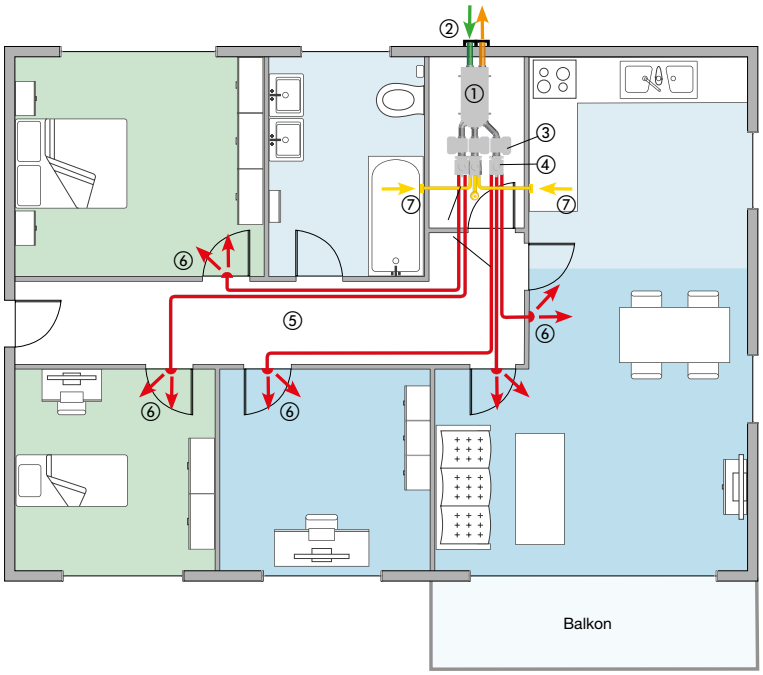
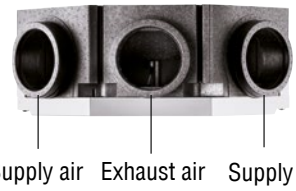
① Ventilation unit WS 160 FLAT KBZET
② Outside and outgoing air connection with Therm duct
③ Tubular sound absorber
④ Air distributor
⑤ Flexible duct
⑥ Supply air valve
⑦ Exhaust air valve



Air flow with patented zone control for supply air / zone 1 ■ zone 2 ■

■ Supply air ■ Exhaust air ■ Outside air ■ Extract air

Left-/right-hand version in one unit



Variant with patented zone control
WS 160 Flat KBZET
Different ventilation intensities at different times can be achieved in the various rooms, e.g. during the day and at night.

Variant without zone control
WS 160 Flat ET
Preset ventilation intensities are constant in the various rooms the whole day long.

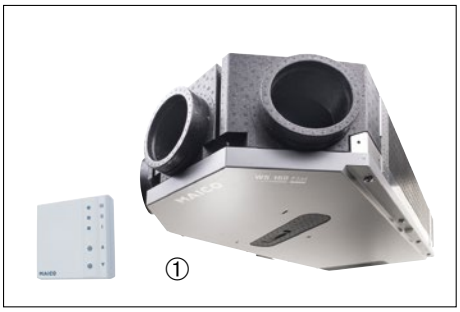
WS 160 Flat

Central ventilation for residential units of up to 140 m²

MATERIAL PER RESIDENTIAL UNIT (example)

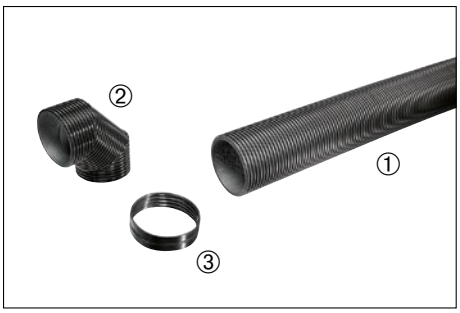
Complete kit comprising:

VENTILATION UNIT WITH HEAT RECOVERY including control unit	ART. NO.	WITH ZONE CONTROL CONTENT/ QUANTITY	WITHOUT ZONE CONTROL CONTENT/ QUANTITY
① WS 160 FLAT KBZET Basic unit with basic equipment	0095.0094	1	
② WS 160 FLAT ET Basic unit with basic equipment	0095.0090		1



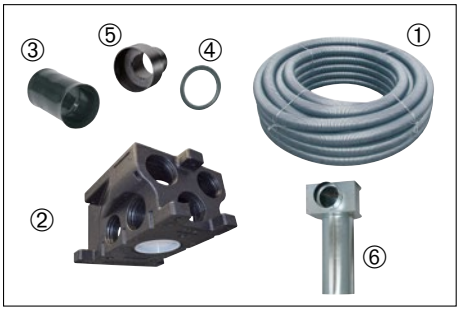
- Max. 160 m³/h at 220 Pa
- Dimensions W x H x D: 582 x 230 x 1260 mm

INDIVIDUAL COMPONENTS FOR THE OUTSIDE AND OUTGOING AIR FLOW WITH INSULATED DN 125 DUCT	ART. NO.	CONTENT/ QUANTITY	CONTENT/ QUANTITY
① L-duct, insulated, MT-R 125 (1 item = 2 m)	0059.0981	1	1
② Elbow, insulated, MT-B 125 90/45	0059.0983	1	1
③ Connector, MT-V 125	0059.0985	13	8



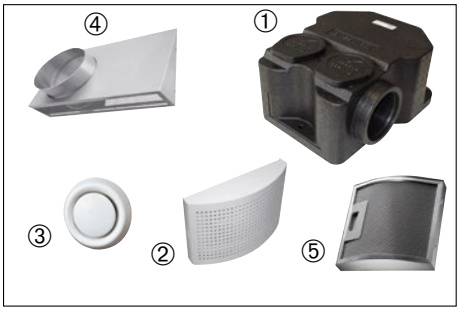
MAICOTherm

INDIVIDUAL COMPONENTS FOR SUPPLY AND EXHAUST AIR DN 90 FLEXIBLE DUCT	ART. NO.	CONTENT/ QUANTITY	CONTENT/ QUANTITY
① Flex duct, MF-F 90 (Roll = 50 m)	0055.0095	1	1
② Air distributor MF-VK 90-7 1 x 125 / 7 x DN 90	0059.0994	3	2
③ Connector MF-FSM 90	0059.0975	1	1
④ Gaskets MF-FDR 90 (Set = 10 pieces)	0175.0263	1	1
⑤ Valve adapter MF-A 90	0059.0963	7	7
⑥ Bracket MF-WLF 100/90	0018.0607	1	1



MAICO*Flex*

MORE INDIVIDUAL COMPONENTS	ART. NO.	CONTENT/ QUANTITY	CONTENT/ QUANTITY
① Sound absorber box SB 12/16	0059.0995	3	2
② Supply air valve, ZWVQ 10	0152.0064	5	5
③ Exhaust air valve, TK 10	0151.0192	3	3
④ Combination wall connection for out side/outgoing air Right-hand version, KWH 16 R	0152.0060	1	1
⑤ Grease filter for kitchen, FFE 10	0092.0506	1	1



MAICO accessories

WS 170 R

Central ventilation for flats with heat recovery

- The supply air rooms are the bedrooms, living room and children's rooms
- The exhaust air rooms are the bathroom, WC, utility room and kitchen
- Disk valves for supply and exhaust air
- Air flows from supply air rooms to exhaust air rooms via door ventilation grilles or door cut-outs
- Revision openings on the air distributors ensure that the ventilation ducts can be cleaned with the cleaning set if necessary

Incl. RLS 1 WR control unit

Optional RLS T1 WS with touchscreen

Description of property

- Installation of ventilation unit in utility room
- Air distributor and all ventilation ducts for supply and exhaust air run in suspended ceiling in corridor
- Outside and outgoing air flows via the external wall
- Control via 4-step switch, home network, app or as an option via a touch panel or KNX

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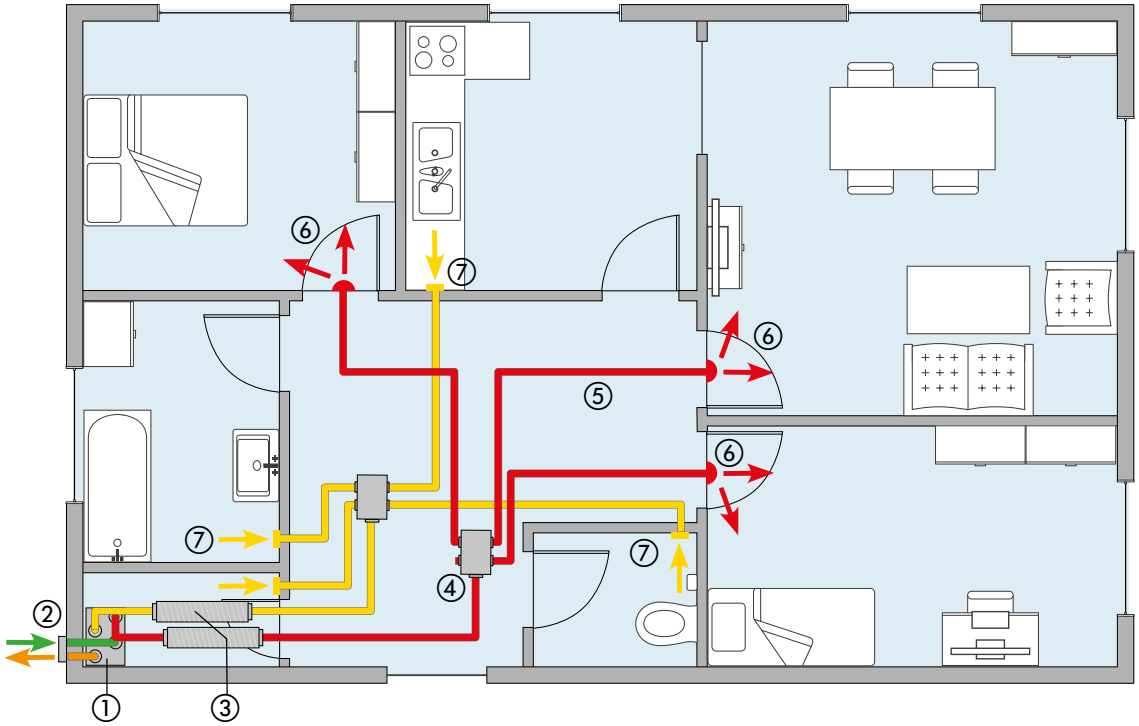
① WS 170 R ventilation unit
② Outside and outgoing air connection with Therm duct
③ Tubular sound absorber
④ Air distributor
⑤ Flexible duct
⑥ Supply air valve
⑦ Exhaust air valve

■ Supply air ■ Exhaust air ■ Outside air ■ Extract air



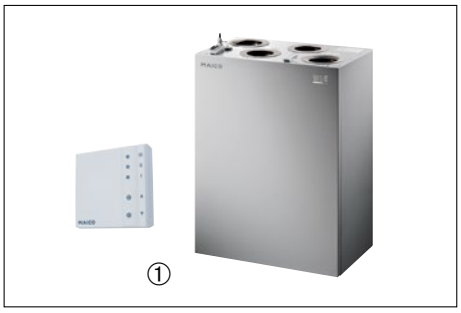
WS 170 R

Central ventilation for residential units of up to 140 m²

MATERIAL PER RESIDENTIAL UNIT (example)

Complete kit comprising:

VENTILATION UNIT WITH HEAT RECOVERY including control unit	ART. NO.	CONTENT/ QUANTITY
① WS 170 R Supply and exhaust air connection on right (standard model)	0095.0081	1
optional: WS 170 L Supply and exhaust air connection on left	0095.0082	optional

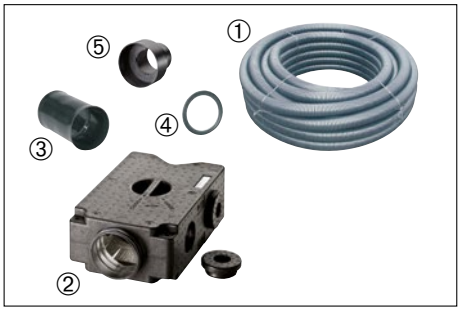


- Max. 160 m³/h at 100 Pa
- Dimensions W x H x D: 582 x 820 x 375 mm

INDIVIDUAL COMPONENTS FOR THE OUTSIDE AND OUTGOING AIR FLOW WITH INSULATED DN 125 DUCT	ART. NO.	CONTENT/ QUANTITY
① L-duct, insulated, MT-R 125 (1 item = 2 m)	0059.0981	6
② Elbow, insulated, MT-B 125 90/45	0059.0983	8
③ Connector, MT-V 125	0059.0985	16
④ Plug connector, SVR 125	0055.0183	4
⑤ Coupling, MT-Ü125	0059.0986	4

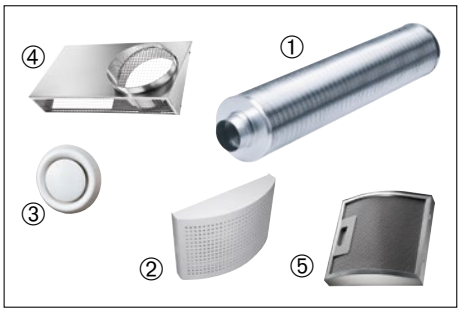
MAICOTherm – appropriate installation solution for tight installation situations

INDIVIDUAL COMPONENTS FOR SUPPLY AND EXHAUST AIR DN 90 FLEXIBLE DUCT	ART. NO.	CONTENT/ QUANTITY
① Flex duct, MF-F 90 (Roll = 50 m)	0055.0095	1
② Air distributor, MF-V90 1 x 125 / 4 x DN 90	0059.0968	2
③ Connector, MF-FSM 90	0059.0975	1
④ Gaskets, MF-FDR 90 (Set = 10 pieces)	0175.0263	1
⑤ Valve adapter, MF-A 90	0059.0963	7



The MAICO*Flex* duct system – the optimum installation solution in terms of speed

MORE INDIVIDUAL COMPONENTS	ART. NO.	CONTENT/ QUANTITY
① Tubular sound absorber RSR 12	0092.0312	2
② Supply air valve, ZWVQ 10	0152.0064	3
③ Exhaust air valve, TK 10	0151.0192	4
④ Combination wall connection for out side/outgoing air Right-hand version, KWH 16 R	0152.0061	1
⑤ Grease filter for kitchen, FFE 10	0092.0506	1



The MAICO-accessories – appropriate individual components

WS 170 KR

Central ventilation of bungalows with heat recovery

- The supply air rooms are the bedrooms and living room
- The exhaust air rooms are the bathroom, WC, utility room and kitchen
- Outside and outgoing air flows via the external walls
- Disk valves for supply and exhaust air
- Air flows from supply air rooms to exhaust air rooms via door ventilation grilles or door cut-outs
- Revision openings on the air distributors ensure that the ventilation ducts can be cleaned with the cleaning set if necessary

Incl. RLS 1 WR control unit

Optional RLS T1 WS with touchscreen

Description of property

- Installation of ventilation unit in utility room on ground floor
- Air distributor and all ventilation ducts for supply and exhaust air (insulating) routed in attic
- Control via 4-step switch, home network, app or as an option via a touch panel or KNX

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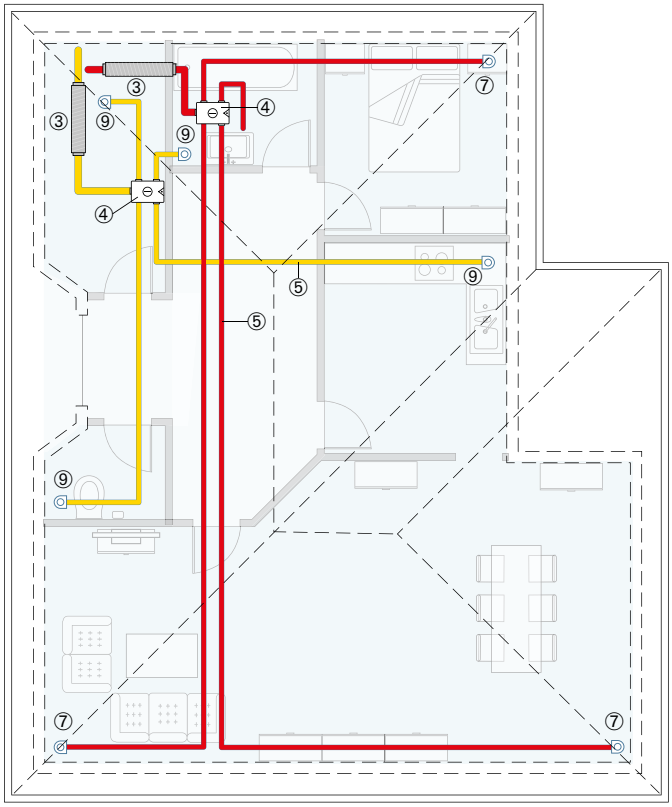
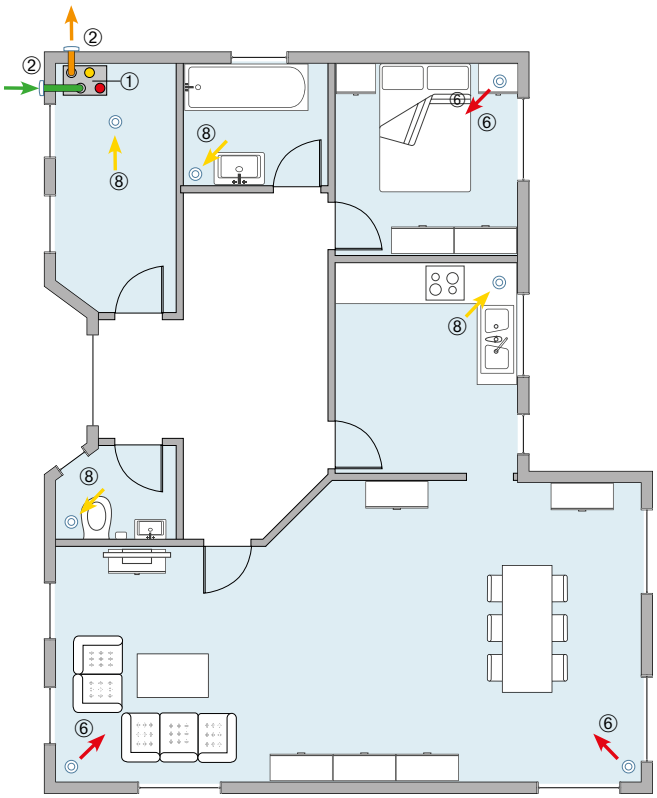
① WS 170 KR ventilation unit
② Outside and outgoing air connection with Therm duct
③ Tubular sound absorber
④ Air distributor
⑤ Flexible duct
⑥ Supply air valve
⑦ Bracket and adapter for supply air valve, ground floor
⑧ Exhaust air valve
⑨ Bracket and adapter for exhaust air valve, ground floor



Loft floor

■ Supply air ■ Exhaust air ■ Outside air ■ Extract air



Ground floor

WS 170 KR

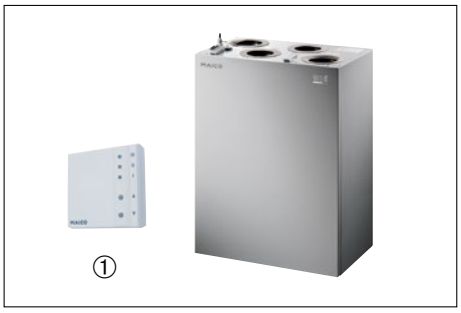
Central ventilation for residential units of up to 140 m²

MATERIAL PER RESIDENTIAL UNIT (example)

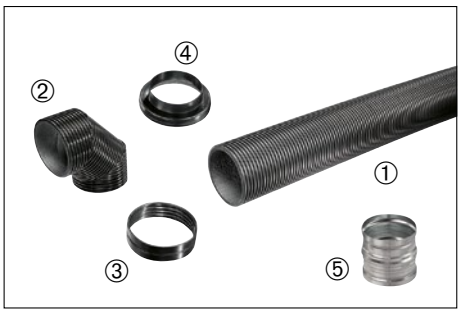
Complete kit comprising:

VENTILATION UNIT WITH HEAT RECOVERY including control unit	ART. NO.	CONTENT/ QUANTITY
① WS 170 KR	0095.0083	1

- Max. 160 m³/h at 100 Pa
- Dimensions W x H x D: 582 x 820 x 375 mm



INDIVIDUAL COMPONENTS FOR THE OUTSIDE AND OUTGOING AIR FLOW WITH INSULATED DN 125 DUCT	ART. NO.	CONTENT/ QUANTITY
① Duct, MT-R125 (1 item = 2 m)	0059.0981	3
② Elbow, MT-B125 90/45	0059.0983	7
③ Connector, MT-V125	0059.0985	12
④ Coupling, MT-Ü125	0059.0986	4
⑤ Plug connector SVR 125	0055.0183	4



MAICOTherm – appropriate installation solution for tight installation situations

INDIVIDUAL COMPONENTS FOR SUPPLY AND EXHAUST AIR	ART. NO.	CONTENT/ QUANTITY
① Plastic air distributor MF-V90	0059.0968	2
② Flexible duct, MF-F90 (Roll = 50m)	0055.0095	1
③ Bracket, MF-WLF 100/90	0018.0607	7
④ Insertion sleeves, MF-FSM90	0059.0975	1

The MAICO*Flex* duct system – the optimum installation solution in terms of speed

MORE INDIVIDUAL COMPONENTS	ART. NO.	CONTENT/ QUANTITY
① Tubular sound absorber, RSR 12/ 50	0092.0324	2
② Disk valve for supply and exhaust, TK 10	0151.0198	7
③ External grille, SG 100	0059.1054	1
④ Shutter, AP 100	0059.1058	1
⑤ Grease filter element, FFE 10	0092.0506	1
⑥ Sealing ring, MF-FDR75	0175.0261	1

The MAICO accessories – appropriate individual components

WS 170 L

Central ventilation of terraced houses or semi-detached houses with heat recovery

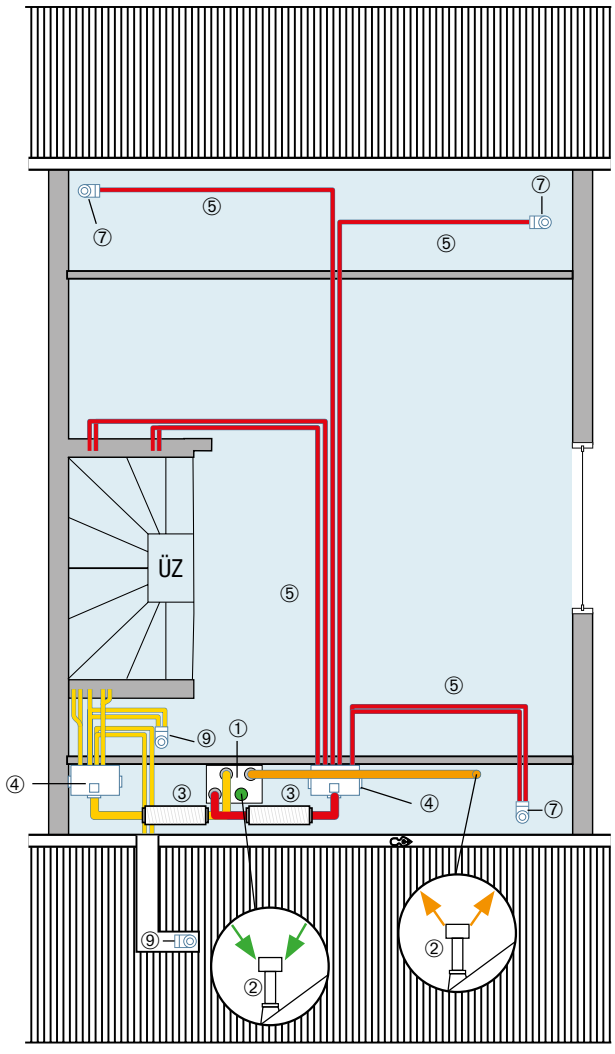
Description of property

– Installation of ventilation unit and air distributor for supply and exhaust air in pointing sill (insulating) of studio floor
– Ventilation ducts for supply and exhaust air are cast into concrete ceilings of floors

Incl. control unit RLS 1 WR

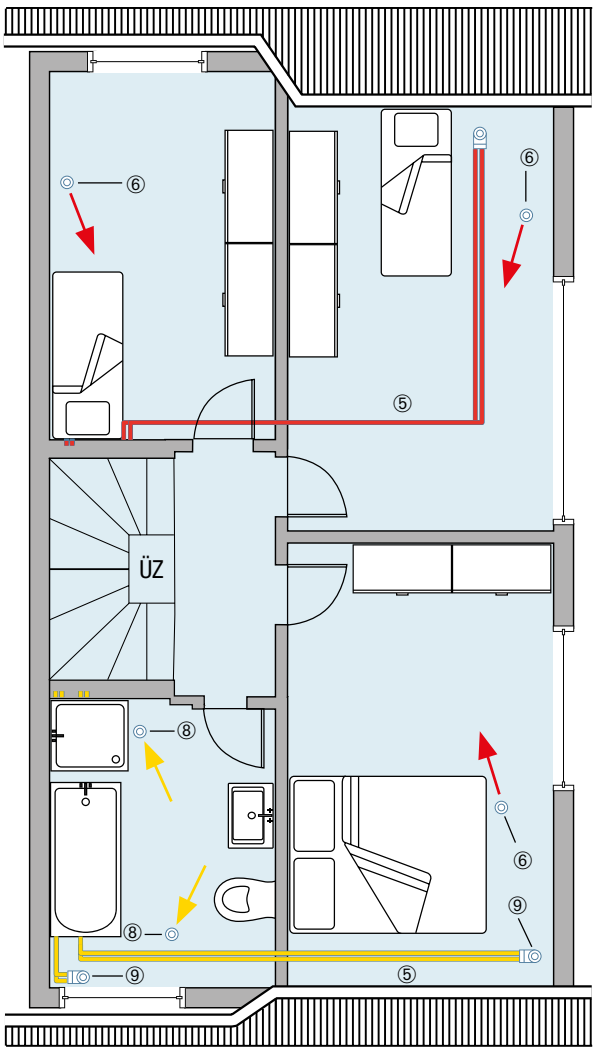
Optional RLS T1 WS with touchscreen

① Ventilation unit WS 170 L
② Outside and outgoing air connection with Therm duct
③ Tubular sound absorber
④ Air distributor
⑤ Flexible duct
⑥ Supply air valve
⑦ Bracket and adapter for supply air valve, ground floor
⑧ Exhaust air valve
⑨ Bracket and adapter for exhaust air valve, ground floor/first floor



Attic

■ Supply air ■ Exhaust air ■ Outside air ■ Extract air



First floor

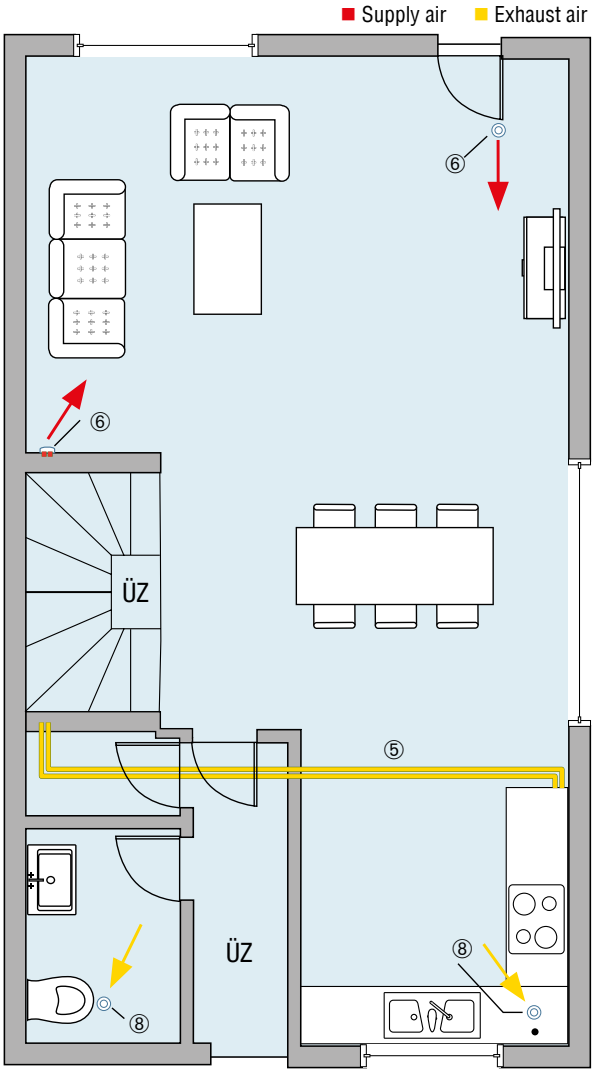
WS 170 L

Central ventilation for residential units of up to 140 m²

Description of property

- The supply air rooms are the bedrooms, living room and children's rooms
- The exhaust air rooms are the bathroom, WC and kitchen
- Outside and outgoing air flows via roof cowls
- Disk valves for supply and exhaust air
- Air flows from supply air rooms to exhaust air rooms via door ventilation grilles or door cut-outs
- Revision openings on the air distributors ensure that the ventilation ducts can be cleaned with the cleaning set if necessary
- Control via 4-step switch, home network, app or as an option via a touch panel or KNX

⑤ Flexible duct
⑥ Supply air valve
⑦ Bracket and adapter for supply air valve, cellar
⑧ Exhaust air valve



Ground floor

WS 170 L

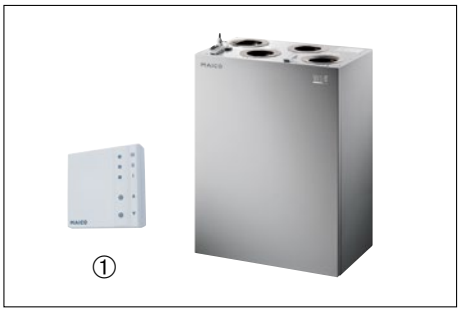
Central ventilation for residential units of up to 140 m²

MATERIAL PER RESIDENTIAL UNIT (example)

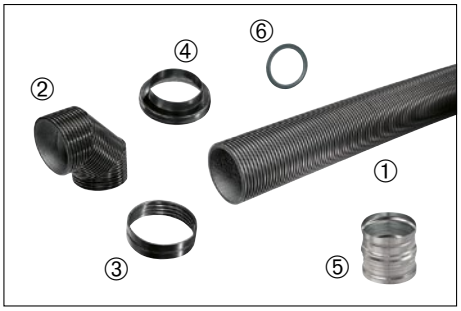
Complete kit comprising:

VENTILATION UNIT WITH HEAT RECOVERY including control unit	ART. NO.	CONTENT/ QUANTITY
① WS 170 L	0095.0082	1

- Max. 160 m³/h at 100 Pa
- Dimensions W x H x D: 582 x 820 x 375 mm

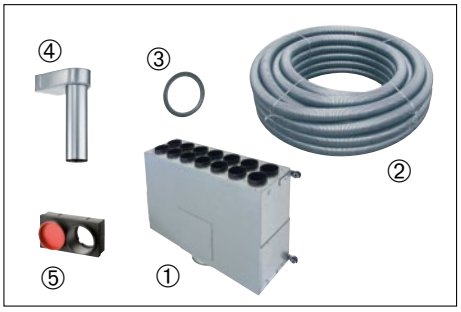


INDIVIDUAL COMPONENTS FOR THE OUTSIDE AND OUTGOING AIR FLOW WITH INSULATED DN 125 DUCT	ART. NO.	CONTENT/ QUANTITY
① Duct, MT-R125 (1 item = 2 m)	0059.0981	3
② Elbow, MT-B125 90/45	0059.0983	8
③ Connector, MT-V125	0059.0985	19
④ Coupling, MT-Ü125	0059.0986	4
⑤ Plug connector, SVR 125	0055.0183	4
⑥ Gaskets, MF-FDR75 (Set = 10 pieces)	0175.0262	1



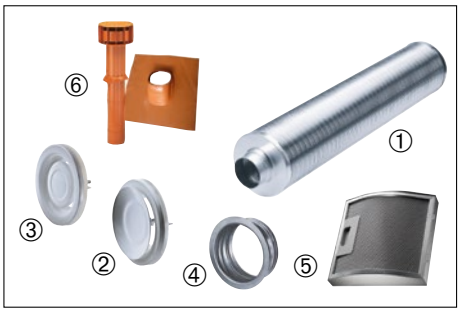
MAICOTherm – appropriate installation solution for tight installation situations

INDIVIDUAL COMPONENTS FOR SUPPLY AND EXHAUST AIR	ART. NO.	CONTENT/ QUANTITY
① Plate distributor, MF-BV75-160-12	0018.0527	2
② Flexible duct, MF-F75 (Roll = 50 m)	0055.0096	2
③ Sealing rings, MF-FDR75 (Set = 10 pieces)	0175.0262	3
④ Bracket, MF-WL 125 80/200	0018.0531	9
⑤ Slide-in adaptor, MF-WE75	0059.0972	9



The MAICO*Flex* duct system – the optimum installation solution in terms of speed

MORE INDIVIDUAL COMPONENTS	ART. NO.	CONTENT/ QUANTITY
① Tubular sound absorber, RSR 12/ 50	0092.0312	2
② Supply air valve, TFZ 12	0151.0365	5
③ Exhaust air valve, TFA 12	0151.0370	4
④ Mounting frame, EBR-D 12 for TFZ/TFA	0092.0494	9
⑤ Grease filter element, FFE 10	0092.0506	1
⑥ Roof outlet with roofing tile DF 125 T DF 125 TB	 0092.0373 0092.0378	 2 2



The MAICO accessories – appropriate individual components

WS 300 Flat KBR

Central ventilation with heat recovery for apartments and detached houses

- The supply air rooms are the living and guest rooms as well as bedrooms and children's rooms.
- The exhaust air rooms are the guest WC, kitchen and utility room as well as the bathroom and corridor on the first floor
- Disk valve for supply and exhaust air in the respective room
- Air flows from supply air rooms to exhaust air rooms via door ventilation grilles or door cut-outs
- Revision openings on the air distributors ensure that the ventilation ducts can be cleaned with the cleaning set if necessary

Description of property

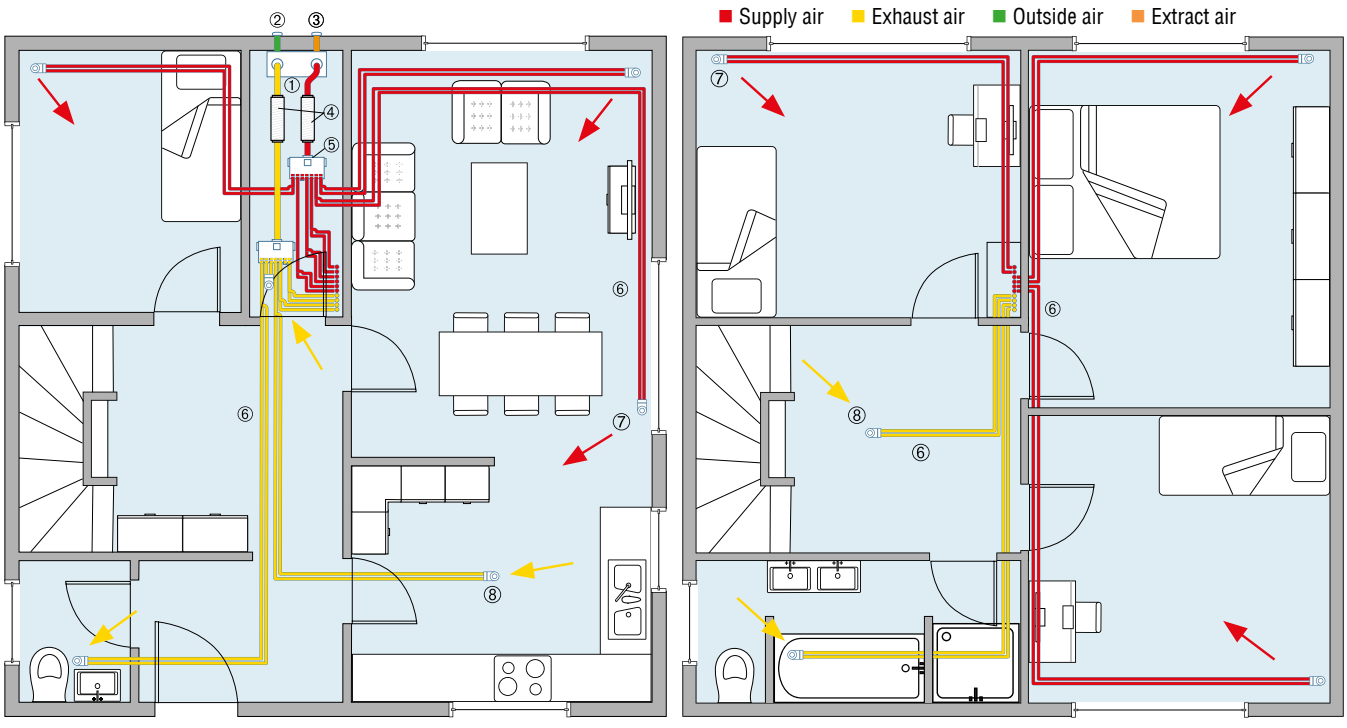
- Unit installation on wall in utility room, can also be installed elsewhere (no condensate drain needed)
- Ventilation ducts for supply and exhaust air are cast into concrete ceilings of floors
- Outside/outgoing air via heat-insulated Therm ducts

Incl. RLS 1 WR control unit

Optional RLS T1 WS with touchscreen

- Control via 4-step switch, home network, app or as an option via a touch panel or KNX

① WS 300 Flat KBR ventilation unit mounted vertically on the outside wall
② Outside air wall connection
③ Outgoing air wall connection
④ Tubular sound absorber
⑤ Air distributor
⑥ Duct system
⑦ Supply air valve
⑧ Exhaust air valve



Ground floor

First floor

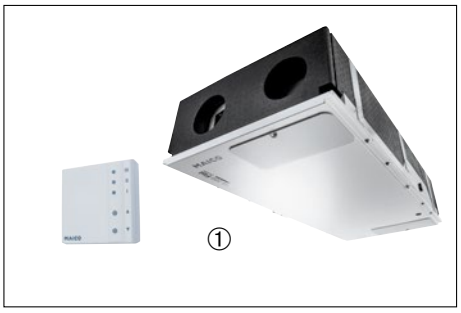
WS 300 Flat KBR

Central ventilation for residential units of up to 300 m²

MATERIAL PER RESIDENTIAL UNIT (example)

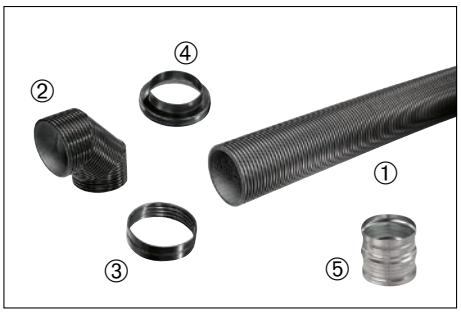
Complete kit comprising:

VENTILATION UNIT WITH HEAT RECOVERY including control unit	ART. NO.	CONTENT/ QUANTITY
① WS 300 Flat KBR	**0095.0144**	1



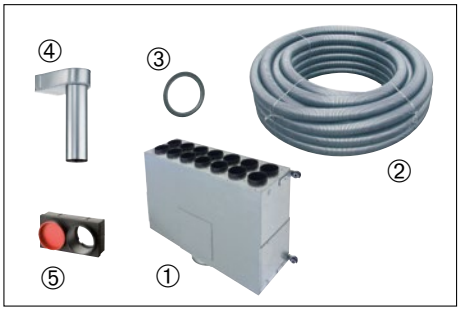
- Max. 300 m³/h at 475 Pa
- Dimensions W x H x D: 700 x 300 x 1500 mm

INDIVIDUAL COMPONENTS FOR THE OUTSIDE AND OUTGOING AIR FLOW WITH INSULATED DN 160 DUCT	ART. NO.	CONTENT/ QUANTITY
① Duct, MT-R160 (1 item = 2 m)	0059.0982	2
② Elbow, MT-B125 90/45	0059.0983	5
③ Connector, MT-V160	0059.0988	10
④ Coupling, MT-Ü160/150	0059.0990	10
⑤ Plug connector, SVR 160	0055.0185	4



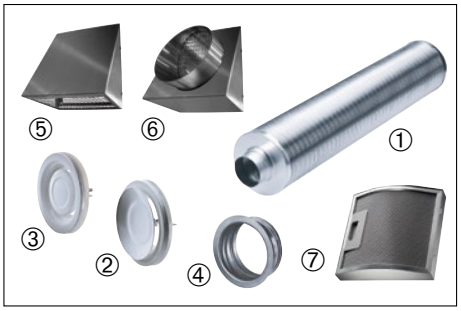
MAICOTherm – appropriate installation solution for tight installation situations

INDIVIDUAL COMPONENTS FOR SUPPLY AND EXHAUST AIR	ART. NO.	CONTENT/ QUANTITY
① Plate distributor, MF-BV75-160-12	0018.0528	2
② Flexible duct, MF-F75 (Roll = 50 m)	0055.0096	4
③ Sealing rings, MF-FDR75 (Set = 10 pieces)	0175.0262	4
④ Bracket, MF-WL 125 80/200	0018.0531	11
⑤ Slide-in adaptor, MF-WE75	0059.0972	11



The MAICO*Flex* duct system – the optimum installation solution in terms of speed

MORE INDIVIDUAL COMPONENTS	ART. NO.	CONTENT/ QUANTITY
① Tubular sound absorber, RSR 16/50	0092.0324	2
② Supply air valve, TFZ 12	0151.0365	6
③ Exhaust air valve, TFA 12	0151.0370	5
④ Mounting frame, EBR-D 12 for TFZ/TFA	0092.0494	11
⑤ Outside air wall connection, KW-AL 20E	0152.0081	1
⑥ Outgoing air wall connection, KW-FL 20E	0152.0083	1
⑦ Grease filter for kitchen, FFE 10	0092.0506	1



The MAICO accessories – appropriate individual components

WS 320 B

Central ventilation with heat recovery for apartments and detached houses

– Disk valve for supply and exhaust air in the respective room.
– Air flows from supply air rooms to exhaust air rooms via door ventilation grilles or door cut-outs.
– Revision openings on the air distributors ensure that the ventilation ducts can be cleaned with the cleaning set if necessary.

Incl. RLS 1 WR control unit

Optional RLS T1 WS with touchscreen

Description of property

– Installation of ventilation unit and air distributor for supply and exhaust air in utility room.
– Ventilation ducts for supply and exhaust air are cast into concrete ceilings of floors.
– The supply air rooms are the living, guest and work rooms as well as bedrooms and children's rooms on the first floor.
– The exhaust air rooms are the guest WC, kitchen and utility room as well as the dressing room and bathroom on the first floor.

– Control via 4-step switch, home network, app or as an option via a touch panel or KNX.

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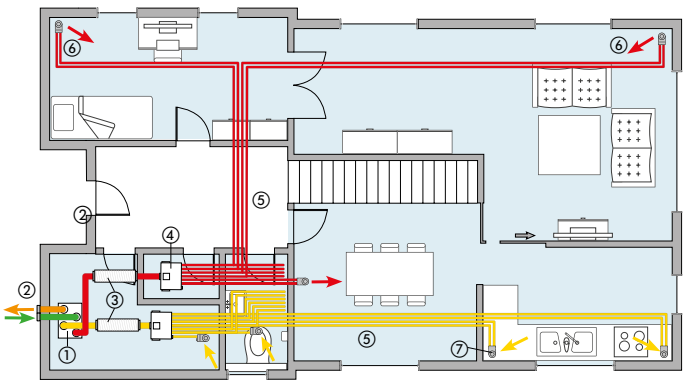
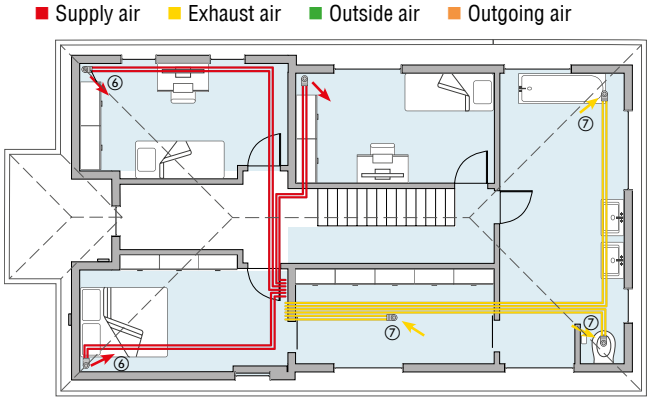
① WS 320 B ventilation unit
② Outside and outgoing air connection with Therm duct
③ Tubular sound absorber
④ Air distributor
⑤ Flexible duct
⑥ Bracket and adapter for supply air valves
⑦ Bracket and adapter for exhaust air valves



Ground floor

■ Supply air ■ Exhaust air ■ Outside air ■ Outgoing air



First floor

WS 320 B

Central ventilation for residential units of up to 300 m²

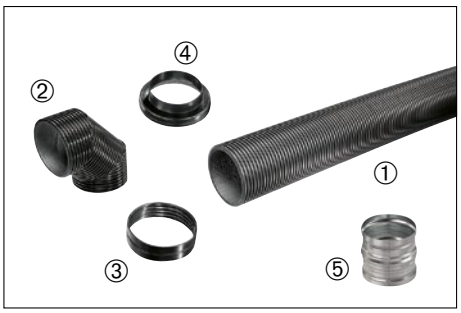
MATERIAL PER RESIDENTIAL UNIT (example)

Complete kit comprising:

VENTILATION UNIT WITH HEAT RECOVERY including control unit	ART. NO.	CONTENT/ QUANTITY
① WS 320 B	0095.0221	1

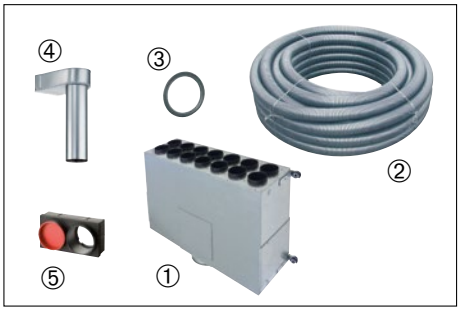
- Max. 320 m³/h at 450 Pa
- Dimensions W x H x D: 841 x 857 x 598 mm

INDIVIDUAL COMPONENTS FOR THE OUTSIDE AND OUTGOING AIR FLOW WITH INSULATED DN 160 DUCT	ART. NO.	CONTENT/ QUANTITY
① Duct, MT-R160 (1 item = 2 m)	0059.0982	4
② Elbow, MT-B160 90/45	0059.0984	8
③ Connector, MT-V160	0059.0988	15
④ Coupling, MT-Ü160/150	0059.0990	10
⑤ Plug connector, SVR 160	0055.0185	4



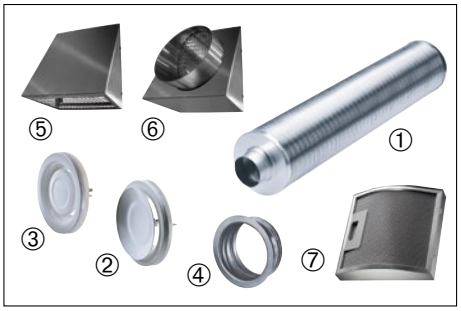
MAICOTherm – appropriate installation solution for tight installation situations

INDIVIDUAL COMPONENTS FOR SUPPLY AND EXHAUST AIR	ART. NO.	CONTENT/ QUANTITY
① Plate distributor, MF-BV63-160-14	0018.0526	2
② Flexible duct, MF-F63 (Roll = 50 m)	0055.0097	5
③ Sealing rings, MF-FDR63 (Set = 10 pieces)	0175.0261	5
④ Bracket, MF-WL 125 80/125	0018.0499	13
⑤ Slide-in adaptor, MF-WE63	0059.0966	13



The MAICO*Flex* duct system – the optimum installation solution in terms of speed

MORE INDIVIDUAL COMPONENTS	ART. NO.	CONTENT/ QUANTITY
① Tubular sound absorber, RSR 16/ 50	0092.0324	2
② Supply air valve, TFZ 12	0151.0365	7
③ Exhaust air valve, TFA 12	0151.0370	6
④ Mounting frame, EBR-D 12 for TFZ/TFA	0092.0494	13
⑤ Outside air wall connection, KW-AL 20E	0152.0081	1
⑥ Outgoing air wall connection, KW-FL 20E	0152.0083	1
⑦ Grease filter for kitchen, FFE 10	0092.0506	1



The MAICO accessories – appropriate individual components

WS 320 B

Central ventilation of semi-detached houses with heat recovery

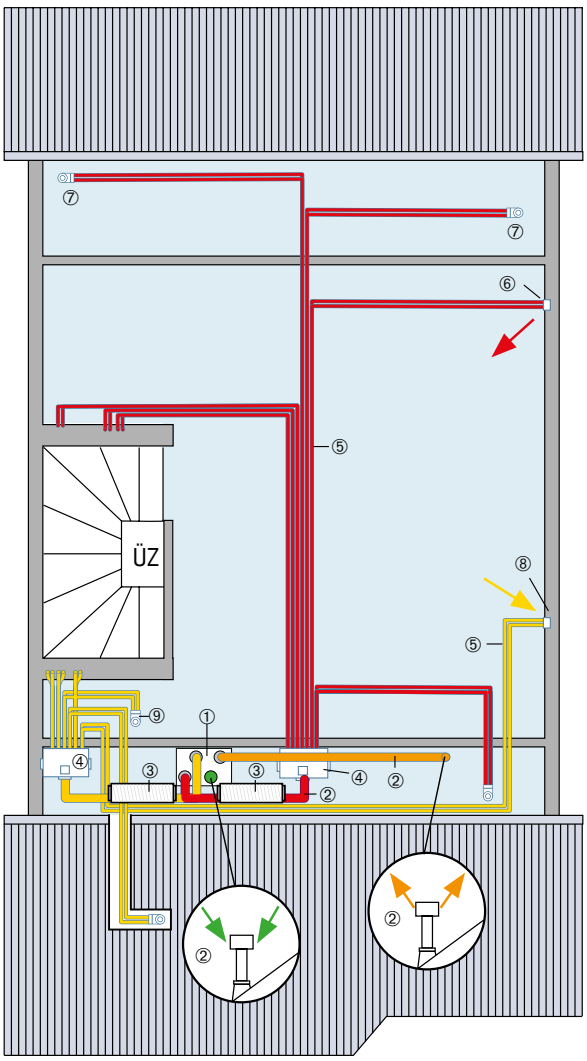
Description of property

– Installation of ventilation unit and air distributor for supply and exhaust air in pointing sill (insulating) of studio floor
– Ventilation ducts for supply and exhaust air are cast into concrete ceilings of floors

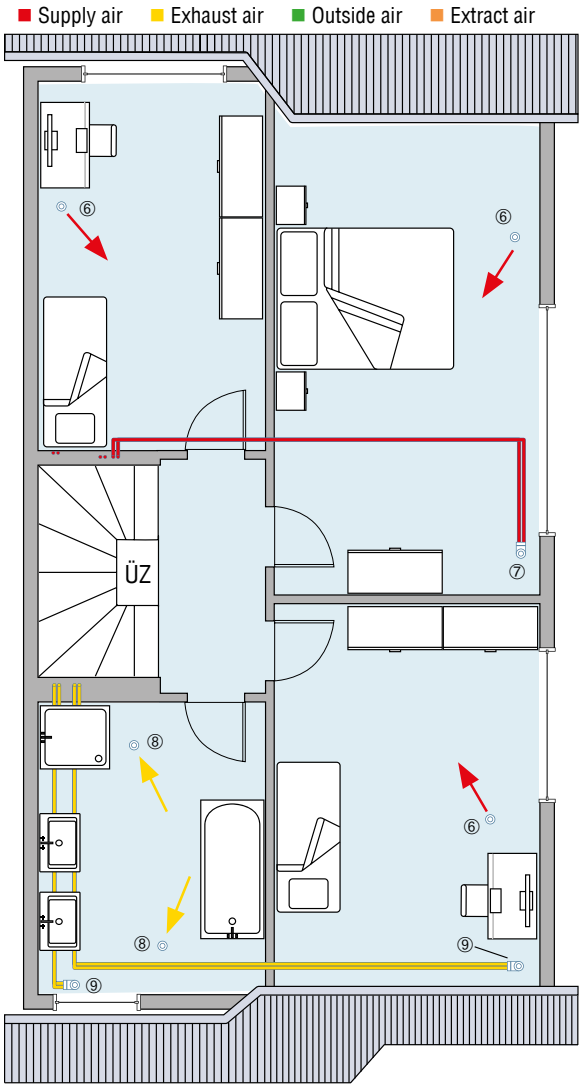
Incl. RLS 1 WR control unit

Optional RLS T1 WS with touchscreen

① WS 320 B ventilation unit
② Outside and outgoing air connection with Therm duct
③ Tubular sound absorber
④ Air distributor
⑤ Flexible duct
⑥ Supply air valve
⑦ Bracket and adapter for supply air valve, ground floor
⑧ Exhaust air valve
⑨ Bracket and adapter for supply air valve, ground floor



Studio



First floor

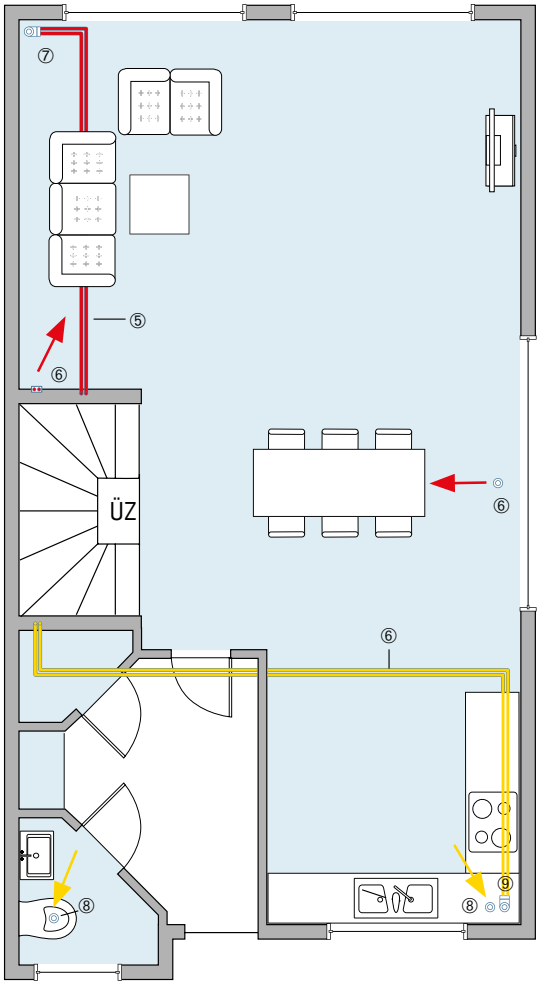
WS 320 B

Central ventilation for residential units of up to 300 m²

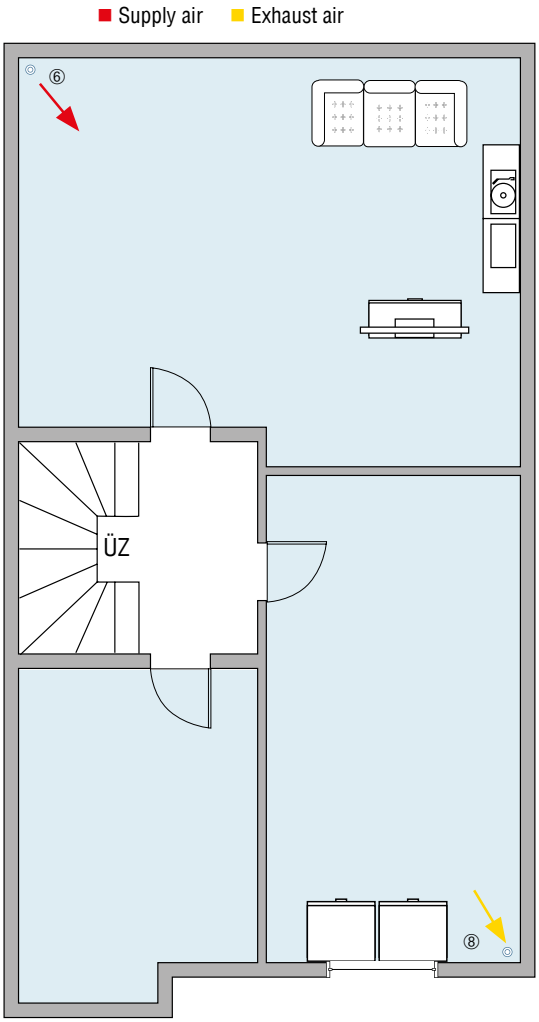
Description of property

- The supply air rooms are the bedrooms, living room and children's rooms as well as the hobby room in the cellar
- The exhaust air rooms are the bathroom, WC and kitchen as well as the utility room
- Outside and outgoing air flows via roof cowls
- Disk valves for supply and exhaust air
- Air flows from supply air rooms to exhaust air rooms via door ventilation grilles or door cut-outs
- Revision openings on the air distributors ensure that the ventilation ducts can be cleaned with the cleaning set if necessary
- Control via 4-step switch, home network, app or as an option via a touch panel or KNX

⑤ Flexible duct
⑥ Supply air valve
⑦ Bracket and adapter for supply air valve, cellar
⑧ Exhaust air valve
⑨ Bracket and adapter for supply air valve, cellar



Ground floor



Cellar

WS 320 B

Central ventilation for residential units of up to 300 m²

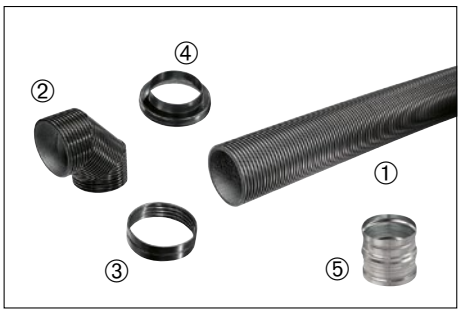
MATERIAL PER RESIDENTIAL UNIT (example)

Complete kit comprising:

VENTILATION UNIT WITH HEAT RECOVERY including control unit	ART. NO.	CONTENT/ QUANTITY
① WS 320 B	0095.0221	1

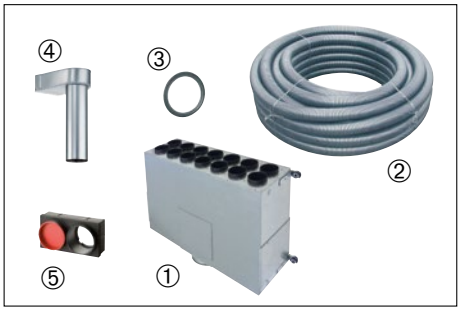
- Max. 320 m³/h at 450 Pa
- Dimensions W x H x D: 841 x 857 x 598 mm

INDIVIDUAL COMPONENTS FOR THE OUTSIDE AND OUTGOING AIR FLOW WITH INSULATED DN 160 DUCT	ART. NO.	CONTENT/ QUANTITY
① Duct, MT-R160 (1 item = 2 m)	0059.0982	5
② Elbow, MT-B160 90/45	0059.0984	8
③ Connector, MT-V160	0059.0988	15
④ Coupling, MT-Ü160/150	0059.0990	12
⑤ Plug connector, SVR 160	0055.0185	4



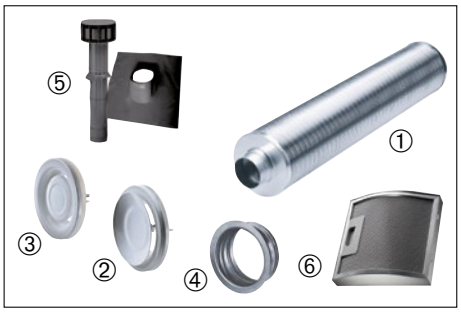
MAICOTherm – appropriate installation solution for tight installation situations

INDIVIDUAL COMPONENTS FOR SUPPLY AND EXHAUST AIR	ART. NO.	CONTENT/ QUANTITY
① Plate distributor, MF-BV63-160-14	0018.0526	2
② Flexible duct, MF-F63 (Roll = 50 m)	0055.0097	5
③ Sealing rings, MF-FDR63 (Set = 10 pieces)	0175.0261	4
④ Bracket, MF-WL 125 80/125	0018.0499	13
⑤ Slide-in adaptor, MF-WE63	0059.0966	13



The MAICO*Flex* duct system – the optimum installation solution in terms of speed

MORE INDIVIDUAL COMPONENTS	ART. NO.	CONTENT/ QUANTITY
① Tubular sound absorber, RSR 16/ 50	0092.0324	2
② Supply air valve, TFZ 12	0151.0365	7
③ Exhaust air valve, TFA 12	0151.0370	6
④ Mounting frame, EBR-D 12 for TFZ/TFA	0092.0494	13
⑤ Roof outlet with roofing tile DF 160 S DP 160 SB	 0092.0374 0092.0380	 2 2
⑥ Grease filter for kitchen, FFE 10	0092.0506	1



The MAICO accessories – appropriate individual components

WS 470 KB

Central ventilation of detached houses with heat recovery

- The supply air rooms are the living, guest and work rooms as well as the fitness room, bedrooms and children's rooms.
- The exhaust air rooms are the guest WC, kitchen and utility room as well as the bathroom and dressing room on the first floor
- Disk valve for supply and exhaust air in the respective room
- Air flows from supply air rooms to exhaust air rooms via door ventilation grilles or door cut-outs
- Revision openings on the air distributors ensure that the ventilation ducts can be cleaned with the cleaning set if necessary

Description of property

- Installation of ventilation unit and air distributor for supply and exhaust air in utility room
- Ventilation ducts for supply and exhaust air are cast into concrete ceilings of floors
- Control via 4-step switch, home network, app or as an option via a touch panel or KNX

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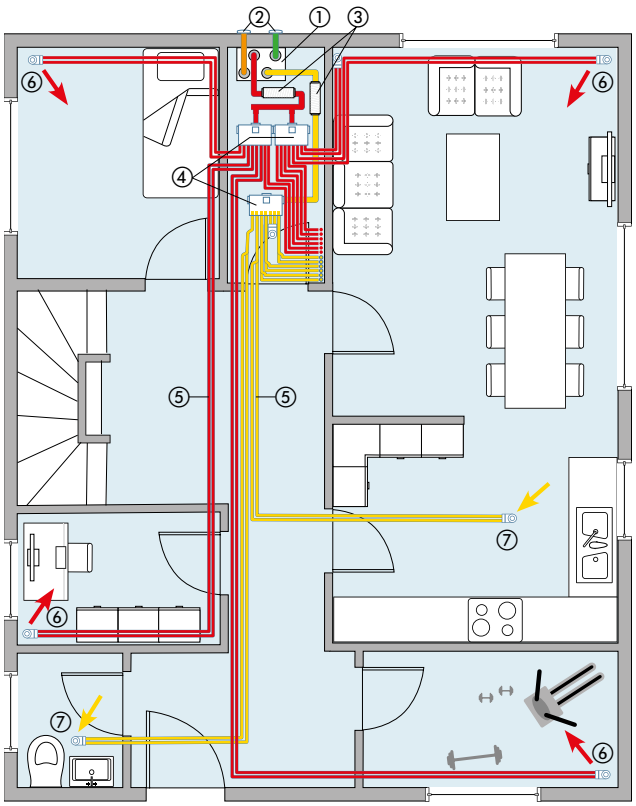
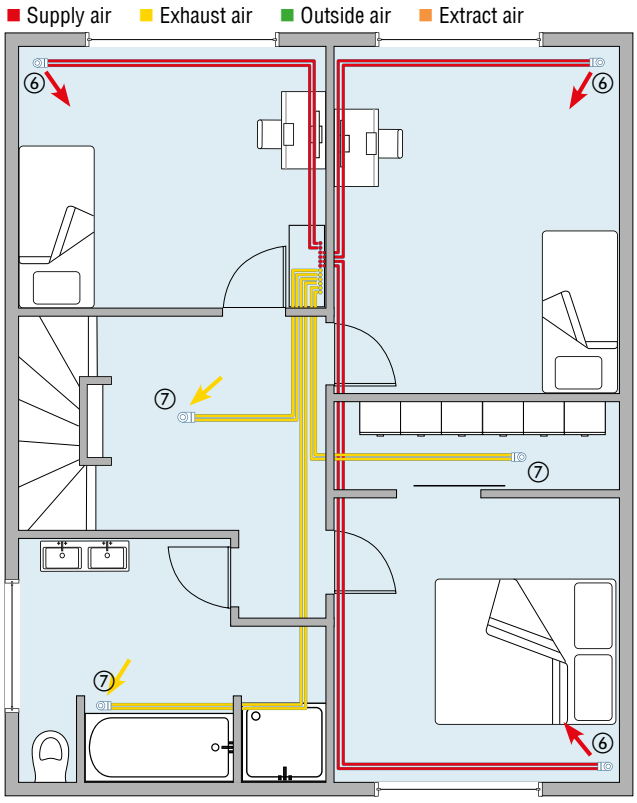
① WS 470 KB ventilation unit
② Outside and outgoing air connection with Therm duct
③ Tubular sound absorber
④ Air distributor
⑤ Flexible duct
⑥ Supply air valve
⑦ Exhaust air valve



Ground floor



First floor

WS 470 KB

Central ventilation for residential units of up to 450 m²

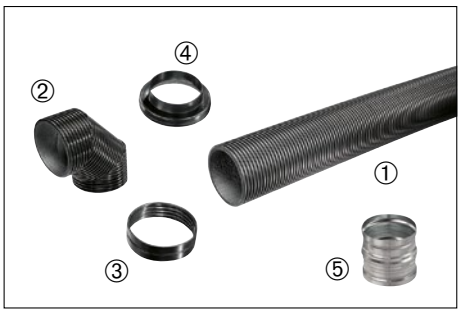
MATERIAL PER RESIDENTIAL UNIT (example)

Complete kit comprising:

VENTILATION UNIT WITH HEAT RECOVERY including control unit	ART. NO.	CONTENT/ QUANTITY
① WS 470 KB with preheating register and bypass	0095.0231	1

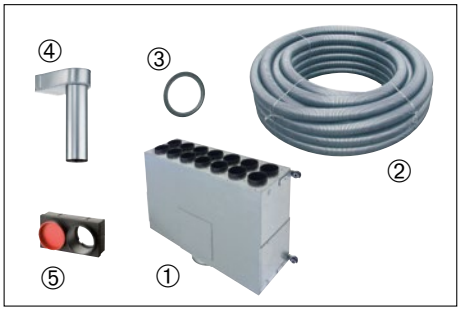
- Max. 450 m³/h at 200 Pa
- Dimensions W x H x D: 841 x 857 x 598 mm

INDIVIDUAL COMPONENTS FOR THE OUTSIDE AND OUTGOING AIR FLOW WITH INSULATED DN 160 DUCT	ART. NO.	CONTENT/ QUANTITY
① Duct, MT-R160 (1 item = 2 m)	0059.0982	4
② Elbow, MT-B160 90/45	0059.0984	8
③ Connector, MT-V160	0059.0988	17
④ Coupling, MT-Ü160/150	0059.0990	10
⑤ Plug connector, SVR 160	0055.0185	4



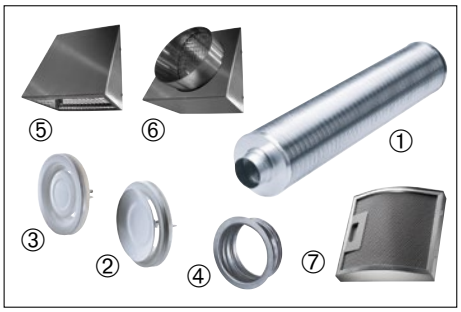
MAICOTherm – appropriate installation solution for tight installation situations

INDIVIDUAL COMPONENTS FOR SUPPLY AND EXHAUST AIR	ART. NO.	CONTENT/ QUANTITY
① Plate distributor, MF-BV75-160-12	0018.0528	3
② Flexible duct, MF-F75 (Roll = 50 m)	0055.0096	5
③ Sealing rings, MF-FDR75 (Set = 10 pieces)	0175.0262	5
④ Bracket, MF-WL 125 80/200	0018.0531	13
⑤ Slide-in adaptor, MF-WE75	0059.0972	13



The MAICO*Flex* duct system – the optimum installation solution in terms of speed

MORE INDIVIDUAL COMPONENTS	ART. NO.	CONTENT/ QUANTITY
① Tubular sound absorber, RSR 16/ 50	0092.0324	2
② Supply air valve, TFZ 12	0151.0365	7
③ Exhaust air valve, TFA 12	0151.0370	6
④ Mounting frame, EBR-D 12 for TFZ/TFA	0092.0494	13
⑤ Outside air wall connection, KW-AL 20E	0152.0081	1
⑥ Outgoing air wall connection, KW-FL 20E	0152.0083	1
⑦ Grease filter for kitchen, FFE 10	0092.0506	1



The MAICO accessories – appropriate individual components

5 Product overview

Central ventilation units

		Cross-counterflow Heat exchanger	Summer Bypass	Pre-heating register	ENTHALPY Heat exchanger	MOBILE CONTROL
Configured for 80 m²						
Trio...	**Up to 120 m³/h**					
	Trio LZ through which air flows lengthwise				●	●
	Trio LZV through which air flows lengthwise			●	●	●
	Trio QZ-A...* through which air flows crosswise				●	●
*... left-/right-hand unit variant	Trio QZ-A...V* through which air flows cross-			●	●	●
Configured for 140 m²						
WS 160 Flat	**Up to 160 m³/h**					
	WS 160 Flat ET				●	●
	WS 160 Flat KET			●	●	●
	WS 160 Flat BET		●		●	●
	WS 160 Flat KBET		●	●	●	●
*with zone ventilation	WS 160 Flat KBZET*		●	●	●	●
WS 170...	**Up to 160 m³/h**					
	WS 170...*	●				
	WS 170 K...*	●		●		
	WS 170 KB...*	●	●	●		●
	WS 170...ET*				●	
	WS 170 K...ET*			●	●	
*... left-/right-hand unit variant	WS 170 KB...ET*		●	●	●	●
Configured for 300 m²						
WS 300 Flat	**Up to 300 m³/h**					
	WS 300 Flat...*				●	●
	WS 300 Flat B...*	●			●	●
*... left-/right-hand unit variant	WS 300 Flat KB...*	●	●	●	●	●
WR 310...	**Up to 320 m³/h**					
WS 320...	WR 310...	●				●
	WS 320 K...	●		●		●
	WS 320 B...	●	●			●
	WS 320 KB...	●	●	●		●
	WS 320...ET				●	●
	WS 320 K...ET			●	●	●
	WS 320 B...ET		●		●	●
	WS 320 K...BET		●	●	●	●
Configured for 450 m²						
WR 410...	**Up to 470 m³/h**					
WS 470...	WR 410...	●				●
	WS 470 K...	●		●		●
	WS 470 B...	●	●			●
	WS 470 KB...	●	●	●		●
	WS 470...ET				●	●
	WS 470 K...ET			●	●	●
	WS 470 B...ET		●		●	●
	WS 470 K...BET		●	●	●	●

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Miscellaneous

- http://www.kostenlose-landkarten.de/bilder/Deutschlandkarte.png, S. 41 Bild mitte

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