



This Technical Information pertaining to the "RAUSILENTO waste water system" is valid from February 2022 onwards.

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## RAUSILENTO

### waste water system

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# 01 Information and safety information

## Validity

This Technical Information is applicable to Austria.

## Navigation

At the beginning of this section of the technical information, you will find a detailed table of contents with hierarchical headings and corresponding page numbers.

## Icons and logos



Safety note



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Important information



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## Currentness of the Technical Information

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## Intended use

The RAUSILENTO waste water system must only be planned, installed and operated as described in this Technical Information. Any other use is deemed to be outside the scope of intended use and therefore is not permitted.

## Safety and operating information

- For your own safety and the safety of other people, please read through all safety and operating instructions carefully and completely prior commencing installation.
- Keep the operating instructions safe and have them available.
- If you do not understand the safety instructions or the individual installation procedures, or if something is unclear, please contact your REHAU sales office.
- Failure to follow the safety instructions can result in damage or injury.

Observe all national and international pipe laying, installation, accident prevention and safety regulations as well as the notes in this Technical Information when installing pipe systems.

Application areas which are not covered by this Technical Information (special applications) require consultation with our Technical Applications Department. For more detailed consulting support, please contact your REHAU sales office.

## Prerequisites for personnel

- Our systems may only be installed by authorised and trained personnel.
- Work on electrical systems or components must only be carried out by trained and competent installers.

## General safety precautions

- Keep your workplace clean and free of objects that may impede you.
- Ensure that your workplace has adequate lighting.
- Keep children, pets and unauthorised persons away from tools and installation areas. This applies in particular to renovations in occupied areas.
- Only use the components intended for the particular REHAU pipe system. The use of components from other systems or the use of tools that are not from the relevant REHAU installation system can result in accidents or other hazards.

**Working clothes**

- Wear safety glasses, appropriate work clothes, safety shoes, a protective helmet and, if you have long hair, a hairnet.
- Do not wear loose-fitting clothing or jewellery, as they may become caught in moving parts.
- When performing work at head-height or above the head, wear a protective helmet.

**During installation**

- Always read and follow the respective operating and installation instructions if provided with the product.
- Observe any regulations on accident prevention.

**Tightness**

Tightness describes the state of leak tightness.

RAUSILENTO push-fit socket joints are pressure tight up to a static internal pressure of 2 bar (20 mWS).

But even at low internal pressures, a risk of pipes and fittings being pushed apart at joints still remains.

Therefore, the clamping force in the direction of the pipes must always be considered and not automatically assumed to be equal to the pressure tightness.

The normative required tightness of the entire RAUSILENTO waste water system allows the joint sockets to be installed in an orientation independent of the direction of flow of the waste water. This is applicable for horizontal or vertical lines (e.g. for double sockets, secondary ventilation).

**Fire protection**

Observe the applicable fire safety regulations and the relevant building regulations/building codes, in particular for pipes which penetrate a fire rated building element (wall or ceiling).

## 02 Areas of application

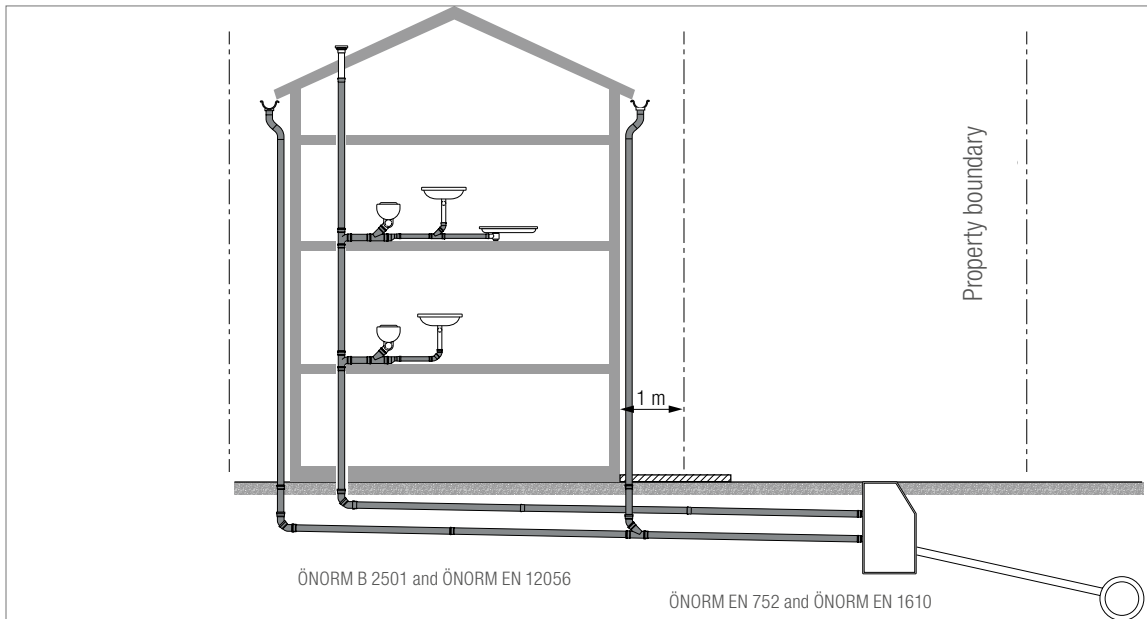


Fig. 02-1 Areas of application

### 02.01 Overview of standards



The RAUSILENTO waste water system is suitable for pressureless domestic drainage inside the building structure in accordance with ÖNORM EN 12056 and ÖNORM B 2501. Installation outside of the building structure or below ground installations are not permissible.

Today, for the construction or acquisition of a building, its technical equipment has a decisive influence on its evaluation. Therefore, in installation engineering, the demand for sound insulation increases, not only for living and sleeping areas, but also for working areas and classrooms. The relevant standards, such as the ÖNORM EN 12056 and the ÖNORM B 2501 as well as the other national directives, are continuously updated and extended from this perspective.

The following standards and directives are applicable for the planning and installation of RAUSILENTO pipes and fittings:

Standard/edition	Title	Areas of application
ÖNORM EN 12056-1: 2000 12 01	Gravity drainage systems inside buildings – Part 1	This European standard holds good for drainage systems operated by gravity. It applies to drainage systems inside residential, business, institutional and industrial buildings. The first part defines fundamental requirements that apply to the planning and dimensioning. It defines restricted specifications for drainage systems which carry away industrial waste water and for liquids that are removed by pumps.
ÖNORM EN 12056-2: 2000 12 01	Gravity drainage systems inside buildings – Part 2	This European standard holds good for drainage systems operated by gravity. It applies to drainage systems inside residential, business, institutional and industrial buildings. This second part defines fundamental requirements that apply to the planning and dimensioning. It defines restricted specifications for drainage systems which carry away industrial waste water and for liquids that are removed by pumps.

<b>Standard/edition</b>	<b>Title</b>	<b>Areas of application</b>
ÖNORM EN 12056-3: 2000 12 01	Gravitation drainage units within buildings Part 3	This European standard holds good for drainage systems operated by gravity. It applies to drainage systems inside residential, business, institutional and industrial buildings. This part of the standard applies to roof drainage systems, in which the drains are big enough to not limit the discharge capacity of a gutter (for example, exposed draining conditions).
ÖNORM EN 12056-4: 2000 12 01	Gravitation drainage units within buildings Part 4	This part of the European standard describes the design, operation and maintenance rules for waste water lifting systems for waste water containing or not containing faecal matter and stormwater inside buildings and on open ground, as well as their connections to the collecting and main pipes. It also applies to excrement pump systems for limited use.
ÖNORM EN 12056-5: 2000 12 01	Gravitation drainage units within buildings Part 5	This European standard holds good for drainage systems operated by gravity. It applies to drainage systems inside residential, business, institutional and industrial buildings. This fifth part defines fundamental requirements for the installation and maintenance of drainage and roof drainage systems.
ÖNORM B 2501: 2016 08 01	Drainage systems on private ground	This ÖNORM supplements the two standards ÖNORM EN 12056 (all parts) and EN 752 and contains specifications for the planning, execution and testing of drainage systems inside buildings and on open ground up to the drainage junction on the road.
EN 1451-1: 2018 07 05	Polymer pipe systems for draining waste water (low and high temperature) within the building structure – polypropylene (PP)	This European standard defines, for solid wall piping systems of polypropylene (PP), requirements for pipe fittings and the piping system for sewer pipes, which are used in gravity drainage systems inside buildings and underground within the building structure for draining waste water (low and high temperature).
EN 681-1: 2007 07 01	Elastomer seals; material requirements for pipe joint seals for water supply and drainage applications	This standard specifies the requirements for the materials for seals made of thermoplastic elastomers (TPE), which are used for the following joints: Piping systems of thermoplastic pipes for pressureless operation sewer pipes in buildings (sporadic flow up to 95 °C) Piping systems of thermoplastic pipes for pressureless operation underground sewer pipes and canals (continuous flow up to 45 °C and sporadically up to 95 °C) Piping systems of thermoplastic pipes for stormwater drainage.
EN 13501-1: 2020 01 15	Fire classification of construction products and construction types	This European standard defines the procedure for classification of the fire behaviour of building components including the products inside components.
B 8115-1: 2011 06 01	Sound insulation and acoustics in building construction	The requirements for the minimum sound insulation are defined in this ÖNORM, with the goal of protecting persons of normal sensitivity from harmful airborne noise transmission and footfall sound transmission under normal behaviour.
B 8115-2: 2021 04 15	Sound insulation and acoustics in building construction	The requirements for the minimum sound insulation are defined in this ÖNORM, with the goal of protecting persons of normal sensitivity from harmful airborne noise transmission and footfall sound transmission under normal behaviour.

Standard/edition	Title	Areas of application
OIB directive 2: 2019 04 12	Fire protection	The OIB Guidelines serve in standardising the construction specifications in Austria. They are issued by the Österreichisches Institut für Bautechnik (Austrian Institute of Construction Engineering). The federal states can declare the OIB Guidelines as binding in their building codes, which already is the case in all federal states. However, a deviation from the OIB Guidelines is possible in accordance with the provisions in the respective ordinances of the federal states, provided that the building permit applicant can prove that an equivalent safety level has been reached as would be the case when adhering to the OIB Guidelines. This is intended to ensure the necessary flexibility for innovative architectural and technical solutions.
OIB directive 5: 2019 04 12	Noise insulation	
DIN 4109	Sound insulation in buildings	This standard stipulates sound insulation requirements that aim to protect people in common rooms from unacceptable noise transmission. In addition, it governs the procedure for proving the required sound insulation.
DIN 1986-100: 2016 12 01	Drainage systems on private ground	This standard applies to drainage systems for draining waste water in all buildings and on open ground in conjunction with DIN 1986-3, DIN 1986-4, DIN 1986-30, DIN EN 12056-1 to DIN EN 12056-5, DIN EN 752 as well as DIN EN 1610, which are mostly operated with gravity pipes.
VDI guideline 4100	Sound insulation in apartments - criteria for planning and assessment	

Tab. 02-1 Overview of standards for domestic waste water (this list is not exhaustive)



Observe all national and international pipe laying, installation, accident prevention and safety regulations as well as the notes in this Technical Information when installing pipe systems.

Also observe currently valid laws, standards, guidelines, regulations (e.g. DIN, EN, ISO, DVGW, VDE and VDI) as well as regulations regarding environmental protection, trade association regulations and regulations from local utility companies.

Application areas which are not covered by this Technical Information (special applications) require consultation with our Technical Applications Department.

For more detailed consulting support, please contact your REHAU Sales Office.

The design and installation instructions relate directly to the relevant REHAU product.

Some sections refer to generally applicable standards or regulations. Please ensure that the guidelines, standards and regulations in use are the valid version in each case. More in-depth standards, regulations and guidelines relating to the design, installation and operation of drainage pipes must also be taken into account and are not part of this Technical Information.

## 03 Definition of terms

### Single connecting pipe

Pipe that takes up the waste water of a draining object, measured from the odour trap or the drain spout up to the onward pipe or up to a waste water pump system.

### Collecting pipe

Pipe that collects the waste water from two or more single pipes and carries it up to the onward pipe or up to a waste water pump system.

### Downpipe

Vertical pipe that takes up the waste water from single and collecting connecting pipes. It opens into a collecting or main pipe.

### Collecting connection pipe

Horizontal drainage pipe that takes up waste water from downpipes or connecting pipes and is not laid underground or in the base plate.

### Main pipe

Drainage pipe that carries the waste water into the connecting duct. The main pipe is normally laid inaccessibly in the foundation plate or underground.

### Bypass pipe

Connecting pipes in the backwater area of a downpipe offset or in the area of the transition of a downpipe into a collecting pipe or main pipe.

### Ventilation pipe

Ventilation pipes do not carry any waste water, at the most, condensate water, but the air that is required for aeration and extract ventilation of the drainage pipes for evening out pressure variations.

### Degree of filling

Indicates the ratio of the cross-section height to the total height of the clear inner cross-section of a sewer pipe. In Austria, waste water pipes are designed with a degree of filling of  $h/d_i = 0.5$  (maximum up to 0.7), to ensure sufficient free cross-section for the necessary transport of air.

### Drainage object

The job of drainage objects is to collect the waste water and stormwater that arises and to carry it on to the drainage pipe. In the case of drainage objects in buildings, sewer gas must not get discharged from the drainage system.

### Back flow level

The highest level up to which the water can rise in a drainage system.

### Main ventilation

Extension of a vertical waste water downpipe above the last connection, going up to over the roof, whose end is open to the atmosphere.

### Pipe for direct secondary ventilation

An additional ventilation pipe installed next to the waste water downpipe, which is joined to the main waste water downpipe on every floor.

### Pipe for indirect secondary ventilation

Additional ventilation pipe at the upper end of a single or collecting pipe, which is taken up to over the roof, or opens out into the main ventilation.

### Recirculation ventilation

Ventilation of single or collecting connection pipes, which is connected on the same floor to the waste water downpipe, the main ventilation or the direct secondary ventilation.

### Waste water

Collective designation for grey water (excrement-free) and black water (containing excrement).

### Drop height

Height difference of the waste water downpipe or stormwater downpipe between the highest drain joint and the opening into the main or collecting pipe.

### Downpipe offset

Non-vertical part of a waste water and stormwater downpipe with constant cross-section as a connection of downpipe parts with an axial displacement up to maximum 10 m length.

### Mixing system

Drainage system that drains stormwater and waste water into one pipe.

### Separation system

Drainage system that drains stormwater and waste water into separate pipes.

### Odour trap

A device that prevents the emission of sewer gas at the outlet through a water trap.

## 04 RAUSILENTO system description

### 04.01 Standards and approvals

RAUSILENTO is a noise-insulated waste water system and meets the requirements of the ÖNORM EN 12056 and ÖNORM B 2501 standards.

For pipe dimensions DN 32 to DN 160 in the style of EN 1451, no special adaptor is required in connecting pipes and fittings of the same nominal diameter, which comply to the following standards: EN 1451, such as PP (HT) system EN 1401, such as KG system.



- Top quality and aesthetically pleasing
- Sound-insulating system properties
  - Specially formulated pipe and fitting materials
  - Partially thickened walls for bend fittings to further reduce air-borne noise transmission
- Optimum low friction properties of the abrasion-resistant inner layer reduce the risk of blockage
- Cold impact resistance, verified break resistance up to  $-10\text{ °C}$  as per EN 1451 and EN 1411
- High level of ultraviolet resistance, can be stored outside for up to two years

Pipes and fittings must not be used for:

- Pipelines subject to a permanent load of more than  $70\text{ °C}$  (short-term  $95\text{ °C}$ )
- Pipelines which carry waste water containing benzene or benzol
- Exposed outside lines

### 04.02 Pipe structure

RAUSILENTO has a three-layer wall structure. This "sandwich construction" is based on modern design principles. Each layer has a significant role to play in the overall working principle of a reliably performing pipe system. The multi-layer technology achieves an increased pipe stiffness. Technically desirable properties are optimised in a targeted manner.

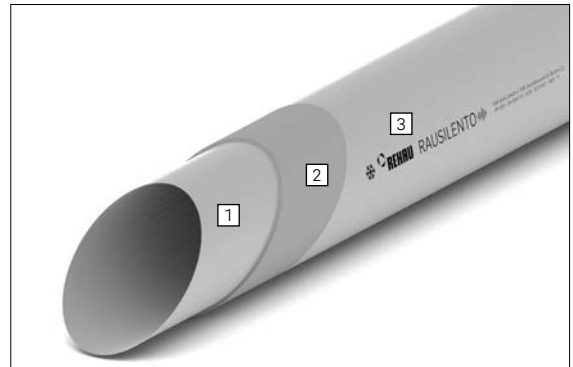


Fig. 04-1 RAUSILENTO pipe structure

- 1 Abrasion-resistant and low friction inner layer made from PP
- 2 Highly rigid middle layer made of mineral-reinforced PP
- 3 Impact-resistant and shock-resistant outer layer made from PP

### 04.03 Range of application

<b>Residential buildings</b>	Building construction sector as per ÖNORM EN 12056 and ÖNORM B 2501 Detached dwelling Multi-family dwellings Housing estates	
<b>Commercial projects</b>	Hotels Office buildings Hospitals Schools, nursery schools High-rise buildings	
<b>Internal stormwater drainage</b>	As a gravity system up to a total height of 20 m	see chapter „06 Internal stormwater drainage pipe“ on page 15

## 05 System components

### 05.01 Pipes and fittings



Fig. 05-1 RAUSILENTO pipes and fittings



Fig. 05-2 RAUSILENTO elbow with reinforced area of impact



- Sound-insulating properties
- Optimum hydraulics thanks to extremely smooth and slippery inner layer
- Greater ease of installation due to tough outer layer
- Cold impact resistance (ice crystal as per EN 1451 and EN 1411)
- Reliable installation at low temperatures
- Easy and efficient installation
  - Push-fit connection
  - Factory-fitted sealing rings
  - Pipes can be trimmed using plastic pipe cutters or saws with fine tooth blades
- Universally compatible with metric HT-PP system, connection to conventional metric HT and KG pipes without special adaptors
- Attractive design
- Colour: grey (similar to RAL 7047)
- Eco-friendly as it can be recycled

Where there are changes in direction, there is a danger that the pipe system will begin to vibrate locally in critical drainage situations. This may have a negative effect on noise-related performance.

To minimise this risk and counteract the negative impact, the bends in nominal diameters DN 90 to DN 160 have been developed with targeted weight optimisation in the critical impact section. This stabilises the noise-related behaviour, reduces noise development and therefore achieves even greater sound insulation in the area of impact.

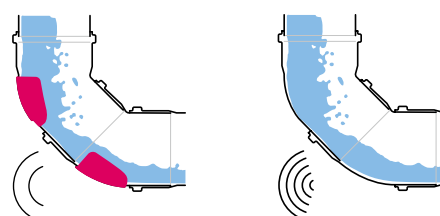


Fig. 05-3 Noise reduction with reinforced area of impact (left) compared to non-reinforced area of impact (right)

### 05.02 Sealing rings

The pipes and fittings are fitted with sealing rings in the factory in accordance with DIN 4060 and DIN EN 681-1.

For waste water with a greater proportion of oils and greases from installations with oil/grease traps in public or commercial areas (e.g. from commercial kitchens, butcher shops, bakeries), it is necessary to replace the factory-fitted sealing rings with ones made of nitrile-butadiene rubber (NBR) to provide a higher chemical resistance.

**05.03 Brackets**

The pipe string is fastened with noise-insulating standard bracket clamps that are fixed to the wall using stair bolts and plastic dowels.

For RAUSILENTO waste pipes only use bracket clamps (e.g. REHAU fixing/security clamps), that fully surround the pipes and are matched to their outer diameter.

The fixing/security clamp forms a fixed point in the piping system. It is thus laid, in ideal circumstances, below the pipe sleeve of each installation length, so that downward slipping of the installation length is avoided.

Lay the pipes in tension-free state

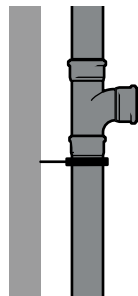


Fig. 05-4 Centre of pipe – wall distance, see table below



To prevent brackets from being opened unintentionally, metal pins can be inserted through the provided holes of the quick quick-snap buckle.

Any pipe insulation must be recessed in the area of the pipe brackets.

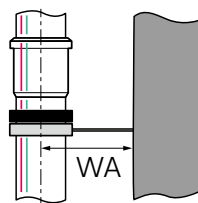


Fig. 05-5 Centre of pipe – wall distance, see table below

Pipe dimensions	Max. distance (WA) from the wall with threaded rods		
	M 8	M 10	M 12
DN 32, 40, 50	400 mm	-	-
DN 75	350 mm	400 mm	-
DN 90	300 mm	350 mm	-
DN 110	250 mm	300 mm	-
DN 125	-	200 mm	250 mm
DN 160	-	150 mm	200 mm

Tab. 05-1 Maximum distance from the wall with threaded rods (reference values)

The illustration below (see Fig. 05-605) depicts an efficient way to support a horizontal acoustic drainage line with RAUSILENTO.

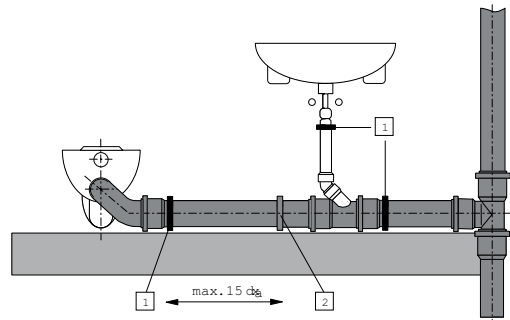


Fig. 05-6 Fastening layout for a horizontal pipe

- 1 Fixing clamp (tight)
- 2 Guiding clamp
- $d_a$  Outer pipe diameter

- For shorter horizontal pipe lines (length  $\leq 15 \times$  outer pipe diameter), install the fixing clamps right behind the pipe socket.
- For longer horizontal pipe lines (length  $> 15 \times$  outer pipe diameter), install additional guiding clamps: The distance between the clamps must not exceed 15 times the pipe diameter. Certain structural conditions may require closer spacing of brackets.

DN	Horizontal pipe line 15 x $d_{ex}$ in mm	Vertical pipe line mm
32	480	1500
40	600	1500
50	750	1500
75	1125	2000
90	1350	2000
110	1650	2000
125	1875	2000
160	2400	2000

Tab. 05-2 Maximum distance between pipe brackets (recommended values)

## 05.04 Push-fit lock



Fig. 05-7 Push-fit lock

The push-fit lock prevents the push-fit connection from being pulled apart in the event of internal pressure of up to 2 bar.

The push-fit lock can be installed and removed with ease. If installed correctly, there is no impact on the pipe system's linear thermal expansion. To install it correctly, the push-fit lock assembly must be pushed all the way up against the socket's groove before tightening the screws.



Fig. 05-8 Push-fit lock

### Range of application

- Internal stormwater drainage pipes with an overall height of max. 20 m to the main pipe, see section "Application for internal stormwater drainage pipes with total height of max. 20 m to the main pipe"
- Pressure pipes for pump systems as per DIN EN 12050 Waste water lifting plants for buildings and sites, see section "Application for pressurised drainage line for pump systems in accordance with DIN EN 12050 Waste water lifting plants for buildings and sites"
- Waste water pipes that are routed through several floors without any additional outlet points
- Pipes in the backwater area
- At pipe sections with possible pressure build-up
- Socket plug safeguard

If slip-on sockets or long sockets are used, push-fit locks can be installed to prevent shifting during subsequent operation.

The push-fit lock can also be installed temporarily during the construction phase in order to provide stability and prevent them from sliding apart.



For pipe installations higher than 10 m or inner water pressure higher than 1 bar, a single branch with socket plug and push-fit lock or securing clip are to be used as an inspection eye.

**Application for internal stormwater drainage pipes with total height of max. 20 m to the main pipe**

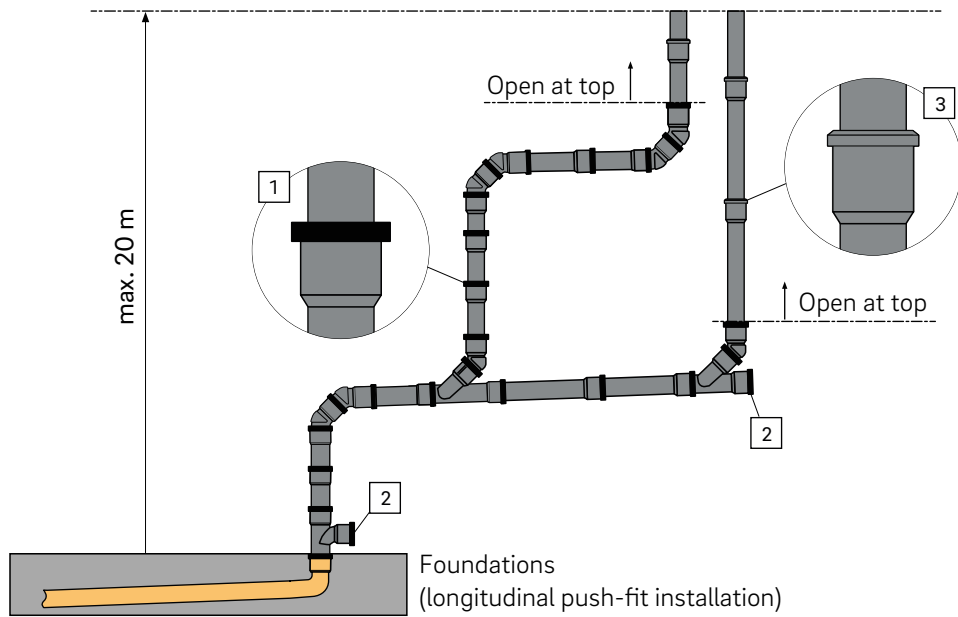


Fig. 05-9 Internal stormwater drainage pipes

- 1 Socket secured with push-fit lock
- 2 Inspection eye
- 3 Socket without push-fit lock

Vertical stack/stormwater pipes with open top are not subject to any longitudinal force created by a water head. However, they do need to be secured to prevent them from buckling. For internal stormwater pipes and pipes in the backwater area and where there are changes in direction, socket connections must be secured against removal over the entire length of the

distortion up to the connection to the sewer. The push-fit lock is suitable for this.

For more information, see chapter "Internal stormwater drainage pipe".

**Application for pressurised drainage line for pump station in accordance with DIN EN 12050 Waste water lifting plants for buildings and sites**

	Application options	Approved dimensions	Pressure load (incl. pressure peaks)
Part 1: Excrement pump station	⊘	-	-
Part 2: Waste water pump station	☑	32 / 40 / 50	max. 2 bar
Part 3: Excrement pump station with limited utilisation	☑	32 / 40 / 50	max. 2 bar

The maximum operating pressure is to be consulted with the manufacturer of the pump station. All push-fit joints within the pressurised drainage line up to the connection to the gravity drainage line have to be secured with push-fit locks.



To install the push-fit lock on the downstream of the fittings, pull the fitting spigot end by 10 mm from the socket joint to create the required amount of space for the push-fit lock.

**Installation**

The push-fit locks can be installed easily, quickly and securely using the provided screws and nuts.



If a cordless screwdriver is used during installation, proceed with the utmost caution not to over-tighten the screws. Refer to the installation instructions.

## 06 Internal stormwater drainage pipe

An example of stormwater drainage pipe layout with offset is shown in Fig. 06-1.

The total height between the sewer line and the stormwater inlet is limited to 20 m due to the potential pressure build-up inside the pipes in case of blockage.

REHAU fire stop collars FP are available for fire protection measures.

For ceiling ducts, follow the advice given in the installation instructions, the ETA and also the respective classification report.

All socket joints must be secured by push-fit lock (1) to prevent them from sliding apart. Push-fit locks are not required for vertical pipe lines that are open at the top (see marking in Fig. 06-1).

### 06.01 Installation as internal stormwater pipe

When installed as a stormwater downpipe within the building, there is a danger of condensate formation. Condensate is formed if, for example, owing to cold stormwater, the temperature of the pipe walls drops below the dew point temperature of the ambient air. Then, atmospheric humidity from the ambient air gets deposited on the surfaces of the pipes. Therefore, in the building, all pipe routes on which condensate formation can be expected must be fitted with diffusion-resistant insulation materials. Insulation of the collecting pipes in the basement can be dispensed with if there is no danger of condensate formation. Generally, this is the case with exposed stormwater downpipes in unheated basements, when temperature balancing has taken place in the downpipe.

### 06.02 Condensate insulation materials

Closed-cell materials with a high steam diffusion resistance are recommended as condensate insulation. If open-cell or fibrous insulation materials are used, they must have a moisture-repelling outer skin layer that is firmly joined with the insulating material. Seal any butt or mitre joints, grooves, cut and end faces of the insulation permanently. Cut out the insulation in the area of the fastening. Pull the insulating material over the fastening and tightly glue it permanently with the bordering insulating material. Use closed-cell insulation materials with a high steam diffusion resistance coefficient ( $\mu > 3000$ ). Select the insulation thickness based on the air humidity and temperatures.

Fit the insulation all the way up to the fire stop collars. The insulation must not enclose the fire collar.

If the pipes require protection against condensation, keep the following in mind:

- Use closed-cell insulation materials with a high steam diffusion resistance coefficient ( $\mu > 3,000$ ).
- Select the insulation thickness based on the air humidity and temperatures.
- Seal any butt or mitre joints and any slits permanently.



If continuous insulation of the stormwater drainage pipe against condensation is necessary, suitable fire-safety solutions must be used.

---



The fastening elements must be positioned and designed in such a way that the pipes, when filled up due to backflow, can take the load and discharge the stormwater in the structure. This can, for example, be done with wall and ceiling consoles in the deflection area.

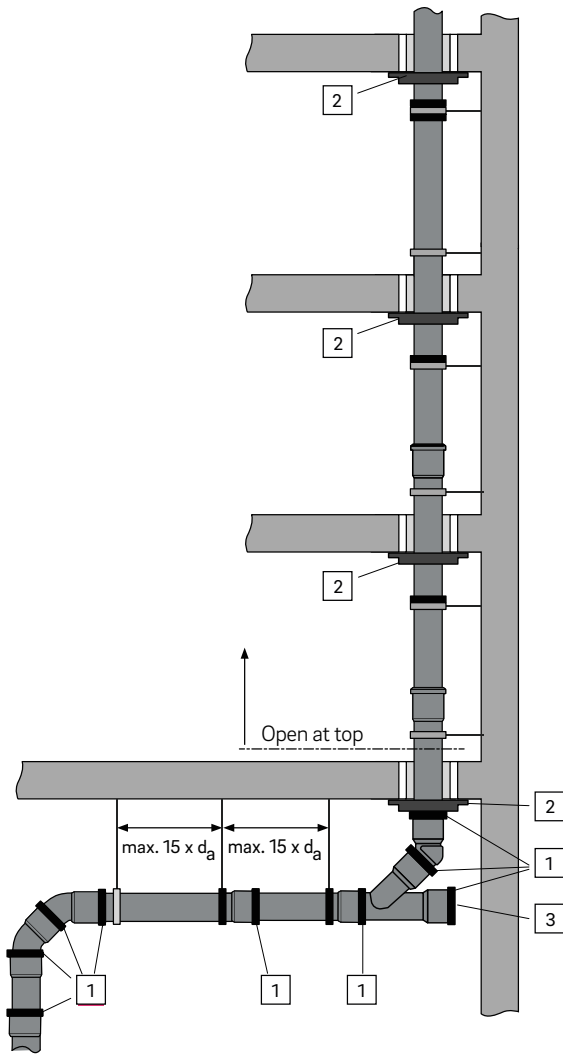


Fig. 06-1 Internal stormwater drainage pipe (example)

- 1 Push-fit lock
- 2 REHAU fire protection solution (e.g. REHAU fire stop collar FP)
- 3 Inspection eye



For pipe installations higher than 10 m or inner water pressure higher than 1 bar, a single branch with socket plug and push-fit lock or securing clip are to be used as an inspection eye.

### 06.03 Condensation

The dew point temperature stands for the temperature at which the steam saturation of the air is reached. In this state, the relative atmospheric humidity is  $\phi = 1$ . If the moist air is cooled to below the dew point temperature, there is a phase change from gaseous to liquid and a part of the steam present in the water is separated as condensate.

Example:

Room temperature: 22 °C

Relative air humidity 55 %

Condensate formation on the pipe surface at 12.53 °C and below

If there is a possibility of the dew point being undershot, the pipe must be insulated accordingly to prevent the formation of condensate.

	Relative humidity													
	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
30 °C	10,51	12,85	14,91	16,75	18,42	19,96	21,37	22,69	23,92	25,07	26,16	27,2	28,18	29,11
29 °C	9,65	11,97	14,01	15,85	17,51	19,03	20,43	21,74	22,96	24,11	25,19	26,22	27,19	28,12
28 °C	8,79	11,09	13,12	14,94	16,59	18,1	19,5	20,79	22,01	23,14	24,22	25,24	26,2	27,12
27 °C	7,93	10,22	12,23	14,04	15,67	17,17	18,56	19,85	21,05	22,18	23,25	24,26	25,21	26,13
26 °C	7,07	9,34	11,34	13,13	14,76	16,25	17,62	18,9	20,09	21,22	22,27	23,28	24,23	25,13
25 °C	6,21	8,46	10,45	12,23	13,84	15,32	16,68	17,95	19,14	20,25	21,3	22,3	23,24	24,14
24 °C	5,35	7,58	9,55	11,32	12,92	14,39	15,74	17	18,18	19,29	20,33	21,32	22,25	23,15
23 °C	4,49	6,71	8,66	10,41	12	13,46	14,81	16,06	17,22	18,32	19,36	20,34	21,27	22,15
22 °C	3,63	5,83	7,77	9,51	11,09	<b>12,53</b>	13,87	15,11	16,27	17,36	18,38	19,36	20,28	21,16
21 °C	2,77	4,95	6,88	8,6	10,17	11,6	12,93	14,16	15,31	16,39	17,41	18,38	19,29	20,17
20 °C	1,91	4,07	5,99	7,7	9,25	10,68	11,99	13,21	14,35	15,43	16,44	17,4	18,31	19,17
19 °C	1,05	3,2	5,09	6,79	8,34	9,75	11,05	12,26	13,4	14,46	15,47	16,42	17,32	18,18
18 °C	0,19	2,32	4,2	5,89	7,42	8,82	10,11	11,32	12,44	13,5	14,49	15,44	16,33	17,19
17 °C	-0,68	1,44	3,31	4,98	6,5	7,89	9,18	10,37	11,48	12,53	13,52	14,46	15,35	16,19
16 °C	-1,54	0,56	2,42	4,08	5,58	6,96	8,24	9,42	10,53	11,57	12,55	13,48	14,36	15,2
15 °C	-2,4	-0,31	1,53	3,17	4,67	6,04	7,3	8,47	9,57	10,6	11,58	12,5	13,37	14,2
14 °C	-3,26	-1,19	0,63	2,27	3,75	5,11	6,36	7,53	8,61	9,64	10,6	11,52	12,38	13,21
13 °C	-4,12	-2,07	-0,26	1,36	2,83	4,18	5,42	6,58	7,66	8,67	9,63	10,54	11,4	12,22
12 °C	-4,98	-2,94	-1,15	0,46	1,92	3,25	4,48	5,63	6,7	7,71	8,66	9,56	10,41	11,22
11 °C	-5,84	-3,82	-2,04	-0,45	1	2,32	3,55	4,68	5,75	6,74	7,69	8,58	9,42	10,23
10 °C	-6,7	-4,7	-2,93	-1,35	0,08	1,39	2,61	3,73	4,79	5,78	6,71	7,6	8,44	9,24
9 °C	-7,56	-5,58	-3,83	-2,26	-0,84	0,47	1,67	2,79	3,83	4,81	5,74	6,62	7,45	8,24
8 °C	-8,42	-6,45	-4,72	-3,16	-1,75	-0,46	0,73	1,84	2,88	3,85	4,77	5,64	6,46	7,25
7 °C	-9,28	-7,33	-5,61	-4,07	-2,67	-1,39	-0,21	0,89	1,92	2,88	3,8	4,66	5,48	6,26
6 °C	-10,14	-8,21	-6,5	-4,97	-3,59	-2,32	-1,15	-0,06	0,96	1,92	2,82	3,68	4,49	5,26
5 °C	-11	-9,09	-7,39	-5,88	-4,51	-3,25	-2,08	-1	0,01	0,96	1,85	2,7	3,5	4,27
4 °C	-11,86	-9,96	-8,29	-6,78	-5,42	-4,17	-3,02	-1,95	-0,95	-0,01	0,88	1,72	2,51	3,27
3 °C	-12,72	-10,84	-9,18	-7,69	-6,34	-5,1	-3,96	-2,9	-1,91	-0,97	-0,1	0,74	1,53	2,28
2 °C	-13,58	-11,72	-10,07	-8,6	-7,26	-6,03	-4,9	-3,85	-2,86	-1,94	-1,07	-0,24	0,54	1,29
1 °C	-14,45	-12,59	-10,96	-9,5	-8,17	-6,96	-5,84	-4,79	-3,82	-2,9	-2,04	-1,22	-0,45	0,29
0 °C	-15,31	-13,47	-11,85	-10,41	-9,09	-7,89	-6,78	-5,74	-4,78	-3,87	-3,01	-2,2	-1,43	-0,7

Tab. 06-1 Dew point table

## 07 Planning

### 07.01 Planning guidelines

For the planning and installation of RAUSILENTO waste water pipes and fittings, the standards EN 12056 Gravity drainage systems inside buildings as well as B 2501 Drainage systems for buildings and property lots are relevant.

The objective is to ensure the intended function of the universal RAUSILENTO universal waste water system, i.e.

- Extraction or blow out of water seals must be prevented
- Ventilation of the drainage system must be ensured
- Nominal diameter larger than those calculated are not to be used to ensure effective drainage
- Soil and waste must drain with little noise
- Anaerobic digestion is to be prevented
- Any gases must escape in a safe manner through the main venting system

### 07.02 System types and system definition

According to ÖNORM EN 12056 and ÖNORM B 2501, drainage systems are classified into four system types. Please note that there can be national and regional variations with any system type.



According to ÖNORM B 2501, System I (single drop pipe system with partially filled connecting pipes) is to be used for waste water pipes in Austria.

#### System I

##### Single drop pipe systems with partially filled connecting pipes

Sanitary drainage objects are connected to the partially filled connecting pipes. The partially filled connecting pipes are designed for a degree of filling of 0.5 (50%) and connected to a single waste water drop pipe.

#### System II

##### Single drop pipe system with connecting pipes of small dimensions

Sanitary drainage objects are connected to the connecting pipes of small dimensions. The connecting pipes of small dimensions show a degree of filling of up to 0.7 (70%), and are connected to a single waste water drop pipe.

#### System III

##### Single drop pipe system with fully filled connecting pipes

Sanitary drainage objects, which are connected via connecting pipes, which are operated fully filled. The fully filled connecting pipes have a degree of filling of 1.0 (100%) and every connecting pipe is separately, individually connected to a single waste water drop pipe.

#### System IV

##### System with separate waste water drop pipes

The types System I, II and III can also be divided into a waste water drop pipe, which drains water from toilets and urinals and a waste water downpipe that drains water from all other drainage objects.

## 07.03 Dimensioning

The following planning documents are presented with the REHAU RAUSILENTO outer diameter ( $d_o$ ) and with nominal diameter (DN) in accordance with EN 12056 or B 2501 respectively.

The comparison of the nominal diameter with the REHAU RAUSILENTO outer and internal diameters can be seen in Tab. 07-1.

nominal width	Minimum inner diameter	Outer diameter RAUSILENTO	Inner diameter RAUSILENTO
DN	$d_{imin}$ (mm)	$d_o$ (mm)	$d_i$ (mm)
30	26	32	28,4
40	34	40	36,4
50	44	50	46,4
70	66	75	71,2
90	79	90	85,6
100	96	110	104,6
125	113	125	118,9
150	144	160	152,2

Tab. 07-1 Comparison of nominal diameter with REHAU RAUSILENTO outer diameter and internal diameter

The following measurement method holds good for all gravity drainage systems that drain domestic waste water. It is based on ÖNORM EN 12056 and ÖNORM B 2501. For all industrial waste water, swimming pools and industrial buildings, which cannot be covered by ÖNORM EN 12056 and ÖNORM B 2501, an individual measurement must be carried out.



The results of the measurement (calculation) of the dimensions must be complied with strictly, since the use of a greater pipe dimension can limit the self-cleaning ability of the pipe.

### Connected loads (DU)

The connected load (DU) is the waste water volume flow in l/s for individual drainage objects. The connected loads (DU = Design Unit) of the individual drainage objects can have a different volume flow in every system.

Drainage object	System I DU	System II DU	System III DU	System IV DU
	(l/s)	(l/s)	(l/s)	(l/s)
Washbasin, bidet	0,5	0,3	0,3	0,3
Shower without plug	0,6	0,4	0,4	0,4
Shower with plug	0,8	0,5	1,3	0,5
Single urinal with flush tank	0,8	0,5	0,4	0,5
Urinal with flushing valve	0,5	0,3	-	0,3
Stand urinal	0,2*	0,2*	0,2*	0,2*
Bathtub	0,8	0,6	1,3	0,5
Kitchen sink	0,8	0,6	1,3	0,5
Dishwasher (household)	0,8	0,6	0,2	0,5
Washing machine up to 6 kg	0,8	0,6	0,6	0,5
Washing machine up to 12 kg	1,5	1,2	1,2	1
WC with 4.0 l flush tank	**	1,8	**	**
WC with 6.0 l flush tank	2	1,8	1,2 to 1,7***	2
WC with 7.5 l flush tank	2	1,8	1,4 to 1,8***	2
WC with 9.0 l flush tank	2,5	2	1,6 to 2,0***	2,5
Floor drain DN 50	0,8	0,9	-	0,6
Floor drain DN 70	1,5	0,9	-	1
Floor drain DN 100	2	1,2	-	1,3

\* per person

\*\* not approved

\*\*\* depending on the toilet type (valid only for vacuum toilets)

- Not used or no data available

Tab. 07-2 Connected loads (DU)

### Run-off coefficient (C)

The run-off coefficient (C) is the simultaneity value for the use of waste water objects depending on the building type.

When carrying out measurements for partial paths with different run-off coefficients, for almost equal waste water drainage, calculations should be carried out with the largest run-off coefficient in each case.

#### Type of building

Irregular use, for example, in blocks of flats, bed-and-breakfast places, offices	0,5
Regular use, for example, in hospitals, schools, restaurants, hotels	0,7
Frequent use, for example in public toilets and/or showers	1,0
Special use, for example, in laboratories	1,2

Tab. 07-3 Run-off coefficient (C)

### 07.04 Waste water discharge ( $Q_{ww}$ )

The waste water discharge  $Q_{ww}$  is the expected waste water discharge in a part of or the entire drainage system, depending on which pipe section is currently being considered, and for which calculations are being performed. (This also holds good for domestic sanitary drainage objects).

$$Q_{ww} = K \times \sqrt{\Sigma DU}$$

$Q_{ww}$	=	waste water discharge (l/s)
C	=	run-off coefficient
$\Sigma DU$	=	total of the installed load

The system I in combination with irregular use (C) is the system that occurs the most frequently in Austria. System I with C=0.5 (blocks of flats, bed-and-breakfast places, offices)

Drainage object	Single connecting pipe	Single connecting pipe	DU (l/s)
	DN	$d_e$ (mm)	
Washbasin, bidet	40	40	0,5
Shower without plug	50	50	0,6
Shower with plug	50	50	0,8
Single urinal with flush tank	50	50	0,8
Urinal with flushing valve	40	40	0,5
Stand urinal	40	40	0,2*
Bathtub	50	50	0,8
Kitchen sink	50	50	0,8
Dishwasher (household)	50	50	0,8
Washing machine up to 6 kg	50	50	0,8
Washing machine up to 12 kg	70	75	1,5
WC with 4.0 l flush tank	**	**	**
WC with 6.0 l flush tank	90	90	2
WC with 7.5 l flush tank	90	90	2
WC with 9.0 l flush tank	100	110	2,5
Floor drain DN 50	50	50	0,8
Floor drain DN 70	70	75	1,5
Floor drain DN 100	100	110	2

\* per person

\*\* not approved

Tab. 07-4 Waste water discharge  $Q_{ww}$

### 07.05 Total waste water discharge ( $Q_{tot}$ )

The total waste water discharge  $Q_{tot}$  is the planned total waste water discharge in a part of or the entire drainage system, where sanitary drainage objects, drainage objects with continuous discharge and/or waste water pumps are connected to the system. The drainage objects are calculated with the run-off coefficient (C); the continuous discharges and the pump deliveries must be added without subtracting a simultaneity coefficient.

$$Q_{tot} = Q_{ww} + Q_c + Q_p$$

$Q_{tot}$	=	total waste water discharge (l/s)
$Q_{ww}$	=	waste water discharge (l/s)
$Q_c$	=	continuous discharge (l/s)
$Q_p$	=	pump delivery (l/s)

#### Measurement rules

The permissible waste water discharge ( $Q_{max}$ ) must at least be as much as the biggest value

- Of the calculated waste water discharge ( $Q_{ww}$ ) or
- The total waste water discharge ( $Q_{tot}$ ) or
- The waste water discharge of the biggest drainage object (DU value)

#### Example:

System I

Building type: irregular use C = 0.5

Drainage object: WC with 7.5 l flush tank DU = 2 l/s

$$Q_{ww} = K \times \sqrt{\Sigma DU}$$

$$Q_{ww} = 0.5 \times \sqrt{2}$$

$$Q_{ww} = 0,71 \text{ l/s}$$

Comparison of  $Q_{ww}$  and DU value

$$Q_{ww} < DU$$

$$0.71 \text{ l/s} < 2 \text{ l/s}$$

The DU value is greater and is used for the dimension determination.

$$Q_{max} = 2 \text{ l/s}$$

The WC with 7.5 l flush tank is connected with DN 90/ $d_e$  = 90.

In System I, at 2 l/s, connection in DN 80 would be possible, but it is not permitted for WCs according to the ÖNORM EN 12056 standard.

## 07.06 Planning connecting pipes

With connecting pipes, a distinction has to be made between single and collecting pipes. Only one drainage object is connected in the case of the single connecting pipe. As soon as another drainage object is connected, the single connecting pipe becomes a collecting pipe.

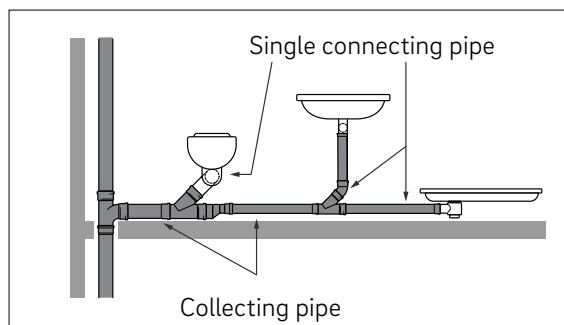


Fig. 07-1 Connecting pipe types

### 07.06.01 Unventilated single connecting pipes

Unventilated single connecting pipes are subject to special application limits with reference to the length, number of turns (elbows), drop height and minimum slope.

Where it is not possible to comply with the application limits, unventilated single connecting pipes must be ventilated, unless national and regional specifications do not permit the use of larger nominal diameters or ventilation valves. The application limits given below are simplifications; additional information on them can be found in the national and regional specifications.

$Q_{\max}$	System I		
	(l/s)	DN	$d_e$
0,4	*	*	*
0,5	40	40	
0,8	50	50	
1	60	75	
1,5	70	75	
2	80**	90**	
2,25	90***	90***	
2,5	100	110	

\* not permitted

\*\* no WCs

\*\*\* not more than two WCs and not more than one 90° total direction change

Tab. 07-5 Unventilated single connecting pipes

## Application limits

Application limits	System I
Maximum pipe length (L)	4,0 m
Maximum number of 90° bends	3*
Maximum drop height (H) (with 45° or more inclination)	1,0 m
Minimum slope	1 %

\* Connecting elbow not integrated

Tab. 07-6 Application limits

The connecting elbow at the end of the single connecting pipe for locating the odour lock is not counted as a deflection. The maximum drop height H stands for the dimension between the connection of a drainage object and the invert of the connecting branch to the downpipe.

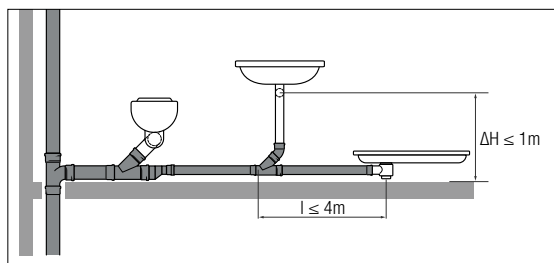


Fig. 07-2 Application limits, unventilated single connecting pipes

As per ÖNORM EN 12056 and ÖNORM B 2501, a maximum of three 90° elbows (total 270°) may be used. If elbows with a smaller angle are used, the total may once again not exceed 270°.

### 07.06.02 Ventilated single connecting pipes

Ventilated connecting pipes are subject to special application limits with reference to the length, drop height and minimum slope.

Where compliance with the application limits is not possible, the pipe guide must be optimised in order to remain within the specified limits.



The maximum single and collecting pipes must be considered and planned for with regard to the placement of downpipes. Through the additional placement of a downpipe, the pipe system can be optimised with reference to the application limits.

The nominal diameters and application limits of ventilated connecting pipes are listed in the tables that follow.

$Q_{max}$	System I		
	(l/s)	DN	$d_e$
0,6	*	*	*
0,75		50/40	50/40
1,5		60/40	75/40
2,25		70/50	75/50
3		80/50**	90/50**
3,4		90/60***	90/75***
3,75		100/60	110/75

\* not permitted  
 \*\* no WCs  
 \*\*\* not more than two WCs and not more than one 90° total direction change

Tab. 07-7 Ventilated single connecting pipes

**Application limits**

The ventilated single connecting pipes are subject to the following application limits.

Application limits	System I
Maximum pipe length (L)	10,0 m
Maximum number of 90° bends	No restriction
Maximum drop height (H) (with 45° or more inclination)	3,0 m
Minimum slope	0,5 %

Tab. 07-8 Application limits

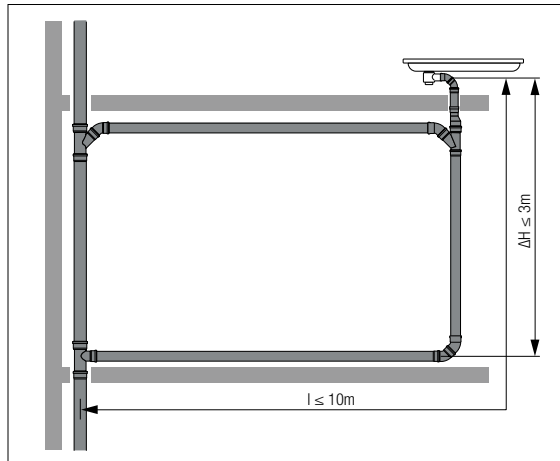


Fig. 07-3 Application limits, ventilated single connecting pipes

**07.07 Ventilation valves for connecting pipes**

Where ventilation valves are used for ventilating connecting pipes or drainage objects, they must conform to prEN 12380 and be dimensioned in conformity with the following table:

system	$Q_a$
	l/s
l	1 x Qtot

$Q_a$  = slipstream air, minimum air quantity in litres per second (l/s)  
 $Q_{tot}$  = total waste water discharge in litres per second (l/s)

Tab. 07-9 Ventilation valves for connecting pipes

**07.08 Collecting pipes**

**07.08.01 Unventilated collecting pipes**

Unventilated collecting pipes are subject to special application limits with reference to the length, number of turns (elbows), drop height and minimum slope.

Where it is not possible to comply with the application limits, unventilated collecting pipes must be ventilated, unless national and regional specifications do not permit the use of larger nominal diameters or ventilation valves.

**07.08.02 Ventilated collecting pipes**

Ventilated collecting pipes are subject to special application limits with reference to the length, drop height and minimum slope.

Where compliance with the application limits is not possible, the pipe guide must be optimised in order to remain within the specified limits – if required by placing another downpipe.

**07.08.03 Dimensioning of collecting pipes**

The application limits given below are simplifications; additional information on them can be found in the national and regional specifications.

Max. value of a drainage object	Collective connecting pipe, unventilated	Collective connecting pipe, ventilated	Dimension		Ventilation	
			DN	ger	DN	ger
DU	ΣDU	ΣDU	DN	ger	DN	ger
l/s	l/s	l/s	-	mm	-	mm
0,5	1	2	50	50	40	40
0,8	1,5	2,2	50	50	40	40
0,8	2	3	60	75	40	40
1,5	3	4,5	70	75	50	50
2	6	8	90c	90	60	75
2,5	15	25	100	110	60	75

- a maximum 4 m, maximum 3 elbows
  - b maximum 10 m, elbows unlimited
  - c maximum 2 WCs and not more than one 90° direction change
- In waterless urinals, a facility for flushing must be provided for the collecting pipe.

Tab. 07-10 Dimensioning of collecting pipes

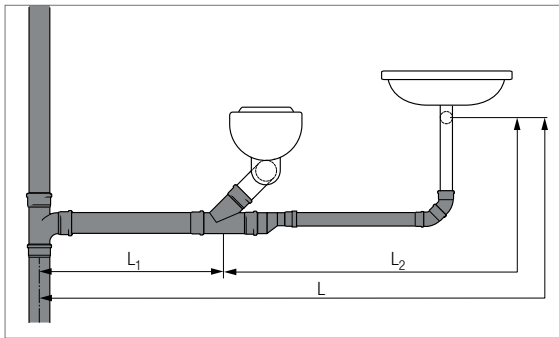


Fig. 07-4 Maximum lengths of single and collecting pipes

- L<sub>1</sub> Length of the collecting pipes
- L<sub>2</sub> Length of the single connecting pipes
- L Sum of collective connecting length and single connecting length

Type of connecting pipe	Maximum length for	
	unventilated connecting pipes	ventilated connecting pipes
Single connecting pipe with length L <sub>2</sub>	4	10
Collecting pipe with length L <sub>1</sub>	4	10
Total of collective connecting pipe and single connecting pipe with total length L	4	10

Tab. 07-11 Maximum length

Pipes more than 10 m in length must be designed as collecting pipes.

## 07.09 Planning waste water downpipes

### 07.09.01 Waste water downpipes with main ventilation

In the case of waste water downpipes with main ventilation, waste water and air jointly flow in the downpipe. Therefore, the entire pipe cross-section is not available to the waste water.

The minimum nominal diameter for waste water and mixed water downpipes is DN 100. Waste water downpipes with main ventilation, System I and a downpipe height of maximum 10 m may be made in DN 90 for hydraulic reasons.

Nominal diameters and application limits, see the following table:

Waste water downpipe with main ventilation (l/s)	DN	System I Q <sub>max</sub> (l/s)	
		Branches	Branches max. flow
90*	90*	2,7	3,5
100**	110**	4	5,2
125	125	5,8	7,6
150	160	9,5	12,4
200	200	16	21

- \* Drop height maximum 10 m
- \*\* Minimum nominal diameter when connecting WCs to System I

Tab. 07-12 Waste water downpipe with main ventilation



Fig. 07-5 RAUSILENTO double branch, max flow



Fig. 07-6 RAUSILENTO single branch

**07.09.02 Waste water downpipes with secondary ventilation**

In direct secondary ventilation, a ventilation pipe is laid parallel to the downpipe to increase the volume flow of waste water.

The downpipe and the ventilation pipe must be connected to one another on every floor, so that the entire pipe cross-section of the downpipe is available to the waste water volume flow.

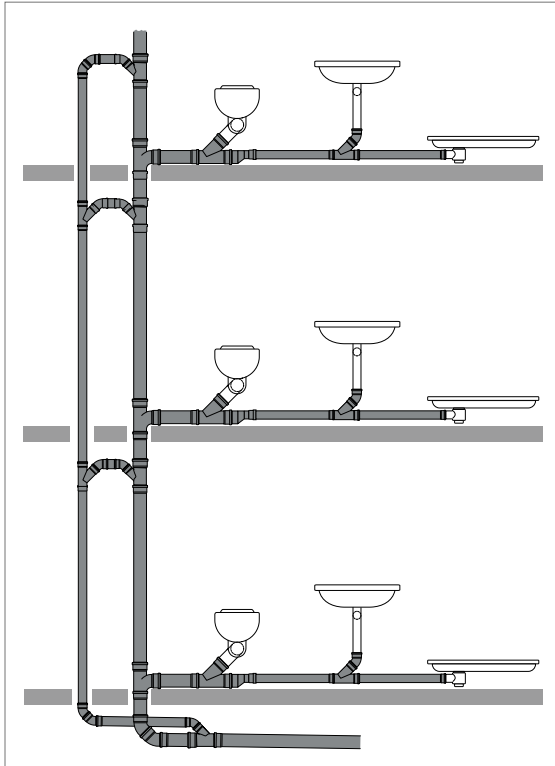


Fig. 07-7 Direct secondary ventilation

Waste water downpipe with main ventilation DN	Secondary ventilation DN	Secondary ventilation $d_e$	System I $Q_{max}$ (l/s)	
			Branches max. flow	Branches max. flow
100*	110*	50	5,6	7,3
125	125	70	12,4	10
150	160	80	14,1	18,3

\* Minimum nominal diameter when WCs are connected to System I

Tab. 07-13 Waste water downpipes with secondary ventilation

**07.10 Direction changes of downpipes**

**07.10.01 Up to 10 m**

The opening into a horizontal pipe must be done with at least two 45° elbows.

**07.10.02 10 m to 33 m**

When opening into a horizontal pipe, there must not be any connection provided 1 m before and after the opening. For the downpipe, the last 2 m of all connections must be kept clear (measured from the base of the channel).

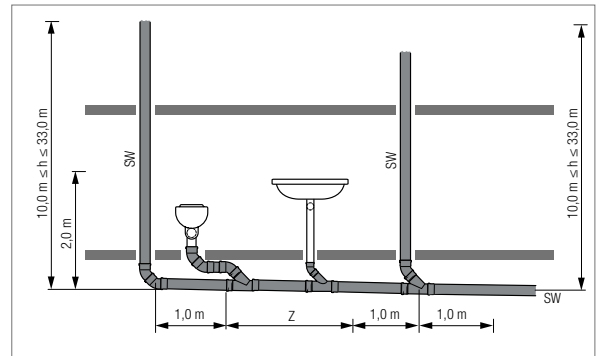


Fig. 07-8 Connection-free zones

In addition, there must not be any connections provided in case of downpipe distortions 1 m before and after the outlet-side elbow.

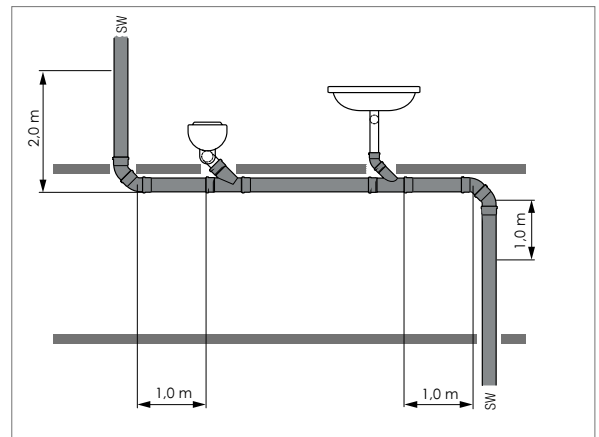


Fig. 07-9 Connection-free zones, downpipe distortion

When the downpipe distortion is less than 2 m, a bypass pipe must be fitted. All the connections in this zone must be integrated in the bypass pipe. Bypass pipes must be connected at least 2 m before the inlet-side elbow and at least 1 m after the outlet-side elbow at an angle of 45° to 67.5°. The bypass pipe must have the same dimension as the downpipe, subject to a maximum of DN 100/de=110.

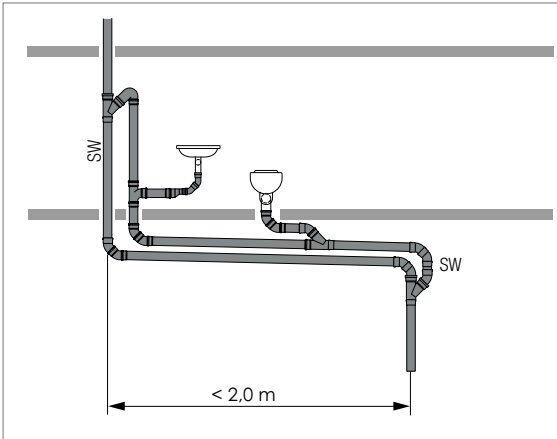


Fig. 07-10 When the downpipe distortion is less than 2 m, a bypass pipe must be fitted.

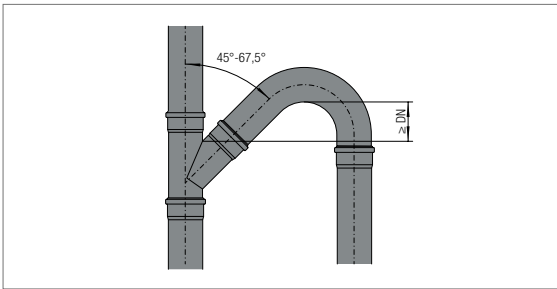


Fig. 07-11 Bypass pipe detail

The openings into a collecting or main pipe and the inflow and outflow-side bends at distortions must often be made with two 45° elbows and an intermediate piece of at least 250 mm.

When a bypass line is constructed, 87° to 88.5° elbows may be used.

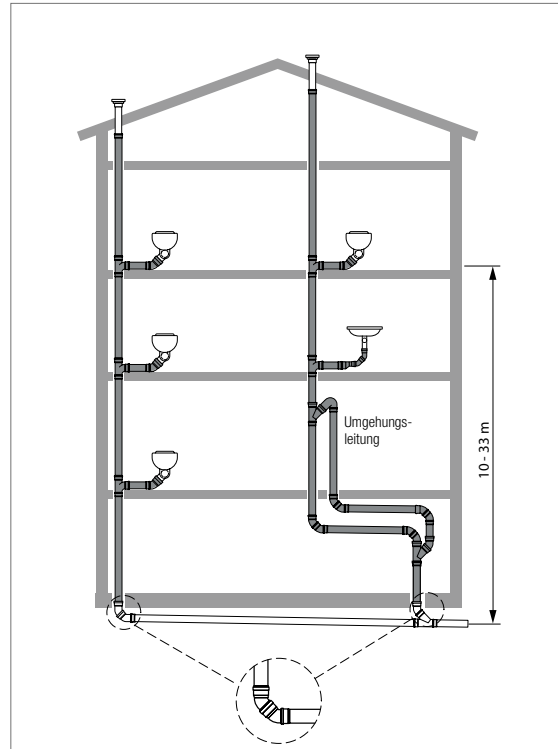


Fig. 07-12 Opening of downpipes (10 m to 33 m drop height) into a collecting pipe (detailed view of the opening with intermediate piece)

**07.10.03 More than 33 m**

If there are downpipe distortions or an opening into a collecting or main pipe, bypass lines must be integrated. The bypass line may open into the collecting or main pipe only 1.5 m after the riser elbow. The diversion of the downpipe must be set up with two 45° elbows and an intermediate piece of at least 250 mm.

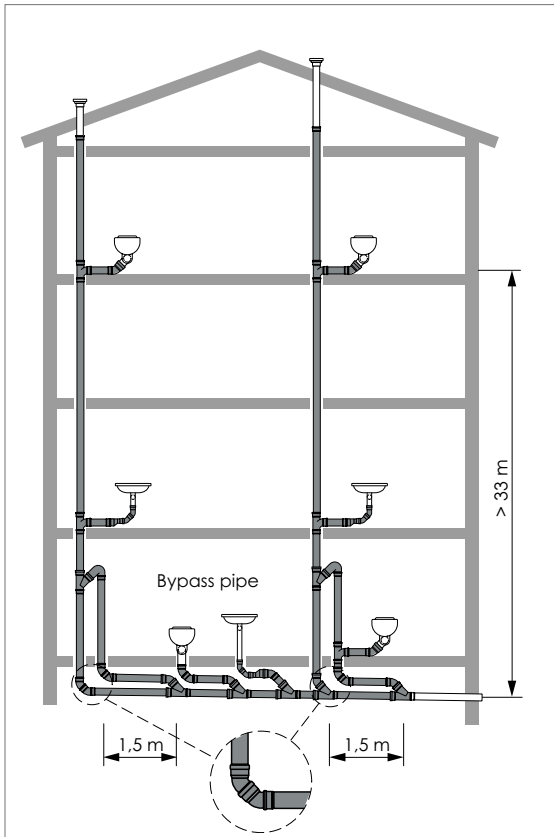


Fig. 07-13 Opening of downpipes (more than 33 m drop height) into a collecting pipe (detailed view of the opening with intermediate piece)

From two downpipe distortions in one downpipe onwards, they must be made with secondary ventilation. The drainage objects must be connected, as far as possible to the horizontal parts of the sewer pipe.

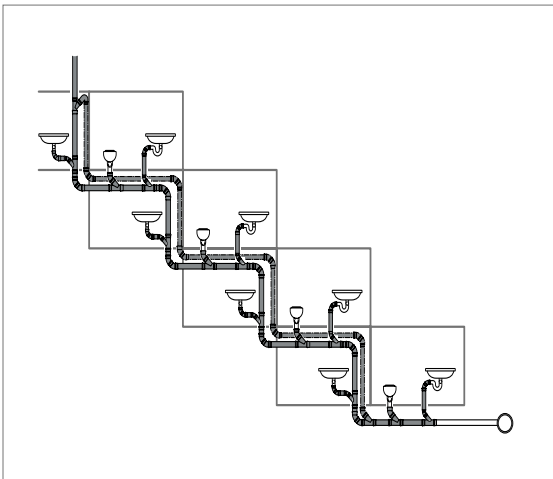


Fig. 07-14 Downpipe distortions in terraced houses

### 07.11 Ventilation valves for waste water downpipes

When ventilation valves are used for ventilating single downpipes, they must conform to prEN 12380 and have dimensions with  $Q_a$  not smaller than  $8 \times Q_{tot}$ .

### 07.12 Ventilation pipes

When main ventilation or secondary ventilation lines or ventilation pipes for connecting pipes are very long or have many elbows, the nominal diameter must be enlarged.



For further information, see the national and regional specifications and technical rules.

#### 07.12.01 Single main ventilation

Every downpipe is individually taken over the roof and vented. The nominal diameter of the single main ventilation corresponds to the diameter of the downpipe.

#### 07.12.02 Collecting main ventilation

As regards the collecting main ventilation, two or more main ventilations are combined above the highest connecting pipe and vented above the roof as one pipe. As a result, the number of roof penetrations reduces and therefore, the danger of roof leaks.

The diameter of the collecting main ventilation must be at least one dimension greater than the biggest single main ventilation; detached houses are an exception. In addition, the cross-section of the collecting main ventilation must be at least as big as half the sum of the cross-sections of the downpipes.

Cross section surface  $A = \frac{d^2 \times \pi}{4}$

ger mm	di mm	A cm <sup>2</sup>	A/2 cm <sup>2</sup>
90	85,6	57,55	28,78
110	104,6	85,93	42,97
125	118,8	110,85	55,43
160	152,2	181,94	90,97

Tab. 07-14 Cross-sectional area

**Example:**

Apartment buildings

Single main ventilation 1: de = 110 mm

Single main ventilation 2: de = 110 mm

Cross-section surface L1 = 85.93 cm<sup>2</sup>

Cross-section surface L2 = 85.93 cm<sup>2</sup>

Collective ventilation L3

$$L_{total} = \frac{L_1 + L_2}{2}$$

$$L_{total} = \frac{85,93 + 85,93}{2}$$

$$L_{total} = 85,93 \text{ cm}^2$$

From this, the dimension de = 110 mm is obtained.

Since the dimension of the collective main ventilation pipe has to be one dimension greater than the greatest single main ventilation pipe, the dimension de = 125 mm must be selected.



For a detached house, the dimension de = 110 mm may be fitted.

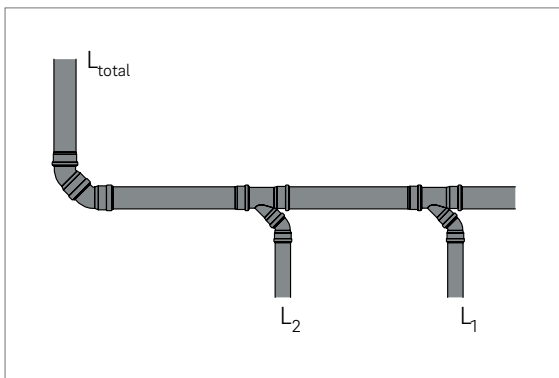


Fig. 07-15 Collecting main ventilation pipe

**07.12.03 Direct secondary ventilation**

In direct secondary ventilation, a ventilation pipe is laid parallel to the downpipe to increase the volume flow of waste water.

The downpipe and the ventilation pipe must be connected to one another on every floor, so that the entire pipe cross-section of the downpipe is available to the waste water volume flow.

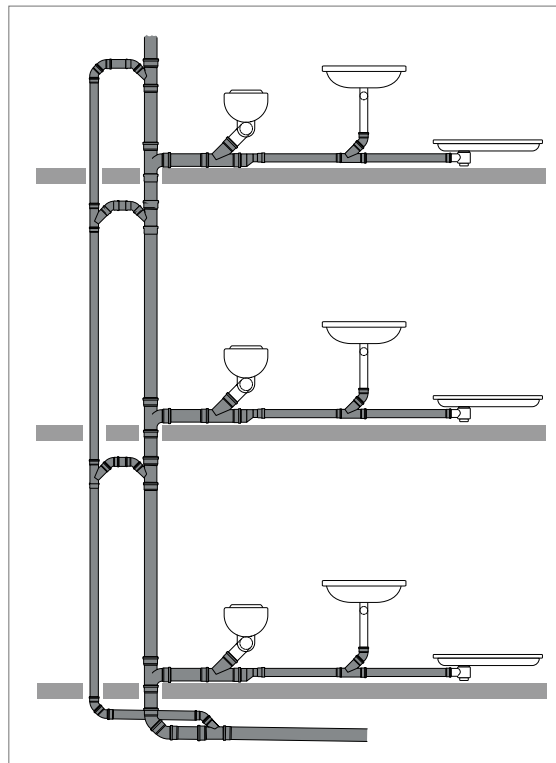


Fig. 07-16 Direct secondary ventilation

**07.12.04 Indirect secondary ventilation**

In contrast to direct secondary ventilation, with indirect secondary ventilation, the ventilation pipe is placed at the end of the collecting pipe.



Indirect secondary ventilation has to be connected before the last drainage object.

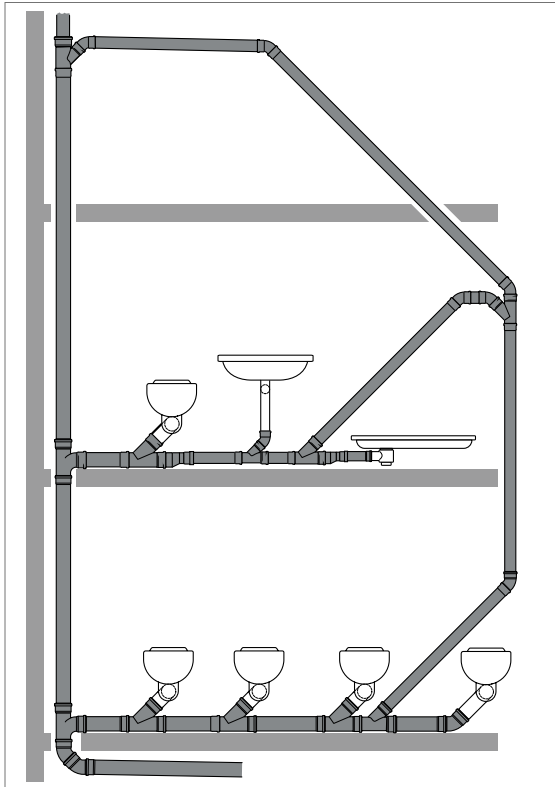


Fig. 07-17 Indirect secondary ventilation

**07.12.05 Recirculation ventilation**

The circulation serves to relieve single and collecting pipes and is connected at the end of the collecting pipe, which is connected once again to the downpipe on the same floor.



The recirculation ventilation has to be connected before the last drainage object.

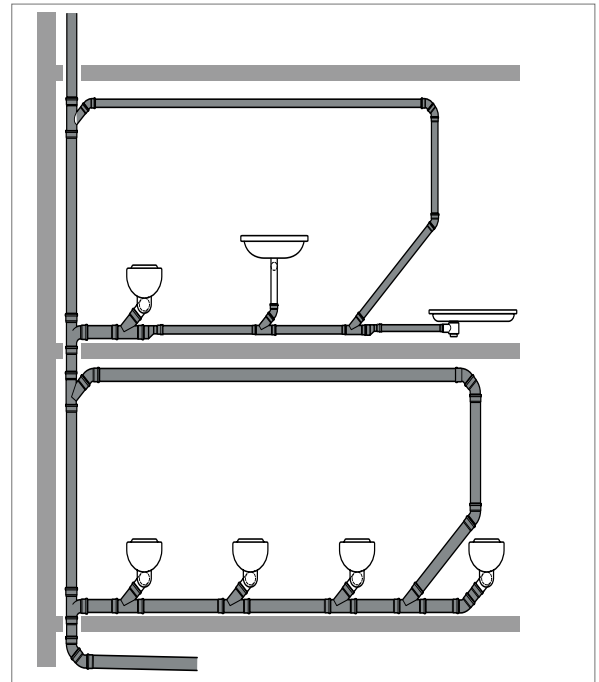


Fig. 07-18 Recirculation ventilation pipe

**Dimensioning of the recirculation ventilation**

Collecting pipe	Recirculation ventilation
≤ de 75	d <sub>e</sub> of the collecting pipe
> de 75	d <sub>e</sub> 75

Tab. 07-15 Dimensioning of the recirculation ventilation

**07.12.06 Ventilation valves**

In order to not have to use recirculation ventilations and indirect secondary ventilations, as a substitute, ventilation valves can be used with a main ventilation system.

In detached and semi-detached dwellings, one main ventilation can be led out over the roof and all the other main ventilations can be replaced with ventilation valves. The ventilation valves must be easily reachable for maintenance, and there must be sufficient air supply available for operation.



Ventilation valves may not be employed in backup-endangered zones below the highest waste water level and as ventilation for separation systems or pumping systems.

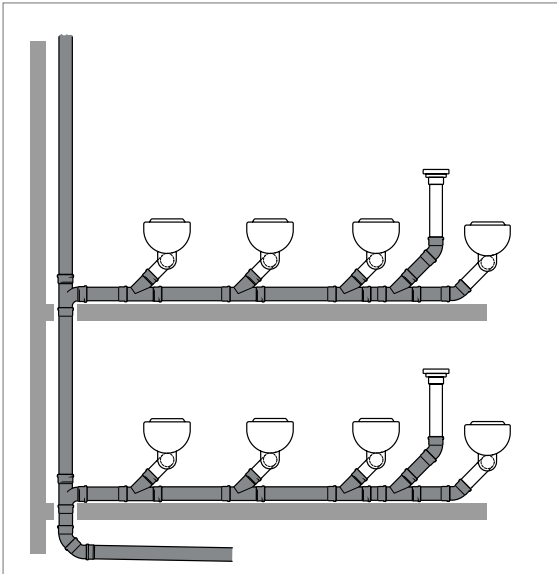


Fig. 07-19 Ventilation valves:

### 07.12.07 Installation of ventilation pipes

Ventilation pipes are subject to the following installation guidelines:

- Straight pipeline routing, avoid deflection as much as possible
- Vertically above the roof
- Extract ventilation hood with flexible connection with max. length 1 m
- Deflections with 45° elbows or less
- Ventilation outlets must have a distance to windows, doors and air inlets of min. 1 m above the opening or min. 2 m next to the opening.

### 07.13 Planning main pipes/collecting pipes

The minimum nominal diameter for collecting and main pipes for waste water, stormwater and mixed water is DN 100/de 110.

The minimum gradient of collecting and main pipes for waste water, stormwater and mixed water with a degree of filling of 70% is, up to DN 200, 1%. This value may be undershot if the flow speed does not drop below 0.7 m/s.

Changes in direction in collecting and main pipes may only be made with single elbows with angles up to maximum 45°.



This limitation does not apply if the single elbow has a radius of at least 500 mm.

Branches with angles of maximum 45° may be integrated in collecting and main pipes. The use of double branches is not allowed.

The permissible waste water discharge of main and collecting pipes must be calculated according to recognised, established formulas. Tables or diagrams may be used for this purpose. However, in cases of dispute, the Prandtl-Colebrook equation (the Prandtl-Colebrook equation is also known as the Colebrook-White equation) must be applied.

For the sake of simplification, permissible waste water discharges, calculated according to the Prandtl-Colebrook equation are given in the tables in section 18.

### 07.14 Installation times

The installation times are for guidance.

They include:

- Inspecting and providing the design drawings and materials at the construction site
- Familiarising with the design drawings
- Preparing valuations of materials used
- Preparing and installing the pipes and fittings
- Connecting the pipes

The given installation times are for one person and are given in minutes (SM). They are based on the installation times for acoustic waste water pipes with push-fit sockets and are taken from the association Spengler, Sanitär- und Heizungstechnik in Munich.

	<b>Pipe</b> (r.m.)	<b>Adaptor and fitting</b> Pieces	<b>Mounting</b> Pcs.
DN 40	15	5	7
DN 50	15	5	7
DN 75	19	7	7
DN 110	22	9	7
DN 125	26	12	7
DN 160	33	14	12

Tab. 07-16 Installation times in single minutes (EM)  
Source: Installation times for sanitaryware, Spengler Sanitär- und Heizungstechnik association, Munich, 6. fully revised and expanded edition 2005

### 07.15 Invitation to tender

#### RAUSILENTO

Waste water system, consisting of hot-water resistant, sound-insulating pipes and fittings RAUSILENTO DN 32 to DN 160 with push-fit sockets of mineral-reinforced PP as well as accessories for installation as sewer pipes inside and outside buildings in accordance with EN 12056 and B 2501. Dimensions in line with EN 1451-1. The sound insulating properties of the system, which are oriented to the requirements of the VDI directive 4100 (Sound insulation in apartments – criteria for planning and assessment) or B 8115 (Sound insulation in building construction), are proved by test report no. P-BA 265/2021 (with standard bracket) of the Fraunhofer-Institut für Bauphysik, Stuttgart.

#### Standards

ÖNORM EN 12056:

Gravitation drainage units within buildings;  
Part 1: General provisions and implementation provisions  
Part 2: Waste water systems, planning and calculations  
Part 3: Roof drainage, planning and calculations  
Part 4: Waste water pump systems, planning and calculation  
Part 5: Installation and testing, operation and maintenance instructions

ÖNORM B 2501:

Drainage systems for buildings;  
Planning, execution and testing – supplementary directives to ÖNORM EN 12056 and ÖNORM EN 752

ÖNORM EN 1451-1:

Polymer pipe systems for draining waste water (low and high temperature) within the building structure – polypropylene (PP);  
Part 1: Requirements for pipes, fittings and the piping system

Technical information pertaining to the RAUSILENTO waste water system as well as the standards, directives and specifications contained in it.

**Installation**

In accordance with the installation instructions in this technical information and in compliance with the specifications of EN 12056, B 2501 and B 8115 as well as VDI directive 4100.

**Quality assurance**

REHAU is certified in accordance with DIN ISO 9001 in the building technology sector and other sectors. This applies to both the production run and the technical and commercial departments.



Tender texts in PDF and Word formats can be obtained from your REHAU sales office. Standardised tender texts according to ÖNORM A 2063 can be obtained at [www.abk.at](http://www.abk.at).

## 08 Installation

### 08.01 Delivery, handling and storage

#### Supply form

- Pipes up to 500 mm and fittings in boxes
- Pipes longer than 1000 mm in pipe coil on pallet

#### Transport

- To be loaded and unloaded by competent persons.
- Do not drag pipes on the ground or across concrete surfaces.
- Transport pipes on a level surface.
- Protect pipes against dirt, mortar, oil, grease, colours, solvents, chemicals, humidity etc.

#### Storage

- Protect boxes from moisture during transport and storage.
- The RAUSILENTO and its sealing elements can be stored outdoors for up to two years due to their UV-stability (Central Europe).
- Protecting RAUSILENTO pipes and fittings from soiling by
  - Keeping them in the box
  - Covering them with tarpaulins (ensure proper ventilation).
- Ensure that the wood frames are aligned squarely when stacking.
- Store the pipes in such a way to avoid any deformation of the socket and spigot end.

### Bevelling and cutting pipes to length



At low temperatures, the mineral-reinforced pipe material RAU-PP becomes more brittle and, as such, more sensitive to impact.

Observe the minimum installation temperature of  $-10\text{ }^{\circ}\text{C}$ .



Fittings must not be trimmed.

1. If necessary, cut pipes to length using widely available plastic pipe cutters or a fine-toothed saw.
2. Make the cut at a  $90^{\circ}$  angle to the pipe axis.
3. For connections to push-fit socket pipe systems, taper the pipe ends with a tapering tool or a coarse file at an angle of approximately  $15^{\circ}$ .
4. Deburr and cut away any sharp edges to avoid accumulation of dirt.

### 08.02 Joining pipe and fittings

1. Clean dirt off the sealing ring, the inside of the socket and the spigot end and ensure that the sealing ring is seated correctly.
2. Lubricate the spigot or pipe end with REHAU lubricant and push it into the socket all the way to the stop.
3. Mark the pushed-in spigot end in this position on the socket edge with a lead or felt pen or something similar.
4. With longer pipes ( $> 500\text{ mm}$ ), pull the spigot another 10 mm out of the socket to create an expansion joint for the thermal expansion.
5. With short pipes ( $\leq 500\text{ mm}$ ) and fittings, push the spigots completely into the sockets.

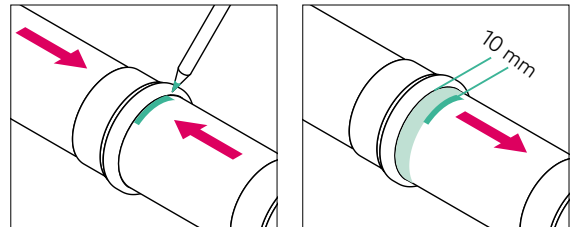


Fig. 08-1 Marking the spigot/pipe ends and pull back to allow for thermal expansion



Pulling the spigot/pipe ends out of the sockets allows for changes in pipe length due to thermal expansion to be accommodated for inside the socket.

Every RAUSILENTO pipe socket can therefore absorb the change in length of a waste water pipe that is up to 3 m long (length expansion coefficient at  $0\text{ }^{\circ}\text{C}$  to  $70\text{ }^{\circ}\text{C}$  according to DIN 53752 is  $0.09\text{ mm}/(\text{m}\cdot\text{K})$  on average).

**08.03 Linear expansion  $\Delta l$**

All materials are subject to an increase or decrease in volume, and hence, to a change in length, upon heating or cooling. Therefore, the change in length must be taken into consideration with every installation system, to avoid possible breakage from uncompensated expansion.

The linear expansion depends on the temperature, the pipe length and the expansion coefficient  $\alpha$ . The pipe dimension does not play a role in the expansion.

Calculation of the linear expansion:

$$\Delta l = L \times \Delta T \times \alpha$$

- L Pipe length up to the next elbow or up to the next branch
- $\Delta T$  Difference between installation temperature (temperature prevailing at the time of installation) and operating temperature
- $\alpha$  Expansion value of the pipe material (0.09 mm/(mK))
- $\Delta l$  Expansion length

Example:

$t_e$  = installation temperature: 10 °C

$t_b$  = operating temperature: 40 °C

L = pipe length: 3 m

$$T = t_b - t_e$$

$$T = 40 - 10$$

$$T = 30 \text{ C}$$

$$\Delta l = L \times \Delta T \times \alpha$$

$$\Delta l = 3 \times 30 \times 0.09$$

$$\Delta l = 8.1 \text{ mm}$$

Pipe length [m]	Temperature difference $\Delta T$ [K]									
	10	20	30	40	50	60	70	80	90	100
1	0,9	1,8	2,7	3,6	4,5	5,4	6,3	7,2	8,1	9,0
2	1,8	3,6	5,4	7,2	9,0	10,8	12,6	14,4	16,2	18,0
3	2,7	5,4	8,1	10,8	13,5	16,2	18,9	21,6	24,3	27,0
4	3,6	7,2	10,8	14,4	18,0	21,6	25,2	28,8	32,4	36,0
5	4,5	9,0	13,5	18,0	22,5	27,0	31,5	36,0	40,5	45,0
6	5,4	10,8	16,2	21,6	27,0	32,4	37,8	43,2	48,6	54,0
7	6,3	12,6	18,9	25,2	31,5	37,8	44,1	50,4	56,7	63,0
8	7,2	14,4	21,6	28,8	36,0	43,2	50,4	57,6	64,8	72,0
9	8,1	16,2	24,3	32,4	40,5	48,6	56,7	64,8	72,9	81,0
10	9,0	18,0	27,0	36,0	45,0	54,0	63,0	72,0	81,0	90,0
12	10,8	21,6	32,4	43,2	54,0	64,8	75,6	86,4	97,2	108,0
14	12,6	25,2	37,8	50,4	63,0	75,6	88,2	100,8	113,4	126,0
16	14,4	28,8	43,2	57,6	72,0	86,4	100,8	115,2	129,6	144,0
18	16,2	32,4	48,6	64,8	81,0	97,2	113,4	129,6	145,8	162,0
20	18,0	36,0	54,0	72,0	90,0	108,0	126,0	144,0	162,0	180,0

**Expansion length [mm]**

Tab. 08-1 Table of expansion length

**08.04 Processing of cut lengths and residual lengths**

The working of cut lengths and residual lengths (pipes with smooth ends) can be done with double sockets and collars up to a maximum installation length of the pipes of 3 m.

Here, too, pay attention to having adequate expansion joints in the pipe sockets.

**08.05 Assembling fittings retrospectively**

Retrospective assembly of fittings in an existing pipeline is possible with slip-on sockets:

- Cut out a sufficiently long piece of pipe from the piping: fitting length + 2 x pipe outer diameter, deburr the pipe ends.
- Push the entire length of a slip-on socket on one of the pipe ends.
- Push the fitting onto the other pipe end.
- Fit the intermediate piece in the remaining intermediate space of the line and deburr it.
- Push the second slip-on socket completely on the intermediate piece.
- Insert the intermediate piece and close both the gaps by pushing the slip-on sockets. Use a generous amount of anti-friction agent.
- The fittings must be secured against unintended displacements (e.g. due to temperature interplay).

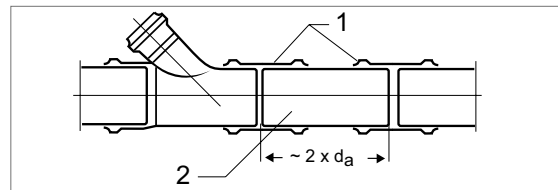


Fig. 08-2 Installing fittings  
 1 Slip-on socket  $d_a$  Pipe outer diameter  
 2 Intermediate piece

**08.06 Connect the pop-up**

There are three options to connect pop-ups (for example, odour traps) to RAUSILENTO pipes or fittings:

- RAUSILENTO Connection pipe
- RAUSILENTO Connection bend
- Direct connection to fitting RAUSILENTO with rubber nipples with sealing bead

**RAUSILENTO Connection pipe**



Fig. 08-3 RAUSILENTO Connection pipe with rubber nipple

- Push the rubber nipple into the widening of the connecting piece.
- Coat the inner surfaces (sealing lips) of the rubber nipple with anti-friction agent.
- Push the run-off socket of the pop-up into the rubber nipple.

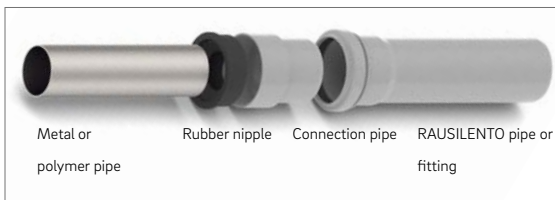


Fig. 08-4 Installation of RAUSILENTO adapter

Metal or polymer pipe	Rubber nipple	Adapter	RAUSILENTO pipe or fitting
Outer diameter: 32 - 40 mm	DN 50/40 (Mat. no.: 11262531002)	DN 50/40-30 (Mat. no.: 15573151001)	DN 50

**RAUSILENTO Connection bend**



Fig. 08-5 RAUSILENTO Connection bend with rubber nipple

- Push the rubber nipple into the widening of the siphon angle.
- Coat the inner surfaces (sealing lips) of the rubber nipple with anti-friction agent.
- Push the run-off socket of the pop-up into the rubber nipple.



Fig. 08-6 Installation of RAUSILENTO waste tap elbow

Metal or polymer pipe	Rubber nipple	Adapter	RAUSILENTO pipe or fitting
Outer diameter: 32 - 40 mm	DN 50/40 (Mat. no.: 11262531002)	DN 40/30 (Mat. no.: 15573421001)	DN 40
Outer diameter: 32 - 40 mm		DN 50/40-30 (Mat. no.: 15573531001)	DN 50
Outer diameter: 47 - 50 mm	DN 50/50 (Mat. no.: 11219131003)	DN 50/50 (Mat. no.: 15573441001)	DN 50

## 08.07 Connecting pieces to cast iron or other pipe systems



Fig. 08-7 Adaptor for same external diameter DN 110/DN 110

When it comes to mixed installations and depending on local conditions, it is advisable to consult the responsible consultant for fire protection in buildings/ building authority in advance as there are different solutions for different installation situations. A uniform installation using the RAUSILENTO waste water system is recommended to allow for the straightforward and reliable allocation of fire protection solutions, certifications and installation guidelines.

Rubber sleeve adaptors are used to connect the RAUSILENTO pipes to cast iron pipes and other pipe systems used in soil and waste systems. These connecting pieces consist of an elastomer seal which is fitted to the pipe ends using two stainless-steel jubilee clips.

Connecting pieces are available for the following situations:

- Connecting pipes that have the same outer diameter (DN 110/DN 110)
- Connecting pipes that have different outer diameters (DN 110/DN 90)



At higher pressures (> 0.5 bar), connections with connecting pieces must be secured separately with additional fastening elements to prevent them from sliding apart.



Metal jubilee clips must be tightened using a starting torque of 3 Nm.

A deformation of the pipe must be avoided.

## 08.08 Cleaning pipe

Cleaning pipes must be integrated in the sewer pipe without fail, so that in case of a blockage, the entire waste water pipe does not have to be opened.

Cleaning pipes are useful not only as pure work openings for removing blockages and for other repairs, but are of great use especially in the present-day technology of canal inspection with an inserted camera.

### 08.08.01 Requirements for cleaning pipes

In downpipes, collecting pipes and main pipes, cleaning pipes must be provided for cleaning and inspection.



Cleaning pipes may not be built in rooms with more stringent hygienic demands (food and pharmaceutical industry) or rooms with LV systems.

The cleaning openings must give the cleaning and inspection equipment sufficient space for carrying out the cleaning and inspection work. Therefore, cleaning openings must have a minimum diameter of  $0.8 \times \text{DN}$ . Moreover, the flow cross-section of the cleaning pipe must be at least equal to the cross-section of the sewer pipe.

### 08.08.02 Array of cleaning pipes

Cleaning pipes must be integrated in collecting and main pipes in the vicinity of the riser elbow as well as at every direction change with a minimum distance of 3.0 m.

When horizontal pipes open into collecting pipes or main pipes, then cleaning pipes must be integrated in these pipes with a maximum distance of 5.0 m from the opening.

In downpipes, cleaning pipes must be arranged above the highest branch as well as above the riser elbow at a maximum distance of 2 m.

The cleaning pipe above the highest branch can be omitted if there is an option for cleaning from the roof, or the drop height of the downpipe is not greater than 10.0 m.

The cleaning pipe above the riser elbow can be omitted if there is a cleaning pipe present in the immediate vicinity of the collecting or main pipe.

The biggest distance between two cleaning openings of collecting and main pipes inside buildings, up to DN 160, may be a maximum of 20.0 m.

In the case of collecting pipes led along the roof, it must be ensured that a clear working space of 0.6 m is available between the top edge of the cleaning pipe lid and the lower edge of the ceiling. If this is not possible, the required working space can be achieved by twisting the cleaning piece through up to  $60^\circ$ .

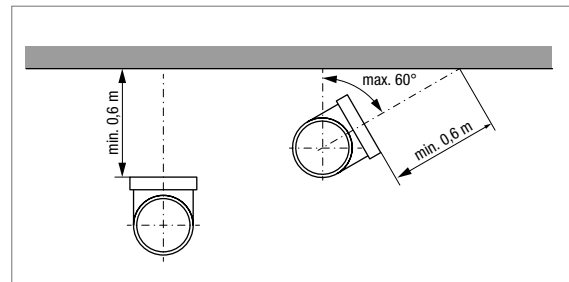


Fig. 08-8 Minimum distances of cleaning pieces

## 08.09 Cleaning the waste pipe system

The mechanical cleaning of the waste pipe system is facilitated through the integration of cleaning pipes.

After assembly of the cleaning pipe, tighten the screw cap with the rubber gasket inserted.



Fig. 08-9 RAUSILENTO access pipe



Do not use any sharp-edged cleaning equipment for mechanical cleaning.

## 09 Installation situations

### 09.01 Installing pipes in installation shafts

It is possible to install the RAUSILENTO waste pipes and fittings in installation shafts without any additional structure-borne sound-dampening. Thermal insulation and protection against condensation are only required in special cases (e.g. internal roof drainage).

- Acoustically isolate the pipes from any wall or ceiling ducts using commonly available moisture-resistant sound proofing.
- Avoid any sound bridges between the pipe and shaft wall.

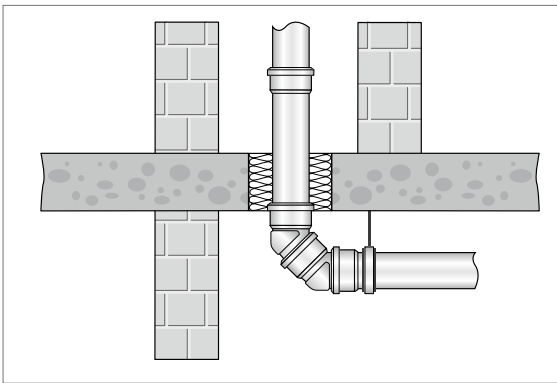


Fig. 09-1 Example of design 1 – Installation in installation shafts

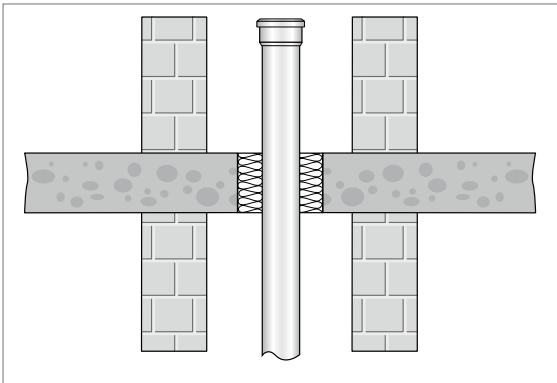


Fig. 09-2 Example of design 2 – Installation in installation shafts

### 09.02 Installing pipes in masonry

Wall chases have an impact on the load-bearing capacity and physical properties of the masonry. A structural analysis may be required. Always check if a chase is allowed.

#### §

For wall chasing and recessing, EN 1996 shall apply.

- Create the wall chase in such a way that the pipe can be installed free of tension.
- Avoid any sound bridges between the masonry and pipe.

If the pipes are to be embedded directly without any plaster membrane (e.g. Rabitz brick web, expanded metal) or casing:

- Wrap pipes and fittings first with flexible materials such as mineral or glass wool or commonly available sleeving.
- If plaster membranes are used, line the chase first, for e.g. with mineral. This prevents the formation of sound bridges between the pipe and wall during plastering.
- In locations where temperatures above 90°C may be reached due to external heat sources, protect pipes and fittings with appropriate measures to avoid excessive heat.

### 09.03 Installing pipes in concrete



For pipes being embedded directly into concrete, it is recommended to acoustically isolate the pipes from the structure using moisture-resistant structure-borne sound proofing with an insulation thickness > 4 mm. A reduction in acoustic performance is still to be expected.

- The structural integrity must never be compromised.
- Fix pipes securely so they cannot move when the concrete is being poured.
- Ensure that a sufficient number of expansion joints are used during installation.
- Seal the socket gap with adhesive tape to prevent the ingress of cement.
- Seal pipe ends prior to concrete-pouring.



- Minimise the weight of the concrete on the pipes by taking measures to dissipate the weight, e.g. by using:
  - Spacers for the reinforcing mesh
  - Goalpost type continuous wire chairs
  - Steel consoles
- The reinforcement must not be positioned on the pipes.
- Avoid walking on the pipes when concreting.

### 09.04 Installations above suspended ceilings

For installation above suspended ceilings, additional measures are required to ensure a high level of sound insulation in view of the special installation.

Possible sound insulation solutions are described in chapter "10 Sound insulation with RAUSILENTO". Exposed installation, especially in rooms requiring protection, must be avoided. The standard-defined sound insulation requirements cannot be complied with here without additional measures (for example, insulation).

The insulation can be carried out with acoustically effective pipe shells (for example, combination of open-pore foam or mineral fibre mats with a thickness of about 30 mm and special heavy sheets). However, since complex ceiling systems are usually involved, the installation instructions of the ceiling manufacturer with regard to sound insulation must be obtained and followed.

The minimum insulation thickness given in Fig. 09-3 of 40 mm mineral fibre, cellulose or wood fibre mats is a recommendation. The sound insulation requirements must be defined on a building-specific basis and must be evaluated by a building physicist, if needed.

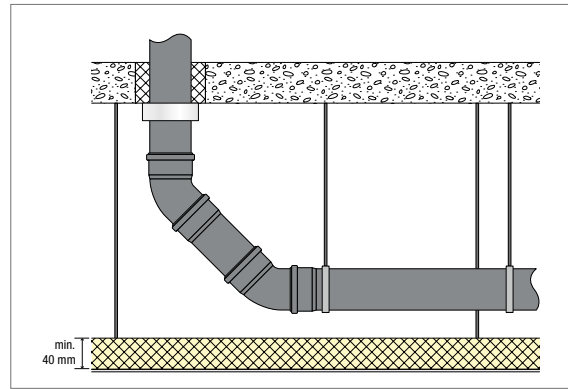


Fig. 09-3 Example for version 1 – Installation in suspended ceiling incl. insulation

- 1 Suspended ceiling, 2 x Knauf Silentboard GKF 12.5
- 2 Mineral wool Knauf, 40 mm TP 115

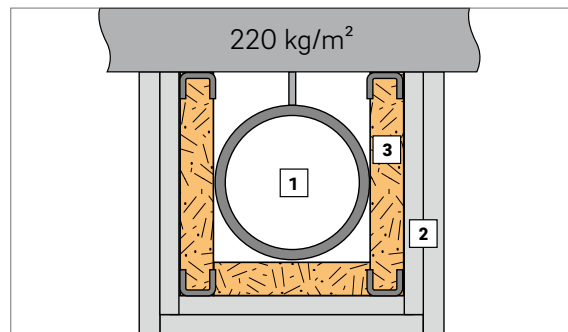


Fig. 09-4 Example for version 2 – Installation in suspended ceiling – casing of the pipe including insulation

- 1 RAUSILENTO
- 2 2 x 12.5 mm Knauf structural panel GKB 12.5
- 3 40 mm mineral wool insulation sheet Knauf TP 115

### 09.05 Ceiling penetrations

Ceiling penetrations must be made in a moisture-proof and sound-insulated manner. Here, it is important to ensure that the pipe's linear expansion through thermal influence is not restricted.

If mastic asphalt is to be applied to the floor: Protect exposed pipeline components with ceiling liner, protective sleeves or by wrapping them with heat-insulating materials.

**09.06 Connecting rules**

**09.06.01 Connections in downpipes**

When connecting to downpipes, external pipe jetting must be prevented. Pipe jetting can be countered through a height-offset of the downpipe connections and no opposite inlets without height-offset.

**Openings of neighbouring drainage objects at the same height into the downpipe:**

- For similar drainage objects, a double branch of 180° is fitted.

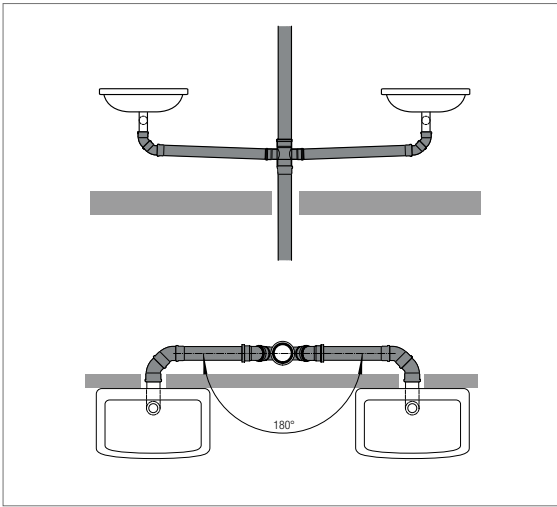


Fig. 09-5 Openings of identical neighbouring drainage objects at the same height into the downpipe (wash basin)

- In WC systems, a double branch with maximum 135° inner angle is fitted.

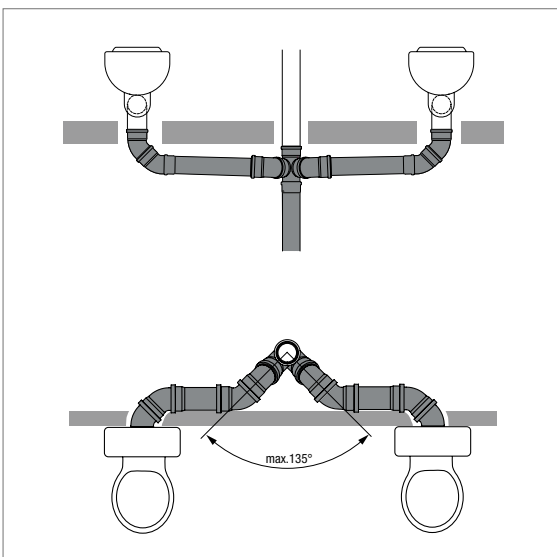


Fig. 09-6 Openings of identical neighbouring drainage objects at the same height into the downpipe (WC systems)

- If the drainage objects are different, a double branch with maximum 135° inner angle is fitted.

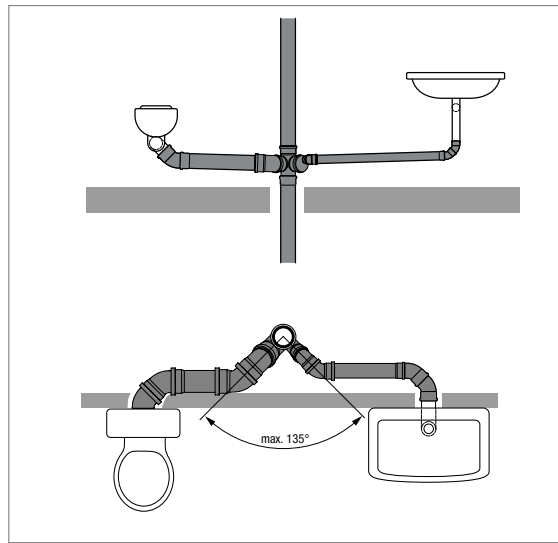


Fig. 09-7 Openings of different neighbouring drainage objects at the same height into the downpipe

- For WC systems or different kinds of drainage objects, a 180° double branch with an outlet bend that has a radius in the centre line and is not smaller than the internal diameter of the pipe is used.

**Opening of neighbouring drainage objects at the different heights into the downpipe:**

- If a larger connecting pipe discharges into a smaller connecting pipe, there is no requirement for minimum distances.
- If smaller connecting pipes discharge into larger connecting pipes, then a minimum distance of 0.25 m must be maintained between the two openings of the connecting pipes (referred to as the floor elevation)

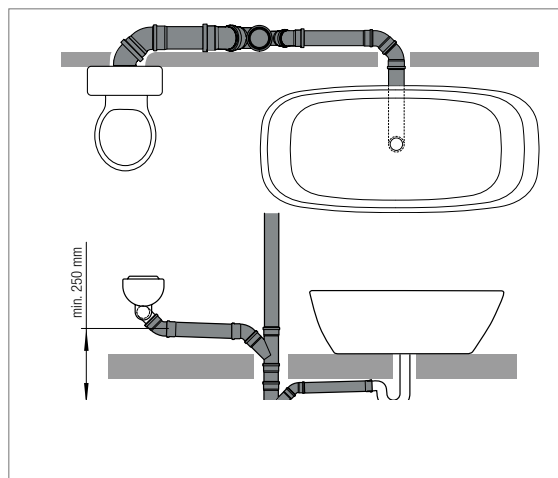


Fig. 09-8 Openings of different neighbouring drainage objects at different heights into the downpipe



Fundamentally, suitable fittings should be used for the piping system for retrospective connection of drainage pipes to existing waste water pipes. A system transition (RAUSILENTO connecting piece) must always be used for third-party brands.

**09.06.02 Connections to collecting and main pipes**

Connections to collecting and main pipes are subject to the following connection rules:

- Direction changes only with single elbows and angles up to 45°

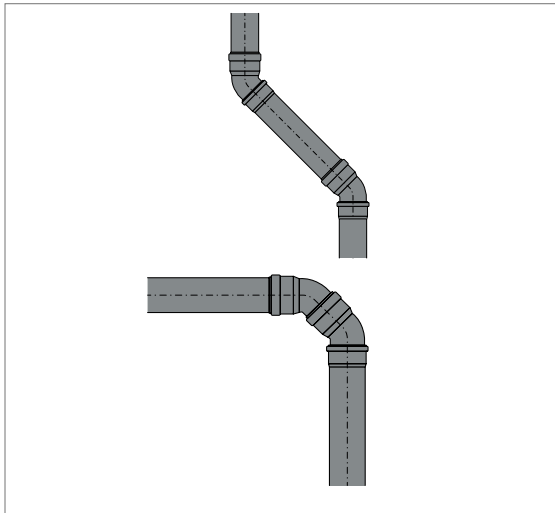


Fig. 09-9 Direction changes for collecting and main pipes

- Branches only with angles up to 45°, double branches are not allowed.
- Openings into collecting and main pipes only with angles up to 45° in the flow direction; for which the side branch pipe must be turned on at least 15° to maximum 45°.

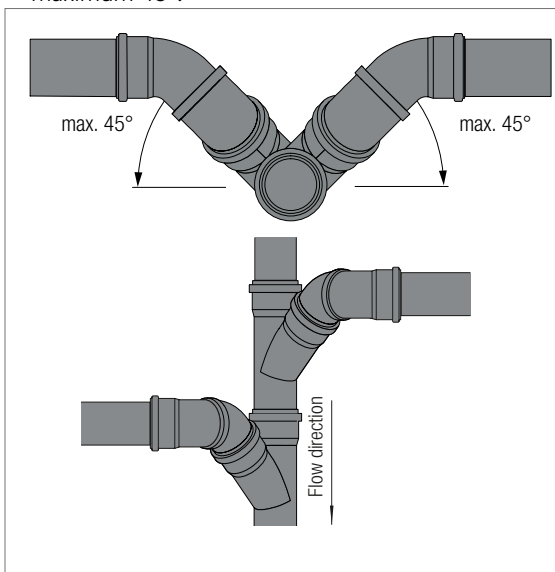


Fig. 09-10 Opening into collecting and main pipes

- For collecting pipes without a downpipe, a ventilation pipe must be led over the roof.
- For main pipes outside the building, every change in direction must be made in accessible shafts.

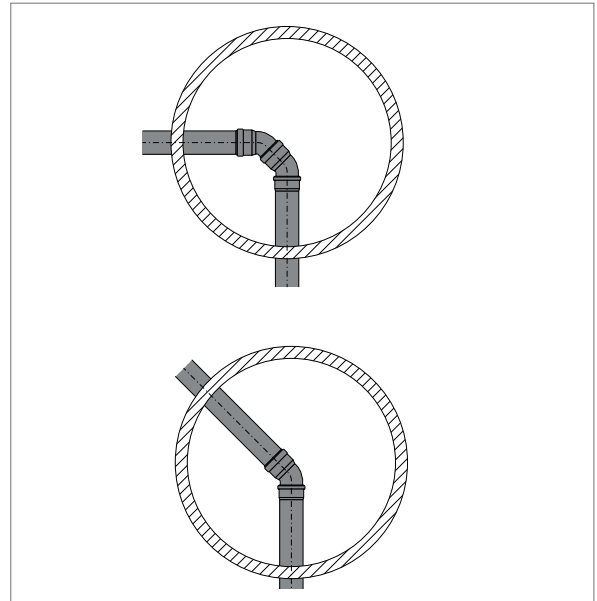


Fig. 09-11 Main pipes outside the building with shaft

**09.06.03 Transition to other dimensions for collecting and main pipes**



When transitioning to other dimensions, care must be taken that the dimensions in the flow direction for waste water pipes may not be reduced.

If, owing to the connection to the existing network, a reduction of the dimension in the flow direction is unavoidable, then this may only be done in a manhole with an open, tapering channel. Because of the possible noise pollution, this shaft must be located outside the building.



Fig. 09-12 Transition pipe fitting

Eccentric transition fittings must be fitted with uniform crown height. The only exception are main pipes, where transition pieces may be fitted at the same level as the base due to easier inspections.

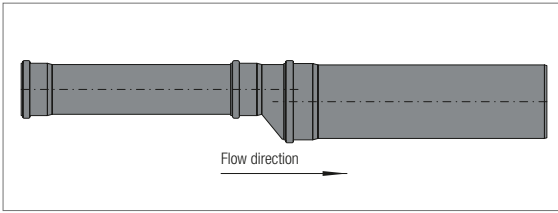


Fig. 09-13 Uniform crown height fitting

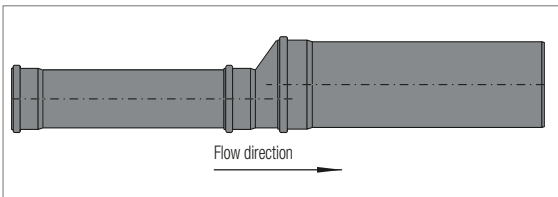


Fig. 09-14 Uniform base height fitting

# 10 Sound insulation with RAUSILENTO

## 10.01 Basic principles

In every area of building construction, especially the construction of apartment buildings, hospitals and care homes, sound insulation plays an increasingly important role. One of the most significant sources of sound within buildings are the sanitary installations and in particular the waste water system.

The most common sources of noise are:

- Taps and mixers when running
- Filling baths, sinks, etc.
- Flushing toilets
- Filling WC cisterns, etc.
- Redirecting water flow

Unsuitable soil and waste systems and the bracketing of such systems are contributing significantly to noise disturbance. The comprehensively tested sound-insulated RAUSILENTO waste water system is the solution.

A distinction is made between air-borne and structure-borne sound depending on how the sound is transmitted.

### Air-borne noise transmission

Noise is directly transmitted directly to the human ear from the source through the air.

### Structure-borne noise transmission

In the case of structure-borne sound, it is first transmitted through a solid body. This causes vibrations that are radiated to the human ear as air-borne sound.

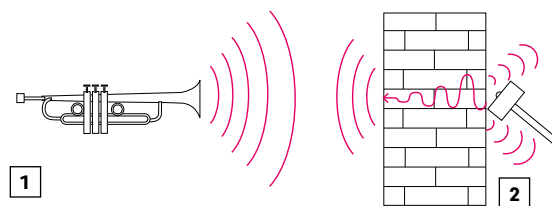


Fig. 10-1 Air-borne and structure-borne sound

- 1 Air-borne noise
- 2 Structure-borne noise

## 10.02 Sound reduction with RAUSILENTO

Both structure-borne and air-borne noises occur in soil and wastes systems. Flow currents and flow noises induce vibrations in the drainage pipe wall. The pipe wall vibrates due to flow turbulence and flow noises. The type and intensity of these vibrations depend on a variety of factors, such as the pipe weight, the pipe material and its sound dampening properties.

The pipe vibrations are emitted directly from the pipe as air-borne noise and are transferred as structure-borne noise via the pipe brackets into the wall.

When developing an acoustic waste water system, both types of noise transmission must be considered.

### Air-borne sound reduction

Air-borne sound is reduced thanks to its special materials, sound-dampening fillers and increased weight of the pipe system.

Pipe bends from DN 90 to DN 160 with targeted mass optimisation in critical areas further improve the acoustic performance.



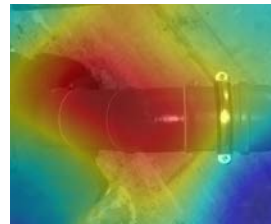
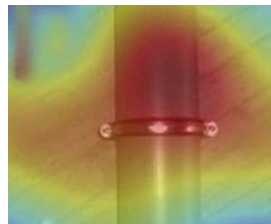
Fig. 10-2 Multi-layer technology



Fig. 10-3 Mass optimisation in pipe bend

**Multi-layer technology**

The exceptionally rigid middle layer with sound-absorbing filler materials increases the mass (pipe density 1.2 g/cm<sup>3</sup> with RAUSILENTO), reducing the sound level considerably.



RAUSILENTO

Standard HT-PP

RAUSILENTO

Standard HT-PP

Lowest noise level

Highest noise level

Lowest noise level

Highest noise level

**10.03 Sound insulation requirements**

There are currently three important sets of rules pertaining to sound insulation in residential buildings:

- ÖNORM B 8115 (sound insulation and room acoustics in building construction)
- DIN 4109 (Sound insulation in building construction; edition July 2016)
- VDI guideline 4100 (Sound insulation in building construction - apartments - Assessment and proposals relating to increased sound insulation, edition October 2012)

**ÖNORM B 8115**

This ÖNORM is to be applied for buildings and building parts that serve for a prolonged stay by persons or whose intended use envisages a requirement for quiet. This includes, in particular, residential buildings, residential establishments, office buildings, accommodation facilities, schools, nurseries, hospitals etc. The noise requirements apply to external areas. There are no sound requirements for one's own living space.

In order to meet the minimum sound insulation requirement according to ÖNORM B 8115-2, building engineering systems must be arranged and designed in such a way that the noise level arising from the operation of these systems from other service units does not exceed the system noise level L<sub>AFmax</sub> (Tab. 10-1) given in the following table.

Type of noise	Maximum permissible system noise level L <sub>AFmax,nt</sub> in dB	
	Normal requirement	Increased sound insulation
Constant or intermittent noises (for example, from heating systems, pumps ) etc.	≤ 25	≤ 20
Short, variable noises (for example, W/C flushing, other drain noises) etc.	≤ 30	≤ 25

Tab. 10-1 Minimum required sound insulation of building engineering systems according to ÖNORM B 8115-2

Increased sound insulation during operation of building engineering systems is required when the system noise level L<sub>AFmax</sub> according to Tab. 10-1 is at least 5 dB lower than the respective minimum requirement. However, increased sound insulation must be agreed separately.

**DIN 4109**

DIN 4109 must be taken into account when planning building drainage systems. DIN 4109 defines the minimum requirements for adjacent rooms located in separate apartments, that are required to be acoustically separated / insulated from one another. These include:

- Bedrooms
- Living areas (including halls and kitchens)
- Class rooms
- Working rooms (offices, treatment rooms, meeting rooms)
- Hospital wards and sanitariums

There are no requirements for one's own living space. A maximum of 30 dB(A) is stipulated for sanitary installations (water supply and soil and waste systems combined).

This standard stipulates sound insulation requirements that aim to protect people in living areas from the nuisance of noise, by setting maximum limits for noise which must be observed.



In terms of public law, DIN 4109 constitutes a minimum requirement. Greater sound insulation requirements are defined in part 5 of DIN 4109.

**VDI guideline 4100**

The VDI Directive 4100 stipulates stricter sound insulation requirements. It defines three sound insulation levels and makes a distinction between apartments in apartment buildings, semi-detached dwellings and terraced houses and, unlike DIN 4109, also takes the resident's own living space into account (water supply and waste water systems combined ).



The VDI Directive 4100 is not legally binding, but it provides guidance and, as such, is highly recognized and observed by experts. Individual contractual agreements under private law therefore allow for these tighter requirements to be included.

Sound insulation level	Apartments in apartment buildings	Dwellings in semi-detached and terraced houses	Own living area
I	30 dB(A) (as per DIN 4109)	30 dB(A) (as per DIN 4109)	30 dB(A)
II	30 dB(A)*	25 dB(A)*	30 dB(A)
III	25 dB(A)	20 dB(A)	30 dB(A)

Tab. 10-2 Sound insulation requirements according to VDI Directive 4100:2012-10 and DIN 4109:2016-07 Part 5

**Sound value definitions**

The exact definition of a sound measurement and the associated regulations/standards are absolutely essential, particularly when comparing sound values. Whilst the term dB(A) is always used, the regulations and standards very often use different variables for sound measurement. As such, sound measurements that have not been converted cannot be compared and usually differ by more than 3 dB(A).

Whereas the sound values of DIN 4109 relate to individual components ( $L_{AFmax,n}$ ), VDI 4100:2012 takes the geometry of the space (spatial volume and partition wall area) and a defined reverberation time into account

( $L_{AFmax,nT}$ ). As such, they deal with fundamentally different assessment principles and performance indicators. In addition, rooms can be divided into those that require noise protection and those that do not depending on their size rather than their use if an agreement pertaining to VDI 4100:2012 is agreed. Noise at the source such as from opening a tap or pressing the flush button on a WC cistern as well as noise spikes must be considered together with the applicable sound insulation level for all spaces.

With this in mind, it is always advisable to involve an acoustic expert early on, particularly when dealing with a high level of sound insulation.

**Installation noise level for rooms requiring noise protection in multi-family dwellings**

Standards/guidelines	$L_{AFmax,n}$ component-related performance indicator		$L_{AFmax,nT}$ situation-related performance indicator (Taking reverberation into account)	
	Room requiring sound insulation diagonally below in an outside area	Own area	Room requiring sound insulation diagonally below in an outside area	Own area
Sound insulation in building construction DIN 4109:2016-07				
Minimum requirements according to part 1	30 dB(A)	-	-	-
Increased sound insulation as per part 5	25 dB(A)	-	-	-
Sound insulation in building construction, apartments VDI 4100:2012-10				
Sound insulation level I (SIL I)	-	-	30 dB(A)	-
Sound insulation level II (SIL II)	-	-	27 dB(A)	-
Sound insulation level III (SIL III)	-	-	24 dB(A)	-
SIL OOS I – own area	-	-	-	35 dB(A)
SIL OOS II – own area	-	-	-	30 dB(A)

Tab. 10-3 Installation noise level

**10.04 Sound measurement in accordance with DIN EN 14366**

With waste water systems, there is a good comparison base thanks to a standardised test set-up as per a European standard.

To determine the acoustic performance, RAUSILENTO waste water system was tested by the independently certified Fraunhofer Institute for Building Physics in Stuttgart (IBP) in accordance with DIN EN 14366 "Laboratory measurement of noise from waste water installations".

Sound measurements were carried out using a standardised installation set-up that has been derived from a real-life installation. Various flow rates were tested as a realistic representation of a household with several family members. The results proved that RAUSILENTO produces a noise level well below the permitted maximum level of 30 dB(A) according to DIN 4109.

In comparison to standard pipe brackets, the sound levels generated with the REHAU structure-borne sound-dampening support bracket were very low indeed. Using this standard bracket option, the system produced sound levels that were well below the maximum limits detailed in part 5 (DIN 4109).

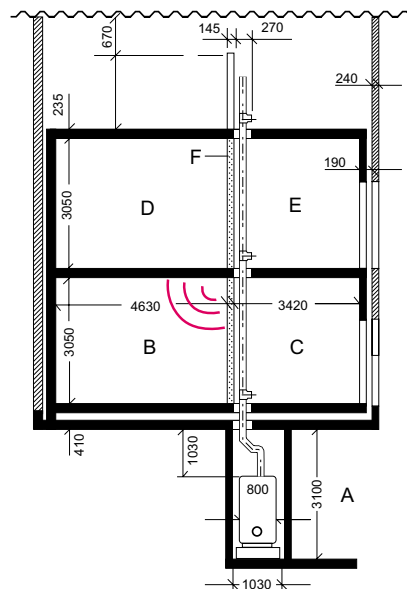


Fig. 10-4 Test facility of the Fraunhofer Institute for Building Physics (all dimensions in mm)

- A Basement
- B Lower level, rear
- C Lower level, front
- D Ground level, rear
- E Ground level, front
- F Installation wall (area weight 220 kg/m<sup>2</sup>)

**10.05 Measurement results**

The values measured in the noise-protected room (room B in Fig. 10-55) are shown in the below chart (source: test report P-BA P-BA 265/2021). By following the recommendation given in our technical information and using structure-borne sound-dampening support

brackets, as well as following the applicable standards and technical guidelines, RAUSILENTO is able to fulfil the planning and requirements of the VDI 4100 Directive.

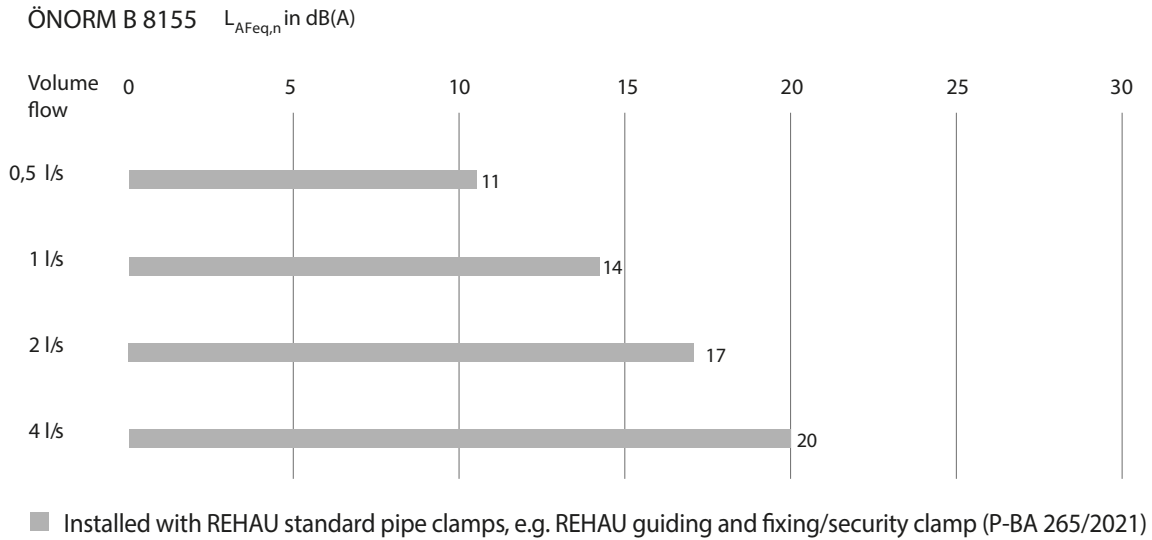


Fig. 10-5 Measurement results

**Difference between  $L_{AFmax}$  and  $L_{AFeq}$**

The sound insulation requirements from noise produced by building service installation specified in DIN 4109 and VDI 4100 refer to the maximum level  $L_{AFmax}$ . At the test facility, all tests measuring the noises from soil and waste systems according to EN 14366 are recorded in an average value, which is expressed in the test reports as  $L_{AFeq}$ .

While  $L_{AFeq}$  denotes the sound level at a continuous flow rate (e.g. 0.5 l/s, 1.0 l/s, 2.0 l/s and 4.0 l/s),  $L_{AFmax}$  constitutes the maximum sound level of an installation during a single operation, e.g. flushing the toilet.

# 11 Fire protection solutions for RAUSILENTO



The relevant national regulations must be observed with regard to fire protection.



The fire behaviour of RAUSILENTO corresponds to construction material class E according to EN 13501-1.

## 11.01 Fire protection

The uppermost objective of fire protection in building services engineering is to make it possible for humans and animals to leave the building without any injuries if there is a fire.

Fires can never be completely avoided, and therefore, the use of only tested and certified systems and construction materials is an absolute must.

Especially in the area of building services engineering, pipes must be led through fire compartments to be able to supply drinking water and heat to the building and to discharge waste water. Therefore, the utmost care has to be taken to fall back on only tested system solutions.

## 11.02 Compartmentalisation principle

In conjunction with building piping, fire protection measures are always required when fire-resistant, partitioning walls and ceilings (for example, fire walls, fire-resistant ceilings and walls) are penetrated by pipes. This compartmentalisation principle must not be jeopardised. Therefore, protective measures with at least the same fire resistance duration are required. Just the use of flame-retardant pipes or non-flammable pipes does not provide fire protection. With metallic sewer pipes, for example, the fire can get transmitted through heat conduction.

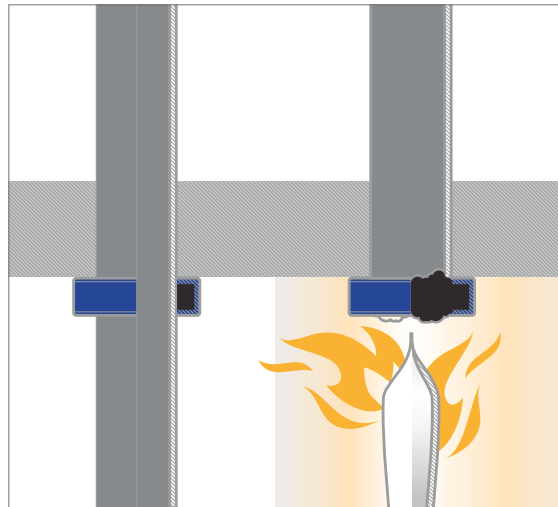


Fig. 11-1 Compartmentalisation principle

## 11.03 Protection goals

A structure has to be constructed according to the state of the art, so that if there is a fire:

- Load-bearing capacity is retained for a certain period
- The development and spreading of fire and smoke is limited
- The spread of fire to neighbouring buildings is limited
- The safety of rescue teams is taken into consideration
- The inhabitants can leave the building safely or can be rescued in some other way

## 11.04 Closing of ceiling and wall breakthroughs

Closing of openings, annular gaps and breakthroughs must be done in a smoke-tight and gas-tight manner and can be done with soft or hard firestop. If hard firestop is used, structure-borne sound bridges must be avoided.

The fire stop collars are fastened to solid components by screwing to the wall or ceiling. On light partition walls, the fire protection collars must be fastened with full-length threaded rods, washers and nuts. With wall mounting, it is absolutely necessary to fit the fire stop collars on both sides.

The correct fire stop collar with regard to dimensions and construction must be selected for all areas of application.

**Closing the annular gap**

The annular gap between the drainage pipe and the ceiling or the wall must be closed with non-flammable material, in a smoke-tight, gas-tight manner. For this purpose, non-flammable rock wool, shrink-free concrete (poured in) or a tested and classified fire protection mass can be used.

The annular gap between the pipe and the collar is covered by means of a suitable insulating foil ( $\leq 5$  mm thickness) (noise decoupling).

Annular gap between pipe and ceiling/wall:

- The annular gap between the pipe and the ceiling or the wall must be grouted or concrete should be poured into it.
- An annular gap of maximum 15 mm may be plugged with rock wool.
- For sound decoupling, in the casting zone, the pipe must be wound with insulating foil.

**11.05 Fastening on soft firestop**

With pipe breakthroughs through a soft firestop, attention must be paid to sufficient fastening of the fire protection equipment. One option would be by using folding pegs.

For installation on both sides, installation on a soft firestop can be done as for lightweight walls, with full-length threaded rods, washers and nuts.

If installing on only one side, sufficient fastening must be ensured, for example, with folding pegs or by using fire stop collars that can be inserted in the soft firestop.

**11.06 Fire stop collars**

The following fire stop collars are available for the fire protection for ceiling and wall breakthroughs of RAUSILENTO domestic waste water pipes:

- REHAU fire stop collar FP 3.0
  - For surface-mounted installations on ceiling or walls
- REHAU fire stop collar FP 6.0
  - For surface-mounted installations on ceiling or walls
  - Integration in ceiling or walls
  - For surface-mounted installations on ceiling or walls for installation with a collar

**Identification of fire protection equipment**

All fire protection equipment that is fitted in a structure must be permanently identified with an identification plate. This relates to fire protection collars, fire protection bands, route insulation, etc.

The following data must be visible on the identification plate:

- Make and designation
- Fire-resistance rating
- Authorisation number
- Manufacturer or distributor
- Installer company
- Installation date



Wall lead-throughs need two collars (on either side of the wall).



Since the fire protection system must have an ETA approval, obtain information before installation as to the suitability of the fire protection system and the pipe system to be partitioned.



For the planning and installation of the fire stop collars, the requirements of the ETA approval and the specifications in the instruction manual are binding. Compliance is required with the building approval specifications (building codes of the countries), the applicable standards and directives as well as the specifications of the local building authorities.

We recommend, in all cases, agreement with the responsible construction authority to satisfy the respective requirements.

Fire protection measures may be necessary in conjunction with domestic waste water pipes.



Fig. 11-2 Identification plate of the fire protection system

All fire protection systems must be entered in the installation plans, fire protection plans and documentation.

## 12 Special applications

### 12.01 Chemical resistance

#### Pipe and fittings

The components of the RAUSILENTO waste water system are chemically resistant to all usual waste waters that are allowed to be discharged into the public sewer system. They are also usually highly resistant to other substances. The special applications are to be clarified on a case by case basis taking into account the material composition, temperature, frequency, etc. and must always be done for the entire system, pipe and sealing material.

#### Rubber gasket

The types of rubber used generally demonstrate very good chemical resistance, although components of esters, ketones and aromatic and chlorinated hydrocarbons in waste water can cause considerable swelling, which can compromise the jointing. In this case, it may be necessary to change the factory-fitted sealing rings to NBR (available separately).

#### Key to tables

- r resistant
- lr limited resistance
- nr not resistant
- - not tested

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
1,2-dichlorethane	100	20	nr
2-Propen-1-ol	96	20	r
	96	60	r
Exhaust gases, containing H <sub>2</sub> CO <sub>3</sub>	any	60	r
Exhaust gases, containing H <sub>2</sub> S <sub>2</sub> O <sub>7</sub>	lower	20	-
	higher	20	nr
Exhaust gases, containing H <sub>2</sub> SO <sub>4</sub> , moist	any	60	r
Exhaust gases, containing HCl	any	60	r
Exhaust gases, containing HF	Traces	60	r
Exhaust gases, containing NO <sub>x</sub>	Traces	60	r
	higher	60	-
Exhaust gases, containing SO <sub>2</sub>	lower	60	r
	50	50	-
Acetaldehyde + acetic acid	90/10	20	-
Acetaldehyde, aqueous	40	40	r
Acetaldehyde, concentrated	100	20	-
Acetone	100	20	r
	100	60	r
Acetone, aqueous	Traces	20	r
Acronal dispersions	comm. form	20	-
Acronal solutions	comm. form	20	-
Acrylic acid ethyl ester	100	20	-
Adipic acid, aqueous	Saturated	20	r
	Saturated	60	-
Alums, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Aluminium chloride	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Aluminium sulphate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Formic acid	100	20	r
	100	60	lr
Formic acid, aqueous	Up to 50	40	r
	50	60	r
Ammonia, liquid	100	20	r
Ammonia, gaseous	100	60	r
Ammonia water	Warm	40	r
	saturated	60	r
	Warm saturated		
Ammonium chloride, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Ammonium fluoride, aqueous	up to 20	20	r
	up to 20	60	r
Ammonium nitrate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Ammonium sulphate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Ammonium sulphide, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Aniline, pure	100	20	r
	100	60	r
Aniline, aqueous	Saturated	20	r
	Saturated	60	r
Aniline hydrochloride, aqueous	Saturated	20	r
	Saturated	60	r
Anthraquinone sulphonic acid, aqueous	Suspension	30	r
Antiformin, aqueous	2	20	-
Antimony chloride, aqueous	90	20	r
Malic acid, aqueous	1	20	r
Cider	comm. form	20	r

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
Arsenic acid, aqueous	Diluted	40	r
	Diluted	60	r
	80	40	r
	80	60	r
Benzaldehyde, aqueous	0,1	60	-
Petrol	100	60	nr
Petrol-benzene mixture	80/20	20	lr
Benzoic acid, aqueous	any	20	r
	any	40	r
	any	60	r
Benzene	100	20	lr
Beer	comm. form	20	r
Beer colour	Standard trade	60	r
Alkaline bisulfite solution, containing SO <sub>2</sub>	Warm saturated	50	r
Lead acetate, aqueous	Warm saturated	50	r
	saturated	40	r
	Diluted	60	r
	Diluted	60	r
	Saturated		
Tetraethyl lead	100	20	r
Borax, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Boric acid, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Brandy	comm. form	20	r
Bromine, liquid	100	20	nr
Bromine vapours	low	20	nr
Hydrobromic acid, aqueous	Up to 10	40	r
	Up to 10	60	r
	48	60	r
Butadiene	100	60	-
Butane, gaseous	50	20	r
Butanediol	Up to 100	20	-
Butanediol, aqueous	Up to 10	20	r
	Up to 10	40	r
	Up to 10	60	r
Butanol	Up to 100	20	r
	Up to 100	40	r
	Up to 100	60	lr
Butynediol	Up to 100	40	-
Butyric acid, aqueous	20	20	r
	Concent.	20	r
Butyl acetate	100	20	lr
Butylene, liquid	100	20	-
Butylphenol	100	20	r
Calcium chloride, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Calcium nitrate, aqueous	50	40	r
Chlorine, gaseous, moist	0,5	20	nr
	1	20	nr
	5	20	nr
Chlorine, gaseous, dry	100	20	nr
Chloramine, aqueous	Diluted	20	-
(Mono) chloroacetic acid	100	40	r
	100	60	-
(Mono) chloroacetic acid aqueous	85	20	r
Chloromethyl	100	20	-
Chloric acid, aqueous	1	40	-
	1	60	-
	10	40	-
	10	60	-
	20	40	-
	20	60	-
Chlorosulphonic acid	100	20	nr
Chlorinated water	Saturated	20	lr

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
Chloric acid, aqueous	Up to 50	40	–
	Up to 50	60	lr
Chromic acid / Sulphuric acid / Water	50/15/35	40	nr
	50/15/35	60	nr
Clophene	comm. form	20	–
	comm. form	60	–
Crotonaldehyde	100	20	r
Potassium cyanide, aqueous	Up to 10	40	r
	Up to 10	60	r
	Saturated	60	r
Cyclohexanol	100	20	r
Cyclohexanone	100	20	r
Densodrin W	comm. form	60	–
Dextrin, aqueous	Saturated	20	r
	18	60	r
Diethyl ether	100	20	lr
Diglycolic acid, aqueous	30	60	r
	Saturated	20	r
Dimethylamine, liquid	100	30	–
Disulphuric acid	10	20	nr
Disulphuric acid vapours	lower	20	lr
	higher	20	nr
Fertiliser salts, aqueous	Up to 10	40	r
	Up to 10	60	r
	Saturated	60	r
Iron chloride, aqueous	Up to 10	40	r
	Up to 10	60	r
	Saturated	60	r
Glacial acetic acid	100	20	r
	100	40	r
Vinegar (wine vinegar)	comm. form	40	r
	comm. form	50	r
	comm. form	60	r
Acetic acid, concentrated	95	40	–
Acetic acid, aqueous	Up to 25	40	r
	Up to 25	60	r
	26–60	60	r
	80	40	r
Acetic anhydride	100	40	r
	100	40	lr
	100	60	lr
Acetic acid ethyl ester	100	20	r
	100	60	nr
Acetic acid ethyl ester	100	20	–
Ethanol (fermentation must)	customary	40	r
	customary	60	–
Ethanol + acetic acid (fermentation must)	customary	20	r
Ethanol, denatured (with 2 % toluene)	96	20	lr
Ethyl alcohol, aqueous	any	20	r
	96	60	r
Ethylene oxide, liquid	100	20	–
Fatty acids	100	60	lr
Hydrogen fluoride, aqueous	Up to 40	20	r
	40	60	r
	60	20	r
	70	20	r
Formaldehyde, aqueous	Diluted	40	r
	Diluted	60	r
	40	30	r
Photographic emulsions	any	40	–
Photo developer	comm. form	40	r
Photographic fixing baths	comm. form	40	r
Frigene	100	20	lr
Cellul. tanning extracts	Standard	20	r
Tanning extracts, vegetable	Standard	20	r
Glucose, aqueous	Saturated	20	r
	Saturated	60	r
Glycine, aqueous	10	40	r
Glycol, aqueous	comm. form	60	r
Glycolic acid, aqueous	37	20	r

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
Glycerine, aqueous	any	60	r
Urea, aqueous	Up to 10	40	r
	Up to 10	60	r
	33	60	r
Hexafluorosilicic acid, aqueous	Up to 32	60	–
Hexanetriol	comm. form	60	r
Dutch glue	Op. conc.	20	r
	Op. conc.	60	r
Hydrosulphite, aqueous	Up to 10	40	r
	Up to 10	60	r
Hydroxylamine sulphate, aqueous	Up to 12	35	r
Caustic potash lye, aqueous	Up to 40	40	r
	Up to 40	60	r
	50/60	60	r
Potassium bichromate, aqueous	40	20	r
Potassium borate, aqueous	1	40	r
	1	60	r
Potassium bromate, aqueous	Up to 10	40	r
	Up to 10	60	r
Potassium bromide, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Potassium chlorate, aqueous	1	40	r
	1	60	r
Potassium chloride, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Potassium chromate, aqueous	40	20	r
Potassium hexacyanidoferrate (II) u.	Diluted	40	r
Potassium hexacyanidoferrate (II), aqueous	Diluted	60	r
	Saturated	60	r
Potassium nitrate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Potassium permanganate, aqueous	Up to 6	20	r
	Up to 6	40	r
	Up to 6	60	r
	Up to 18	40	–
Potassium persulphate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	40	r
	Saturated	60	r
Silicic acid, aqueous	any	60	r
Cooking salt, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Carbonic acid, moist	any	40	r
	any	60	r
Carbonic acid, dry	100	60	r
Carbonic acid, aqueous below 8 atm	Saturated	20	–
Coconut oil alcohol	100	20	r
	100	60	lr
Cresol, aqueous	Up to 90	45	–
Copper fluoride, aqueous	2	50	r
Copper sulphate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Liqueurs	comm. form	20	r
Magnesium chloride, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Magnesium sulphate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Maleic acid, aqueous	Saturated	40	r
	Saturated	60	r
	35	40	r
Molasses	Op. conc.	20	r
	Op. conc.	60	r

Reagent	Concent. %	Temp. Deg/C	RAU-PP
Molasses wort	Op. conc.	60	r
Mersol D	Op. conc.	40	-
Methanol	100	40	r
	100	60	r
Methylamine, aqueous	32	20	r
Methylene chloride	100	20	nr
Methylsulphuric acid, aqueous	Up to 50	20	r
	Up to 50	40	r
	100	40	-
	100	60	-
Milk	comm. form	20	r
Lactic acid, aqueous	Up to 10	40	r
	Up to 10	60	r
	90	60	r
Mixed acid I (sulphuric acid / nitric acid / water)	48/49/3	20	nr
	48/49/3	40	nr
	50/50/0	20	nr
	50/50/0	40	nr
	10/20/70	50	lr
	10/87/3	20	nr
	50/31/19	30	nr
Mowilith D	comm. form	20	-
Sodium benzoate, aqueous	Up to 10	40	r
	Up to 10	60	r
	36	60	r
Sodium carbonate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Sodium chlorate, aqueous	Up to 10	40	r
	Up to 10	60	r
	Saturated	60	r
Sodium chlorite, aqueous	50	20	r
	Diluted	60	nr
Sodium hydrogen sulphite, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Sodium hypochlorite, aqueous	Diluted	20	r
Sodium hypochlorite solution, 12.5% active chlorine	Norm. conc.	40	-
	Norm. conc.	60	lr
Sodium sulphide, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Caustic soda, aqueous	Up to 40	40	r
	Up to 40	60	r
	50/60	60	r
Nekal, BX, aqueous	Diluted	40	-
	Diluted	60	-
Nickel sulphate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Nicotine, aqueous	Norm. conc.	20	-
Nicotine compounds, aqueous	Norm. conc.	20	-
Nitrous gases	Concent.	20	r
	Concent.	60	-
Fruit tree carbolineum, aqueous	Norm. conc.	20	-
Fruit pulp	Op. conc.	20	r
Oils and fats	comm. form	60	lr
Oleic acid	comm. form	60	lr
Oxalic acid, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Ozone	100	20	lr
	10	30	r
Palm kernel fatty acid	100	60	-
Paraffin emulsions	comm. form	20	-
	comm. form	40	-
Perchloric acid, aqueous	Up to 10	40	r
	Up to 10	60	r
	Saturated	60	-
Phenol, aqueous	Up to 90	45	r
	1	20	-
Phenyldiazine	100	20	lr
	100	60	-

Reagent	Concent. %	Temp. Deg/C	RAU-PP
Phenyldiazine hydrochloride, aqueous	Saturated	20	-
	Saturated	60	-
Phosgene, liquid	100	20	nr
Phosgene, gaseous	100	20	lr
	100	60	lr
Phosphorous pentoxide	100	20	r
Phosphoric acid, aqueous	Up to 30	40	r
	Up to 30	60	r
	40	60	r
	80	20	r
	80	60	r
Phosphorous trichloride	100	20	r
Hydrogen phosphide	100	20	-
Picric acid, aqueous	1	20	r
Potash, aqueous	Saturated	40	-
Propane, liquid	100	20	-
Propane, gaseous	100	20	-
Propargyl alcohol, aqueous	7	60	r
Ramasite	comm. form	20	-
	comm. form	40	-
Beef tallow emulsion, sulphurised	comm. form	20	-
Roasting gases, dry	any	60	r
Nitric acid, aqueous	Up to 30	50	r
	30/50	50	nr
	98	20	nr
	98	60	nr
Hydrochloric acid, aqueous	Up to 30	40	r
	Up to 30	60	r
	above 30	20	r
	above 30	60	r
Oxygen	any	60	-
Sulphur dioxide, moist and aqueous	any	40	r
	50	50	r
	any	60	r
Sulphur dioxide, liquid	100	-10	-
	100	20	r
	100	60	r
Sulphur dioxide, dry	any	60	r
Sulphur dioxide, aqueous below 8 atm	Saturated	20	-
Carbon disulphide	100	20	lr
Sulphuric acid, aqueous	Up to 40	40	r
	Up to 40	60	r
	70	20	r
	70	60	lr
	80-90	40	lr
	96	20	r
	96	60	nr
Hydrogen sulphide, dry	100	60	r
Hydrogen sulphide, aqueous	Warm saturated	40	r
	Warm saturated	60	r
	Warm saturated		
Sea water	-	40	r
	-	60	r
Soap solution, aqueous	concentrated	20	r
	concentrated	60	r
Silver nitrate, aqueous	Up to 8	40	r
	Up to 8	60	r
Starch, aqueous	any	40	r
	any	60	r
Starch syrup	Op. conc.	60	r
Stearic acid	100	60	lr
Yeast wort	Op. conc.	40	r
	Op. conc.	60	r
Tallow	100	20	r
	100	60	r
Tanigan extra A, aqueous	any	20	-
Tanigan extra B, aqueous	any	20	-
Tanigan extra D, aqueous	Saturated	40	-
	Saturated	60	-

<b>Reagent</b>	<b>Concent.</b>	<b>Temp.</b>	<b>RAU-PP</b>
	<b>%</b>	<b>Deg/C</b>	
Tanigan F, aqueous	Saturated	60	–
Tanigan U, aqueous	Saturated	40	–
	Saturated	60	–
Carbon tetrachloride, technical	100	20	nr
Thionyl chloride	100	20	nr
Toluene	100	20	nr
Glucose, aqueous	Saturated	20	r
	Saturated	60	r
Trichloroethylene	100	20	nr
Triethanolamine	100	20	r
Trilone	comm. form	60	–
Trimethylolpropane, aqueous	Up to 10	40	–
	Up to 10	60	–
	comm. form	40	r
	comm. form	60	r
Urine	normal	40	r
	normal	60	r
Vinyl acetate	100	20	r
Wax alcohol	100	60	lr
Water	100	40	r
	100	60	r
Hydrogen	100	60	r
Hydrogen peroxide, aqueous	Up to 30	20	r
	Up to 20	50	r
Brandy	comm. form	20	r
Wine, red and white	comm. form	20	r
Tartaric acid, aqueous	Up to 10	40	r
	Up to 10	60	r
	Saturated	60	r
Xylene	100	20	nr
Zinc chloride, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Zinc sulphate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Tin (II) chloride, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Citric acid, aqueous	bis10	40	r
	Up to 10	60	r
	Saturated	60	w

# 13 Overview tables

## 13.01 Technical data of RAUSILENTO

RAUSILENTO has been designed as a waste water system for residential drainage. The materials are suitable for the following temperatures if not subject to mechanical and chemical load.

Material	PP-MD mineral reinforced (pipes and fittings)	
Colour	grey (similar to RAL 7047)	
Dimensions	DN 32, DN 40, DN 50, DN 75, DN 90, DN 110, DN 125, DN 160	
Application	residential soil and waste, pressureless with ph value 2 – 12	
Temperature resistance	Continuously short-term	max. 70 °C max. 95 °C <sup>2)</sup>
Trace heating	max. 45 °C	
Pressure-resistance <sup>1)</sup>	at a negative pressure	up to 20 m water head with push-fit lock <sup>1)</sup> up to 0.5 bar
Density	Pipes Fittings	1.2 g/cm <sup>3</sup> 1.0 – 1.25 g/cm <sup>3</sup>
Coefficient of linear expansion	0.09 mm/m x K	
Min. installation temperature	–10 °C	
Tensile strength	> 16 N/mm <sup>2</sup>	
Elongation at break	approx. 150%	
Flexural modulus of tension	approx. 2,100 N/mm <sup>2</sup>	
MFR 230/2.16	approx. 0.5 g/10 min.	
Parts containing halogen	Halogen-free (no F, Cl, Br, J)	
Fire behaviour	E as per EN 13501	
Acoustic performance as per DIN EN 14366 Acoustic performance as per B 8115	with standard bracket	P-BA 265/2021 Fraunhofer-Institut: 21 dB(A) at 4 l/s P-BA 265/2021 Fraunhofer-Institut: 20 dB(A) at 4 l/s
Ultraviolet resistance	UV-stabilised, but not resistant (see also chapter "08.01 Delivery, transport and storage")	
External quality control	TGM - VA KU 29405-2	Conformance according to ÖNORM EN 1451-1 / external quality control (TGM Vienna)
Tests	System test on the basis of EN 1451-1 "Ice crystal" as per EN 1451 and EN 1411	

Tab. 13-1

<sup>1)</sup> The tightness describes only the leak tightness status. There is always the risk here that the pipes are pulled apart. Therefore, the connecting points must be secured in a longitudinally stable manner.

<sup>2)</sup> Temperature collective:

Continuous temperature	70 °C	8 h / day	146,000 h in 50 years
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Short periods of time	95 °C	10 min / day	3,000 h in 50 years
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Short-term	98 °C	40 s / day	200 h in 50 years
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Remaining time at room temperature (< 30 °C)			
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For more detailed advice on divergent temperature-load spectra, please contact your REHAU sales office.

## 13.02 Discharge capacity

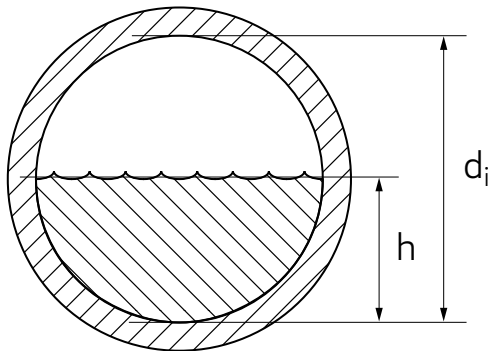


Fig. 13-1 Cross cut of a partly filled pipe

$d_i$  pipe inside diameter

$h$  Degree of filling

Discharge capacity at  $h/d_i = 0.5$ 

J cm/m	DN 40 $d_i = 36.4$		DN 50 $d_i = 46.4$		DN 75 $d_i = 71.2$		DN 90 $d_i = 85.6$		DN 110 $d_i = 104.6$		DN 125 $d_i = 118.8$		DN 160 $d_i = 152.2$	
	Q l/s	v m/s	Q l/s	v m/s	Q l/s	v m/s	Q l/s	v m/s	Q l/s	v m/s	Q l/s	v m/s	Q l/s	v m/s
0,5									2,2	0,5	3,1	0,6	6	0,7
0,6					0,9	0,4	1,4	0,5	2,4	0,6	3,4	0,6	6,6	0,7
0,7					0,9	0,5	1,5	0,5	2,6	0,6	3,7	0,7	7,1	0,8
0,8					1,0	0,5	1,6	0,6	2,8	0,7	3,9	0,7	7,6	0,8
0,9					1,1	0,5	1,7	0,6	3	0,7	4,2	0,8	8,1	0,9
1,0					1,1	0,6	1,8	0,6	3,1	0,7	4,4	0,8	8,6	0,9
1,1					1,2	0,6	1,9	0,7	3,3	0,8	4,6	0,8	9	1
1,2			0,4	0,5	1,2	0,6	2	0,7	3,4	0,8	4,8	0,9	9,4	1
1,3			0,4	0,5	1,3	0,6	2,1	0,7	3,6	0,8	5	0,9	9,8	1,1
1,4			0,4	0,5	1,3	0,7	2,2	0,8	3,7	0,9	5,2	0,9	10,1	1,1
1,5			0,4	0,5	1,4	0,7	2,3	0,8	3,9	0,9	5,4	1	10,5	1,2
2,0	0,3	0,5	0,5	0,6	1,6	0,8	2,6	0,9	4,5	1	6,3	1,1	12,1	1,3
2,5	0,3	0,6	0,6	0,7	1,8	0,9	2,9	1	5	1,2	7	1,3	13,6	1,5
3,0	0,3	0,6	0,6	0,7	2,0	1,0	3,2	1,1	5,5	1,3	7,7	1,4	14,9	1,6
3,5	0,3	0,7	0,7	0,8	2,1	1,1	3,5	1,2	5,9	1,4	8,3	1,5	16,1	1,8
4,0	0,4	0,7	0,7	0,8	2,3	1,1	3,7	1,3	6,3	1,5	8,9	1,6	17,2	1,9
4,5	0,4	0,8	0,8	0,9	2,4	1,2	3,9	1,4	6,7	1,6	9,4	1,7	18,3	2
5,0	0,4	0,8	0,8	0,9	2,5	1,3	4,1	1,4	7,1	1,6	9,9	1,8	19,3	2,1

**Discharge capacity at  $h/d_i = 0.7$** 

J cm/m	DN 40 $d_i = 36.4$		DN 50 $d_i = 46.4$		DN 75 $d_i = 71.2$		DN 90 $d_i = 85.6$		DN 110 $d_i = 104.6$		DN 125 $d_i = 118.8$		DN 160 $d_i = 152.2$	
	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v
	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s
0,5							2,2	0,5	3,7	0,6	5,2	0,6	10,1	0,7
0,6					1,5	0,5	2,4	0,6	4,1	0,6	5,7	0,7	11,1	0,8
0,7					1,6	0,5	2,6	0,6	4,4	0,7	6,2	0,7	12	0,9
0,8					1,7	0,6	2,8	0,6	4,7	0,7	6,6	0,8	12,8	0,9
0,9					1,8	0,6	2,9	0,7	5	0,8	7	0,8	13,6	1
1,0			0,6	0,5	1,9	0,6	3,1	0,7	5,3	0,8	7,4	0,9	14,3	1,1
1,1			0,6	0,5	2,0	0,7	3,2	0,8	5,5	0,9	7,8	0,9	15	1,1
1,2			0,7	0,5	2,1	0,7	3,4	0,8	5,8	0,9	8,1	1	15,7	1,2
1,3	0,4	0,5	0,7	0,5	2,1	0,7	3,5	0,8	6	0,9	8,5	1	16,3	1,2
1,4	0,4	0,5	0,7	0,6	2,2	0,7	3,7	0,8	6,2	1	8,8	1,1	17	1,2
1,5	0,4	0,5	0,7	0,6	2,3	0,8	3,8	0,9	6,5	1	9,1	1,1	17,6	1,3
2,0	0,4	0,6	0,8	0,7	2,7	0,9	4,4	1	7,5	1,2	10,5	1,3	20,3	1,5
2,5	0,5	0,6	0,9	0,7	3,0	1,0	4,9	1,1	8,4	1,3	11,8	1,4	22,7	1,7
3,0	0,5	0,7	1,0	0,8	3,3	1,1	5,4	1,2	9,2	1,4	12,9	1,6	24,9	1,8
3,5	0,6	0,7	1,1	0,9	3,5	1,2	5,8	1,3	9,9	1,5	13,9	1,7	26,9	2
4,0	0,6	0,8	1,2	0,9	3,8	1,3	6,2	1,4	10,6	1,7	14,9	1,8	28,8	2,1
4,5	0,7	0,8	1,3	1,0	4,0	1,4	6,6	1,5	11,3	1,8	15,8	1,9	30,5	2,2
5,0	0,7	0,9	1,3	1,1	4,2	1,4	6,9	1,6	11,9	1,8	16,7	2	32,2	2,4

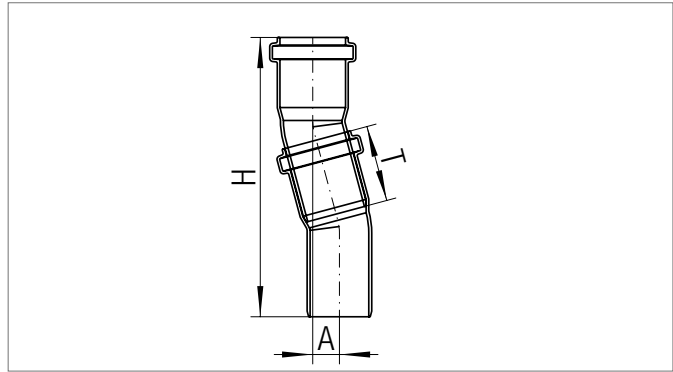
**Discharge capacity at  $h/d_i = 1.0$** 

J cm/m	DN 40 $d_i = 36.4$		DN 50 $d_i = 46.4$		DN 75 $d_i = 71.2$		DN 90 $d_i = 85.6$		DN 110 $d_i = 104.6$		DN 125 $d_i = 118.8$		DN 160 $d_i = 152.2$	
	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v
	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s
0,5									4,4	0,5	6,2	0,6	12,1	0,7
0,6							2,8	0,5	4,9	0,6	6,8	0,6	13,2	0,7
0,7					1,9	0,5	3,1	0,5	5,2	0,6	7,4	0,7	14,3	0,8
0,8					2,0	0,5	3,3	0,6	5,6	0,7	7,9	0,7	15,3	0,8
0,9					2,1	0,5	3,5	0,6	6	0,7	8,4	0,8	16,2	0,9
1,0					2,2	0,6	3,7	0,6	6,3	0,7	8,8	0,8	17,1	0,9
1,1					2,4	0,6	3,9	0,7	6,6	0,8	9,3	0,8	18	1
1,2			0,8	0,5	2,5	0,6	4,0	0,7	6,9	0,8	9,7	0,9	18,8	1
1,3			0,8	0,5	2,6	0,6	4,2	0,7	7,2	0,8	10,1	0,9	19,5	1,1
1,4			0,8	0,5	2,7	0,7	4,4	0,8	7,5	0,9	10,5	0,9	20,3	1,1
1,5			0,9	0,5	2,8	0,7	4,5	0,8	7,7	0,9	10,8	1	21	1,2
2,0	0,5	0,5	1,0	0,6	3,2	0,8	5,2	0,9	8,9	1	12,5	1,1	24,3	1,3
2,5	0,6	0,6	1,1	0,7	3,6	0,9	5,8	1	10	1,2	14	1,3	27,2	1,5
3,0	0,6	0,6	1,2	0,7	3,9	1,0	6,4	1,1	11	1,3	15,4	1,4	29,8	1,6
3,5	0,7	0,7	1,3	0,8	4,2	1,1	6,9	1,2	11,8	1,4	16,6	1,5	32,2	1,8
4,0	0,7	0,7	1,4	0,8	4,5	1,1	7,4	1,3	12,7	1,5	17,8	1,6	34,4	1,9
4,5	0,8	0,8	1,5	0,9	4,8	1,2	7,9	1,4	13,4	1,6	18,9	1,7	36,5	2
5,0	0,8	0,8	1,6	0,9	5,1	1,3	8,3	1,4	14,2	1,6	19,9	1,8	38,5	2,1

## 14 Fitting combinations

### RAUSILENTO bend

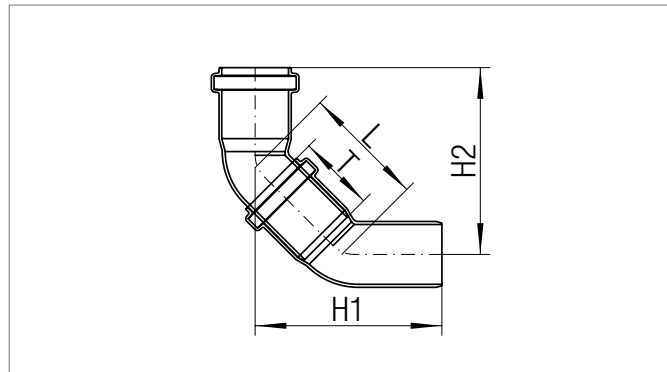
Stage with bends 15°–87°



Angle	DN	H [mm]	A [mm]	T [mm]
15°	40	174	17	48
	50	177	17	49
	75	187	18	51
	90	195	19	53
	110	228	24	59
	125	250	25	63
	160	289	29	68
30°	40	159	31	43
	50	183	36	49
	75	197	39	51
	90	213	43	53
	110	247	51	59
	125	272	56	63
	160	318	67	68
45°	40	175	53	47
	50	182	57	46
	75	213	67	52
	90	223	70	53
	110	252	80	58
	125	287	93	63
	160	328	107	70
	200	438	149	78
67°	50	180	88	49
	75	203	102	51
	110	262	136	59
	125	293	154	63
87°	40	141	92	44
	50	164	111	49
	75	191	134	51
	90	213	154	53
	110	247	181	59
	125	277	205	63
	160	327	246	70
	200	418	329	78

**RAUSILENTO bend**

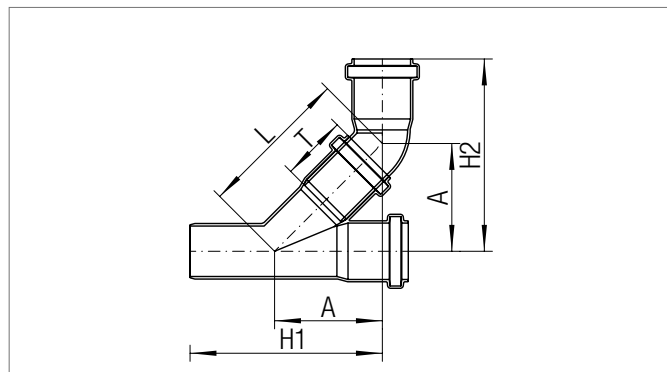
Deflection 90° with two elbows 45°



Angle	DN	H1 [mm]	H2 [mm]	T [mm]	L [mm]
45°	40	114	114	47	75
	50	121	118	46	80
	75	140	140	52	94
	90	146	148	53	100
	110	163	169	58	113
	125	190	190	63	131
	160	216	219	70	151
	200	297	290	78	211

**RAUSILENTO single branch with bend**

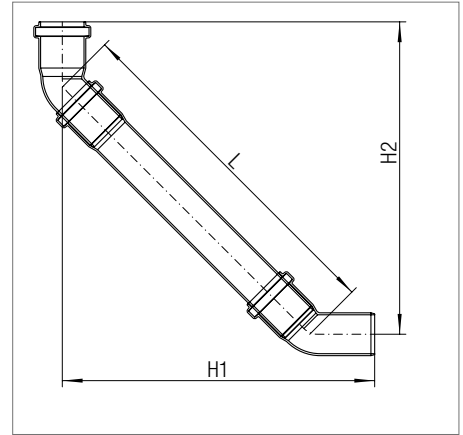
Branch 45° with bend 45°



Angle	DN/OD	H1 [mm]	H2 [mm]	T [mm]	L [mm]	A [mm]
45°	40/40	139	139	48	110	78
	50/50	150	159	46	125	88
	75/50	151	162	45	143	101
	75/75	185	189	51	164	116
	90/50	155	170	45	154	109
	90/75	189	197	51	175	124
	90/90	206	208	52	185	131
	110/50	160	180	45	168	118
	110/75	197	206	52	188	133
	110/110	241	246	57	223	158
	125/110	248	248	58	226	160
	125/125	274	274	63	250	178
	160/110	287	266	57	251	178
	160/125	278	290	62	273	193
	160/160	323	326	70	303	214
	200/160	399	363	68	354	250
	200/200	433	425	78	403	285

**RAUSILENTO bend**

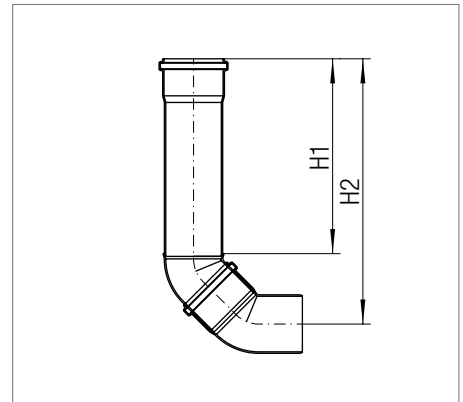
Deflection with two elbows 45° + 250 mm settling path



Angle	DN	H1 [mm]	H2 [mm]	L [mm]
45°	40	293	293	328
	50	299	297	333
	75	319	319	347
	90	324	327	353
	110	342	347	366
	125	369	368	384

**RAUSILENTO deflector bend**

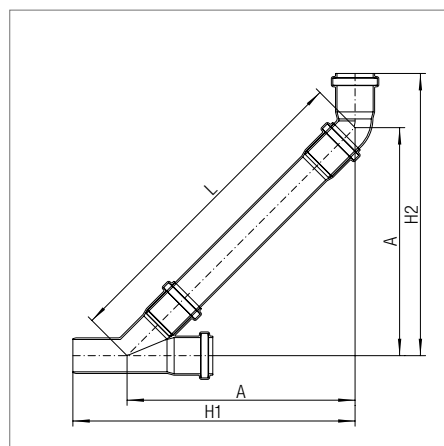
Deflection 90° with 1 bend 45° + 1 deflection bend 45°



Angle	DN	H1 [mm]	H2 [mm]
45°	75	250	340
	90	250	348
	110	250	364

**RAUSILENTO bend**

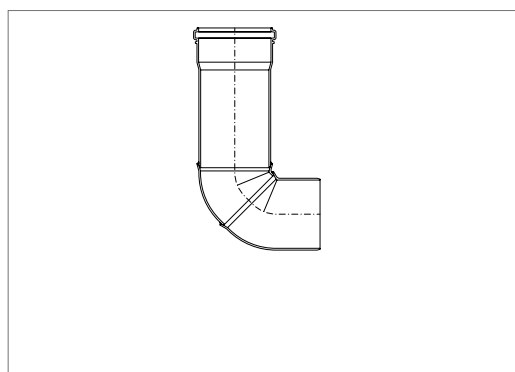
Branch 45° with bend 45° + 250 mm settling path



Angle	DN/OD	H1 [mm]	H2 [mm]	L [mm]	A [mm]
45°	40/40	318	318	363	257
	50/50	329	327	378	267
	75/50	330	342	396	280
	75/75	364	368	417	295
90/50	334	349	407	288	
90/75	368	376	429	303	
90/90	384	387	438	309	
110/50	339	359	421	298	
110/75	376	385	441	312	
110/110	414	419	470	332	
125/110	427	428	480	339	
125/125	453	453	503	356	
160/110	466	445	504	357	
160/125	455	469	526	372	

**RAUSILENTO deflector bend**

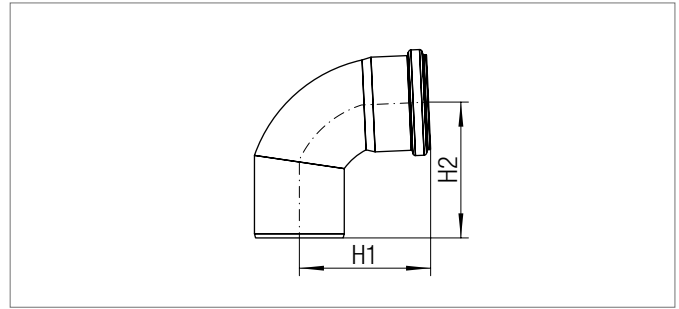
Deflection 87° without appendage



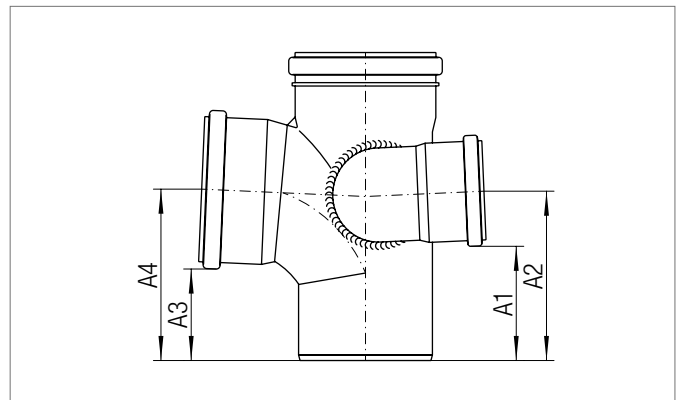
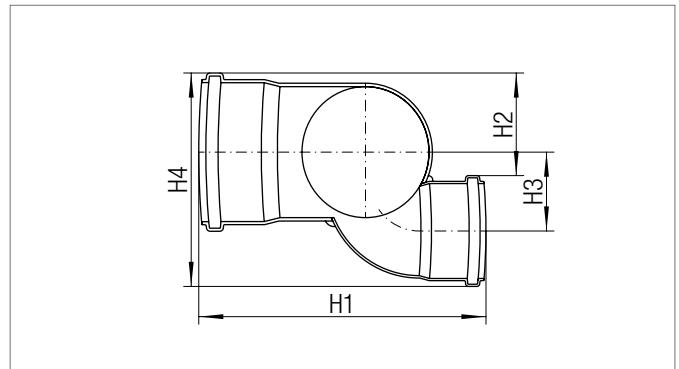
Angle	DN	H1 [mm]	H2 [mm]
87°	75	202	257
	90	202	267
	110	208	286

**RAUSILENTO long bend**

Long bend 87°



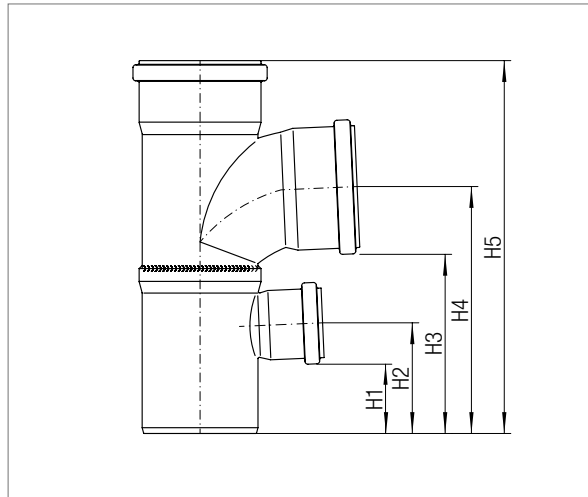
Angle	DN	H1 [mm]	H2 [mm]
87°	110	139	148

**RAUSILENTO shaft branch**Shaft branch dimensioned left  
(Shaft branch correspondingly on the right)

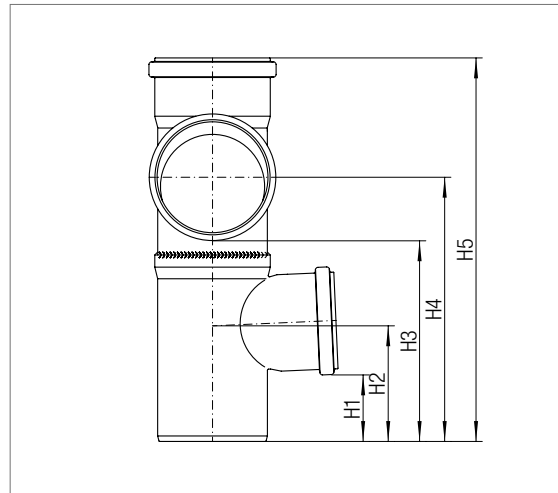
Angle	DN/OD	H1	H2	H3	H4	A1	A2	A3	A4
87°	110/75/110	236	74	63	162	91	135	73	137
	90/75/90	222	60	59	148	69	114	63	115

**RAUSILENTO double branch**

Double branch, one side



Angle	DN/OD	H1 [mm]	H2 [mm]	H3 [mm]	H4 [mm]	H5 [mm]
87°	90/90/50	54	86	133	186	284
	110/110/50	58	91	160	224	333

**RAUSILENTO stepped branch**Stepped branch dimensioned right  
(Stepped branch on the left correspondingly)

Angle	DN/OD	H1 [mm]	H2 [mm]	H3 [mm]	H4 [mm]	H5 [mm]
87°	110/90/75	63	105	176	225	331
	110/110/75	63	105	176	234	351

# 15 Fire protection

## 15.01 Preamble

The following chapter is intended to make the background of preventive fire protection easier to understand, and makes recommendations for the preventive fire protection of pipes in building systems.

These clarifications and recommendations hold good exclusively for Austria.

Standards, regulations and guidelines are subject to continuous changes. Therefore, all information is being provided in good faith and to the best of our knowledge. However, no guarantee can be assumed for its correctness, completeness and topicality. Liability is excluded for damage arising from the use of data in this documentation. We therefore recommend agreeing on the preventive fire protection measures with the responsible building authorities. The newest valid versions of the technical specifications in force in the respective Federal States are applicable.

## 15.02 Harmonised technical building codes in Austria

One important task of the OIB is involvement in the harmonisation of the building codes in Austria. The necessity for this comes about on the one hand, from the European harmonisation process, and on the other from requirements within Austria. The OIB directives serves as the basis for the harmonisation of the construction specifications in the Federal states and the states can use them for this purpose. The Federal states can declare legal binding of the OIB directives at their discretion and this can be done in the following way:

- Declaration of obligation to comply with the specifications from the OIB directives
- Granting of the option to provide certification regarding compliance with the generally recognised rules of engineering by declaring conformity with the OIB directives.

If a Federal state does not declare the OIB directives as legally binding, they must nonetheless be viewed as the state of the art, and can therefore be considered for planning preventive fire protection concepts.

The system of the OIB directives is oriented to the basic requirements for buildings in accordance with Annex I of the Construction Product Ordinance:

### OIB directives

1. Mechanical strength and stability
2. Fire protection with the sub-directives
  - 2.1. Fire protection for factory buildings
  - 2.2. Fire protection of garages, covered parking and parking levels
  - 2.3. Fire protection of buildings with an escape height of more than 22 m
3. Hygiene, health and environment protection
4. Usage safety and accessibility (absence of barriers)
5. Sound insulation
6. Energy saving and heat insulation

In Austria, the introduction of OIB directive 2 with the sub-directives harmonises dealing with the specifications for the fire protection of buildings, and provides a new evaluation method with evaluation on the basis of a building class grading in directive 2.

The new approach in fire protection is therefore easier to understand:

An increasing building risk (higher building classes, GK) results in more stringent specifications with regard to the choice of the construction products (construction materials flammability classes), the fire resistance of the load-bearing constructions, partitioning walls and ceilings, as well as measures against fire flashovers at facades and the like.

## 15.03 Free movement of goods according to the EU agreement

The EU follows a clear objective, i.e. the free movement of goods within the European Economic Community. However, that can only happen if the trade barriers between the member states of the Union (Article 34 of the agreement on the method of working of the European Union) are abolished (for example, national regulations in conjunction with the approval of products or preferential treatment of inland products) and the members of the union agree on a harmonised level. At the level of construction products (building materials, components, prefabricated parts), this means, first, the definition of harmonised protection objectives (basic requirements) and further, the standardisation or harmonisation of the standards (testing standards, classification standards, product standards) for achieving the relevant approval. What this will achieve is that goods manufactured in a member state of the EU will be permitted to be marketed in all other member states. The visible

eligibility mark is the "CE mark", which implies a declared capability provided by the manufacturer satisfies the applicable requirements (declaration of capability).

This is basically governed in the earlier construction product directive of the EU (Directive 89/106/EEC of the Council dated 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products), which is now replaced by the construction product ordinance of the EU (Regulation no. 305/2011 of the European Parliament and the Council for laying down harmonised conditions for marketing construction products).

The implementation of the construction product directive in the member states of the EU was temporarily only recommended (Guidance Paper J with transition agreements in accordance with the construction product directive), because of which the same status did not prevail in many countries. The result was the introduction of the present EU regulation, which came immediately in force for all member countries and does not have to be incorporated in the national laws first.






#### **15.04 Goal of preventive fire protection in building construction**

Fire protection is becoming increasingly important both in building engineering as well as for the use of installation shaft constructions. Fundamentally, in conjunction with building piping, fire protection measures are always required when fire-resistant, partitioning walls and ceilings are penetrated by pipes. In this case, measures should be taken to prevent the spread of fire and smoke if there is a fire.

The goal of preventive constructive fire protection is to limit a fire locally. To that end, buildings are divided into individual fire zones by partitioning the components in accordance with the compartmentalisation principle. Building engineering installations that go across zones hinder the fire safety of the building. The compartmentalisation principle must not be jeopardised. Therefore, protective measures that prevent the spread of smoke and fire in accordance with the legal regulations (federal/state/district) are required. Planning, construction and operation of sanitary, heating and ventilation systems place high demands on the planners and the executors. This technical information shows practical solutions for satisfying the requirements for noise protection, fire protection and heat insulation of the pipe systems of REHAU used for supply and disposal.

Technically correct implementation requires, right from the beginning, close cooperation between planners, architects, building authorities and the installation company. A request for bids that is totally aligned towards the project, and construction monitoring have the same amount of importance. Often, complicated and therefore expensive retrofitting can be avoided only in this manner.

### Depiction of building classes in tabular form

<b>Building class gradation according to the OIB definition of terms (OIB-BB)</b>					
<b>Escape level</b>	<b>GK 1</b>	<b>GK 2</b>	<b>GK 3</b>	<b>GK 4</b>	<b>GK 5</b>
≤ 22 m					
≤ 11 m				3rd floor	
≤ 7 m	2nd floor	2nd floor	2nd floor	2nd floor	
	1st floor	1st floor	1st floor	1st floor	
	Ground floor	Ground floor	Ground floor	Ground floor	
Definition	Free-standing ≤ 3 floors ≤ 7 m <sup>(5)</sup> 1 BE/1 WE (dwelling unit) ≤ 400 m <sup>2</sup> BGF (gross floor area)	≤ 3 floors ≤ 7 m <sup>(5)</sup> ≤ 5 BE/5 WE ≤ 400 m <sup>2</sup> BGF Terraced houses	≤ 3 floors ≤ 7 m <sup>(5)</sup>	≤ 4 floors ≤ 11 m <sup>(5)</sup> 1 BE/1 WE/∞ m <sup>2</sup> X BE/X WE ≤ 400 m <sup>2</sup> BGF	≤ 22 m <sup>(5)</sup>
<b>Schedule line</b>	<b>GK 1</b>	<b>GK 2</b>	<b>GK 3</b>	<b>GK 4</b>	<b>GK 5</b>
Illustration					
<b>1 Load-bearing component (except ceilings and fire-compartmentalising walls)</b>					
1.1 In the uppermost floor	-	R 30	R 30	R 30	R 60 <sup>(1)</sup>
1.2 In the other above-ground floors	R 30 <sup>(2)</sup>	R 30	R 60	R 60	R 90 and A2
1.3 In underground floors	R 60	R 60	R 90 and A2	R 90 and A2	R 90 and A2
<b>2 Partitioning walls (except walls of staircases)</b>					
2.1 In the uppermost floor	not applicable	REI 30 EI 30	REI 30 EI 30	REI 60 EI 60	REI 60 <sup>(1)</sup> EI 60 <sup>(1)</sup>
2.2 In above-ground floors	not applicable	REI 30 EI 30	REI 60 EI 60	REI 60 EI 60	REI 90 and A2 EI 90 and A2
2.3 in underground floors	not applicable	REI 60 EI 60	REI 90 and A2 EI 90 and A2	REI 90 and A2 EI 90 and A2	REI 90 and A2 EI 90 and A2
2.4 Between dwellings or operation units in terraced houses	not applicable	REI 60 EI 60	not applicable	REI 60 EI 60	not applicable
<b>3 Walls and ceilings forming fire compartments</b>					
3.1 Walls forming fire compartments on the premises or construction site limit	REI 60 EI 60	REI 90 <sup>(3)</sup> EI 90 <sup>(3)</sup>	REI 90 and A2 EI 90 and A2	REI 90 and A2 EI 90 and A2	REI 90 and A2 EI 90 and A2
3.2 Other walls or ceilings forming fire compartments	not applicable	REI 90 EI 90	REI 90 EI 90	REI 90 EI 90	REI 90 and A2 EI 90 and A2
<b>4 Ceilings and pitch roofs with a slant &lt; 60°</b>					
4.1 Ceilings above the uppermost floor	-	R 30	R 30	R 30	R 60 <sup>(1)</sup>
4.2 Partition ceilings above the uppermost floor	-	REI 30	REI 30	REI 60	REI 60 <sup>(1)</sup>
4.3 Partition ceilings above the other above-ground floors	-	REI 30	REI 60	REI 60	REI 90 and A2
4.4 Ceilings inside dwellings or operating units in above-ground floors	R 30 <sup>(2)</sup>	R 30	R 30	R 30	REI 90 <sup>(1)</sup> and A2
4.5 Ceilings above the underground floors	R 60	REI 60 <sup>(4)</sup>	REI 90 and A2	REI 90 and A2	REI 90 and A2
<b>3 Walls and ceilings forming fire compartments</b>				<b>R 30 or A2</b>	<b>R 30 and A2</b>

<sup>(1)</sup> In buildings with not more than six above-ground floors, a fire resistance duration of 60 minutes without A2 is sufficient for the two uppermost floors

<sup>(2)</sup> Not required for buildings that serve only for living or office use or office-like use

<sup>(3)</sup> In the case of terraced houses, for the walls between the dwellings or operating units, even on the boundary of the premises or construction site, a version in REI 60 or EI 60 is sufficient

<sup>(4)</sup> For terraced houses as well as buildings with not more than two dwellings or two operating units with office use or office-like use, the requirement R 60 is adequate

<sup>(5)</sup> Escape level

BGF Gross floor area

BE Operating unit

WE Living unit

## 15.05 Construction products in Austria

Austria was the first EU member state to have started implementing the requirements of the construction product directive of the EU. With 4 May 2010 being the cut-off date, only the European construction product flammability classes (A-F) and fire-resistance designations (for example, REI 90, EI2 30-C) are permitted to be used in Austria in conjunction with constructional fire protection.

The most important changes through the construction product directive of the EU are:

- Amendment to the testing standards
- Amendment to the test set-ups
- Amendment to the testing procedures

This resulted in new classification methods, new services and new designations.

### 15.05.01 Construction product laws and ordinances in Austria's federal states

With the implementation of the European Construction Product Directive, Austria's federal states were required to follow a uniform path with regard to the usability of construction products. This took place through an Article 15a agreement in accordance with the Federal Constitution (B-VG), jointly by all federal states.

As a result, the same construction product laws were passed in the federal states, in which the:

- Provision of construction products on the market
- Use of construction products that are mass-produced or near-mass produced and for which harmonised technical specifications are not available
- Use of construction products for which harmonised technical specifications are available
- Structural engineering approval, and so on

are governed. Also, in these construction product laws, the Österreichische Institut für Bautechnik (the Austrian Civil Engineering Institute) was authorised to maintain construction product lists, for which a CE declaration of performance has to be submitted and the CE mark must be affixed.

#### Construction product list ÖA

for those construction products that conform to a national specification (for example, an ÖNORM or a usage guideline of the OIB) and must carry the integration mark UA:

- Fire protection doors according to ÖNORM B 3850, like swing doors
- Fire protection doors according to ÖNORM B 3852 like lift gates, lifting-type sectional shutter doors, tilt doors, tambour doors, sliding doors and folding

doors and gates

- Fire protection glazing according to ÖNORM EN 357
- Fire protection window according to ÖNORM B 3850
- Shutter assemblies in ventilation pipes based on intumescent materials without mechanical/with mechanical locking element (FLI/FLI-VE) in accordance with the usage principle of the OIB

#### Construction product list ÖE

For construction products with defined European technical specifications in the form of a harmonised European standard – Ventilation of buildings – fire dampers in accordance with ÖNORM EN 15650 (currently the only fire protection element based on a harmonised European product standard)

#### Construction product list ÖE

For construction products with defined European technical specifications in a European evaluation document (earlier European technical approval Guideline)

- Non-load-bearing inner walls – products with European technical approvals in accordance with ETAG 003 "Internal partition kits for use as non-load-bearing walls"
- Heat insulation composite systems (WDVS) – products with European technical approvals in accordance with ETAG 004 "External thermal insulation composite systems (ETICS) with rendering"
- Penetration seals – products with European technical approvals in accordance with EAD
- Linear joint and gap seals – products with European technical approvals in accordance with ETAG 026 – part 3 "Fire stopping and fire sealing of products"

These construction material lists are issued by the Österreichisches Institut für Bautechnik (Austrian Civil Engineering Institute) and are uniformly legally binding in all the Austrian federal states. Therefore, when selecting a construction product, it is necessary to first check whether that product is in one of the construction material lists, so that the product's performance certification is clearly regulated (UA mark or CE mark).

Construction products that are neither in the construction material list ÖA nor in the construction material list ÖE and for which there is no structural engineering approval, may only be used if such use would comply with the regulations of the particular federal state in whose administrative area the construction product is to be used.

## 15.06 Harmonised European construction product flammability classes and fire resistance classes

**15.07 European construction product  
flammability classes – EN 13501 part 1**

<b>Construction product flammability class according to ÖN EN 13501-1</b>	<b>Requirement level for construction products (except flooring and pipe insulation)</b>	<b>Classification comparison with the previous construction product flammability class in accordance with ÖN B 3800-1*</b>
<b>A1</b>	<b>"No contribution to fire"</b> There is no contribution to the fire in any phase, including the fully developed fire.	
<b>A2</b>	<b>"Negligible contribution to the fire"</b> Criteria as for Class B, but under the conditions of the fully developed fire, no substantial contribution to the fire and to the increase in the fire, or there are additional criteria for the value of the heat of vapourisation (PCS value).	Non-flammable A
<b>B</b>	<b>"Very limited contribution to the fire"</b> <b>Flame exposure period 30 seconds</b> with a vertical flame spread of max. 150 mm above the flame exposure point after 60 sec. <u>Testing for determining the release of heat:</u> $FIGRA_{0,2 MJ} \leq 120 \text{ W/s}$ $THR_{600s} \leq 7.5 \text{ MJ}$	Slow burning B1
<b>C</b>	<b>"Limited contribution to the fire"</b> <b>Flame exposure period 30 seconds</b> with a vertical flame spread of max. 150 mm above the flame exposure point after 60 sec. <u>Testing for determining the release of heat:</u> $FIGRA_{0,4 MJ} \leq 250 \text{ W/s}$ $THR_{600s} \leq 15 \text{ MJ}$	
<b>D</b>	<b>"Acceptably low contribution to the fire"</b> <b>Flame exposure period 30 seconds</b> with a vertical flame spread of max. 150 mm above the flame exposure point after 60 sec. <u>Testing for determining the release of heat:</u> $FIGRA_{0,4 MJ} \leq 750 \text{ W/s}$	Normal flammability B2
<b>E</b>	<b>"Acceptable fire behaviour"</b> <b>Flame exposure period 15 seconds</b> with a vertical flame spread of max. 150 mm above the flame exposure point after 20 sec.	
<b>F</b>	The performance was not determined or it could not be graded in one of the classes A1, A2, B, C, D, E. Easily flammable.	Easily flammable B3

\* Comparison purely informative in nature, direct comparison not permissible

<b>Additional classification for smoke formation (smoke)</b>	<b>Requirement level</b>
s3	There is no limit to smoke formation (very smoky).
s2	The entire quantity of smoke released, as well as the proportion of increase in smoke formation, are limited (normal level of smoke).
s1	Strict criteria with regard to the quantity of smoke released are fulfilled (slightly smoky).

<b>Additional classification for dripping/dropping while burning (droplets)</b>	<b>Requirement level</b>
d2	No restrictions (dripping while burning, dropping while burning).
d1	No dripping/dropping while burning that lasts longer than 10 seconds within 600 seconds (dripping, dropping).
d0	No dripping/dropping while burning within 600 seconds (not dripping, not dropping).

### Format of the classification in the classification report

Fire behaviour	Smoke formation	Dripping while burning
A1 to F (according to test)	s	1, 2 or 3 (according to test)
		d
		0, 1 or 2 (according to test)

#### For example

A1

A2-s1, d0 / A2-s2, d1 / A2-s1, d2

B-s1, d0 / B-s1, d1 / B-s1, d2

C-s1, d0 / C-s1, d1 / C-s1, d2

E/E-s2,d2

F

and the like

#### 15.07.01 European fire resistance classes – EN 13501 part 2, part 3, part 4

With the background of different testing and classification methods in the member states, the fire resistance of components and structures was brought under uniform regulation for the first time:

- Part 2: Classification using data from fire resistance tests, excluding ventilation services
- Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers
- Part 4: Classification using data from fire resistance tests on components of smoke control systems

The important change in the classification method as compared to the old designation is that a component is not designated using the first letter any more, but the designation letters now stand for performance properties, of which each one indicates an important characteristic of fire resistance behaviour.

For Austria and other member countries with a similarly high fire protection level, it is of great importance that the so-called uniform temperature-time curve (model for a fully developed fire or the fire phase after the flash-over) has been retained as a mathematical function (equation) and hence, other member states are challenged to improve their fire protection products. However, there are also other temperature stresses on structures, such as the smouldering fire curve, natural fire, external fire curve or constant temperature stress.

#### 15.07.02 Fire classification of construction products and construction types

- EN 13501 part 5 and part 6

For the sake of completeness, part 5 of the EN 13501 for classification using data from external fire exposure to roofs test must be mentioned. In this context, with the help of four different testing methods with different assumptions (incendiary composition without and with wind as well as additional radiation), the spread of fire inside the roof and on its outside, the outer and inner damage as well as any fire penetration and the occurrence of dripping or dropping while burning are determined.

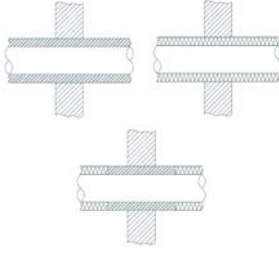
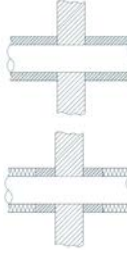


The latest part 6 of this series of standards EN 13501 treats the classification with the results from the tests on fire behaviour of electric cables, a not insignificant fire hazard in technical building equipment, and is therefore quite relevant in the context of building fire protection.

**Characteristic performance properties of components  
according to ÖNORM EN 13501 part 2 are:**

<b>Identification alphabet according to ÖN EN 13501-2</b>	<b>Designation/performance property</b>
R	Load bearing capacity Limited deformation, limited deformation rate
E	Integrity Ignition of the cotton wool ball, gap and openings, occurrence of persistent flames on the unflamed side
I (also I <sub>1</sub> , I <sub>2</sub> )	Thermal insulation Average temperature increase, maximum temperature increase
W	Radiation Maximum radiation level
M	Impact stress (mechanical) Resistance to impact stress
C	Self-closing (Closing) Automatic closing in case of fire (C0 to C5 according to EN 14600) Appendage "T" if the lasting operability (for example, for closing fixtures, clearing fixtures, etc.) is certified
S (also S <sub>a</sub> , S <sub>m</sub> )	Smoke-tightness (Smoke) Limited smoke leakage (components with particular limitation of the smoke density)
G	Resistance to soot fire Resistance to soot fire for exhaust systems and the relevant products
K (also K <sub>1</sub> , K <sub>2</sub> )	Fire protection action Fire protection function of a fire protection clothing for a fixed time
<b>Other codes</b>	<b>Designation/performance/requirement</b>
IncSlow	Smouldering fire curve
sn	Natural fire
ef	Bonfire test curve
r	Reduced fire exposure (constant fire exposure 500 °C)
i > o	Classified from indoors to outdoors
o > i	Classified from the outside to the inside
o < > i	Classified from the inside to the outside and from the outside to the inside
a > b	Classification only from top (a) to bottom (b)
b > a	Classification only from bottom (b) to top (a)
a < > b	Classification for both tests (equally from the bottom and the top)
U	Pipe end configuration "open" (uncapped)
C	Pipe end configuration "closed" (capped)
ve	Installation position of the fire protection closure "vertical"
ho	Installation position of the fire protection closure "horizontal"
H	Testing of component joints: horizontal load-bearing structures
V	Testing of component joints: vertical load-bearing structures – vertical joints
T	Testing of component joints: vertical load-bearing structures – horizontal joints
X	Testing of component joints: no movement
M000	Testing of component joints: movement forced (in %)

Other codes	Designation/performance/requirement
M	Testing of component joints: joint area prefabricated
F	Testing of component joints: joint area made at the site
B	Testing of component joints: joint area prefabricated as well as made at the site
W00 to 99	Testing of component joints: zone of the widths of joints (in mm)

### Pipe insulation according to ÖNORM EN 1366-3:2009

	Continuous	Interrupted
Continuous over the entire pipe length		
	Case CS	Case CI
Local "route insulation"		
	Case LS	Case LI

The table shown above shows the possible arrangements of pipe insulation in accordance with ÖNORM EN 1366-3. The designations CS, CI, LS or LI are employed for the respective data.

### Pipe end configuration according to ÖNORM EN 1366-3:2009

Test condition	Arrangement of pipe closures		Pipe type
	Within the test body	Outside the test body	
U/U	Open	Open	Polymer: Stormwater, waste water vented (disposal pipe)
U/C	Open	Closed	Polymer: Unventilated waste water, gas, tap water, hot water, (supply pipe) Metal: non-fireproof suspension/joining systems
C/U	Closed	Open	Metal: fireproof suspension/joining systems
C/C	Closed	Closed	---

## Format of the classification in the classification report

Performance property				Resistance duration		Additional services, parameters							
R	E	I	W	t	t	-	M	S	C	IncSlow	sn	ef	r

### Examples

Firewall: REI 90 / REI 90-M  
 Lightweight wall: EI 90  
 Fire protection door: EI2 90-C / EI2 30-C  
 Smoke protection door: EI2 30-CSm  
 Fire sealing: EI 90  
 Pipe sealing: EI 90 U/U / EI 90 C/U EI 90 C/C  
 Fire damper: EI 90 veho / EI 90 ho  
 and the like

In this technical information, we have dispensed with the preparation of the standard parts 3 (fire resisting ducts and fire dampers) and 4 (smoke control systems).

### 15.08 Construction products in Europe and national implementation

A common mode of operation of construction products in Europe and the national implementation with regard to the requirements of the building fire protection is possible because

- At the European Union level, the construction product directive (now the Construction Product Ordinance) defines the basic essential requirements for structures and fire protection in the building
- In Austria, the OIB specifies directives in a descriptive manner on this basis, as to how and through which measures this fire protection level can be reached
- The building classes introduced in the OIB specifications (GK 1 to GK 5) with increasing risk (corresponds to a higher building class), the requirements for
  - the construction product flammability classes (governed in ÖN EN 13501-1, -5 and -6) and
  - the fire resistance duration of the load-bearing constructions as well as those of partitioning walls, ceilings and fire partitions (governed in ÖN EN 13501-2, -3 and -4) with fire protection closures of the same quality as specified for the surrounding components and hence, the European fire protection standards for construction products must be applied

For those construction products (construction materials, components, prefabricated parts, etc.), for which national or even, already, European technical specifications are available, the construction product lists ÖA and ÖE of the Austrian Institute for Civil Engineering, the specifications for the usability of these construction products apply, so that

Among other things, and in future, only CE construction products with certified performance can be used at any time for the fire protection of buildings in Austria

### 15.09 Usage categories

Sealing can only be used under different environment conditions and is classified in the following so-called usage categories:

**Type X:** Products for sealing for use in areas with weather exposure.

**Type Y<sub>1</sub>:** Products for sealing for use at temperatures below 0 °C with UV exposure, but without being subject to rain. **Type Y<sub>2</sub>:** Products for sealing for use at temperatures below 0 °C without UV exposure and rain.

**Type Z<sub>1</sub>:** Products for sealing for use in interiors with high humidity, but without temperatures below 0 °C.

**Type Z<sub>2</sub>:** Products for sealing for use in interiors with other humidity classes than Z<sub>1</sub>, but without temperatures below 0 °C.

### 15.10 Conclusion

Since successive European product standards (EN) are being developed, issued and are replacing national standards, building fire protection will be more and more regulated at a European level, so that national differences in the approvals of construction products will disappear.

i Source: Legal information of the Federal Chancellor Office, <https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10000138>

ii OIB Österreichisches Institut für Bautechnik (Austrian Civil Engineering Institute), Schenkenstrasse 4, 1010 Vienna, <http://www.oib.or.at>

iii Source: BSC Brandschutzconsult Bautechnik GmbH, <http://www.m-a-r-k.at/start-kontakt/verlinkte-dateien/>

iv Source: OIB Österreichisches Institut für Bautechnik (Austrian Civil Engineering Institute), <http://www.oib.or.at/BPV.pdf>

# 16 REHAU fire stop collar FP

## 16.01 General

REHAU fire stop collars FP are fire stop collars for polymer pipes made from power-coated stainless steel with a special intumescent insert.

The fire stop collars are tested according to the European standards for open polymer pipe systems (U/U).

## 16.02 Technical data

Technical data and properties			
Collar types	Collar diameters, internal (mm)	Collar diameters, outer (mm)	Number of fastening lugs
Fire stop collar FP 3.0 / 32	35	53	2
Fire stop collar FP 3.0 / 40	45	61	2
Fire stop collar FP 3.0 / 50	60	76	3
Fire stop collar FP 3.0 / 75	85	106	3
Fire stop collar FP 3.0 / 90	100	122	3
Fire stop collar FP 3.0 / 110	120	142	4
Fire stop collar FP 3.0 / 125	135	157	4
Fire stop collar FP 3.0 / 160	170	202	5
Fire stop collar FP 6.0 / 50	60	76	3
Fire stop collar FP 6.0 / 63	73	90	3
Fire stop collar FP 6.0 / 75	85	106	3
Fire stop collar FP 6.0 / 90	100	122	3
Fire stop collar FP 6.0 / 110	120	142	4
Fire stop collar FP 6.0 / 125	135	157	4
Fire stop collar FP 6.0 / 140	150	177	4
Fire stop collar FP 6.0 / 160	170	202	5

Fig. 16-1 Technical data

## 16.03 Areas of application

REHAU fire stop collars FP are tested and approved for wall and ceiling sealing for walled-in and on-wall installation. They are tested and approved for use in the RAUSILENTO pipe system.

- Fire stop collar FP 3.0: Construction height of 32 mm for straight pipe breakthroughs and pipe diameter up to 160 mm
- Fire stop collar FP 6.0: Construction height of 62 mm for collars and pipe diameter up to 200 mm

## 16.04 Customer benefits

- Simple and quick installation
- Zero distance possible
- Usage category Y<sub>1</sub>
- Collar heights: 32 and 62 mm

## 16.05 Standards and guidelines

The REHAU fire stop collars are tested, classified and approved according to the following standards and directives:

- ÖNORMEN 1366-3
- ÖNORM EN 13501-1/2
- ETAG 026-2

## 16.06 Commercial form

- REHAU fire stop collar FP 3.0 / 32 up to REHAU fire stop collar FP 3.0 / 160 at 48 units/box
- REHAU fire stop collar FP 6.0 / 50 up to REHAU fire stop collar FP 6.0 / 160 at 28 units/box
- REHAU fire stop collar FP 6.0 / 200 at 2 units/box

## 16.07 Storage

The REHAU fire stop collars FP must be stored in dry rooms. Moreover, it must be ensured that the stored fire stop collars do not get dirty or damaged. Storage outdoors is not permissible.

## 17 Variants of polymer pipe sealing

### 17.01 General information

The construction product REHAU fire stop collar FP is defined as a pipe closing device, light partition walls, solid walls and solid ceilings.

supporting structures	Component thickness	Number of pipe collars
Light partition wall	≥ 100 mm	2
Solid wall	≥ 100 mm	2
Solid ceiling	≥ 150 mm	1

Tab. 17-1 Load-bearing structures and number of fire stop collars

There are several possibilities for assembly: directly on or in the load-bearing structure or on the soft firestop.

Position list	
1	REHAU fire stop collar FP
2	Annular gap, see installation procedure
3	Suitable fastening material
4	RAUSILENTO
5	Load-bearing structure according to Tab. 17-1
6	Flammable insulation
7	Fire protection coating (PROMASTOP®-CC or PROMASTOP®-I)
8	Mineral wool in accordance with Tab. 6-2
9	Identification plate
Certification: ETA-17/0459	

Tab. 17-2 Position list

#### 17.01.01 Installation procedure

- If necessary, fit a sound insulation pad (adhesive tape)
- For ceiling applications, the installation is basically carried out on the ceiling underside. With wall mounting (exception: shaft wall), installation must be done on both sides.
- There are three options for closing the annular gap:
  - With fire protection mortar (e.g. PROMASTOP-VEN)
  - With gypsum plaster
  - Backfilling with mineral wool of class A1 (according to EN 13501-1) and annular gap closing with fire protection acryl mass (e.g. PROMASEAL-A) at a depth of ≥ 5 mm
- Place the fire protection collar around the pipe, snap in the closure, bend the lug(s) back through 180°
- For on-wall installation, screw the fire protection collar onto the solid wall or ceiling with the accompanying fastening materials. See below for other fastening details.
- Mark the firestop

### 17.02 Light partition wall

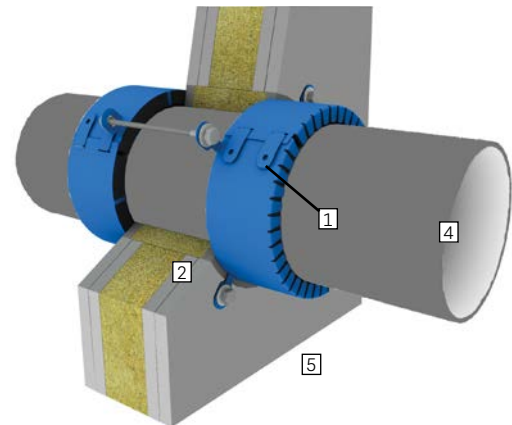


Fig. 17-1 REHAU fire stop collar FP on a light partition wall

The wall must be ≥ 100 mm thick and consist of wood or metal studs, which are clad on both sides with at least two layers of 12.5 mm thick fire protection plates (other plate thicknesses are permissible, keep the minimum thickness in mind). For wooden stud walls, a minimum distance of 100 mm from the sealing to every wooden stud must be maintained and filled with 100 mm insulation material of class A1 or A2 (corresponds to EN 13501-1). The components (load-bearing structures) must be classified as per EN 13501-2 for the required fire resistance duration.

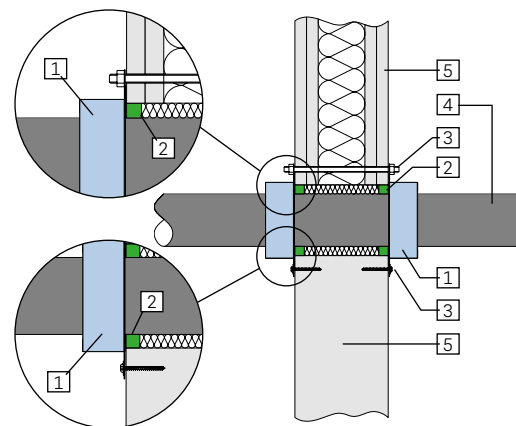


Fig. 17-2 REHAU fire stop collar FP on a light partition wall and solid wall

#### 17.02.01 Mounting

In the case of light wall constructions as well as soft or upholstery sealing, M6 or M8 threaded rods are used for the installation.

### 17.02.02 Acoustic decouplers

In light partition wall and solid wall constructions, any acoustic decoupler with a PE foam base of class E (according to EN 13501-1) or higher, with a maximum thickness of 5 mm may be used.

When embedding in the mortar, it must be kept in mind that with U/U applications, the collars project at least 10 mm out of the surface. For U/C, C/U and C/C applications, the REHAU fire stop collar FP plan can be mortar-embedded. Completely covering it with mortar is not permitted.

### 17.03 Solid ceiling

Ceilings in solid construction must be  $\geq 150$  mm thick and have a density of  $\geq 450$  kg/m<sup>3</sup>. For ceiling constructions, the fire stop collars are fitted only on one side (fitted-on or embedded in the mortar).

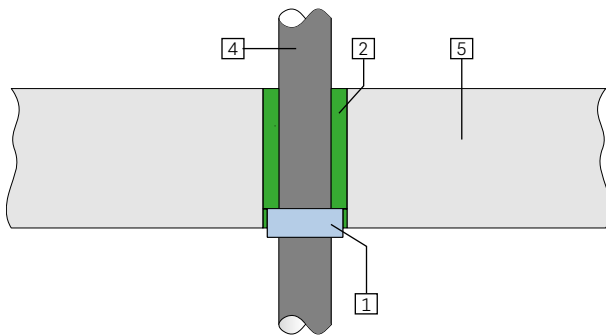


Fig. 17-3 Polymer pipe sealing in solid ceiling construction

### 17.04 Solid wall

Walls in solid construction must be  $\geq 100$  mm thick and have a density of  $\geq 450$  kg/m<sup>3</sup>. (Fabrication tolerances were not taken into account here). In wall constructions, the fire protection collars are fitted on both sides (fitted-on or embedded in the mortar).

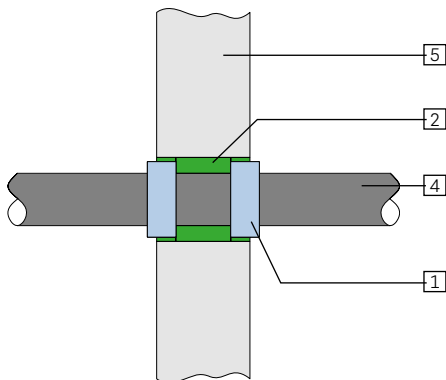


Fig. 17-4 Polymer pipe sealing in solid wall construction

### 17.05 Mounting in case of solid components

In the case of solid components, the REHAU fire stop collar FP is either fastened on the wall with the accompanying screws, or it may also be partially or completely embedded in the mortar (see Fig. 17-33 and Fig. 17-44).

## 17.06 Installation situation

<b>RAUSILENTO</b>					
Specification	Thickness (mm)	Dimension Ø...pipe diameter	FP 3.0 / 6.0	Collar position	Resistance to fire
Solid wall	≥ 100	Ø 40 – Ø 160	FP 3.0	Installed on the wall	EI 120-U/U
Solid wall	≥ 100	Ø 40 – Ø 125 Pipe with socket, max. Ø 125	FP 6.0	Installed on the wall	EI 120-U/U
Solid wall	≥ 150	Ø 40 – Ø 125 Pipe with socket, max. Ø 125	FP 6.0	Embedded in the wall mortar	EI 120-U/U
Solid ceiling	≥ 150	Ø 40 – Ø 160	FP 6.0	Embedded in the ceiling mortar	EI 120-U/U
Solid ceiling	≥ 150	Ø 40 – Ø 125 Pipe with socket, max. Ø 125	FP 6.0	Embedded in the ceiling mortar	EI 120-U/U
Solid ceiling	≥ 150	Ø 40 – Ø 160	FP 6.0	Fitted on the underside of the ceiling	EI 90-U/U
Solid ceiling	≥ 150	Ø 40 – Ø 160	FP 6.0	Fitted on the underside of the ceiling	EI 120-U/U
Solid ceiling	≥ 150	Ø 40 – Ø 125 Pipe with socket, max. Ø 125	FP 6.0	Fitted on the underside of the ceiling	EI 120-U/U
Solid ceiling	≥ 150	Ø 40 – Ø 160 Pipe with socket, max. Ø 125	FP 6.0 +SPC	Fitted on the underside of the ceiling	EI 120-U/U

Tab. 17-3 Overview of pipe material, dimensions, installation situations and classification

Please see the classification report or the ETA for details about the application areas.  
Dimensions in mm

## 17.07 Special applications in light partition wall or solid wall

### 17.07.01 REHAU fire stop collar FP 6.0 for collar application

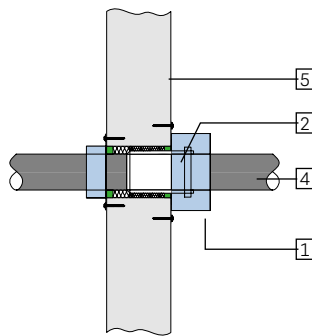


Fig. 17-5 REHAU fire stop collar FP 6.0 for collar application

The collar application is possible with the REHAU fire stop collar FP 6.0. The diameter of the tested collar application can be reduced but not increased.

Project	Distance (mm)
REHAU fire stop collar FP – REHAU fire stop collar FP	0
REHAU fire stop collar FP – flammable insulation	0
REHAU fire stop collar FP – non-flammable insulation	0
REHAU fire stop collar FP – cables, cable ducts, cable conductor	0

Tab. 17-4 Information about minimum distance

# 18 Polymer pipe sealing in soft firestop

The REHAU fireproofing collars FP 3.0 and FP 6.0 are suitable for on-wall and in-wall installation. In walls, the fire protection collars are fitted on both sides. In ceilings, the collar is fastened on the underside of the ceiling.

The REHAU fire stop collars FP 3.0 and FP 6.0 can be used for RAUSILENTO in the sizes 40 to 160 mm – see Tab. 18-3.

In the case of on-wall installation, several collars can also be fitted without lateral distance between them. Optionally, a sound insulation pad of up to 5 mm can be fitted on the polymer pipe.

If the annular gap between the polymer pipe and the mineral wool is too big, the annular gap must be filled with a suitable filler.

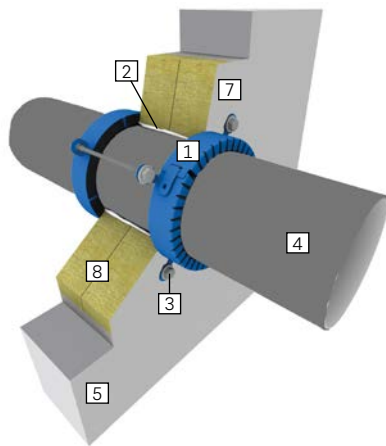


Fig. 18-1 Polymer pipe sealing in solid wall with soft firestop

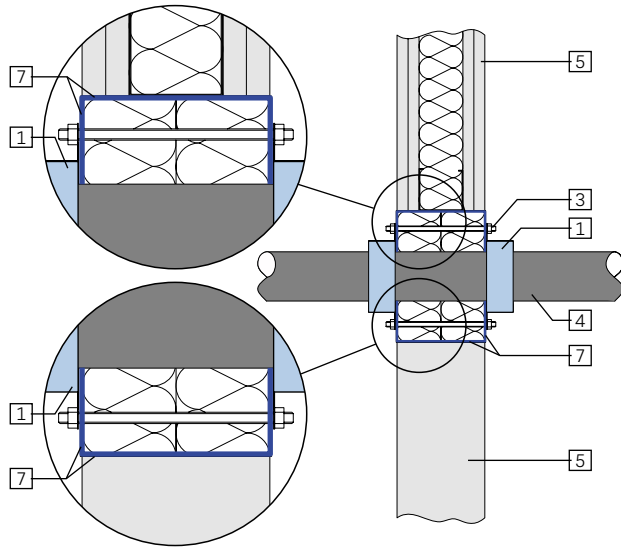


Fig. 18-2 Polymer pipe sealing in a light partition wall and solid wall

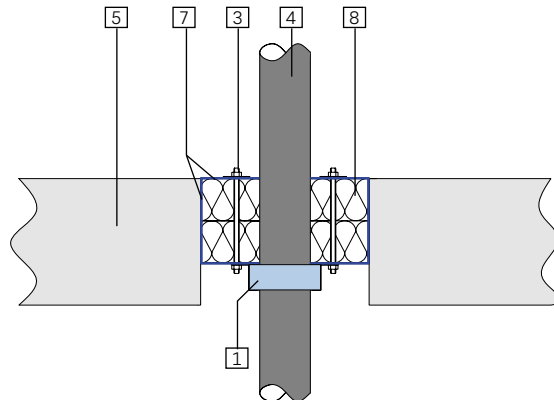


Fig. 18-3 Polymer pipe sealing in a solid ceiling

Position list	
1	REHAU fire stop collar FP
2	Annular gap, see installation procedure
3	Suitable fastening material
4	RAUSILENTO
5	Load-bearing structures according to Tab. 4-1 or Tab. 6-4
6	Flammable insulation
7	Fire protection coating (PROMASTOP®-CC or PROMASTOP®-I)
8	Mineral wool in accordance with Tab. 6-2
9	Identification plate
Certification: ETA-17/0459	

Tab. 18-1 Position list

Project	Distance (mm)
REHAU fire stop collar FP – non-flammable pipe with insulation	0
REHAU fire stop collar FP – cable tray	20
REHAU fire stop collar FP – polymer pipe	0
REHAU fire stop collar FP – aluminium composite pipe	0
REHAU fire stop collar FP – REHAU fire stop collar FP	0
REHAU fire stop collar FP – flammable insulation	0
REHAU fire stop collar FP – non-flammable insulation	0
REHAU fire stop collar FP – load-bearing construction/ component jamb	20
REHAU fire stop collar FP – for all undefined objects	100

Tab. 18-2 Information about minimum distance

From a diameter of  $\geq 160$  mm, as well as for collar sealing, the REHAU fire stop collar FP 6.0 must be used without fail. For details, please contact your REHAU sales office.

### 18.01 Overview of pipe material, dimensions, installation situations and classifications

Designation	Range of sizes $\emptyset$ ...pipe diameter (mm)	Soft firestop (mm)	Direction	Collar types	Classification
			D...ceiling W...wall	FP 3.0 / FP 6.0	
RAUSILENTO	$\emptyset 40 - \emptyset 160$	1 x 50	D	FP 6.0	EI60-U/U
RAUSILENTO	$\emptyset 40 - \emptyset 160$	1 x 80	D	FP 6.0	EI90-U/U
RAUSILENTO	$\emptyset 40 - \emptyset 160$	2 x 50	D	FP 6.0	EI90-U/U
RAUSILENTO (+socket)	$\emptyset 40 - \emptyset 125$	1 x 50	D	FP 6.0	EI60-U/U
RAUSILENTO (+socket)	$\emptyset 40 - \emptyset 125$	1 x 80	D	FP 6.0	EI90-U/U
RAUSILENTO (+socket)	$\emptyset 40 - \emptyset 125$	2 x 50	D	FP 6.0	EI90-U/U
RAUSILENTO (+socket)	$\emptyset 40 - \emptyset 125$	1 x 50	W	FP 6.0	EI60-U/U
RAUSILENTO (+socket)	$\emptyset 40 - \emptyset 125$	1 x 80	W	FP 6.0	EI90-U/U
RAUSILENTO (+socket)	$\emptyset 40 - \emptyset 125$	2 x 50	W	FP 6.0	EI120-U/U

Tab. 18-3 Overview of pipe material, dimensions, installation situations and classifications

Please see the classification report or the ETA for details about the application areas.

# 19 Combination firestop for pipes and cables

## Advantages

- Sealing size up to 3.75 m<sup>2</sup> in wall and ceiling tested
- Moisture resistant
- Wet film thickness 0.9 mm on mineral wool plate (=dry film thickness 0.7 mm) when using PROMASTOP®-CC
- Wet film thickness 1.3 mm on mineral wool plate (=dry film thickness 1.0 mm) when using PROMASTOP®-I

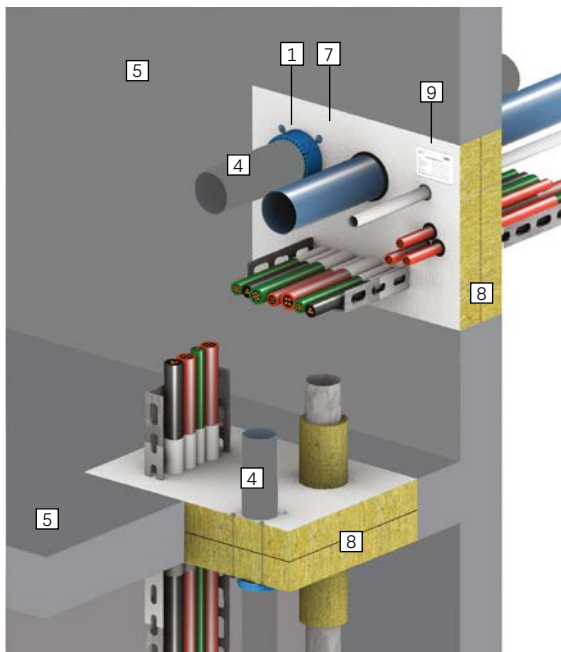


Fig. 19-1 Combination firestop in solid wall and solid ceiling

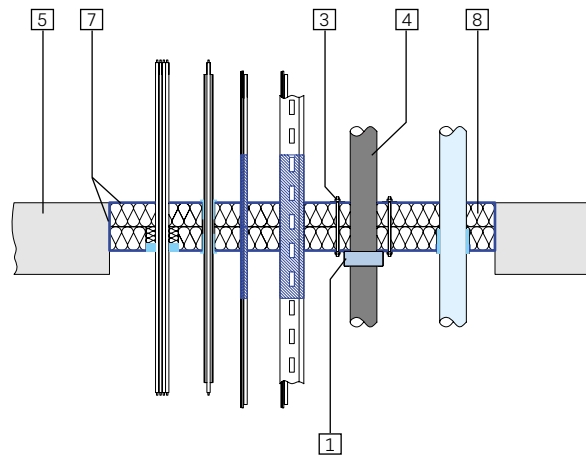


Fig. 19-3 Combination firestop in solid ceiling

### Position list

1	REHAU fire stop collar FP
2	Annular gap, see installation procedure
3	Suitable fastening material
4	RAUSILENTO
5	Load-bearing structure
6	Flammable insulation
7	Fire protection coating (PROMASTOP®-CC or PROMASTOP®-I)
8	Mineral wool
9	Identification plate

Certification: ETA-17/0459

Tab. 19-1 Position list

## 19.01 Installation procedure

- Use boards of non-flammable mineral wool (A1 according to EN 13501-1), with a melting point of  $\geq 1000$  °C and a weight per unit volume of  $\geq 140$  kg/m<sup>3</sup>, unless otherwise defined (see Tab. 19-2).
- In case of a double layer, distance between the mineral wool plates:  $\geq 0$  mm
- The mineral wool plates must be coated on the respective outer sealing side as well as the hems and cut edges with a fire protection coating (PROMASTOP®-CC or PROMASTOP®-I). The two-dimensional inner sides of the mineral wool plates remain uncoated.
- Plug the remaining gaps and intermediate spaces with mineral wool and coat them flush with the surface.
- Coating the bordering wall and ceiling surfaces is not necessary.
- Secure the ceiling sealing against entry.
- Fit the identification plate.

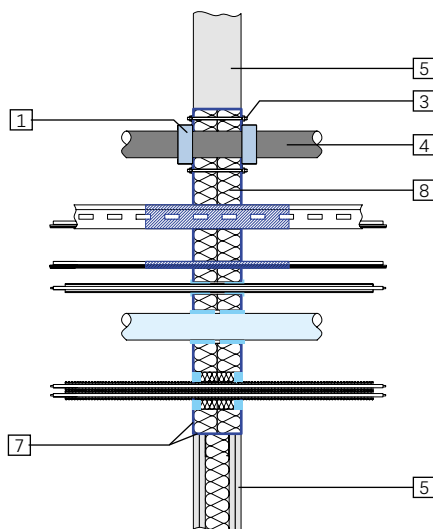


Fig. 19-2 Combination firestop in a light partition wall and solid wall

**19.01.01 Tested and approved mineral wool**

The Tab. 19-2 contains a list of the mineral wools tested and approved in the system (bulk density  $\geq 140 \text{ kg/m}^3$ , melting point  $\geq 1000 \text{ }^\circ\text{C}$ , A1 according to EN 13501-1).

Manufacturer	Designation
Rockwool	RP-XV, Hardrock II, Rockwool 360, Taurox D-C, Taurox Duo NP, Rockwool Paneel 755
Knauf Insulations	Knauf Insulations DP-15, Knauf Insulations FDB D150
Paroc OY AB	Pyrotech slab 140 – 180, Paroc Pro Roof Slab
Isover	Orsil T-N

Tab. 19-2 Tested and approved mineral wool

**19.01.02 Positioning possibilities for the mineral wool plates**

In Fig. 19-4, there are three possibilities shown for fitting a mineral wool sealing in solid ceiling and/or solid wall constructions  $\geq 100 \text{ mm}$

- Flush with the upper edge of the ceiling
- Flush with the lower edge of the ceiling
- Both mineral wool plates flush with the ceiling and floor edge

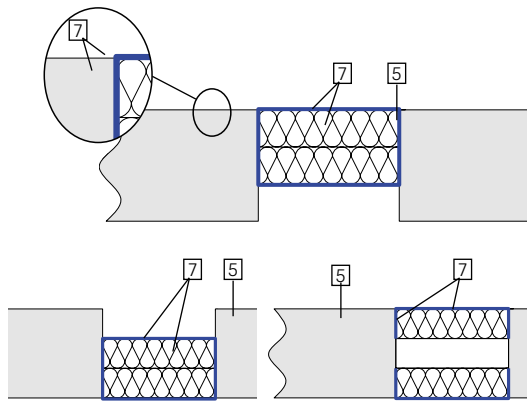


Fig. 19-4 Positioning possibilities for the mineral wool plates

**19.02 Jamb formation**

The sealant may be fitted in walls and ceilings in accordance with Tab. 19-3 (when using PROMASTOP®-CC) or Tab. 19-4 (when using PROMASTOP®-I). Attention must be paid to the maximum dimensions and they may not be exceeded.

Installation situation	Thickness of the mineral wool plate		
	1 x 50 mm	1 x 80 mm	2 x 50 mm
Light partition wall $\geq 100 \text{ mm}$	1,80 m <sup>2</sup>	1,80 m <sup>2</sup>	3,75 m <sup>2</sup>
Solid wall $\geq 100 \text{ mm}$	1,80 m <sup>2</sup>	1,80 m <sup>2</sup>	3,75 m <sup>2</sup>
Solid ceiling $\geq 150 \text{ mm}$	1,95 m <sup>2</sup>	1,95 m <sup>2</sup>	3,75 m <sup>2</sup>
Consumption	1.35 kg/m <sup>2</sup>	1.35 kg/m <sup>2</sup>	1.35 kg/m <sup>2</sup>

Tab. 19-3 Range of application and maximum firestop size with PROMASTOP®-CC

Load-bearing structure	Mineral wool 2 x 50 mm	Fire resistance class
Light partition wall	$\leq 1,44 \text{ m}^2$	EI120
Solid wall	$\leq 1,44 \text{ m}^2$	EI120
Solid ceiling	$\leq 1,44 \text{ m}^2$	EI90

Tab. 19-4 Range of application, maximum firestop size and fire resistance class (empty firestop) with PROMASTOP®-I

With a light partition wall, the following options are available for jamb formation:

- If there is a surrounding metal profile present, the jamb lining can be dispensed with.
- If there is a metal profile present, it is used for jamb formation and the remaining open sides are clad with a metal profile to get a peripheral frame.
- Alternatively, even if there is a metal profile, the jamb can be additionally clad with plates of the wall extension.

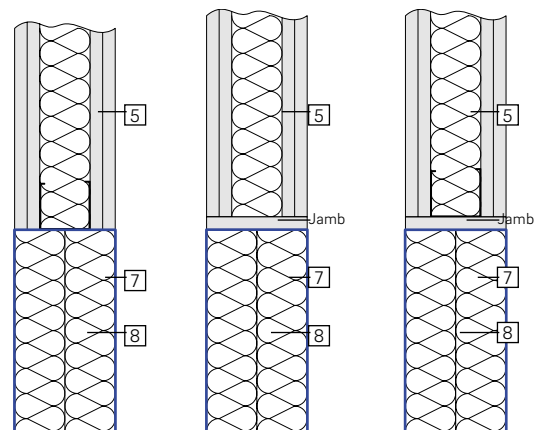


Fig. 19-5 Jamb formation with a light partition wall

### 19.03 Application

In Tab. 19-3 and Tab. 19-4, the maximal tested and approved sealant sizes as well as the various installation situations can be seen. Attention must be paid to the maximum dimensions and they may not be exceeded.

### 19.04 Light partition wall

The wall must be  $\geq 100$  mm thick and consist of wood or metal studs, which are clad on both sides with at least two layers of 12.5 mm thick fire protection plates (other plate thicknesses are permissible, keep the minimum thickness in mind). For wooden stud walls, a minimum distance of 100 mm from the compartmentalisation to every wooden stud must be maintained and the hollow space between the stud and the compartmentalisation filled with at least 100 mm insulation material of class A1 or A2 (corresponds to EN 13501-1). A separate jamb formation is not necessary. The components (load-bearing structure) must be classified as per EN 13501-2 for the required fire resistance duration.

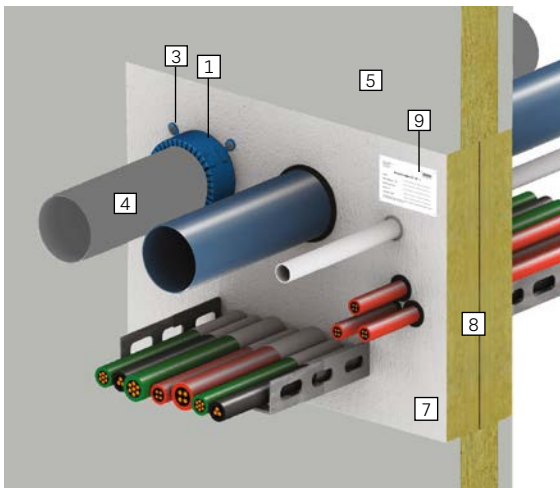


Fig. 19-6 Combination sealing in a light partition wall

### 19.04.01 Solid wall

The wall, in solid construction, must be  $\geq 100$  mm thick and have a density of  $\geq 450$  kg/m<sup>3</sup>. Test results that were achieved with a solid standard load-bearing structure also apply to space-enclosing components of concrete or brickwork with the same or greater thickness and density than tested. The classification of the results in light partition walls can be applied for solid wall structures whose thickness and density is greater than that of the tested structure.

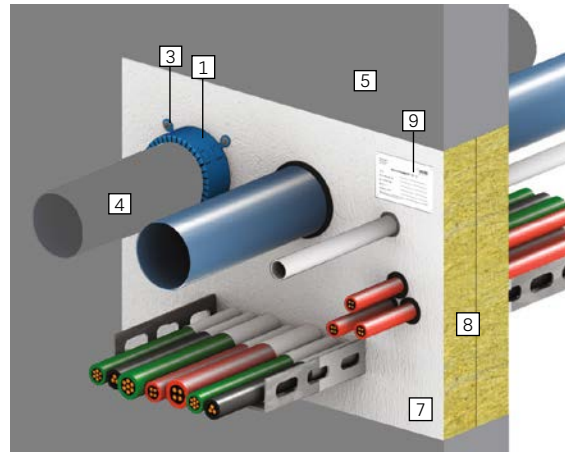


Fig. 19-7 Combination firestop in solid wall

### 19.04.02 Solid ceiling

The ceiling must be  $\geq 150$  mm thick and have a density of  $\geq 450$  kg/m<sup>3</sup>.

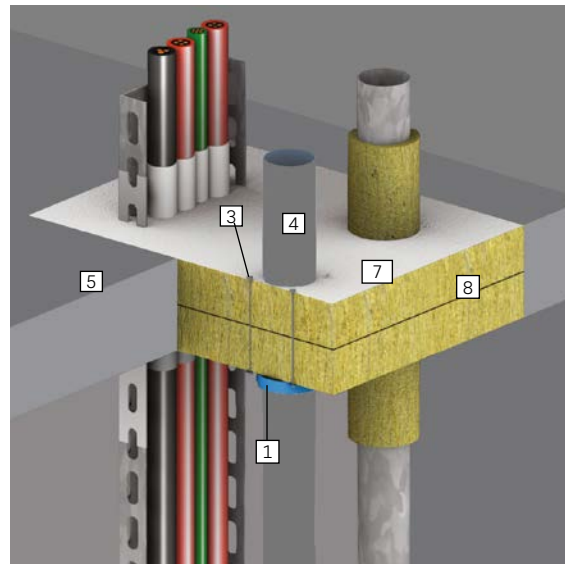


Fig. 19-8 Combination firestop in solid ceiling

### 19.05 Polymer pipe compartmentalisation: Combination firestop with REHAU fire stop collar FP

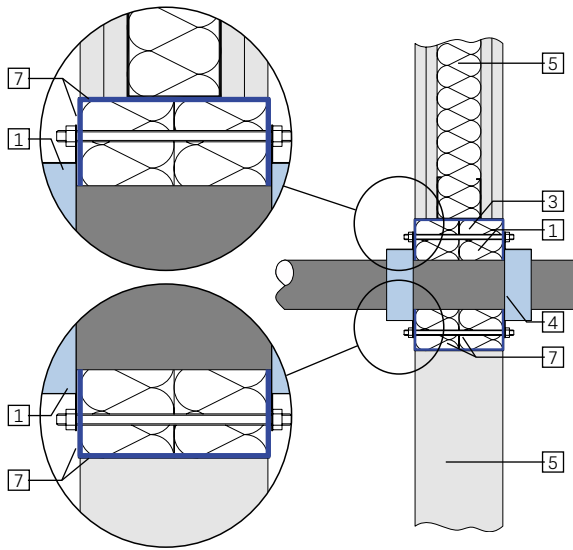


Fig. 19-9 Polymer pipe sealing in a light partition wall and solid wall in soft firestop

- REHAU fire stop collars FP 3.0 and FP 6.0 are suitable for on-wall and embedded installation.
- For wall application, fire protection collars must be fitted on both sides of the soft firestop, for ceiling application, only on the underside.
- Any acoustic decoupler with a PE foam base of class E (according to EN 13501-1) or higher, with a maximum thickness of 5 mm may be used.
- A test with the pipe end configuration U/U also covers the pipe end configuration C/U, U/C and C/C.
- A test with the pipe end configuration U/C also covers the pipe end configuration C/C.
- The diameter of the tested push-fit socket can be reduced but not increased. For sockets, the REHAU fire stop collar FP 6.0 in installation height 62 mm should always be used.
- With a soft firestop, the fastening is done with threaded rods M6 or M8.
- The annular gap between the polymer pipe and the mineral wool must be filled up with PROMASEAL®-A, PROMASEAL®-AG or PROMASTOP®-I.

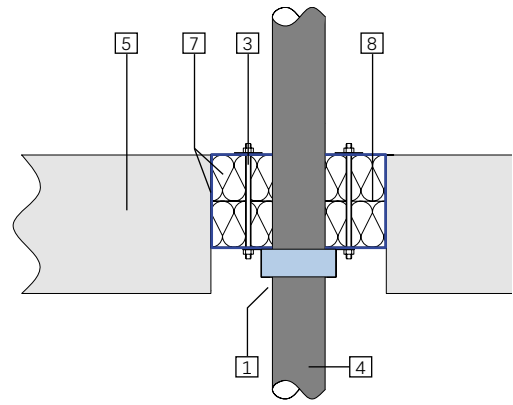


Fig. 19-10 Polymer pipe sealing in solid ceiling with soft firestop

Project	Distance (mm)
REHAU fire stop collar FP – REHAU fire stop collar FP	0
REHAU fire stop collar FP – fire protection band PROMASTOP®-W	0
REHAU fire stop collar FP – cable sleeve PROMASTOP®-IM CJ21	0
REHAU fire stop collar FP – flammable insulation	0
REHAU fire stop collar FP – non-flammable insulation	0
REHAU fire stop collar FP – cable tray	20
REHAU fire stop collar FP – cable bundle	≥ 80
REHAU fire stop collar FP – component embrasure	≥ 30
REHAU fire stop collar FP – Self-guiding ventilation pipes and their sheathing of PROMATECT®-AD fire protection structural panels	0
REHAU fire stop collar FP – Busbar distributors and their sheathing	≥ 20
REHAU fire stop collar FP – for all undefined objects	≥ 100

Tab. 19-5 Information about minimum distance

From a diameter of  $\geq 160$  mm onwards, as well as for collar sealing, the REHAU fire stop collar FP 6.0 must be used. For details, please contact your REHAU sales office.

<b>Designation</b>	<b>Range of sizes</b>	<b>Soft firestop</b>	<b>Direction</b>	<b>Collar type</b>	<b>Classification</b>
	<b>Ø...pipe diameter</b>	<b>(mm)</b>	<b>D...ceiling W...wall</b>	<b>FP 3.0 / FP 6.0</b>	
RAUSILENTO	Ø 40 – Ø 160	2 x 50	D	FP 6.0	EI 90-U/U
RAUSILENTO (+socket)	Ø 40 – Ø 125	2 x 50	D	FP 6.0	EI 90-U/U
RAUSILENTO (+socket)	Ø 40 – Ø 125	2 x 50	W	FP 6.0	EI 120-U/U

Tab. 19-6 Overview of pipe material, dimensions, installation situations and classification

Please see the classification report or the ETA for details about the application areas.

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