REHAU®
Unlimited Polymer Solutions

RAUPIANO PLUS AND LIGHT WASTE WATER SYSTEMS

Technical information

CONTENTS

1 INFORMATION AND SAFETY INSTRUCTIONS

Notes regarding this technical information

Validity
This technical information is applicable to Austria.

This technical information pertaining to the "RAUPIANO PLUS and LIGHT Waste Water System" is valid from July 2018 onwards.

With the publication of this document, the previous technical information 444600 (May 2016) is no longer valid.

Other applicable technical information:
- Technical information “REHAU fire stop collar FP”

Our current technical documentation is available for download from www.rehau.com.

All dimensions and weights are guide values. Subject to errors and changes.

Navigation
At the beginning of this chapter you will find a detailed table of contents with the hierarchical headings and the corresponding page number.

Pictograms and logos

Safety warnings

Legal information

Important information that must be taken into account

Information on the Internet

Your benefits

For your own safety and for the correct application of our products, please check regularly whether a newer version of your technical information is available.
The publication date of your technical information is always found on the bottom left of the cover page.
You can obtain the current technical information from your REHAU sales office, specialist wholesaler or you can download it from the internet at **www.rehau.com**

The RAUPIANO PLUS and LIGHT waste water systems must only be planned, installed and operated as described in this technical Information. Any other use is not in accordance with the specification and is therefore not permitted.
- For your own safety and the safety of other people, please read through all safety instructions and operating instructions carefully and completely before 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.

General precautions
- Observe generally applicable regulations relating to safety and the prevention of accidents when installing pipe connections.
- Keep your workplace clean and free of obstructions.
- Ensure that your work space has adequate lighting.
- Keep children, pets and unauthorised persons away from tools and installation areas. This particularly applies to renovations in occupied areas.
- Use only the components intended for the respective REHAU pipe system. The use of components from other systems or the use of tools not from the relevant REHAU installation system can result in accidents or other risks.

Fire protection

Please closely observe the relevant fire protection regulations and the relevant applicable building codes/construction regulations.

Prerequisites for personnel

- Our systems must only be installed by authorised and trained personnel.
- Work on electrical equipment or wiring may only be carried out by qualified and authorised individuals.

Working clothes

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

During installation

- Read and always follow the operating instructions of the REHAU installation tool being used.
- Cutting tools have a sharp blade. Store and handle them in such a way that there is no risk of injury from the cutting tools.
- When cutting the pipes to length, keep a safe distance between the hand holding the pipe and the cutting tool.
- Never reach into the cutting zone of the tool or touch moving parts during the cutting process.
- During maintenance, upkeep or retooling work and when changing the assembly area, always unplug the tool and prevent it from being switched on accidentally.

2 APPLICATION AREA

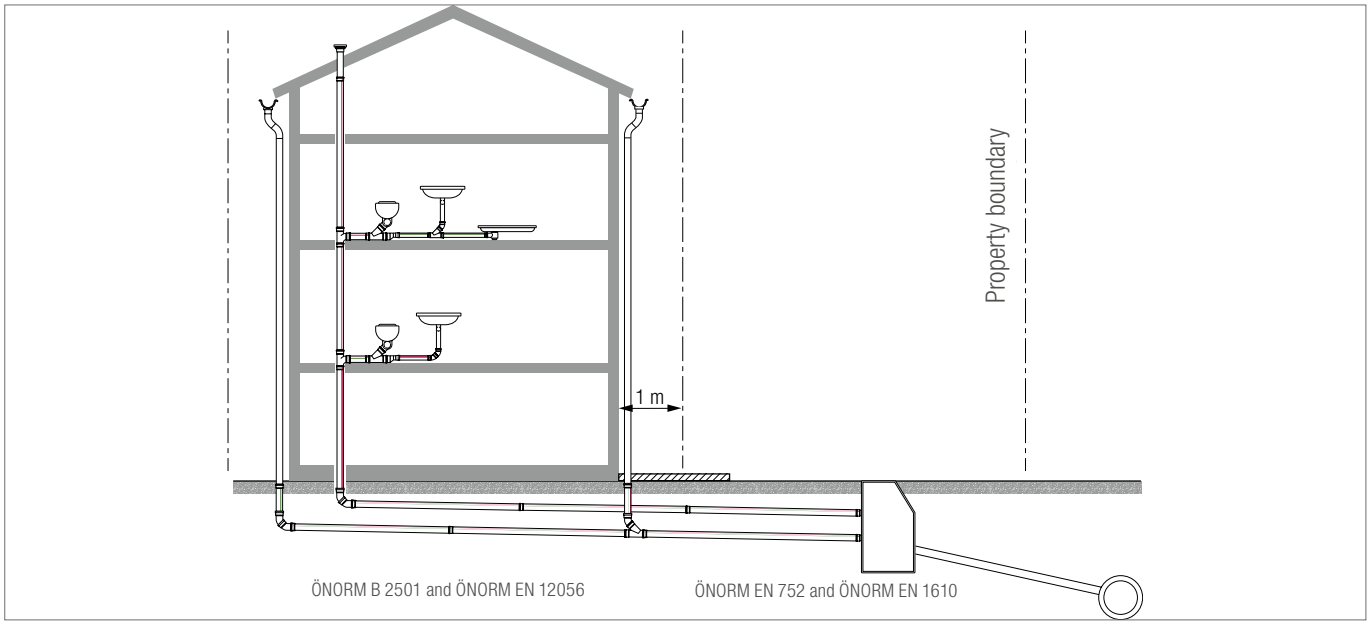


Fig. 2-1 Application area

2.1 Overview of standards

The waste water systems RAUPIANO PLUS and RAUPIANO LIGHT must be planned, calculated, fabricated and operated in accordance with the ÖNORM EN 12056, ÖNORM B 2501 and the recognised rules of engineering.

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 RAUPIANO PLUS and LIGHT pipes and fittings:

Standard/edition	Title	Application area
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.

Standard/edition	Title	Application area
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.
ÖNORM EN 12056-3: 2000 12 01	Gravity drainage systems inside 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	Gravity drainage systems inside 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	Gravity drainage systems inside 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 for buildings and property	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.
ÖNORM EN 752: 2017 07 01	Drainage systems outside buildings – sewer management	This European standard defines targets for drainage systems outside buildings. It lays down functional requirements for achieving these goals as well as principles for strategy and procedures with regard to planning, dimensioning, construction, operation, maintenance and renovation.
ÖNORM EN 1610: 2015 12 01	Installation and testing of sewer pipes and channels	This European standard applies to the installation and testing of sewer pipes and canals that are usually laid underground but, under gravity conditions, are operated at up to 0.5 kPa at overpressure.
ÖNORM EN 476: 2011 03 01	General requirements for components for sewer pipes and channels	This European standard lays down general requirements for components inside and outside buildings (see EN 12056-1), like pipes, fittings and manholes with their respective joints, which are intended for sewer pipes and canals and which are operated as gravity drainage systems with maximum 40 kPa.
ÖNORM EN 1451-1: 2016 03 01	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).

Standard/edition	Title	Application area
ÖNORM EN 681-2: 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: 1. Piping systems of thermoplastic pipes for pressureless operation sewer pipes in buildings (sporadic flow up to 95 °C) 2. 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) 3. Piping systems of thermoplastic pipes for stormwater drainage.
ÖNORM EN 13501-1: 2017 09 01	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.
ÖNORM B 8115-2: 2006 12 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.
DIN 4109: 2018 01 01	Sound insulation in building construction	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 for buildings and property	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.
ÖNORM H 6036:2007 06 01	Ventilation systems – requirement-dependent ventilation of dwellings or individual residential areas	This ÖNORM treats the planning and assembly as well as the operation and maintenance of ventilation and extract ventilation systems of dwellings and individual living areas and rooms envisaged for similar purposes (for example, living units in hotels or accommodation facilities).

Tab. 2-1 Overview of standards for domestic waste water (this list is not exhaustive)

3 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 pipes. It opens into a collecting or main pipe.

Collecting 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
Pipe for carrying the discharge of connecting pipes in the water storage 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/di = 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 distortion
Non-vertical part of a waste water downpipe with constant cross-section as a connection of drop pipe 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.

4 SYSTEM DESCRIPTION FOR THE RAUPIANO PLUS

4.1 Function

RAUPIANO PLUS is a universal noise-insulated waste water system for pressureless domestic and open ground drainage; it meets the requirements of the German General Building Approval (AbZ) 42.1-223 and the standards ÖNORM 12056, ÖNORM EN 752 and ÖNORM B 2501. It can be used as a universal drainage system in a range from detached houses right through to large-scale properties.

RAUPIANO PLUS is available in nominal diameters of DN 32 to DN 200. An extensive range of fittings and fastenings rounds off the system.

- Top quality and aesthetically pleasing
- Excellent acoustic properties
  - Patented REHAU sound-dampening brackets to reduce structure-borne sound transmission
  - Specially formulated pipe and fitting materials
  - Partially thickened walls for bend fittings to further reduce air-borne noise transmission
- Optimum slip properties of the abrasion-resistant inner layer reduce the risk of blockage
- Excellent cold impact resistance, verified break resistance up to –10 °C
- High level of ultraviolet resistance, can be stored outside for up to 2 years
- High impact resistance – robust during transportation, storage and on the construction site

4.2 Range of application

Overview

Residential buildings	Building construction sector as per ÖNORM EN 12056 and ÖNORM B 2501 Detached house Apartment buildings Housing estates	
Commercial projects	Hotels Office buildings Hospitals Schools, nursery schools High-rise buildings	
Below ground installations	within and below the building's structure	see section 4.2.3 Below ground installations
Commercial kitchens	Collecting, main and connecting pipes	see section 4.2.4 Commercial kitchens
Internal stormwater drainage pipes	as a gravity system up to a total height of 20 m	
Mechanical ventilation	in detached and semi-detached dwellings for decentralised and centralised extract ventilation of bathrooms, toilet rooms and kitchens as per DIN 18017-3	see section 4.2.5 Ventilation

4.2.1 Residential buildings

RAUPIANO PLUS is the universal system for unpressurised domestic drainage in accordance with ÖNORM EN 12056 and ÖNORM B 2501 for building construction applications, both as a standard drainage system without special noise insulation requirements as well as with increased sound insulation requirements (VDI directive 4100).
For example, in
- Detached house
- Apartment buildings
- Housing estates

4.2.2 Commercial projects

RAUPIANO PLUS can also be used in buildings with increased sound insulation requirements (VDI directive 4100). Thanks to its superb acoustic properties, RAUPIANO PLUS is particularly suitable for:
- Hotels
- Office buildings
- Hospitals

RAUPIANO PLUS satisfies the increasing demand of people for quiet and rest and ensures a high level of living comfort.

The pipe dimensions according to ÖNORM EN 1451 allow, for pipes and fittings with the same nominal diameter, the problem-free transition to HT according to ÖNORM EN 1451, or KG according to ÖNORM EN 1401, without special adapters being required.

Fig. 4-1 Compatibility with HT/KG systems

4.2.3 Below ground installations

RAUPIANO PLUS is approved for below ground installations within and outside the building structure in all the available dimensions.

Installation must be done in accordance with ÖNORM EN 12056, ÖNORM EN 752, ÖNORM B 2501 as well as ÖNORM EN 1610.

Moreover, the RAUPIANO PLUS system is radon-tight up to 0.2 bar.

4.2.4 Commercial kitchens

As an internal collecting pipe, RAUPIANO PLUS is suitable for carrying waste water containing grease away from commercial kitchens to the grease trap.

If the grease trap is a long distance away, the use of pipe trace heating may be necessary. This prevents the premature build-up of grease deposits. The temperature of the pipe trace heating suitable for polymer pipes must not exceed 45 °C.

In the event of contact with oils and greases from commercial kitchens with grease traps, it is necessary to replace the SBR sealing rings with sealing rings made of nitrile-butadiene rubber (NBR) to achieve the required higher chemical resistance.

4.2.5 Ventilation

RAUPIANO PLUS can also be used in detached and semi-detached dwellings for decentralised and centralised extract ventilation of bathrooms, toilet rooms and kitchens. Attention must be paid to fire protection measures.

We recommend using a common DN 110 RAUPIANO PLUS as exhaust air duct, particularly when bathrooms and/or WCs are situated above each other.

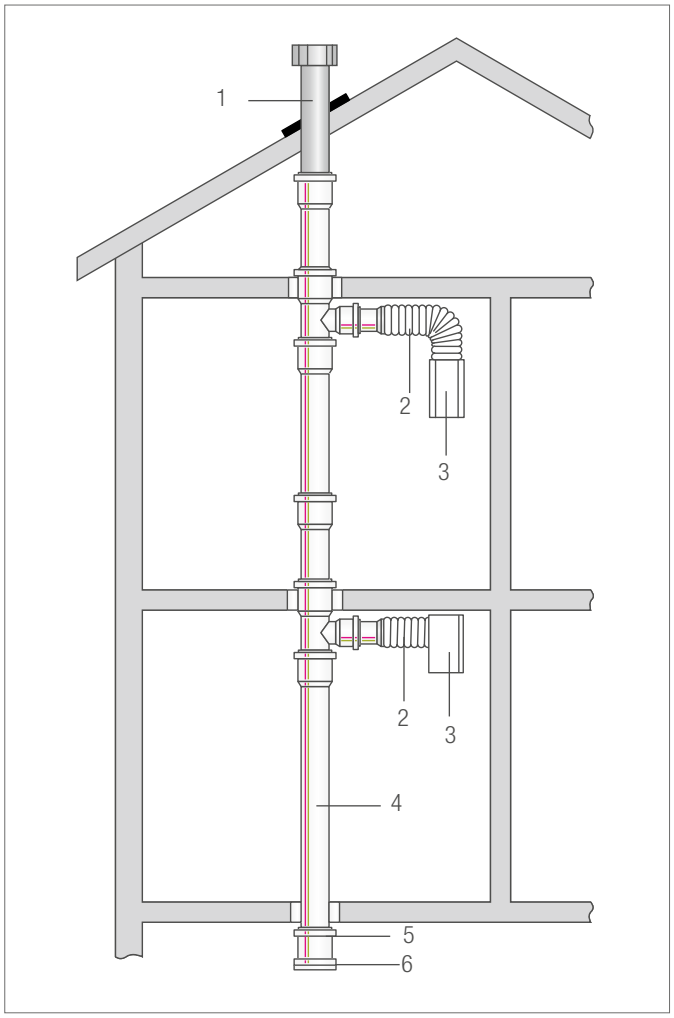


Fig. 4-2 Decentralised ventilation with RAUPIANO PLUS

1 Exhaust outlet
2 Flexible tubing
3 Extraction fan
4 RAUPIANO PLUS
5 Double socket
6 Socket plug

Decentralised extract ventilation

During the installation process, keep in mind that an inspection opening is provided in the basement. This can be achieved with a double socket and a socket plug, which can be removed if necessary.

At the height of the intended extraction fan, a DN 110/75/87° branch with connecting piece for the DN 80 ventilation pipe provides what is required to connect the fan to the exhaust air duct using aluminium flexible tubing (internal diameter of 80 mm).
The aluminium flexible tubing is pulled over the connecting branch of the fan and connecting piece and is fixed in place using hose clamps available from fitting suppliers, thus forming an air-tight connection. Alternatively, a suitable sealing strip made of butyl rubber can be used for securing connection into place.

If steel flexible tubing is used, a suitable sealing strip made of butyl rubber must be used on the connecting branch for support and sealing purposes.

- Up to 4 radial extraction fans can be connected to a DN 110 exhaust air duct.
- A kitchen must be ventilated using a separate ventilation device (not an extractor hood). The existing exhaust air duct for the bathroom/WC cannot be used for this.
- Connecting an extractor hood to this common ventilation pipe is not permitted. Ventilation must be established using a separate pipe.
- Supply air must be able to flow in without the use of any specific supply air facilities (e. g. gaps in the building envelope).

Roof penetration

A suitable, weather-resistant roof vent must be used for the roof penetration. This is connected to the RAUPIANO PLUS extract ventilation pipe beneath the roof panel. Any possible build-up of condensation must be prevented by way of appropriate measures (see chapter 11.2 on page 64).

Centralised extract ventilation

When it comes to centralised extract ventilation, so-called exhaust grills are fitted in the rooms to be ventilated instead of extraction fans. A radial extraction unit under the roof is used to purge the exhaust air. This type of extract ventilation is seldom found in detached houses.

4.2.6 Central vacuum cleaning system VACUCLEAN

Owing to its outstanding noise-insulating properties, and the abrasion-resistant inner layer having been optimised with regard to the slip properties, RAUPIANO PLUS is particularly suitable as a piping system for central vacuum systems.

REHAU offers the central vacuum system VACUCLEAN, which consists of a central vacuuming unit, piping and fittings, fastenings and suction sockets. More detailed information on it can be found in the technical information “Central vacuum cleaning system VACUCLEAN” or on the Internet at www.rehau.com.

4.3 Application area

Fig. 4-3 RAUPIANO PLUS pipes and fittings

The noise-insulating waste water system RAUPIANO PLUS is suitable for the gravity drainage systems according to ÖNORM EN 12056, ÖNORM EN 752 and ÖNORM B 2501 inside buildings as well as for below ground installations inside and outside the building structure, and approved by the DIBt, the German Institute for Civil Engineering (AbZ-42.1-223).

The pipes, fittings and sealing elements can be used at up to 95°C (short-term). They are suitable for draining chemically aggressive waste water with a pH value of between 2 (acid) and 12 (alkaline). The fire behaviour conforms to D-s2, d0 normal flame-resistance to EN 13501-1.
The pipe joints are leak-tight up to an inner water overpressure of 1 bar (10 m head of water).

Pipes and fittings must not be used for:
- Pipelines subject to a permanent load of more than 70 °C (short-term 95 °C)
- Pipelines which carry waste water containing benzene or benzol
- Exposed outside lines

For use in areas where, during installation, temperatures of up to –10 °C are common, additional testing is required to ÖNORM EN 1451.
RAUPIANO PLUS has passed this test and can therefore be labelled with the “ice crystal” according to ÖNORM EN 1451 and ÖNORM EN 1411 and can also be installed in these regions.

For end pipes of ventilation piping, do not use RAUPIANO PLUS; use UV-resistant pipes.

§ Observe all the generally applicable regulations relating to laying, installation, prevention of accidents and safety specifications when installing pipe systems, as well as the notes in this technical information.

Application areas not covered by this technical information (special applications) require consultation with our Technical Applications Department. Contact your REHAU sales office.

4.4 Pipe structure

These days, modern pipe systems have a multi-layer structure. With such a structure, desirable pipe properties can be tailored in a focused manner to the respective requirements.

RAUPIANO PLUS 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.

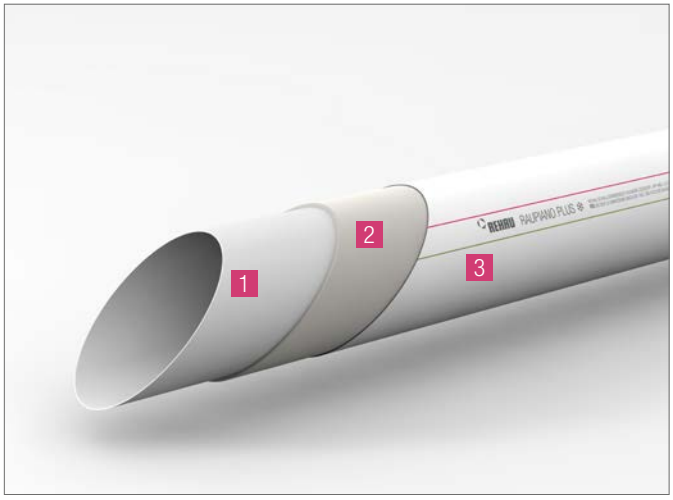


Fig. 4-4 Pipe structure of the RAUPIANO PLUS

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

- RAUPIANO PLUS – robust during transportation, storage, and at the construction site
- Break resistance up to –10 °C
- Outdoor storage possible for up to 2 years
- Optimum hydraulic conditions. Deposits and incrustations are reliably prevented.
- Unchanged peak in sound insulation

These good properties are achieved through the three-layer structure of the pipe and the special adaptation of every individual layer to the respective requirements:
- High ring stiffness
- Impact resistance and low-temperature impact resistance of the outer layer
- Elevated ultraviolet resistance
- Abrasion-proof and smooth inner layer
- Highly rigid middle layer made of mineral-reinforced PP

4.5 Pipe fittings

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 the noise-related performance.

To minimise this risk and counteract the negative impact, the bends in the size range of DN 90 to DN 125 have been developed with targeted weight optimisation in the critical impact section. This further improves the acoustic performance by reducing the noise generation in the area of impact.

Fig. 4-5 RAUPIANO PLUS elbow with reinforced area of impact

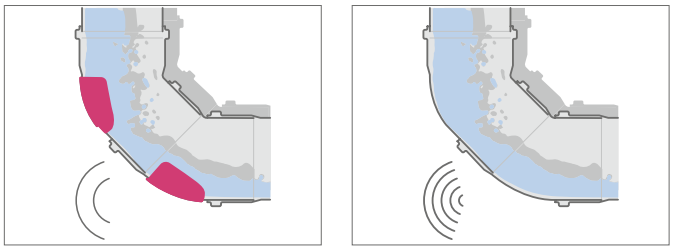


Fig. 4-6 Noise reduction with reinforced area of impact (left) compared to non-reinforced area of impact (right)

4.6 Sound insulation

The highly sound-insulating RAUPIANO PLUS waste water system guarantees quality, quiet and living comfort in a central area of the building technology. During measurements carried out by the officially recognised Fraunhofer-Institut für Bauphysik (Frauenhofer Institute for Building Physics), Stuttgart, in line with current practice, RAUPIANO PLUS achieved a sound pressure level below the most stringent requirement of the VDI Directive 4100.

- Superb acoustic properties
- High pipe-stiffness (ring stiffness > 4 kN/m² in accordance with DIN EN ISO 9969)
- Optimum hydraulics thanks to extremely smooth and slippery inner layer
- Greater ease of installation due to tough outer layer
- Excellent cold impact resistance (ice crystal as per ÖNORM EN 1451/1411)
- Reliable installation at low temperatures
- Easy and efficient installation
  - Push-fit connection
  - Factory-fitted sealing rings
  - Cutting to size with common pipe cutters or fine saw
- Complete pipe and fittings product range
- Universally compatible with metric HT-PP system, connection to conventional metric HT and KG pipes without special adaptors
- Attractive design
- Clean white colour
- Eco-friendly as it can be recycled

4.7 System components

Pipes and fittings

- Made of mineral-reinforced RAU-PP
- Pigmented white (similar to RAL 9003)
- Nominal diameters DN 32, 40, 50, 75, 90, 110, 125, 160, 200
- Effective lengths from 150 mm to 3000 mm
- Complete fittings product range
  - Elbows from 15° to 87° (DN 90 to DN 125 in wall-thickened version)
  - Single branch
  - Double branch
  - Corner double branch
  - Parallel branch
  - Other special fittings

Sealing elements

The pipes and fittings are fitted with sealing rings in the factory in accordance with DIN 4060 and DIN EN 681-1.
Hardness: 60 ±5 Shore A
Material: styrene-butadiene-rubber (SBR)

Fastening elements

- Structure-borne sound-dampening support bracket (Fig. 4-7)
- Guiding clamp with spacer (DN 40, 50 and 200 without quick release) (Fig. 4-8)
- Guiding clamp with quick release (Fig. 4-9)
- Fixing clamp (Fig. 4-10)

Fig. 4-7 Patented structure-borne sound-dampening support bracket

Fig. 4-8 Guiding clamp with spacer

Fig. 4-9 Guiding clamp with quick release

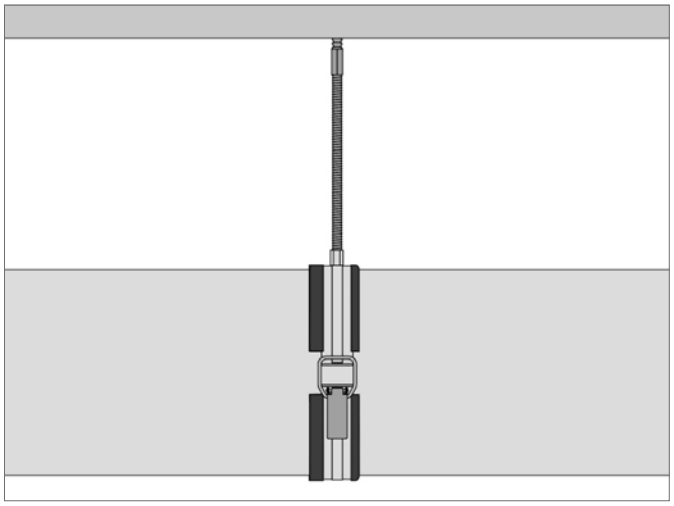


Fig. 4-10 Fixing clamp

Fire protection

§ The fire behaviour corresponds to construction material class D-s2, d0 according to EN 13501-1. There are fire stop collars from REHAU available for lead-throughs of the RAUPIANO PLUS pipe through fire-resistant ceilings or walls. Compliance is required with the national fire protection regulations and the applicable respective building codes/constructions.

4.8 Advantages of nominal diameter DN 90

Fig. 4-11 Hydraulically optimised branch DN 90 with inner radius

The high noise-insulating waste water system RAUPIANO PLUS was enhanced with the nominal diameter DN 90. For connecting, drop and collecting pipes, in keeping with the standardising regulations in ÖNORM EN 12056 and ÖNORM B 2501, waste water pipes of nominal diameter DN 90 can be used.
Then, the self-cleaning capacity of the entire pipe system, when using water-saving flushing systems, is ensured with a flushing water volume of 4 to 6 l.
In this manner, the entire waste water installation (including the collecting pipe laid in the basement) in buildings with up to three residential units can be designed with just two dimensions, DN 90 and DN 50. Nominal diameter DN 90 allows a space-saving waste water installation, especially in the installation shaft and in the pre-wall installation.
The branches DN 90/90/87° and DN 110/110/87° have an inner radius and thus increase the hydraulic efficiency of the overall system. When these branches are used, the drop pipe can be stressed to a much greater extent, or a smaller size can be used (see tables 11 and 12 of ÖNORM EN 12056-2), since here, in contrast to sharp-edged branches, a hydraulic termination of the drop pipe in the entry zone is prevented.

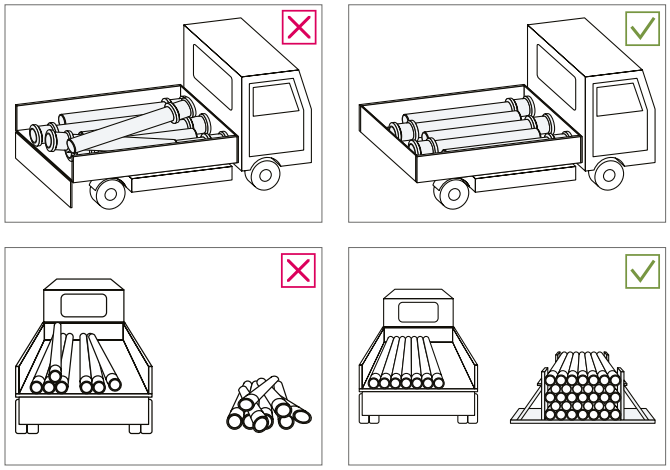
4.9 Supply form and storage

Supply form

- Pipes up to 500 mm and fittings in cartons
- Pipes measuring 750 mm and above in timber frame crates

Transport

Because of its three-layer structure and its tough and impact-resistant structure, RAUPIANO PLUS behaves in a robust manner during transport and at the construction site. Care must be taken that pipes are in contact over the entire length.

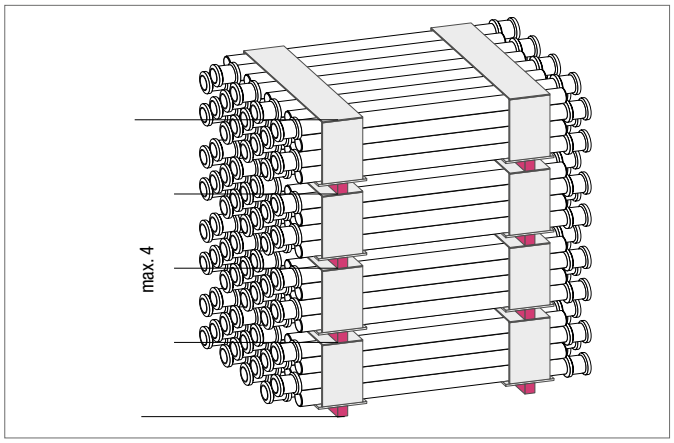


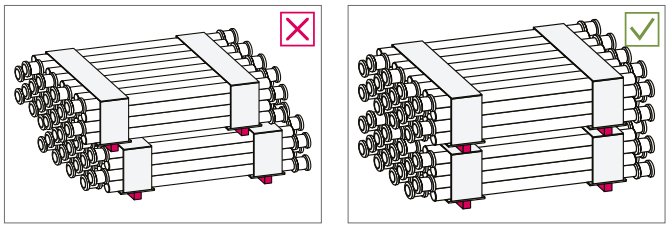
Storage

- Protect cartons from moisture during transport and storage.
- RAUPIANO PLUS and its seals can be stored outdoors for up to 2 years due to their UV-stability (Central Europe).

We recommend:

- Protecting RAUPIANO PLUS pipes and fittings from direct sunlight and dirt
  - Keeping them in the box
  - Covering them with tarpaulins (ensure proper ventilation)
- Stack no more than four wooden crates on top of one another
- Ensure that the wood frames are aligned squarely when stacking
- Store the pipes in such a way that they are exposed and clear, and any deformation of the socket and spigot end is avoided





4.10 Identification

Pipes and fittings are marked with:
- The manufacturer's logo
- Authorisation number
- Certification mark
- Ice crystal (ÖNORM EN 1451/ 1411)
- Nominal diameter (DN)
- Year of manufacture
- Manufacturing plant
- Material
- Angle specification (for bends and branches)

4.11 Recycling

RAUPIANO PLUS pipes and fittings are 100% recyclable.

4.12 Warranty

For the waste water system RAUPIANO PLUS, there is a warranty available in the framework of the legal regulations applicable nationally.

5 SYSTEM DESCRIPTION OF THE RAUPIANO LIGHT

5.1 Function

RAUPIANO LIGHT is a universal, sound-insulating waste water system for unpressurised domestic drainage in accordance with ÖNORM EN 12056 and ÖNORM B 2501.

RAUPIANO PLUS is available in nominal diameters of DN 32 to DN 160.
An extensive range of fittings and fastenings rounds off the system.

The system stands out due to the following features:

- Top quality and aesthetically pleasing
- Outstanding sound-insulating properties
- Patented REHAU sound-dampening brackets to reduce structure-borne sound transmission
- Noise-insulating pipe and fitting materials
- Increasing the air-borne sound insulation in the area of bend fittings through partially thickened elbows
- Optimum slip properties of the abrasion-resistant inner layer reduce the risk of blockage
- Excellent cold impact resistance, break resistance up to –10 °C
- High level of ultraviolet resistance, can be stored outside for up to two years
- High impact resistance – robust during transportation, storage and on the construction site

5.1.1 Residential buildings

RAUPIANO LIGHT is a universal system for unpressurised domestic drainage in accordance with ÖNORM EN 12056 and ÖNORM B 2501 for building construction, both as a standard drainage system without special sound insulation requirements as well as with low technical sound insulation requirements.
For example, in
- Detached house
- Apartment buildings
- Housing estates

5.1.2 Commercial projects

RAUPIANO LIGHT, it is also possible to integrate objects with special sound insulation requirements. Thanks to its noise-insulating properties, it represents a tailor-made solution in many areas, and satisfies the increasing needs of people for quiet and rest.

The pipe dimensions according to ÖNORM EN 1451 allow, for pipes and fittings with the same nominal diameter, the problem-free transition to HT according to ÖNORM EN 1451, or KG according to ÖNORM EN 1401, without special adapters being required.

Fig. 5-1 Compatibility with HT/KG systems

5.1.3 Commercial kitchens

As a collecting pipe, RAUPIANO LIGHT is suitable for carrying waste water containing grease away from commercial kitchens to the grease trap.

If the grease trap is a long distance away, the use of pipe trace heating may be necessary. This prevents the premature build-up of grease deposits. The temperature of the pipe trace heating suitable for polymer pipes must not exceed 45 °C.

5.1.4 Central vacuum cleaning system VACUCLEAN

Owing to its outstanding noise-insulating properties, and the abrasion-resistant inner layer having been optimised with regard to the slip properties, RAUPIANO LIGHT is particularly suitable as a piping system for central vacuum systems.
REHAU offers the central vacuum system VACUCLEAN, which consists of a central vacuuming unit, piping and fittings, fastenings and suction sockets. More detailed information on it can be found in the technical information “Central vacuum cleaning system VACUCLEAN” or on the Internet at www.rehau.com.

5.2 Application area

Fig. 5-2 RAUPIANO LIGHT pipes and fittings

The noise-insulating waste water system RAUPIANO LIGHT is suitable for the gravity drainage systems according to ÖNORM EN 12056 and ÖNORM B 2501 inside buildings.

The pipes, fittings and sealing elements can be used at up to 95° C (short-term). They are suitable for draining chemically aggressive waste water with a pH value of between 2 (acid) and 12 (alkaline).
The fire behaviour corresponds to E, normal flame-resistance as per EN 13501-1.
The pipe joints are leak-tight up to an inner water overpressure of 0.5 bar (5 m head of water).

Pipes and fittings must not be used for:
- Pipelines subject to a permanent load of more than 70° C (short-term 95° C)
- Pipelines which carry waste water containing benzene or benzol
- Exposed outside lines

For end pipes of ventilation piping, do not use RAUPIANO LIGHT, but UV-resistant pipes.

§ Observe all the generally applicable regulations relating to laying, installation, prevention of accidents and safety specifications when installing pipe systems, as well as the notes in this technical information.

Application areas not covered by this technical information (special applications) require consultation with our Technical Applications Department. Contact your REHAU sales office.

5.3 Pipe structure

These days, modern pipe systems have a multi-layer structure. With such a structure, desirable pipe properties can be tailored in a focused manner to the respective requirements.

RAUPIANO LIGHT 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.

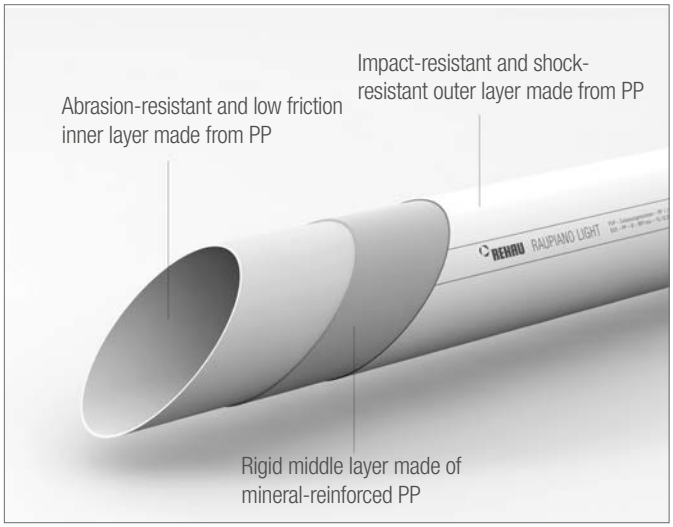


Fig. 5-3 Pipe structure of the RAUPIANO LIGHT

- RAUPIANO LIGHT – robust during transportation, storage and on the construction site
- Break resistance up to –10 °C
- Outdoor storage possible for up to two years
- Optimum hydraulic conditions. Deposits and incrustations are reliably prevented.
- High sound-insulating properties

These good properties are achieved through the three-layer structure of the pipe and the special adaptation of every individual layer to the respective requirements:
- High ring stiffness
- Elevated ultraviolet resistance
- Abrasion-proof and smooth inner layer
- Middle layer made of mineral-reinforced PP

5.4 Pipe fittings

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 the noise-related performance.

To minimise this risk and counteract the negative impact, the bends in the size range of nominal diameter DN 110 to DN 125 have been developed with targeted weight optimisation in the critical impact section. This further improves the acoustic performance by reducing the noise generation in the area of impact.

Fig. 5-4 RAUPIANO LIGHT elbow with reinforced area of impact

5.5 Sound insulation

The sound-insulating RAUPIANO LIGHT waste water system guarantees quality, quiet and living comfort in a central area of the building technology. During measurements carried out by the officially recognised Fraunhofer-Institut für Bauphysik (Frauenhofer Institute for Building Physics), Stuttgart, in line with current practice, RAUPIANO LIGHT achieved a sound pressure level significantly below that of most standard systems.

- Excellent sound insulation
- Optimised hydraulics thanks to extremely smooth and slippery inner layer
- Greater ease of installation due to tough outer layer
- Reliable installation at low temperatures
- Easy and efficient installation
  - Push-fit connection
  - Factory-fitted sealing rings
  - Cutting to size with common pipe cutters or fine saw
- Complete pipe and fittings product range
- Universally compatible with metric HT-PP system, connection to conventional metric HT and KG pipes without special adaptors
- Attractive design
- Clean white colour
- Eco-friendly as it can be recycled

5.6 System components

Pipes and fittings

- Made of mineral-reinforced RAU-PP
- Pigmented white (similar to RAL 9003)
- Nominal diameters DN 32, 40, 50, 75, 110, 125, 160
- Effective lengths from 150 mm to 3000 mm
- Complete fittings product range
  - Elbows from 15° to 87° (DN 90 to DN 125 in wall-thickened version)
  - Single branch
  - Double branch
  - Corner double branch
  - Parallel branch
  - Other special fittings

Sealing elements

The pipes and fittings are fitted with sealing rings in the factory in accordance with DIN 4060 and DIN EN 681-1.
Hardness: 60 ±5 Shore A
Material: styrene-butadiene-rubber (SBR)

Fastening elements

- Structure-borne sound-dampening support bracket Fig. 5-5)
- Guiding clamp with spacer (Fig. 5-6)
- Guiding clamp with quick release (Fig. 5-7)
- Fixing clamp (Fig. 5-8)

Fig. 5-5 Patented structure-borne sound-dampening support bracket

Fig. 5-6 Guiding clamp with spacer

Fig. 5-7 Guiding clamp with quick release

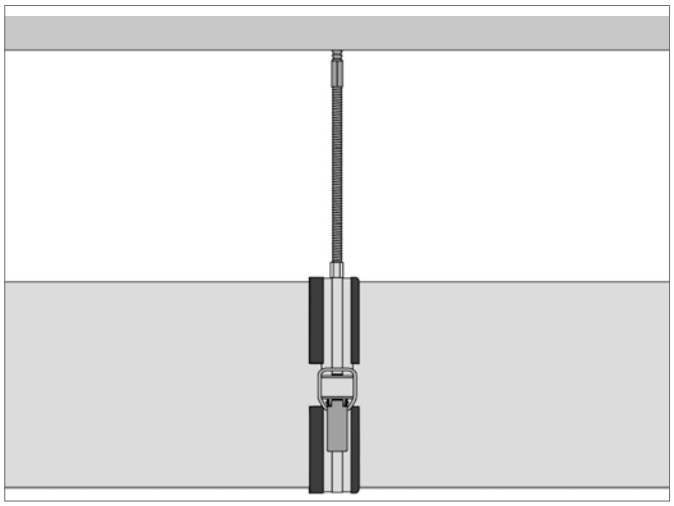


Fig. 5-8 Fixing clamp

Fire protection

§ The fire behaviour corresponds to E, normal flame-resistance as per EN 13501-1.
For lead-throughs of the RAUPIANO LIGHT pipe through fire-resistant ceilings or walls, compliance is required with the national fire protection regulations and the applicable respective building codes/constructions.

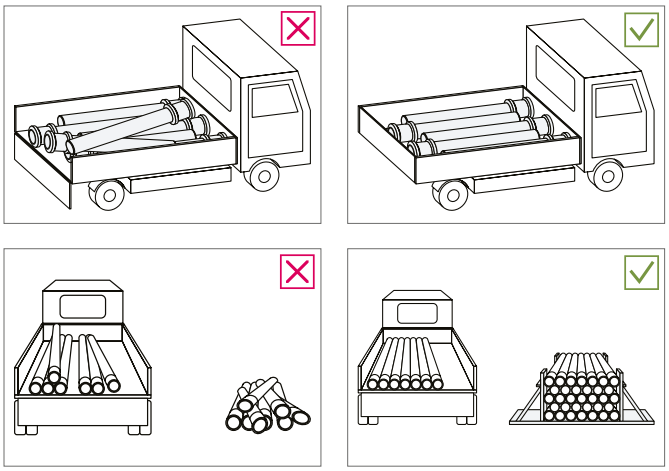
5.7 Supply form and storage

Supply form

- Pipes up to 500 mm and fittings in boxes
- Pipes measuring 1000 mm and above in timber frame crates

Transport

Because of its three-layer structure and its tough and impact-resistant structure, RAUPIANO LIGHT behaves in a robust manner during transport and at the construction site. Care must be taken that pipes are in contact over the entire length.

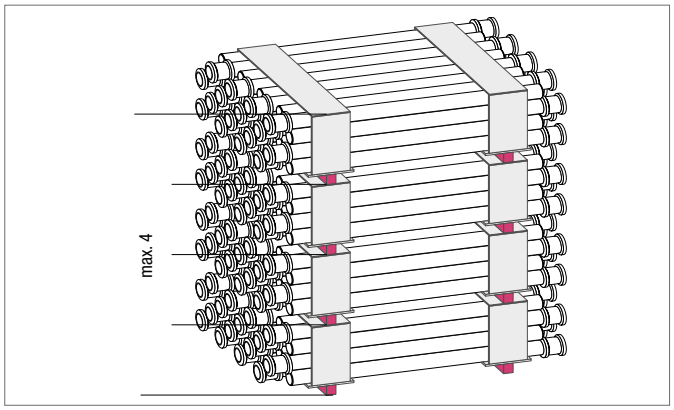


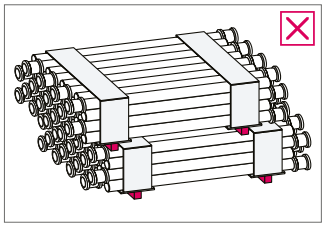
Storage

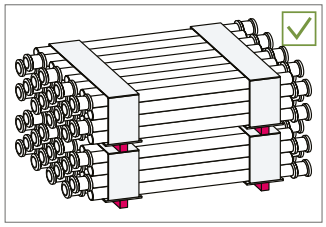
- Protect boxes from moisture during transport and storage.
- RAUPIANO LIGHT including its sealing elements can be stored outdoors for up to two years due to their UV-stability (Central Europe).

We recommend:

- Protecting RAUPIANO LIGHT pipes and fittings from direct sunlight and dirt
  - Keeping them in the box
  - Covering them with tarpaulins (ensure proper ventilation)
- Stack no more than four wooden crates on top of one another
- Ensure that the wood frames are aligned squarely when stacking
- Store the pipes in such a way that they are exposed and clear, and any deformation of the socket and spigot end is avoided







5.8 Identification

Pipes and fittings are marked with:
- The manufacturer's logo
- Authorisation number
- Certification mark
- Nominal diameter (DN)
- Year of manufacture
- Manufacturing plant
- Material
- Angle specification (for bends and branches)

5.9 Recycling

RAUPIANO LIGHT pipes and fittings are 100% recyclable.

5.10 Warranty

For the waste water system RAUPIANO LIGHT, there is a warranty available in the framework of the legal regulations in force nationally.

6 RAUPIANO PLUS AND RAUPIANO LIGHT OVERVIEW

	RAUPIANO PLUS	RAUPIANO LIGHT
Pressureless domestic drainage	as per ÖNORM EN 12056 and ÖNORM B 2501	as per ÖNORM EN 12056 and ÖNORM B 2501
Groundwater drainage	as per ÖNORM EN 752 and ÖNORM B 2501	–
Nominal diameters	DN 32 – DN 200	DN 32 – DN 160
Sound insulation	highly noise-insulating ÖNORM B 8115-2 / DIN 4109 VDI-Directive 4100:2007 Sound insulation level III	noise-insulating ÖNORM B 8115-2 / DIN 4109 VDI Directive 4100:2007 Sound insulation level II
Material density	1.9 g/cm^3	1.2 g/cm^3
Range of application		
Residential buildings	Building construction sector as per ÖNORM EN 12056 and ÖNORM B 2501 Detached house Apartment buildings Housing estates	Building construction sector as per ÖNORM EN 12056 and ÖNORM B 2501 Detached house Apartment buildings Housing estates
Large projects	Buildings with increased sound insulation requirements (VDI Directive 4100:2007 Sound insulation level III) Hotels Office buildings Hospitals	Buildings with special sound insulation requirements as per standard VDI Directive 4100:2007 Sound insulation level II
Below ground installations	inside and outside the building structure; radon-tight up to 0.2 bar	–
Commercial kitchens	Collecting and main pipe	Collecting pipe
Extract ventilation	in detached and semi-detached dwellings for decentralised and centralised extract ventilation of bathrooms, toilet rooms and kitchens	–
Central vacuum cleaning system VACUCLEAN	suitable	suitable
Minimal installation temperature	up to –10 °C "Ice crystal" as per ÖNORM EN 1451 and ÖNORM EN 1411	up to –10 °C
Fire protection	Fire protection behaviour corresponds to construction material class D-s2, d0 according to EN 13501-1 REHAU fire stop collars FP can be used	Fire protection behaviour corresponds to construction material class E according to EN 13501-1

Tab. 6-1

Other properties of RAUPIANO PLUS and RAUPIANO LIGHT, see the chapter „4 System description for the RAUPIANO PLUS“, page 11 and „5 System description of the RAUPIANO LIGHT“, page 19.

7 SOUND INSULATION

7.1 Fundamentals

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.

Most common sources of noise are:
- Taps and mixers when running
- Filling baths, sinks, etc.
- Flushing
- Filling WC cisterns, etc.
- Redirecting water flow

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 sound

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.

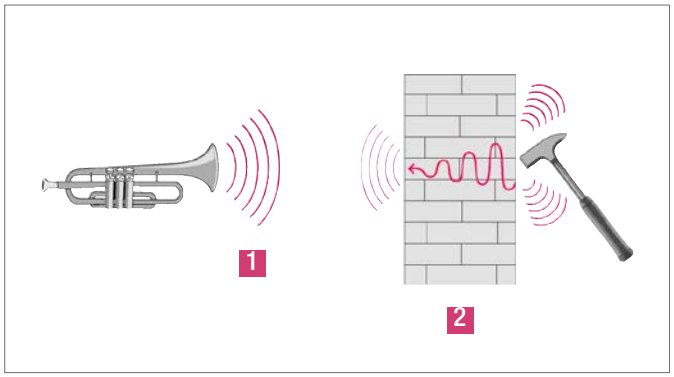


Fig. 7-1 Air-borne and structure-borne sound

1 Air-borne noise

2 Structure-borne sound

7.2 Noise reduction with RAUPIANO PLUS and RAUPIANO LIGHT

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 turbulences 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 a sound-insulated waste water system, both types of noise transmission must be considered.

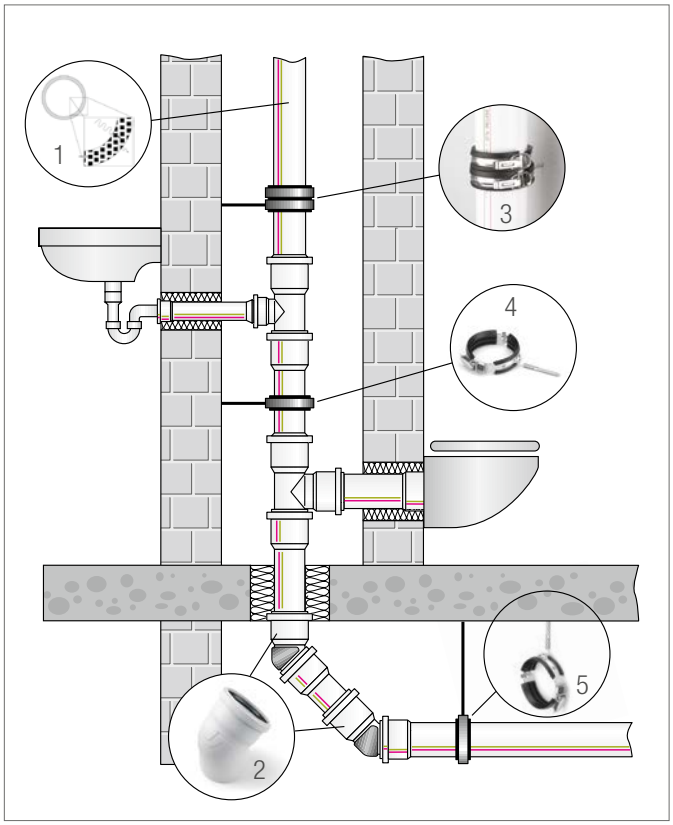


Fig. 7-2 Minimisation of noise

Reduction in airborne sound through

1 Specially formulated pipe and fitting materials

2 Pipe bend with mass optimisation of fittings

Minimisation of structure-borne sound by way of:

3 Patented structure-borne sound-dampening bracket

4 Optimised guiding clamp

5 Fixing clamp with rubber lining

7.2.1 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 nominal diameter DN 90 to DN 125 with targeted mass optimisation in critical areas further improve the acoustic performance.

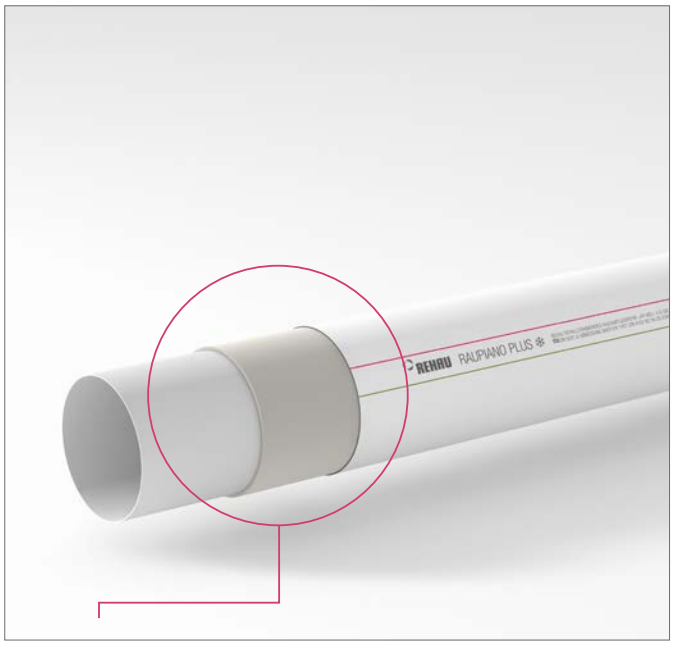


Fig. 7-3 Multi-layer technology

Multi-layer technology

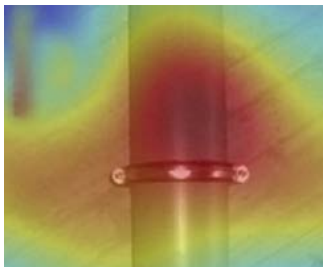
The exceptionally rigid middle layer of the pipes with sound-absorbing filler materials increases the mass (pipe density 1.9 g/cm^3 of RAUPIANO PLUS, pipe density 1.2 g/cm^3 of RAUPIANO LIGHT), substantially reducing the sound level.

Pipe bend with air-borne sound-dampening mass optimisation

Reinforced-wall fittings with optimised fluidics reduce the impact noises in the critical bend areas of vertical stack drainage pipes to a minimum.

Mass optimisation in pipe bend

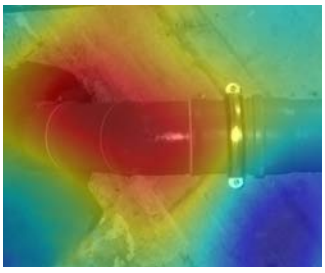
RAUPIANO PLUS



Standard HT-PP

Lowest noise level — Highest noise level

RAUPIANO PLUS

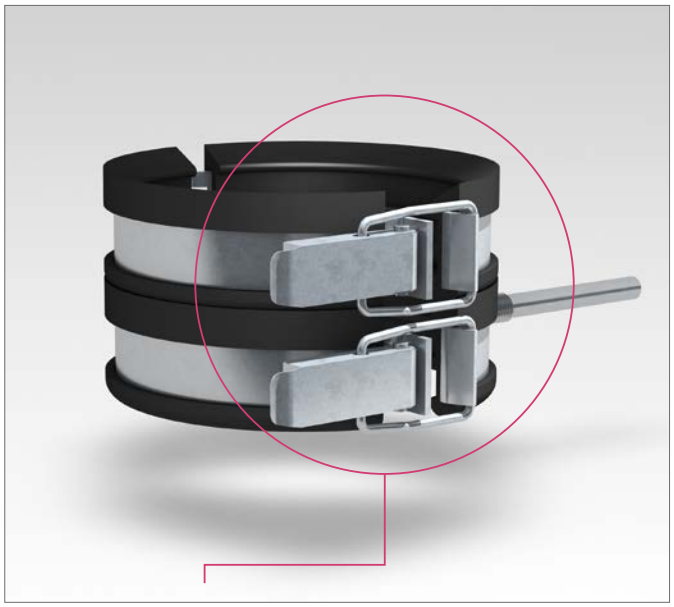


Standard HT-PP

Lowest noise level — Highest noise level

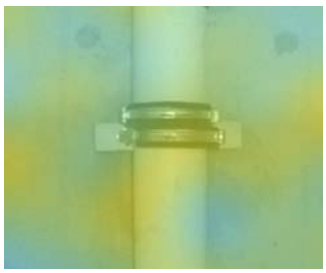
7.2.2 Structure-borne sound insulation

The transmission of structure-borne sound into the installation wall is reduced with the use of patented sound-dampening brackets:
- A supporting bracket with merely a loose fit around the pipe is fixed to the wall
- A fixing bracket without a tight fit rests on the supporting bracket, locking the pipe into position

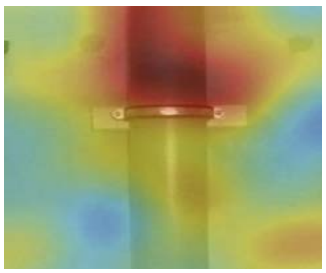


Patented structure-borne sound-dampening bracket

The fastening technology sets up the joint to the installation wall. Therefore, particular importance is attached to it. Through the use of the patented, high noise-insulating fastening clamp, consisting of a supporting clamp and a fixing bracket, structure-borne sound transmission to the installation wall is significantly reduced.



RAUPIANO PLUS



Standard HT-PP

Lowest noise level — Highest noise level

Through this mostly mechanical decoupling of the pipe, brackets and installation wall from each other, the transmission of structure-borne sound is disrupted substantially (see chapter 12 on page 66).

Structure-borne sound bridges negatively impact the sound reduction of any sound insulation system.
- Prevent the pipes from coming into direct contact with the wall.
- Prevent possible structure-borne sound bridges through other trades.
- Only use brackets that are optimised for RAUPIANO PLUS and RAUPIANO LIGHT.

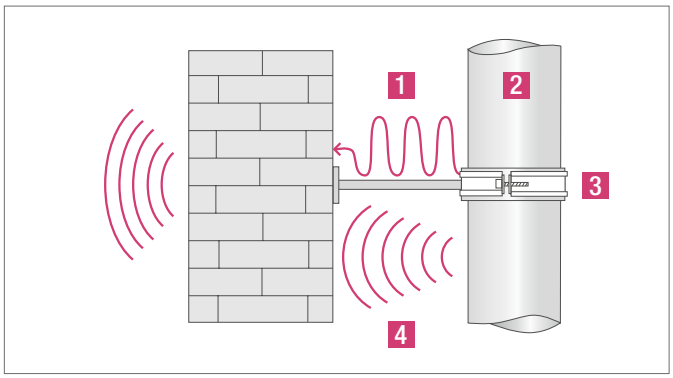


Fig. 7-4 Sound transmission in waste water system

1 *Structure-borne sound*
2 *Standard soil and waste pipe*
3 *Standard fixing method (bracket clamp with/without rubber lining)*
4 *Air-borne sound*

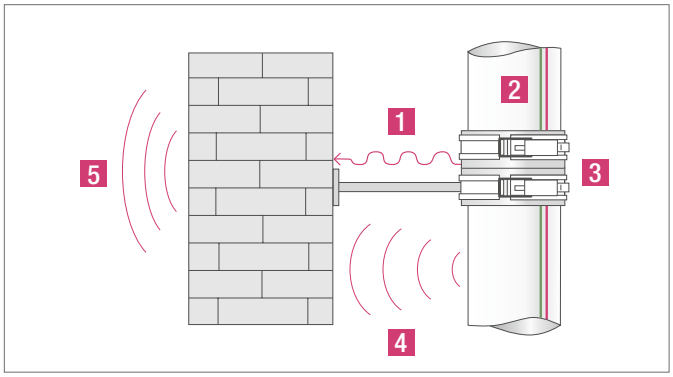


Fig. 7-5 Sound insulation with RAUPIANO PLUS and RAUPIANO LIGHT

1 *Structure-borne sound insulation*
2 *RAUPIANO PLUS and RAUPIANO LIGHT pipe with sound-dampening fillers*
3 *RAUPIANO PLUS or RAUPIANO LIGHT bracket, patented structure-borne sound-dampening support bracket*
4 *Air-borne sound insulation*
5 *Sound insulation in accordance with the VDI Directive 4100:2007 or DIN 4109*

7.3 Sound insulation requirements

There are currently the following 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)
- VDI Directive 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 LAFmax (Tab. 7-1) given in the following table.

Type of noise	Maximum permissible system noise level $L_{AFmax,nT}$ 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, WC flushing, other drain noises) etc.	≤ 30	≤ 25

Tab. 7-1 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 LAFmax according to Tab. 7-1 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 requirements for rooms requiring insulation located in another apartment. These include:
- Bedrooms
- Living spaces
- Class rooms
- Working rooms (offices, treatment rooms, meeting rooms)

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 from noise. It sets maximum limits for noise, which must be observed to protect people in living areas from the nuisance of noise.

§ In terms of public law, DIN 4109 constitutes a minimum requirement. Greater sound insulation requirements are defined in supplement 2 of DIN 4109.

VDI Directive 4100

The VDI Directive 4100 stipulates stricter noise 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 one's own living space into account (water supply and waste water systems combined (see Tab. 7-2).

§ The VDI Directive 4100 is not legally binding, but it provides guidance and, as such, enjoys a high degree of recognition from 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. 7-2 Sound insulation requirements according to VDI Directive 4100:2007

* corresponds to DIN 4109 – supplement 2, edition 2001

Sound 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 limits of DIN 4109 relate to individual components, VDI 4100:2012 does take the geometry of the space (spatial volume and partition wall area) and a defined reverberation time into account ($\overline{L_{AFmax,nT}}$). 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 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 apartment buildings

Standards/guidelines	$L_{AFmax,n}$ component-related performance indicator		$\overline{L_{AFmax,nT}}$ space-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 noise protection as per supplement 2	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)

7.4 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 to a European standard.

To determine the acoustic performance, RAUPIANO PLUS waste system was tested by the independently certified Fraunhofer Institute for Building Physics in Stuttgart 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 RAUPIANO PLUS 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 supplement 2 (DIN 4109).

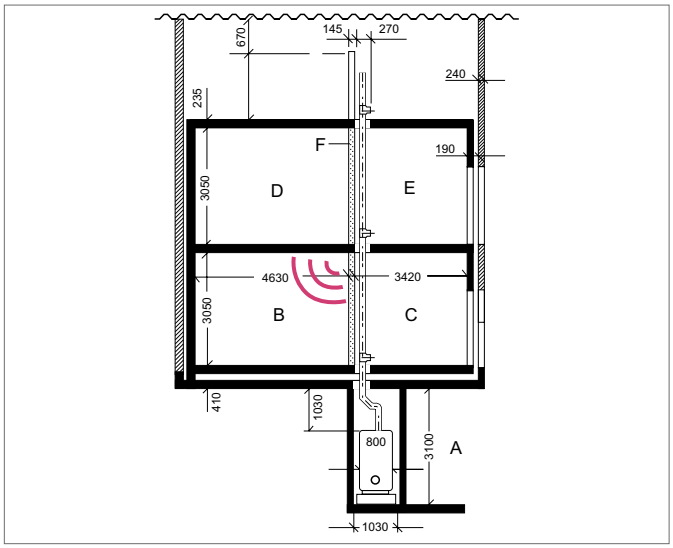


Fig. 7-6 Test facility of the Fraunhofer Institute for Building Physics (all dimensions in mm)
A Basement
B Lower level, rear
C Lower level, front
D Ground level, rear
E Ground level, front
F Installation wall (area weight 220 kg/m²)

7.5 Measurement results

The values measured in the noise-protected room (room B in Fig. 7-6) are shown in the below chart (source: test report P-BA 274/2016 and P-BA 275/2016).
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, RAUPIANO PLUS is able to fulfil the requirements of VDI 4100 directive.

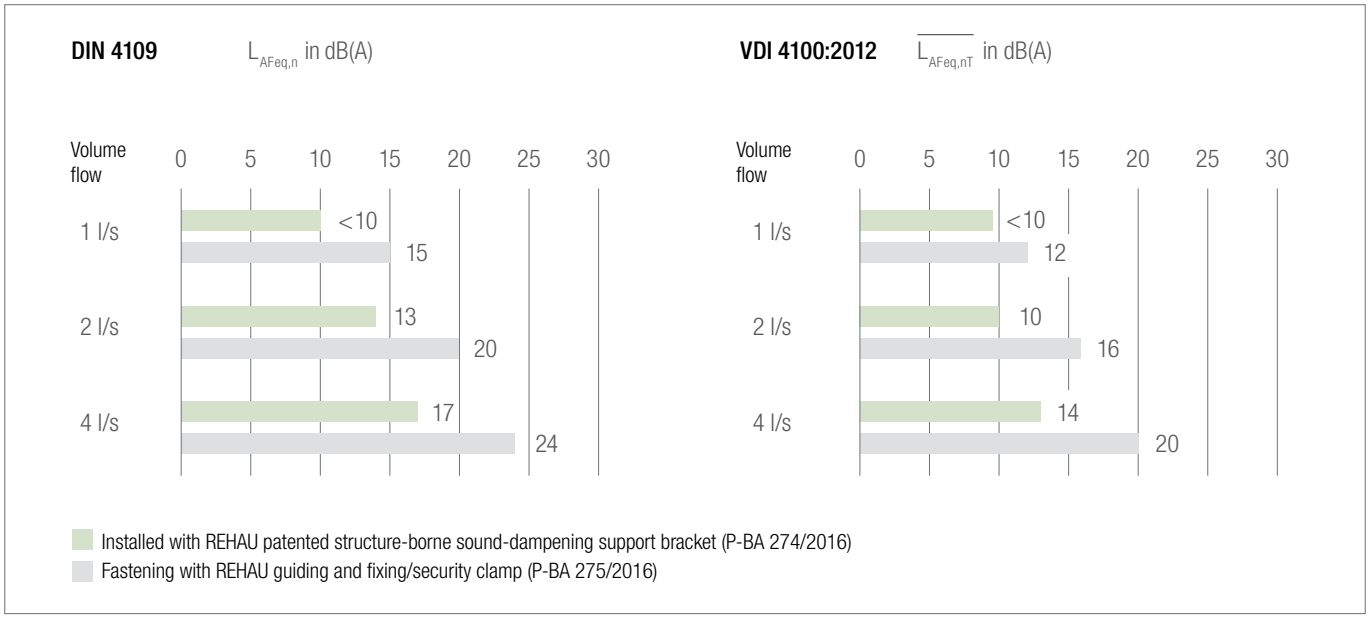


Fig. 7-7 Measurement results

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 $_{LAFmax}$. At the test facility, all tests measuring the noises from soil & waste system 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. 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.

7.6 Sound measurements of complete installation systems

The results are based on:
- Objective and independent tests carried out in the Fraunhofer Institute test facility in Stuttgart
- Construction and installation done by independent local installers and builders
- Variety of wall structures (light and/or heavy weight)
- Toilet fixtures includes flushing technology (7 l flush volume)
- RAUTITAN water supply pipes (riser and distribution/connecting pipes)
- RAUPIANO PLUS soil & waste system (vertical stack and branch line)
- Ceiling thickness of 19 cm

$L_{AFmax,n}$			$\overline{L_{AFmax,nT}}$			
Result per	Requirements acc. to		Result per	Requirements acc. to		
DIN 4109-2016	DIN 4109-2016	DIN 4109-2016 Supplement 2	VDI 4100-2012	VDI 4100-2012 SIL I	VDI 4100-2012 SIL II	VDI 4100-2012 SIL III
24 dB(A)	≤ 30 dB(A)	≤ 25 dB(A)	22 dB(A)	≤ 30 dB(A)	≤ 27 dB(A)	≤ 24 dB(A)
Assessment	☑	☑ / ☒	Assessment	☑	☑	☑ / ☒

☒ *Only wet construction of solid wall with Supplement 2 and SIL III respectively*

Front-wall installation in front of drywall (Knauf WM 112)

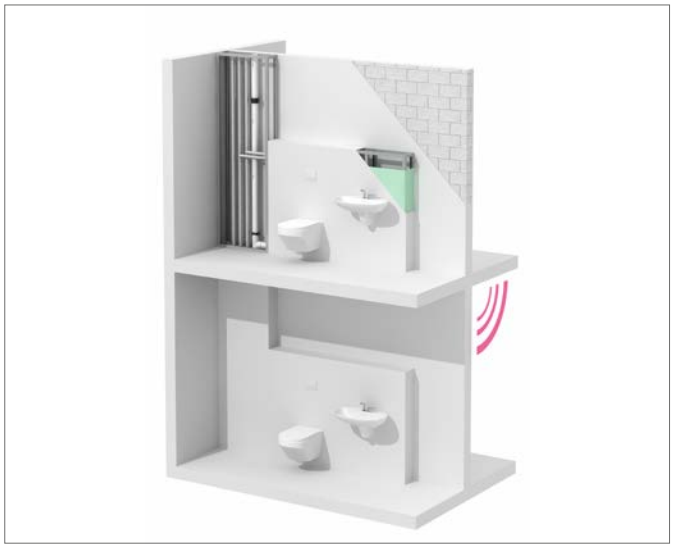
Installation sound level incl. Flushing technology	$L_{AFmax,n}$ = 19 dB(A)	$\overline{L_{AFmax,nT}}$ = 15 dB(A)
DIN 4109/A1	☑	
DIN 4109/supplement 2	☑	
VDI 4100: 2012 Sound insulation levell III		☑

Test report number P-BA 43-1/2012

Embedded installation in space-enclosing drywall (Knauf WM 116)

Installation sound level incl. Flushing technology	$L_{AFmax,n}$ = 22 dB(A)	$\overline{L_{AFmax,nT}}$ = 19 dB(A)
DIN 4109/A1	☑	
DIN 4109/supplement 2	☑	
VDI 4100: 2012 Sound insulation levell III		☑

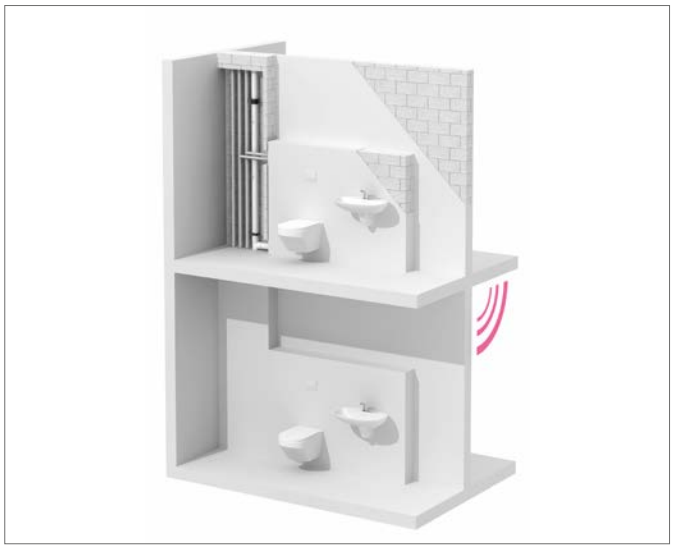
Test report number P-BA 44-1/2012



Front-drywall installation in front of solid wall

Installation sound level	$L_{AFmax,n}$ = 25 dB(A)	$\overline{L_{AFmax,nT}}$ = 22 dB(A)
DIN 4109 / A1	☑	
DIN 4109/ supplement 2	☑	
VDI 4100: 2012 Sound insulation levell III		☑

Test report number P-BA 42-1/2012



Front-solidwall installation in front of solid wall

Installation sound level	$L_{AFmax,n}$ = 30 dB(A)	$\overline{L_{AFmax,nT}}$ = 27 dB(A)
DIN 4109 / A1	☑	
DIN 4109 /supplement 2	☒	
VDI 4100: 2012 Sound insulation levell II		☑
VDI 4100: 2012 Sound insulation levell III		☒

Test report number P-BA 41-1/2012

7.7 Sound measurement of suspended ceiling installations

To provide guidance in installing RAUPIANO PLUS above suspended ceiling within sound-protected room, tests were carried out in collaboration with the companies Knauf Gips KG and L'ISOLANTE K-FLEX GmbH at the Fraunhofer Institute. The acoustic performance of three different configurations were evaluated. Measurements were taken in the same room as the suspended ceiling was installed (see test schematic).

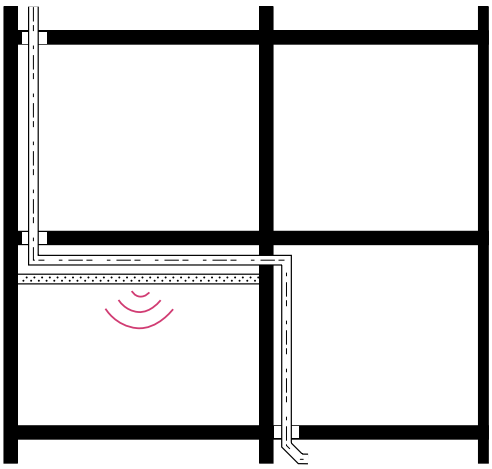
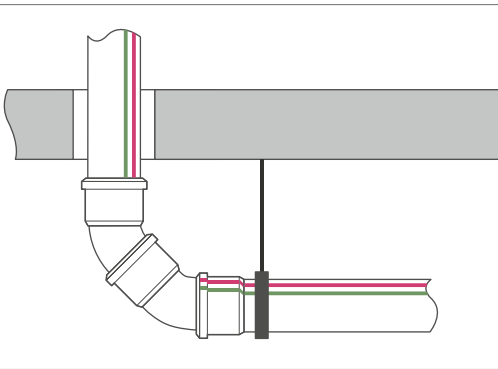


Fig. 7-8 Structural diagram for the installation test facility at the Fraunhofer Institute for Building Physics

Test report number P-BA 72/2017

The measurement results were determined in accordance with DIN 4109 based on DIN EN 14366 at different flow rates as $L_{AFeq,n}$ in dB(A).

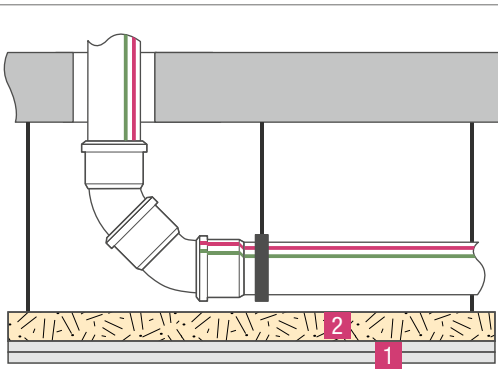


Without suspended ceiling

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{AFeq,n}$ [1)]	46 dB(A)	54 dB(A)	56 dB(A)	58 dB(A)
$\overline{L_{AFeq,nT}}$ [2)]	45 dB(A)	53 dB(A)	55 dB(A)	57 dB(A)

[1)] on the basis of DIN 4109

[2)] on the basis of VDI 4100



Suspended Ceiling

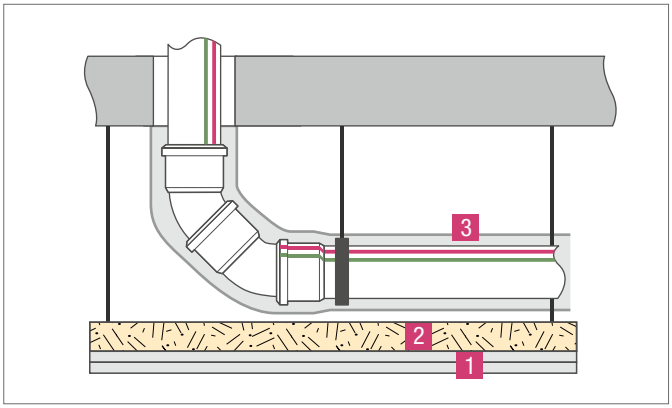
Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{AFeq,n}$ [1)]	10 dB(A)	17 dB(A)	20 dB(A)	23 dB(A)
$\overline{L_{AFeq,nT}}$ [2)]	<10 dB(A)	17 dB(A)	20 dB(A)	23 dB(A)

[1)] on the basis of DIN 4109

[2)] on the basis of VDI 4100

1 *Suspended ceiling, 2 x Knauf Silentboard GKF 12.5*

2 *Mineral wool Knauf, 40 mm TP 115*



1 *Suspended ceiling, 2 x Knauf Silentboard GKF 12.5*
2 *Mineral wool Knauf, 40 mm TP 115*
3 *RAUPIANO PLUS with acoustic pipe insulation K-Flex K-Fonik ST GK 072 + alu*

Suspended ceiling with insulated RAUPIANO plus

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{AFeq,n}$ [1)]	<10 dB(A)	<10 dB(A)	12 dB(A)	16 dB(A)
$\overline{L_{AFeq,nT}}$ [2)]	<10 dB(A)	<10 dB(A)	12 dB(A)	16 dB(A)

1) on the basis of DIN 4109
2) on the basis of VDI 4100

7.8 Sound measurements of pipe shaft enclosures

Tailored room designs always demand specialised solutions for installing sewer pipes. One such example is the installation of a vertical drainage stack through a sound-protected room within the same or in another apartment Such cases requires acoustically-rated pipe shaft enclosures. The differences in noise generation by different enclosure configurations are detailed below. The measurement results were determined in accordance with DIN 4109 based on DIN EN 14366 at different flow rates as $L_{AFeq,n}$ in dB(A). Measurements were taken in the front basement room.

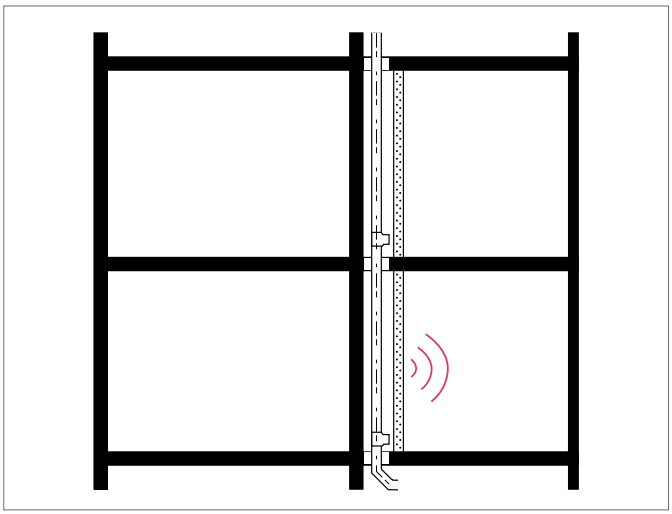
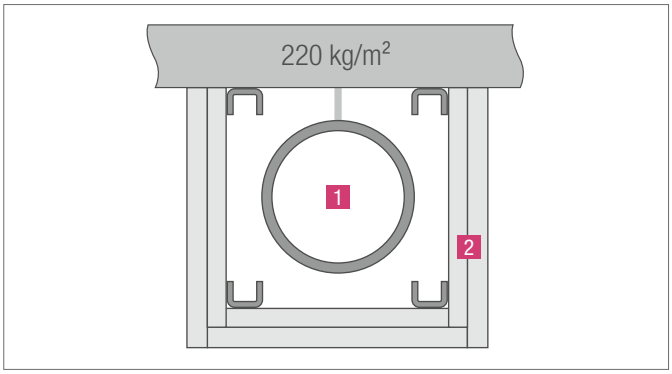


Fig. 7-9 Structural diagram for the installation test facility at the Fraunhofer Institute for Building Physics

Solid wall: Test report number P-BA 70/2017
Lightweight wall: Test report number P-BA 71/2017

Three different enclosure configurations (40 x 40 cm) were tested on both a solid wall (220 kg/m²) and a drywall.

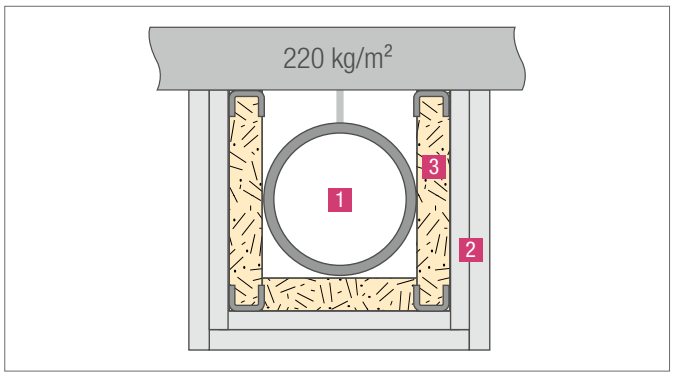


1 *RAUPIANO PLUS*
2 *2 x 12.5 mm Knauf structural panel 12.5*

Solid wall: enclosure consists of Knauf structural panel

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{AFeq,n}$ [1)]	19 dB(A)	22 dB(A)	25 dB(A)	28 dB(A)
$\overline{L_{AFeq,nT}}$ [2)]	16 dB(A)	20 dB(A)	23 dB(A)	26 dB(A)

1) on the basis of DIN 4109
2) on the basis of VDI 4100

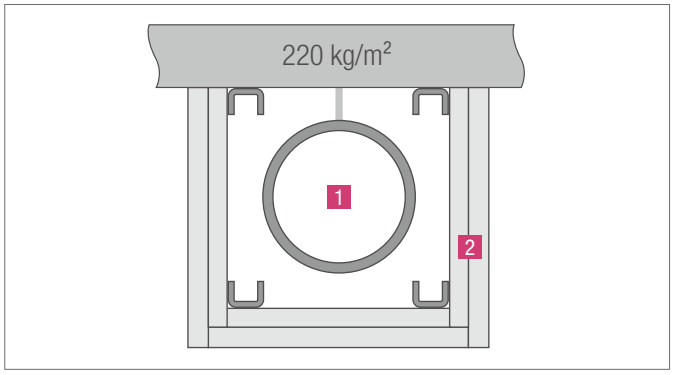


1 *RAUPIANO PLUS*
2 *2 x 12.5 mm Knauf structural panel 12.5*
3 *40mm Mineral wool slab Knauf TP 115*

Solid wall: enclosure consists of Knauf structural panel and mineral wool

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{AFeq,n}$ [1)]	<10 dB(A)	13 dB(A)	15 dB(A)	20 dB(A)
$\overline{L_{AFeq,nT}}$ [2)]	<10 dB(A)	11 dB(A)	13 dB(A)	18 dB(A)

1) on the basis of DIN 4109
2) on the basis of VDI 4100

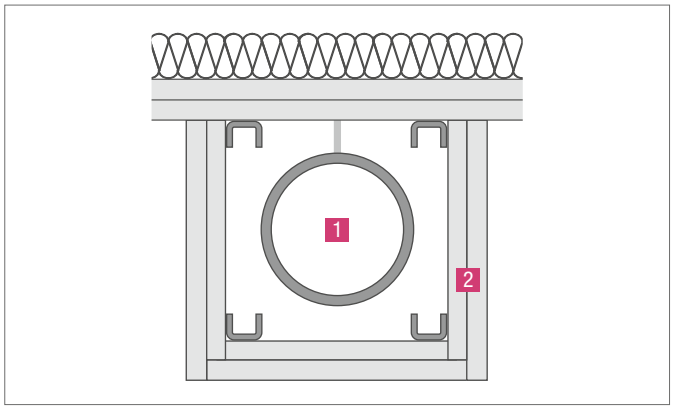


1 *RAUPIANO PLUS*
2 *2 x 12.5 mm Knauf structural panel 12.5*

Solid wall: enclosure consists of Knauf Silentboard

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{AFeq,n}$ [1)]	13 dB(A)	17 dB(A)	20 dB(A)	23 dB(A)
$\overline{L_{AFeq,nT}}$ [2)]	11 dB(A)	14 dB(A)	17 dB(A)	21 dB(A)

1) on the basis of DIN 4109
2) on the basis of VDI 4100

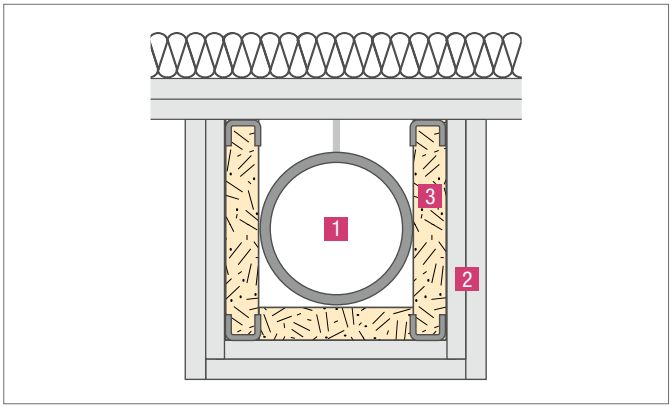


1 *RAUPIANO PLUS*
2 *2 x 12.5 mm Knauf Wallboard 12.5*

Knauf lightweight wall W 112: enclosure made of Knauf structural panel

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{AFeq,n}$ [1)]	21 dB(A)	26 dB(A)	28 dB(A)	31 dB(A)
$\overline{L_{AFeq,nT}}$ [2)]	20 dB(A)	25 dB(A)	27 dB(A)	30 dB(A)

1) on the basis of DIN 4109
2) on the basis of VDI 4100

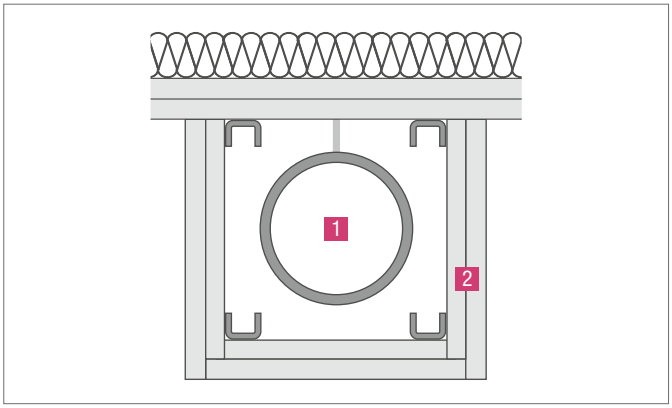


1 *RAUPIANO PLUS*
2 *2 x 12.5 mm Knauf structural panel 12.5*
3 *40mm Mineral wool slab Knauf TP 115*

Knauf lightweight wall W 112: enclosure made of Knauf structural panel and mineral wool

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{AFeq,n}$ [1)]	13 dB(A)	18 dB(A)	23 dB(A)	27 dB(A)
$\overline{L_{AFeq,nT}}$ [2)]	12 dB(A)	17 dB(A)	21 dB(A)	25 dB(A)

1) on the basis of DIN 4109
2) on the basis of VDI 4100



1 *RAUPIANO PLUS*
2 *2 x 12.5 mm Knauf structural panel 12.5*

Knauf lightweight wall W 112: enclosure made of Knauf Silentboard

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{AFeq,n}$ [1)]	17 dB(A)	22 dB(A)	24 dB(A)	27 dB(A)
$\overline{L_{AFeq,nT}}$ [2)]	16 dB(A)	20 dB(A)	23 dB(A)	26 dB(A)

1) on the basis of DIN 4109
2) on the basis of VDI 4100

8 FIRE PROTECTION

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

⚠ This chapter applies exclusively to RAUPIANO PLUS!

§ The fire behaviour of RAUPIANO PLUS corresponds to construction material class D-s2, d0 according to EN 13501-1.

8.1 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 zones to be able to supply drinking water and heat to the building. Therefore, the utmost care has to be taken to fall back on only tested system solutions.

8.2 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.

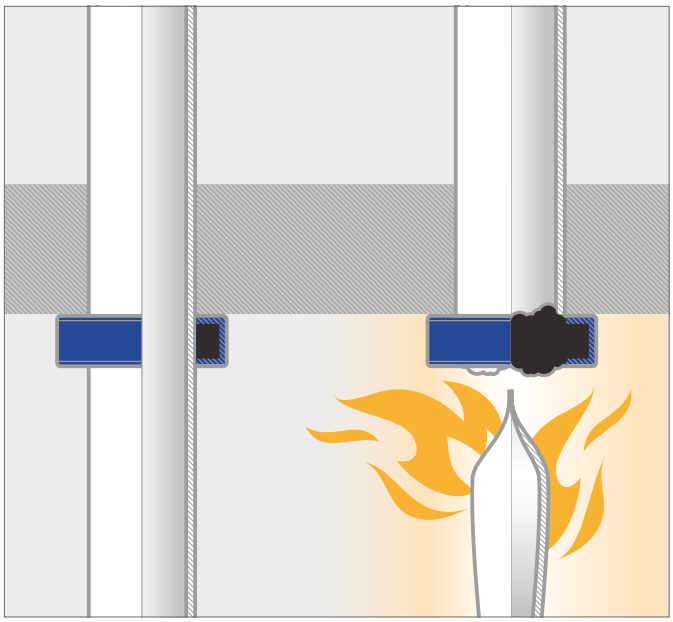


Fig. 8-1 Compartmentalisation principle

8.3 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 without injuries, or can be rescued in some other way

8.4 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 protection collars are fastened to a solid wall by screwing to the wall or ceiling. On light partition walls, the fire protection collars must be fastened on both sides 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.

The annular gap between the pipe and the collar is covered by means of a suitable insulating foil (≤ 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.

8.5 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.

8.6 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.

8.7 Fire stop collars

Detailed descriptions of the legal requirements currently in force and other information on the subject of fire protection can be found in the section “Fire protection” (see p. 91).

The following fire stop collars are available for the fire protection for ceiling and wall breakthroughs of RAUPIANO PLUS 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 slanted breakthroughs
  - 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


REHAU Gesellschaft m.b.H.
Industriestraße 17
A-2353 Guntramsdorf
www.rehau.com

REHAU
Unlimited Polymer Solutions

Brandabschottung gemäß EN 13501 - 2

System: _____

Klassifikationsbericht / ETA: _____

Feuerwiderstandsdauer: _____

Einbaudatum: _____

Ausführender Betrieb: _____

Diese Abschottung darf nicht beschädigt werden. Bei Beschädigungen umgehend den Hersteller der Abschottung oder die Werksleitung, Abteilung Sicherheit, Hausverwaltung etc. benachrichtigen.

Fig. 8-2 Identification plate of the fire protection system

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

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.

9 PLANNING

9.1 Planning guidelines

For the planning and installation of RAUPIANO PLUS and RAUPIANO LIGHT waste water pipes and fittings, the standards ÖNORM EN 12056 Gravity drainage systems inside buildings, ÖNORM EN 752 Drain and sewer systems outside buildings as well as ÖNORM B 2501 Drainage systems for buildings and property lots are relevant.

The objective is to ensure the intended function of the RAUPIANO PLUS and RAUPIANO LIGHT 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

A standard-conformant design is ensured using of our planning software RAUCAD.

The following standards are applicable for the planning and installation of RAUPIANO PLUS and RAUPIANO LIGHT:
- ÖNORM B 2501, Drainage systems for buildings and property lots
- ÖNORM EN 12056, Gravity drainage systems inside buildings
- ÖNORM EN 752 Drain and sewer systems outside buildings (only RAUPIANO PLUS)

9.2 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.

9.3 Measurement

The following planning documents are presented with the REHAU RAUPIANO PLUS and RAUPIANO LIGHT outer diameter (d_e) and with nominal diameter (DN) in accordance with ÖNORM EN 12056 or ÖNORM B 2501 respectively.

The comparison of the nominal diameter with the REHAU RAUPIANO PLUS and RAUPIANO LIGHT outer and internal diameters can be seen in Tab. 9-1 .

Nominal diameter	Minimum internal diameter	Outer diameter REHAU RAUPIANO PLUS and RAUPIANO LIGHT	Internal diameter REHAU RAUPIANO PLUS and RAUPIANO LIGHT
DN	d_{imin} (mm)	d_e (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
200	184	200	187.6

Tab. 9-1 Comparison of nominal diameter with REHAU RAUPIANO PLUS and RAUPIANO LIGHT 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 system 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	1.0
WC with 4.0 l flush tank	**	1.8	**	**
WC with 6.0 l flush tank	2.0	1.8	1.2 to 1.7***	2.0
WC with 7.5 l flush tank	2.0	1.8	1.4 to 1.8***	2.0
WC with 9.0 l flush tank	2.5	2.0	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	-	1.0
Floor drain DN 100	2.0	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. 9-2

Run-off coefficient (K)

The run-off coefficient (K) 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	K
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. 9-3

9.4 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)
K = run-off coefficient
ΣDU = total of the installed load

The system I in combination with irregular use (K) is the system that occurs the most frequently in Austria.

System I with K=0.5 (blocks of flats, bed-and-breakfast places, offices)

Drainage system object	Single connection pipe	Single connection pipe	DU
	DN	d_e (mm)	(l/s)
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	2.0
WC with 7.5 l flush tank	90	90	2.0
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	2.0

* per person
** not approved

Tab. 9-4

9.5 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 (K); 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

a. Of the calculated waste water discharge (Q_{ww})
   or
b. The total waste water discharge (Q_{tot})
   or
c. The waste water discharge of the biggest drainage object (DU value).

Example:
System I
Building type: irregular use K = 0.5
Drainage object: WC with 7.5 l flush tank DU = 2 l/s

$Q_{ww} = K \times \sqrt{\Sigma DU}$
$Q_{ww} = 0.5 \times \sqrt{2}$
$Q_{ww} = 0.71$ l/s

Comparison of Q_{ww} and DU value

$Q_{ww} < DU$
0.71 l/s < 2 l/s

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

Q_{max} = 2 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.

9.6 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.

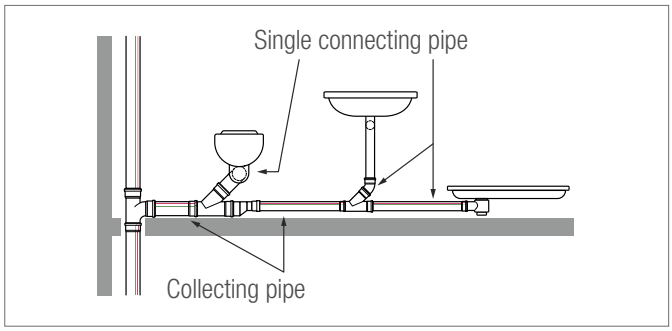


Fig. 9-1 Connecting pipe types

9.6.1 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
0.40	*	*
0.50	40	40
0.80	50	50
1.00	60	75
1.50	70	75
2.00	80**	90**
2.25	90***	90***
2.50	100	110

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

Tab. 9-5

Application limits
The unventilated single connecting pipes are subject to the following 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. 9-6

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.

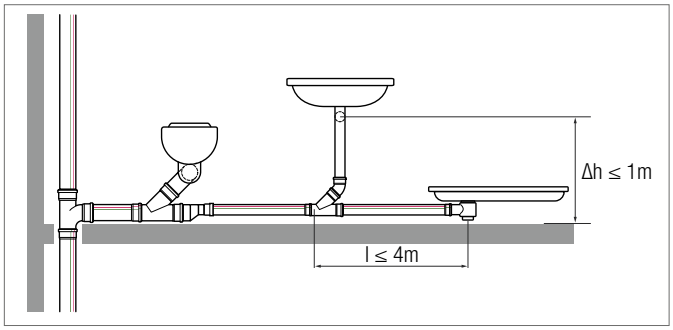


Fig. 9-2 Application limits, unventilated single connecting pipes

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°.

9.6.2 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
	Connection/ventilation	
0.60	*	*
0.75	50/40	50/40
1.50	60/40	75/40
2.25	70/50	75/50
3.00	80/50**	90/50**
3.40	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. 9-7

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. 9-8

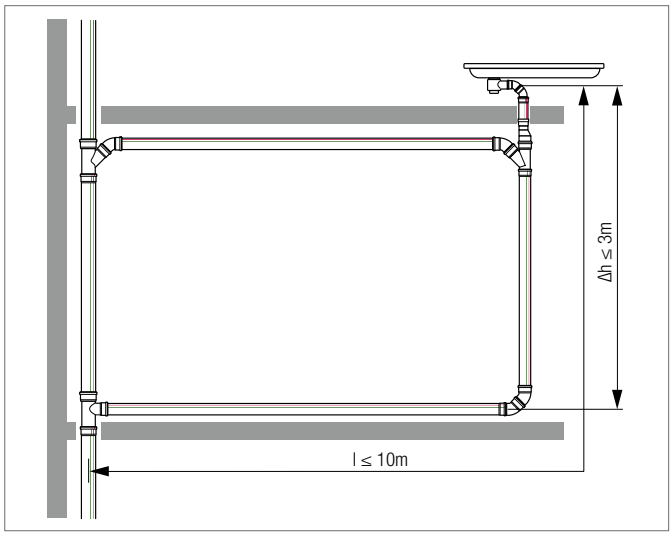


Fig. 9-3 Application limits, ventilated single connecting pipes

9.7 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
I	1 x Q_{tot}

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. 9-9

9.8 Collecting pipes

9.8.1 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.

9.8.2 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.

9.8.3 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[a]	Collective connecting pipe, ventilated[b]	Dimensions		Ventilation	
DU	ΣDU	ΣDU	DN	d_e	DN	d_e
l/s	l/s	l/s	-	mm	-	mm
0,5	1,0	2,0	50	50	40	40
0,8	1,5	2,2	50	50	40	40
0,8	2,0	3,0	60	75	40	40
1,5	3,0	4,5	70	75	50	50
2,0	6,0	8,0	90[c]	90	60	75
2,5	15,0	25,0	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. 9-10

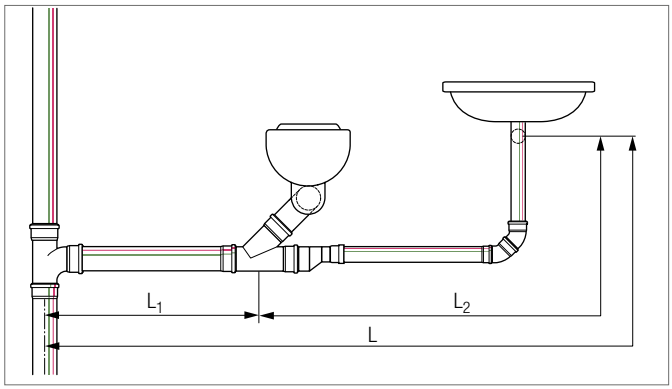


Fig. 9-4 Maximum lengths of single and collecting pipes

L_1 Length of the collecting pipes
L_2 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	Maximum length for ventilated connecting pipes
	m	m
Single connecting pipe with length L_2	4	10
Collecting pipe with length L_1	4	10
Total of collective connecting pipe and single connecting pipe with total length L	4	10

Tab. 9-11

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

9.9 Planning waste water downpipes

9.9.1 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		System I Q_{max} (l/s)	
DN	d_e	Branches	Branches max. flow
90*	90*	2.7	3.5
100**	110**	4.0	5.2
125	125	5.8	7.6
150	160	9.5	12.4
200	200	16.0	21.0

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

Tab. 9-12

Fig. 9-5 RAUPIANO branch max. flow

Fig. 9-6 RAUPIANO single branch

9.9.2 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.

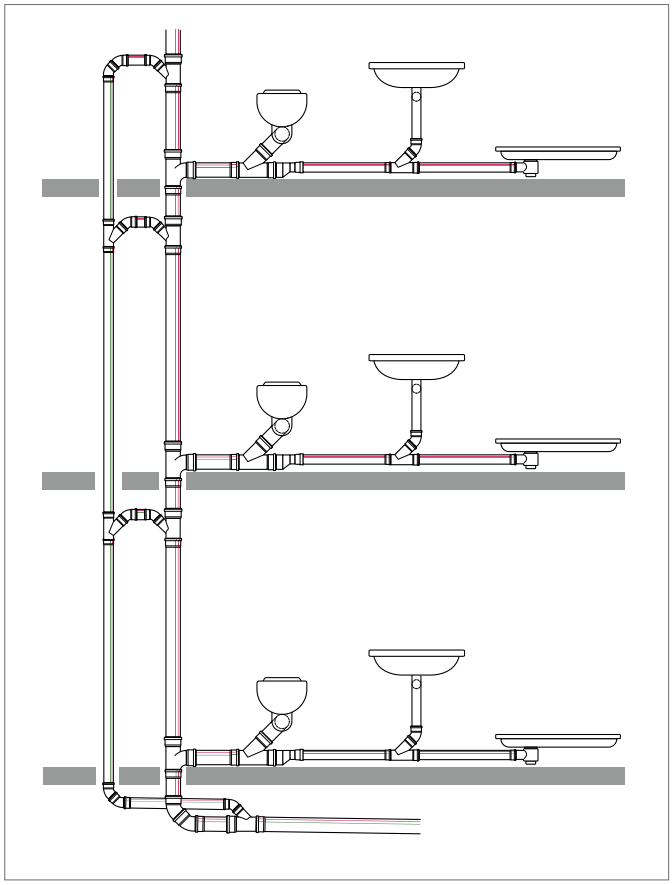


Fig. 9-7 Direct secondary ventilation

Waste water downpipe with main ventilation		Secondary ventilation		System I Q_{max} (l/s)	
DN	d_e	DN	d_e	Branches	Branches max. flow
100*	110*	50	50	5.6	7.3
125	125	70	75	12.4	10.0
150	160	80	90	14.1	18.3
200	200	100	110	21.0	27.3

* Minimum nominal diameter when WCs are connected to System I

Tab. 9-13

9.10 Direction changes of downpipes

9.10.1 Up to 10 m

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

9.10.2 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).

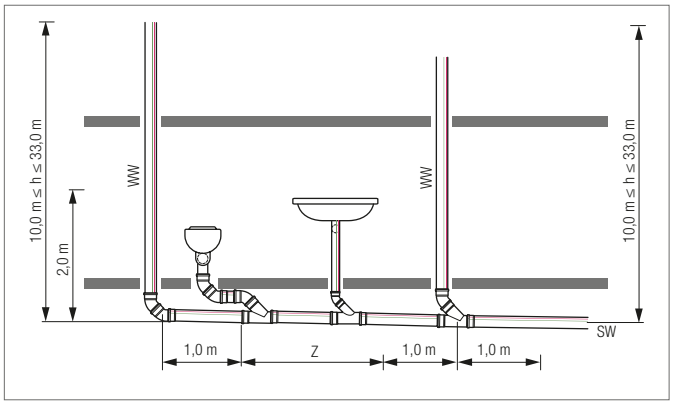


Fig. 9-8 Connection-free zones

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

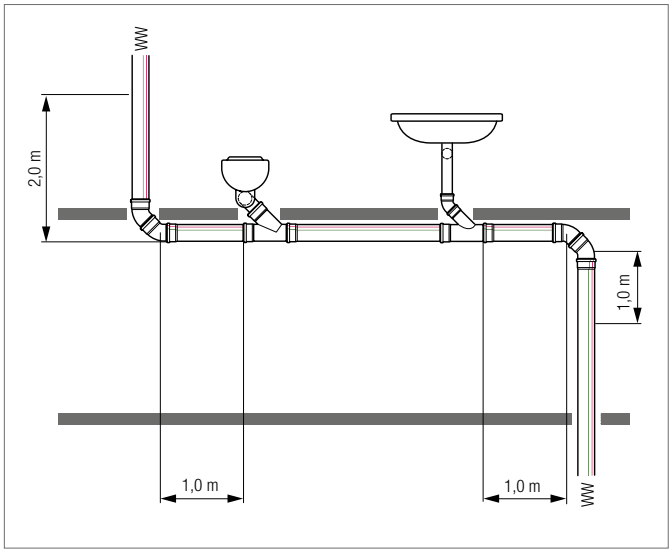


Fig. 9-9 Connection-free zones, downpipe distortion

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.

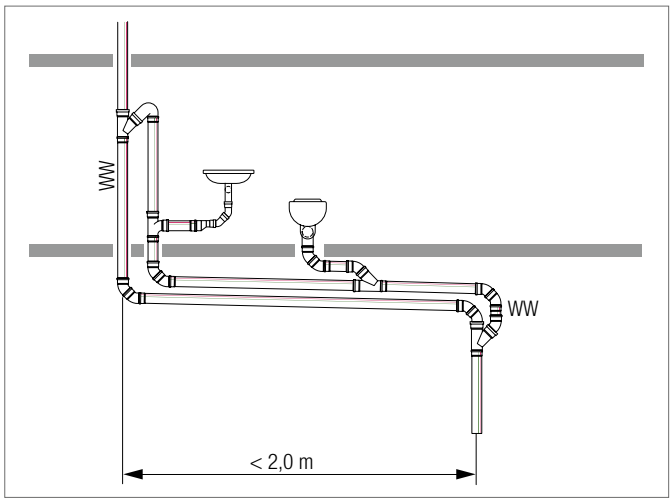


Fig. 9-10 When the downpipe distortion is less than 2 m, a bypass pipe must be fitted.

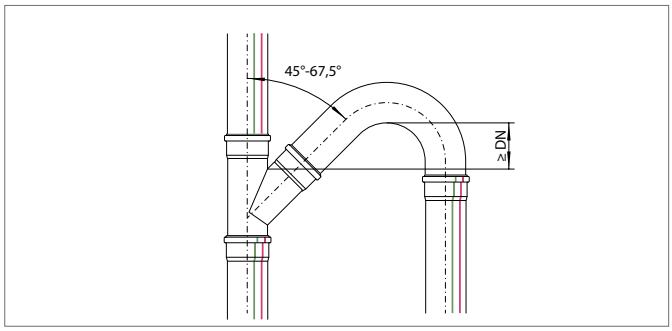


Fig. 9-11 Bypass pipe detail

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.

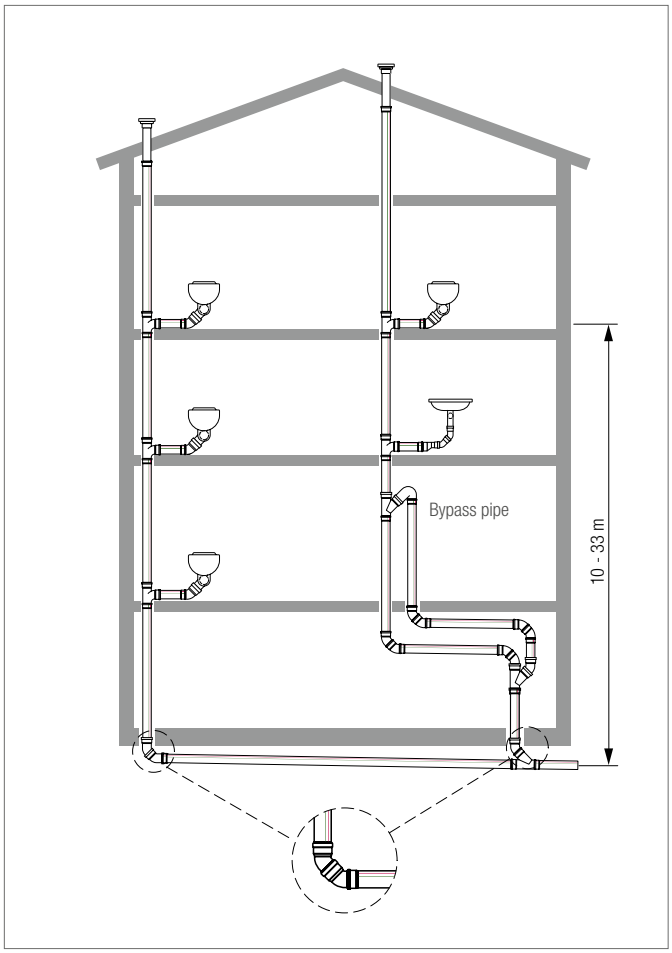


Fig. 9-12 Opening of downpipes (10 m to 33 m drop height) into a collecting pipe (detailed view of the opening with intermediate piece)

9.10.3 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.

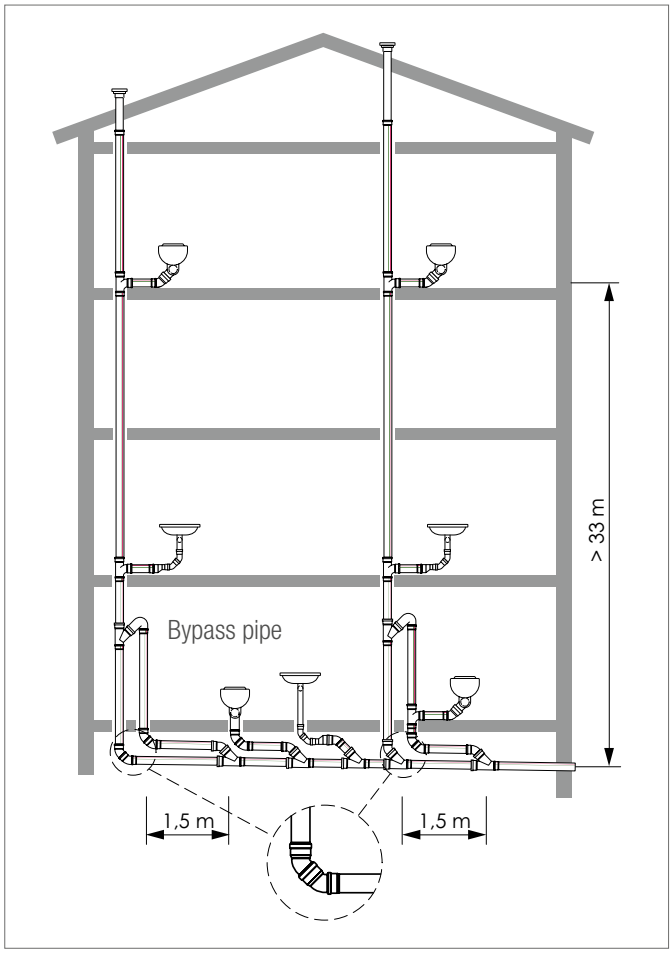


Fig. 9-13 Opening of downpipes (more than 33 m drop height) into a collecting pipe (detailed view of the opening with intermediate piece)

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.

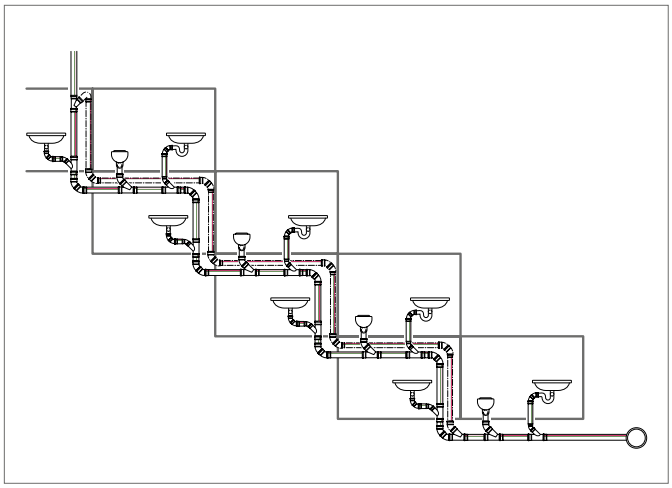


Fig. 9-14 Downpipe distortions in terraced houses

9.11 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 x Q_{tot} .

9.12 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.

9.12.1 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.

9.12.2 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 $A = \frac{d^2 \times \pi}{4}$

d_e	d_i	A	A/2
(mm)	(mm)	[cm²]	[cm²]
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
200	187.6	276.41	138.21

Tab. 9-14

Example:
Apartment buildings
Single main ventilation 1: $d_e = 110$ mm
Single main ventilation 2: $d_e = 110$ mm

Cross-section surface $L_1 = 85.93$ cm²
Cross-section surface $L_2 = 85.93$ cm²

Collective ventilation L_3

$$L_3 = \frac{L_1 + L_2}{2}$$

$$L_3 = \frac{85.93 + 85.93}{2}$$

$L_3 = 85.93$ cm²

From this, the dimension $d_e = 110$ 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 $d_e = 125$ mm must be selected.

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

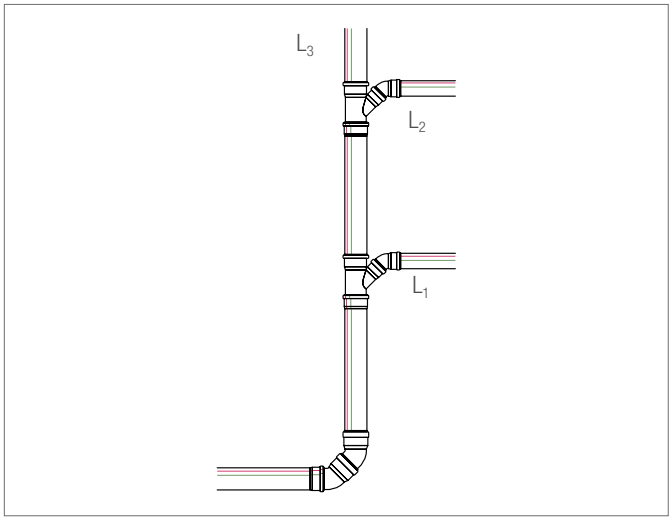


Fig. 9-15 Collecting main ventilation pipe

9.12.3 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.

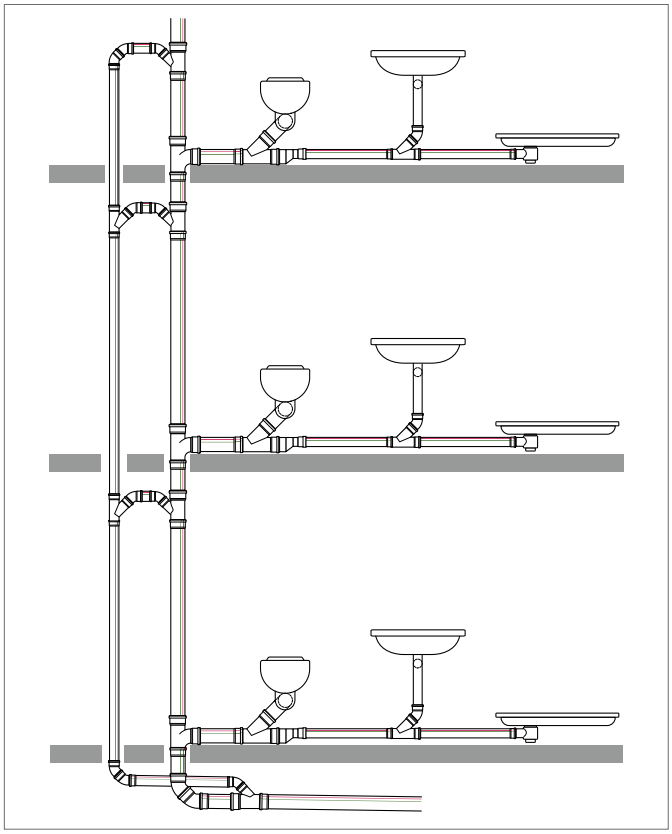


Fig. 9-16 Direct secondary ventilation

9.12.4 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.

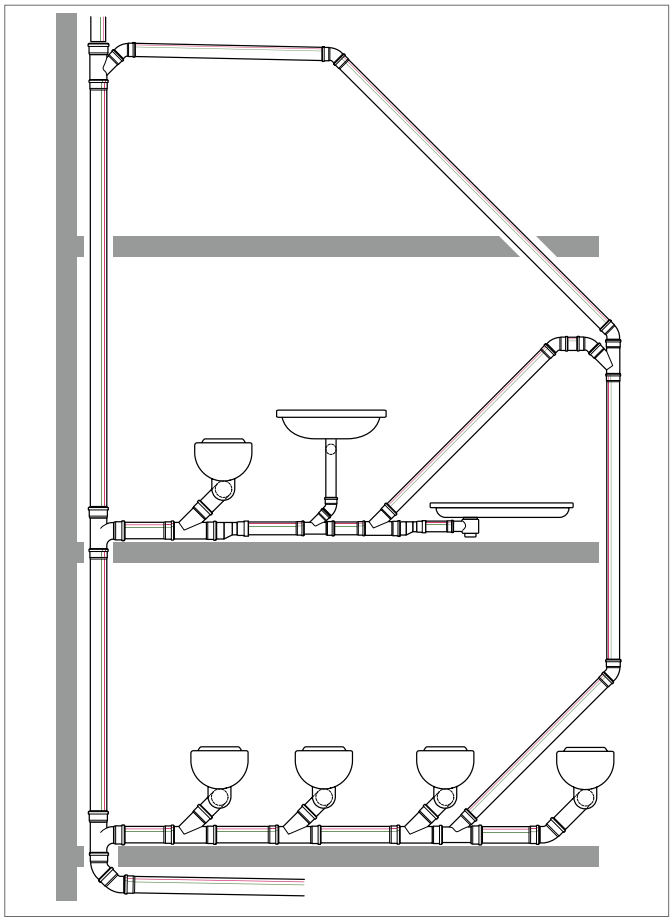


Fig. 9-17 Indirect secondary ventilation

9.12.5 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.

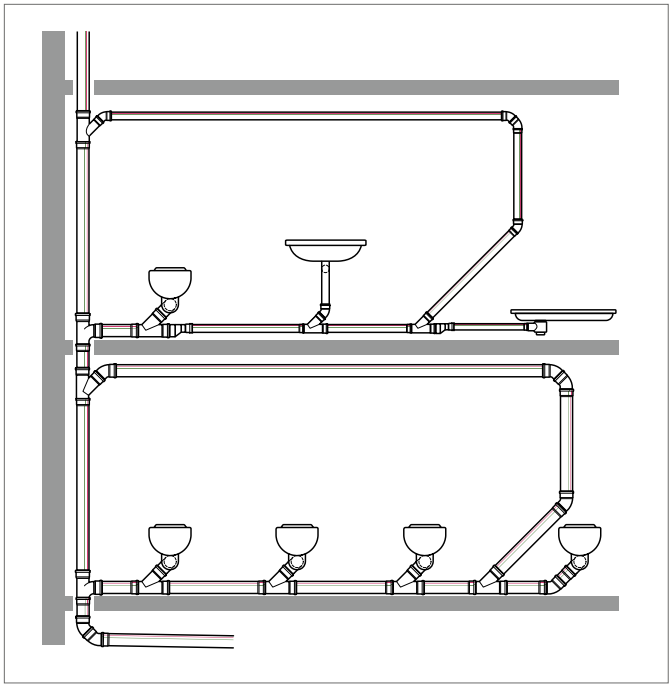


Fig. 9-18 Recirculation ventilation pipe

Dimensioning of the recirculation ventilation

Collecting pipe	Recirculation ventilation
≤ d_e 75	d_e of the collecting pipe
> d_e 75	d_e 75

Tab. 9-15

9.12.6 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.

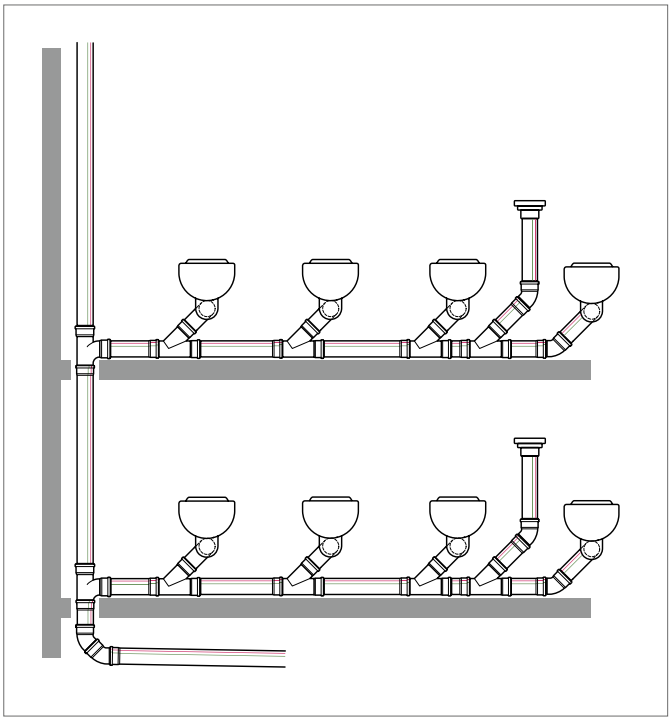


Fig. 9-19 Ventilation valves:

9.12.7 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.

9.13 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.

9.14 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.

	Pipe	Adaptor and fitting	Mounting
	(r.m.)	Pieces	Pieces
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. 9-16 Installation times in single minutes (EM)
Source: Installation times for sanitaryware, Spengler Sanitär- und Heizungstechnik association, Munich, 6. fully revised and expanded edition 2005

9.15 Invitation to tender

RAUPIANO PLUS

Waste water system, consisting of hot-water resistant, sound-insulating pipes and fittings RAUPIANO PLUS DN 32 to DN 200 with push-fit sockets of mineral-reinforced PP as well as accessories for installation as sewer pipes inside and outside buildings in accordance with ÖNORM EN 12056, ÖNORM EN 752 and ÖNORM B 2501. The dimensions conform to ÖNORM 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 DIN 4109 (Sound insulation in building construction), are proved by test report no. P-BA 274/2016 (with structure-borne sound-dampening support bracket) or P-BA 275/2016 (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 752:
Drain and sewer systems outside buildings

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 "RAUPIANO PLUS and LIGHT waste water system" as well as the standards, directives and specifications contained in it.

Certifications, quality assurance

German general building approval Z-42.1-223 of the German Institute of Civil Engineering.
In addition to continuous self-monitoring, contractually governed quality assurance (external monitoring) is carried out by the South German Polymer Centre in Würzburg in accordance with the German general building approval.
The quality mark of the external monitoring body and the approval no. Z-42.1-223 are applied to the pipes and fittings.

Installation
In accordance with the installation instructions in this technical information and in compliance with the specifications of ÖNORM EN 12056, ÖNORM B 2501, ÖNORM EN 752 and VDI directive 4100 or DIN 4109.

Quality assurance
REHAU is certified in accordance with DIN ISO 9001 in the Bulding 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.

RAUPIANO LIGHT
Waste water system, consisting of hot-water resistant, sound-insulating pipes and fittings RAUPIANO LIGHT DN 40 to DN 160 with push-fit sockets of mineral-reinforced PP as well as accessories for installation as sewer pipes inside buildings in accordance with ÖNORM EN 12056. The dimensions conform to ÖNORM EN 1451-1. The sound dampening properties of the system are verified by test report no. P-BA 278/2016 (with structure-borne sound-dampening support 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

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

ÖNORM B 2501:
Drainage systems for buildings;
Planning, execution and testing – supplementary directives to ÖNORM EN 12056 and ÖNORM EN 752

Installation
In accordance with the installation instructions in this technical Information and in compliance with the specifications of ÖNORM EN 12056, ÖNORM B 2501 and DIN 4109.

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.

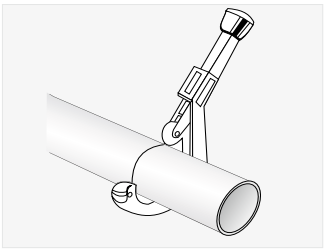
Tender texts in PDF and Word formats can be obtained from your REHAU sales office. Standardised tender texts according to ÖNORM A 2063 can be obtained at www.abk.at.

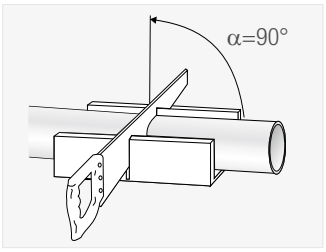
10 INSTALLATION

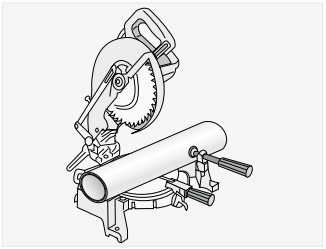
10.1 Bevelling and cutting pipes to length

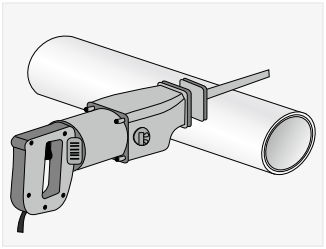
Fittings must not be cut.

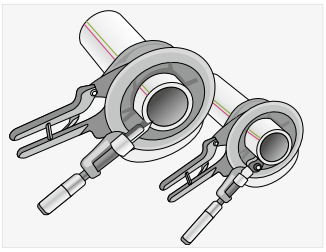
1. If necessary, cut pipes to length using widely available pipe cutters or a fine-toothed saw.
2. Make the cut at a 90° angle to the pipe axis.



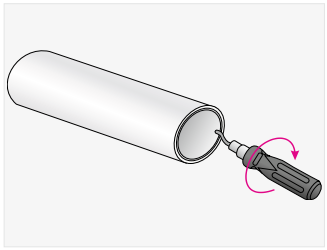


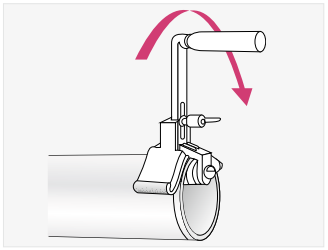


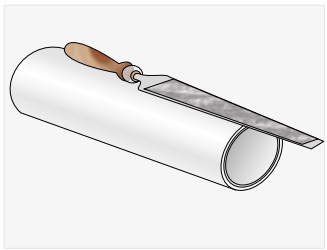




3. For connections to push-fit socket pipe systems, taper the pipe ends with a tapering tool or a coarse file at an angle of approximately 15°.
4. Deburr the cut edge on the inside of the pipe, so that no dirt can get deposited there.







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

Thanks to the optimised material formula, **RAUPIANO PLUS** and **RAUPIANO LIGHT** distinguish themselves through outstanding low-temperature impact strength.
RAUPIANO PLUS is therefore marked with the ice crystal as per ÖNORM EN 1451/1411.

10.2 Joining pipe and fittings

1. Clean dirt off the sealing ring, the inside of the socket and the spigot end.
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 mm), pull the spigot another 10 mm out of the socket to create an expansion joint for the thermal expansion.
5. With short pipes (≤ 500 mm) and fittings, push the spigots completely into the sockets.

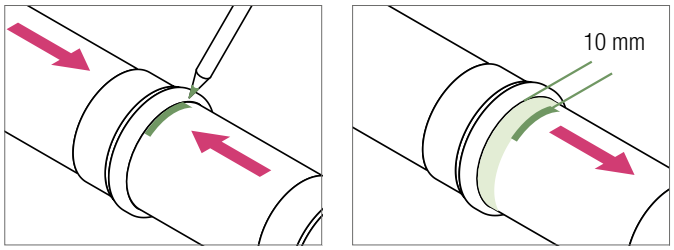


Fig. 10-1 Marking the spigot/pipe ends and pull back to allow for thermal expansion

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 RAUPIANO PLUS and RAUPIANO LIGHT 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 °C to 70 °C according to DIN 53752 is 0.09 mm/(m·K) on average).

10.3 Linear expansion ΔI

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 α. The pipe dimension does not play a role in the expansion.

Calculation of the linear expansion:
$\Delta I = L \times \Delta T \times \alpha$

L Pipe length up to the next elbow or up to the next branch
ΔT Difference between installation temperature (temperature prevailing at the time of installation) and operating temperature
α Expansion value of the pipe material (0.09 mm/(mK)
ΔI Expansion length

Example:
t_e = installation temperature: 10 °C
t_b = operating temperature: 40 °C
L = pipe length: 3 m

$T = t_b - t_e$
$T = 40 - 10$
$T = 30$ K

$\Delta I = L \times \Delta T \times \alpha$
$\Delta I = 3 \times 30 \times 0.09$
$\Delta I = 8.1$ mm

Pipe length [m]	Temperature difference ΔT [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. 10-1 Table of expansion length

10.4 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.

10.5 Assembling fittings retrospectively

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

1. Cut out a sufficiently long piece of pipe from the piping:
2. Fitting length + 2 x pipe outer diameter.
3. Deburr the pipe ends.
4. Push the entire length of a slip-on socket on one of the pipe ends.
5. Push the fitting onto the other pipe end.
6. Fit the intermediate piece in the remaining intermediate space of the line and deburr it.
7. Push the second slip-on socket completely on the intermediate piece.
8. Insert the intermediate piece and close both the gaps by pushing the slip-on sockets. Use a generous amount of anti-friction agent.

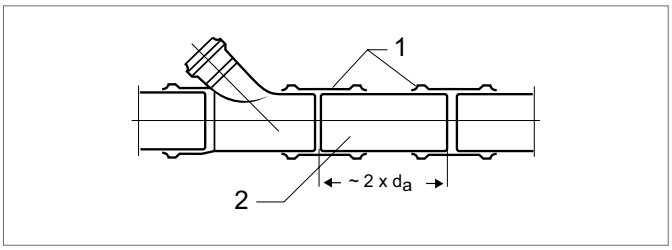


Fig. 10-2 Installing fittings
1 Slip-on socket
2 Intermediate piece
d_a Pipe outer diameter

10.6 Connect the pop-up

There are three options to connect pop-ups (for example, odour traps) to waste pipes or fittings RAUPIANO PLUS or RAUPIANO LIGHT :
- RAUPIANO PLUS and RAUPIANO LIGHT connecting piece
- Siphon angle RAUPIANO PLUS and RAUPIANO LIGHT
- Direct connection to fitting RAUPIANO PLUS and RAUPIANO LIGHT with rubber nipples with sealing bead

RAUPIANO PLUS and RAUPIANO LIGHT connecting piece

Fig. 10-3 Connecting piece RAUPIANO PLUS and RAUPIANO LIGHT with rubber nipple

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

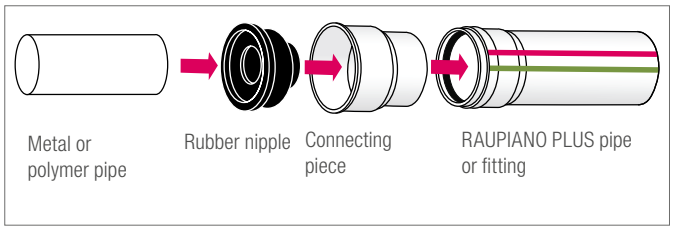


Fig. 10-4 Installation of RAUPIANO PLUS and RAUPIANO LIGHT connecting piece

Metal or polymer pipe	Rubber nipple	Connecting piece	RAUPIANO PLUS pipe or fitting
Outer diameter 32 - 40 mm	DN 50/40 (Mat. no.: 11262531002)	DN 40/40 (Mat. no.: 11231641001)	DN 40
Outer diameter 32 - 40 mm		DN 50/40-30 (Mat. no.: 11214141001)	DN 50
Outer diameter 47 - 50 mm	DN 50/50 (Mat. no.: 11219131003)	DN 50/50 (Mat. no.: 11214241001)	DN 50

Siphon angle RAUPIANO PLUS and RAUPIANO LIGHT

Fig. 10-5 Siphon angle RAUPIANO PLUS and RAUPIANO LIGHT with rubber nipple

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

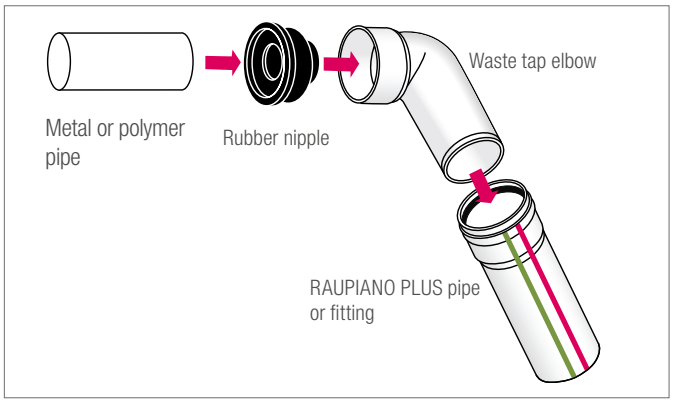


Fig. 10-6 Installation of siphon angle RAUPIANO PLUS and RAUPIANO LIGHT

Metal or polymer pipe	Rubber nipple	Connecting piece	RAUPIANO PLUS pipe or fitting
Outer diameter 32 - 40 mm	DN 50/40 (Mat. no.: 11262531002)	DN 40/30 (Mat. no.: 11231741001)	DN 40
Outer diameter 32 - 40 mm		DN 50/40-30 (Mat. no.: 11226941001)	DN 50
Outer diameter 47 - 50 mm	DN 50/50 (Mat. no.: 11219131003)	DN 50/50 (Mat. no.: 11214441001)	DN 50

10.7 Connecting pieces to cast iron or other pipe systems

Fig. 10-7 Connecting piece for the same outer diameter DN 110/DN 110

Fig. 10-8 Connecting piece for different outer diameters DN 110/DN 90

Special connecting pieces are used to connect the RAUPIANO PLUS and RAUPIANO LIGHT 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)

The connecting pieces can be used for new construction and for renovation.

Jubilee clips must be tightened using a tightening torque of 3 Nm.

10.8 Flexible connection to exhaust outlet

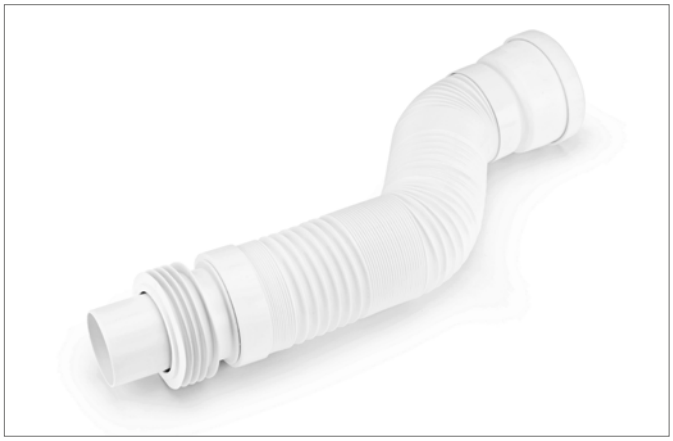


Fig. 10-9 Flexible connection to exhaust outlet

The flexible connection adaptor range connects exhaust outlets with the RAUPIANO PLUS and RAUPIANO LIGHT vent stacks of a drainage system.

- No need for complex fitting combinations
- Reducing installation time

The flexible combo-connection made from PP is suitable for the connecting to RAUPIANO PLUS pipes with the following nominal diameters:
- DN 75
- DN 90
- DN 110

10.9 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.

10.9.1 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 x DN. Moreover, the flow cross-section of the cleaning pipe must be at least equal to the cross-section of the sewer pipe.

10.9.2 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 200, 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°.

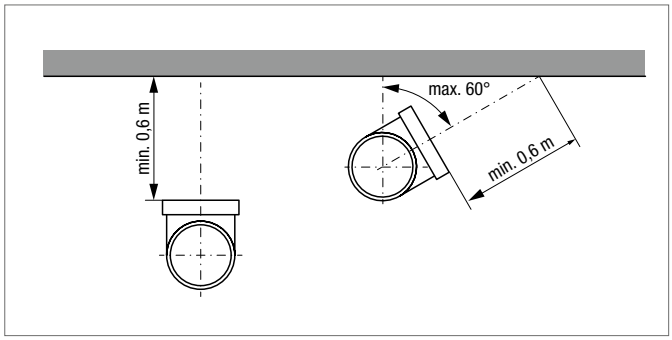


Fig. 10-10 Minimum distances of cleaning pieces

10.10 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. 10-11 RAUPIANO PLUS cleaning pipe

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

10.11 Push-fit lock

Fig. 10-12 RAUPIANO push-fit lock

The RAUPIANO push-fit lock makes it possible to increase the safety of the push-fit socket connection from being pulled apart in the event of high stresses.

Fig. 10-13 RAUPIANO push-fit lock (mounted on the socket)

The RAUPIANO push-fit lock bracket is distinguished by its ease of assembly and dismantling, since it sticks to the pipe even in the unscrewed state and does not fall off.

Range of application
- Internal stormwater downpipes with a height of maximum 20 m
- Socket plug safeguard if there is an internal pressure

The RAUPIANO push-fit lock bracket can also be used during the construction phase for securing the pipe runs and preventing from sliding apart.

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

10.12 Connecting rules

10.12.1 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.

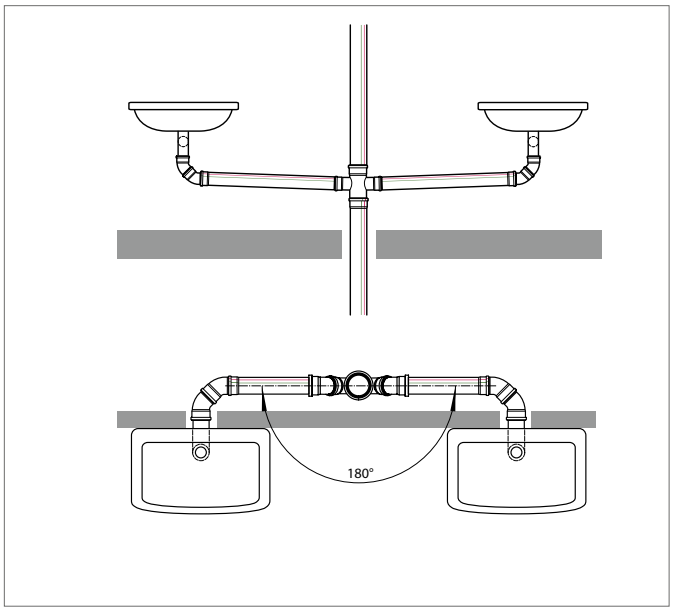


Fig. 10-14 Openings of identical neighbouring drainage objects at the same height into the downpipe (wash basin)

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

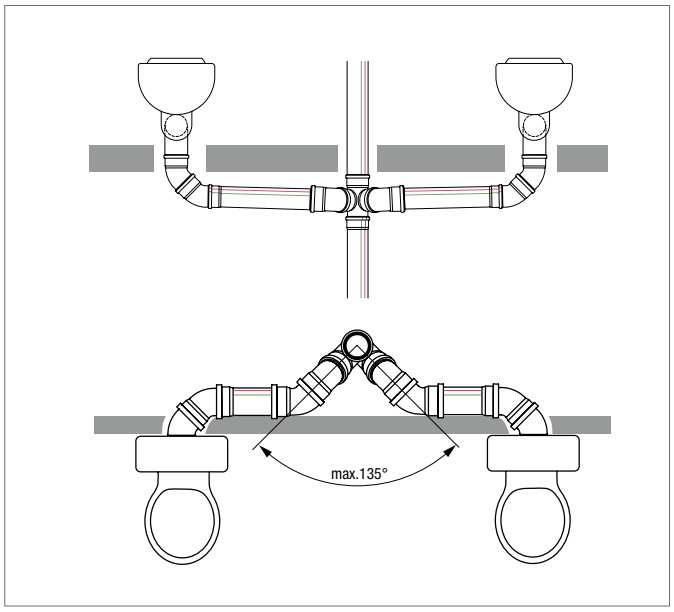


Fig. 10-15 Openings of identical neighbouring drainage objects at the same height into the downpipe (WC systems)

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

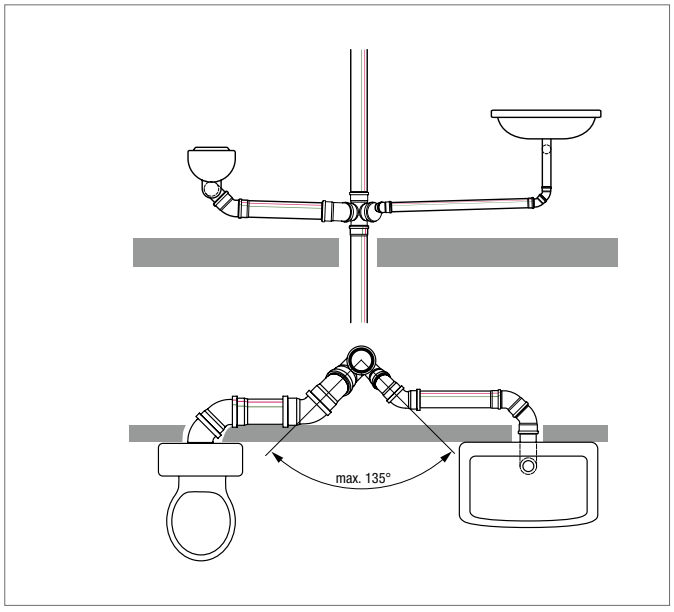


Fig. 10-16 Openings of different neighbouring drainage objects at the same height into the downpipe

- 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)

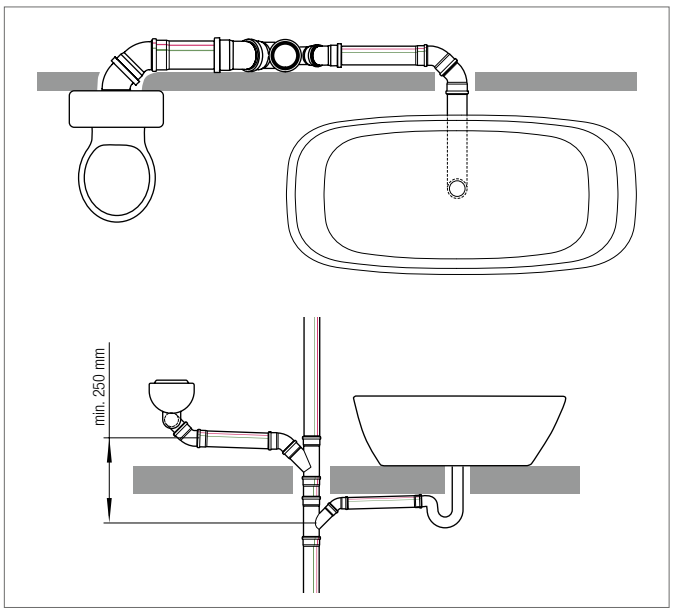


Fig. 10-17 Openings of different neighbouring drainage objects at different heights into the downpipe

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

10.12.2 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°

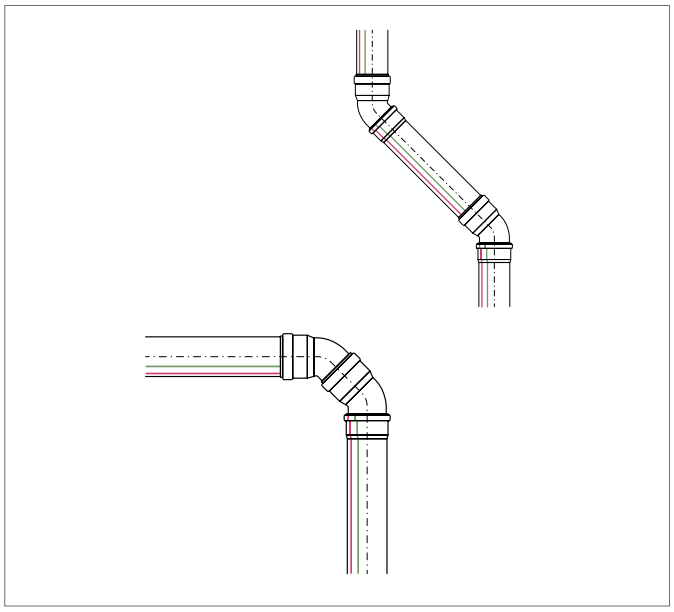


Fig. 10-18 Direction changes for collecting and main pipes

- 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°.

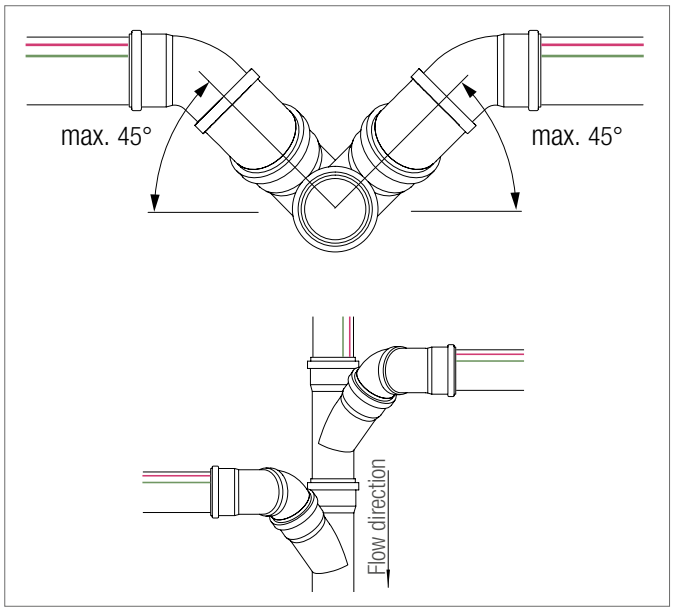


Fig. 10-19 Opening into collecting and main pipes

- 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.

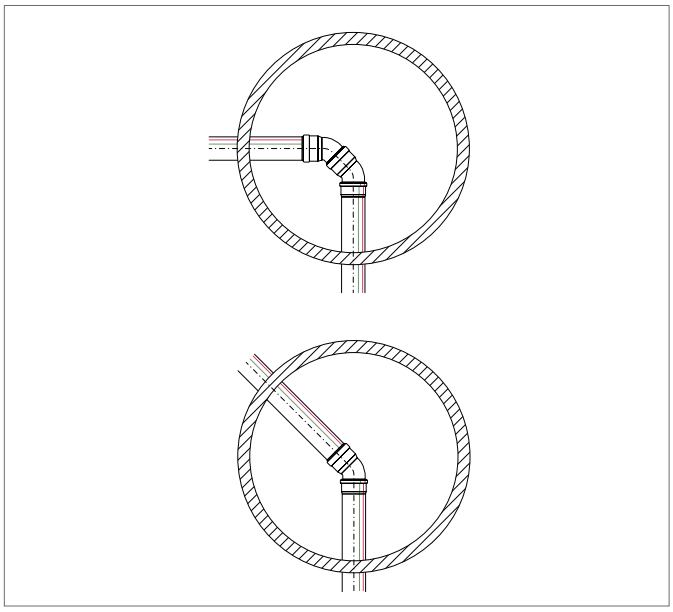


Fig. 10-20 Main pipes outside the building with shaft

10.12.3 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. 10-21 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.

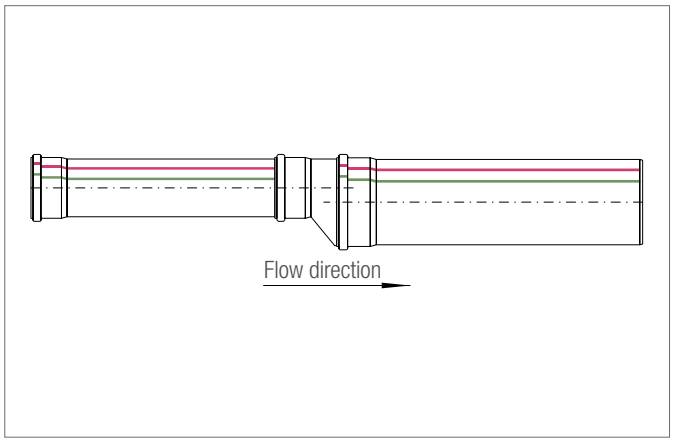


Fig. 10-22 Uniform crown height fitting

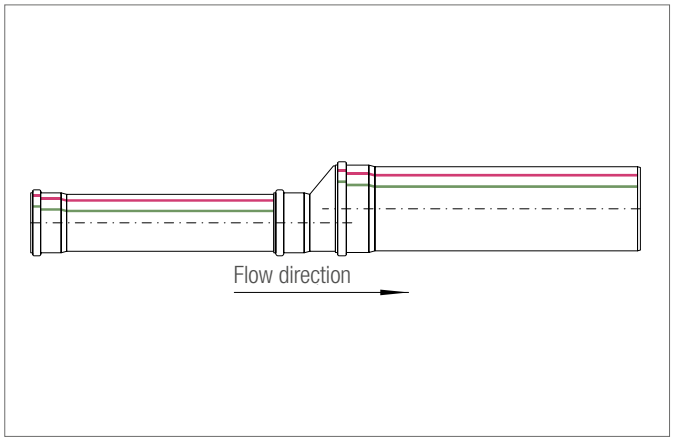


Fig. 10-23 Uniform base height fitting

10.13 Installing pipes in installation shafts

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

In order to reduce structure-borne sound and to improve the acoustic properties of the waste water system RAUPIANO PLUS and RAUPIANO LIGHT, direct contact from the pipe to ceiling breakthroughs or installation walls must be avoided.

The wall or ceiling penetrations must be made using commonly available moisture-resistant structure-borne sound insulation so as to acoustically uncouple the pipelines.

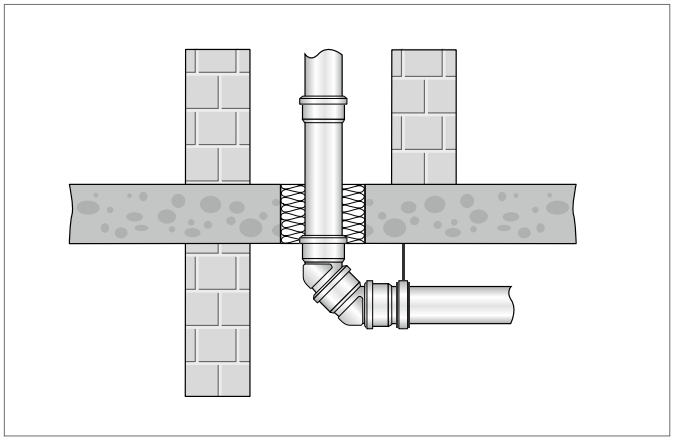


Fig. 10-24 Example of design 1 – Installation in insulation shafts

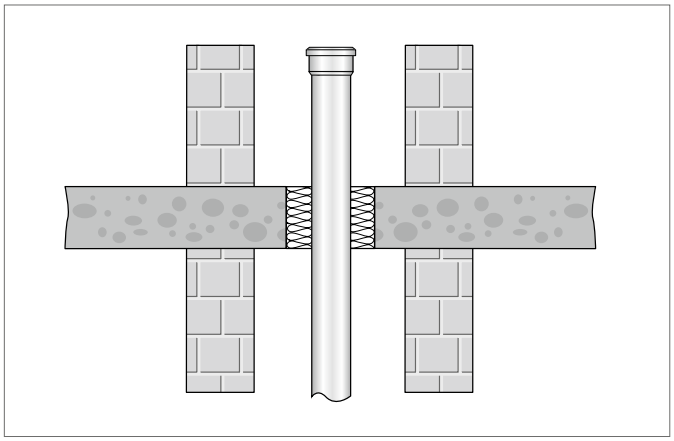


Fig. 10-25 Example of design 2 – Installation in installation shafts

10.14 Installing pipes in masonry

- Create the wall slit 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 a casing, the following points must be kept in mind:
- 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.

10.15 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.
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. 10-27 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.

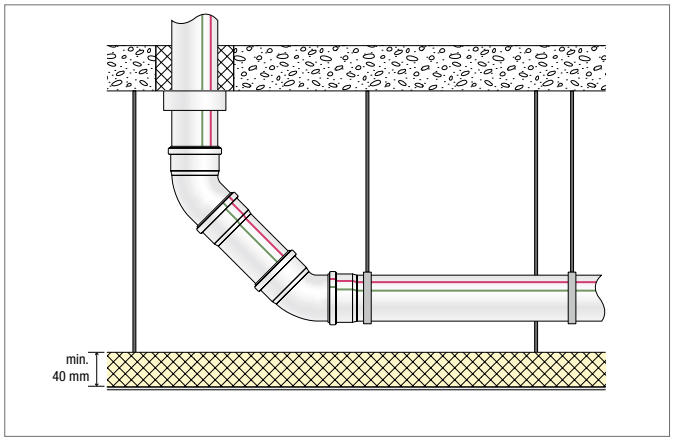


Fig. 10-26 Example for version 1 – Installation in suspended ceiling incl. insulation

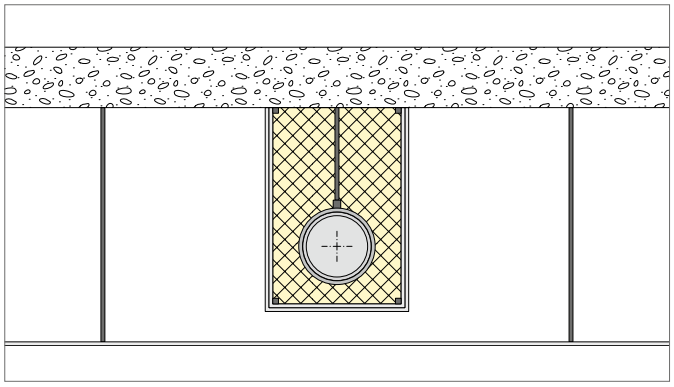


Fig. 10-27 Example for version 2 – Installation in suspended ceiling – casing of the pipe including insulation

10.16 Ceiling ducts

Ceiling penetrations must be made in a moisture-proof manner.

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.

11 INTERNAL STORMWATER DRAINAGE

11.1 Installation of the inner stormwater downpipe

An example of stormwater drainage pipe layout with offset is shown in Fig. 11-1 .
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 (3) are available for fire protection measures. If a pipe socket is located within the area of the fire stop collar or the pipe penetrates the ceiling at an angle (up to 45°), then the REHAU fire stop collar FP 6.0 should be used.
For ceiling penetrations (7), the notes given in the installation instructions as well as in the ETA approval (ETA-17-0459) must be followed.
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. 11-1) (see „10.11 Push-fit lock“, page 59).

11.2 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.

11.3 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.

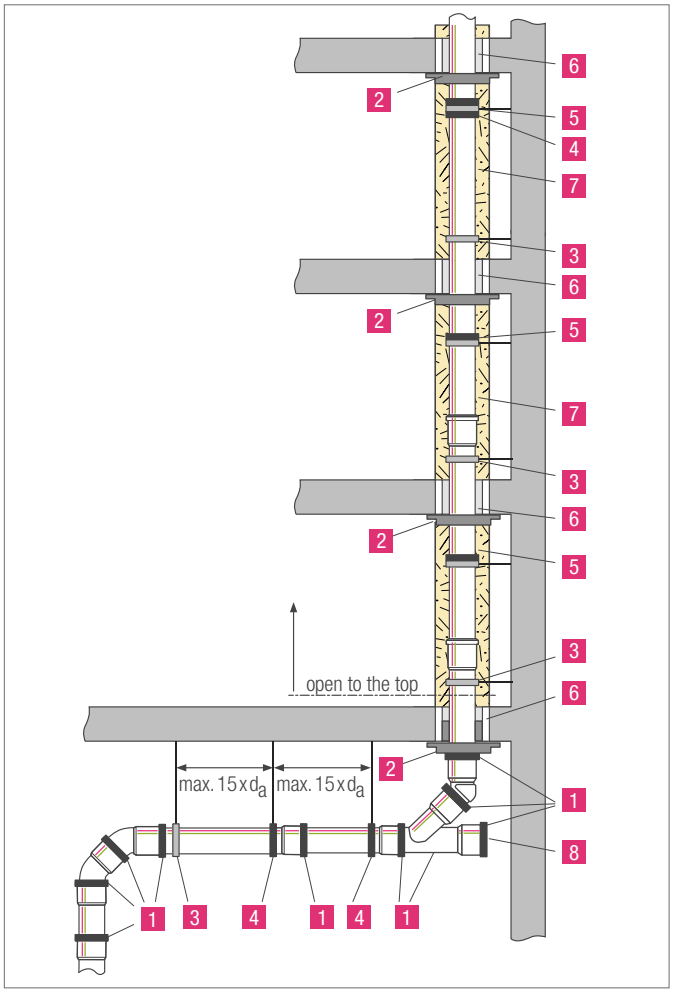


Fig. 11-1 Internal stormwater drainage pipes

1. *Push-fit lock*
2. *REHAU fire stop collar FP*
3. *Guiding clamp*
4. *Fixing/security clamp*
5. *Sound-dampening support brackets*
6. *Ceiling penetration (see ETA-17-0459 REHAU fire stop collar FP)*
7. *Insulation against condensation*
8. *Inspection eye*

11.4 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 air humidity:													
		30 %	35 %	40 %	45 %	50 %	55 %	60 %	65 %	70 %	75 %	80 %	85 %	90 %	95 %
Air temperature	30 °C	10.51	12.85	14.91	16.75	18.42	19.96	21.37	22.69	23.92	25.07	26.16	27.20	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	18.10	19.50	20.79	22.01	23.14	24.22	25.24	26.20	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	18.90	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	21.30	22.30	23.24	24.14
	24 °C	5.35	7.58	9.55	11.32	12.92	14.39	15.74	17.00	18.18	19.29	20.33	21.32	22.25	23.15
	23 °C	4.49	6.71	8.66	10.41	12.00	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	12.53	13.87	15.11	16.27	17.36	18.38	19.36	20.28	21.16
	21 °C	2.77	4.95	6.88	8.60	10.17	11.60	12.93	14.16	15.31	16.39	17.41	18.38	19.29	20.17
	20 °C	1.91	4.07	5.99	7.70	9.25	10.68	11.99	13.21	14.35	15.43	16.44	17.40	18.31	19.17
	19 °C	1.05	3.20	5.09	6.79	8.34	9.75	11.05	12.26	13.40	14.46	15.47	16.42	17.32	18.18
	18 °C	0.19	2.32	4.20	5.89	7.42	8.82	10.11	11.32	12.44	13.50	14.49	15.44	16.33	17.19
	17 °C	-0.68	1.44	3.31	4.98	6.50	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	15.20
	15 °C	-2.40	-0.31	1.53	3.17	4.67	6.04	7.30	8.47	9.57	10.60	11.58	12.50	13.37	14.20
	14 °C	-3.26	-1.19	0.63	2.27	3.75	5.11	6.36	7.53	8.61	9.64	10.60	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	11.40	12.22
	12 °C	-4.98	-2.94	-1.15	0.46	1.92	3.25	4.48	5.63	6.70	7.71	8.66	9.56	10.41	11.22
	11 °C	-5.84	-3.82	-2.04	-0.45	1.00	2.32	3.55	4.68	5.75	6.74	7.69	8.58	9.42	10.23
	10°C	-6.70	-4.70	-2.93	-1.35	0.08	1.39	2.61	3.73	4.79	5.78	6.71	7.60	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	3.80	4.66	5.48	6.26
	6 °C	-10.14	-8.21	-6.50	-4.97	-3.59	-2.32	-1.15	-0.06	0.96	1.92	2.82	3.68	4.49	5.26
	5°C	-11.00	-9.09	-7.39	-5.88	-4.51	-3.25	-2.08	-1.00	0.01	0.96	1.85	2.70	3.50	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	-5.10	-3.96	-2.90	-1.91	-0.97	-0.10	0.74	1.53	2.28
	2 °C	-13.58	-11.72	-10.07	-8.60	-7.26	-6.03	-4.90	-3.85	-2.86	-1.94	-1.07	-0.24	0.54	1.29
	1 °C	-14.45	-12.59	-10.96	-9.50	-8.17	-6.96	-5.84	-4.79	-3.82	-2.90	-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	-2.20	-1.43	-0.70

Tab. 11-1 Dew point table

12 MOUNTING

12.1 Brackets

Fig. 12-1 Patented structure-borne sound-dampening support bracket

The patented sound-dampening support bracket consists of a support bracket with a spacer (closes loosely around the pipe and is anchored firmly to the wall) and a fastening bracket (closes tightly around the pipe without any contact to the wall). The quick-snap buckle always ensures the perfect closing force. It is not necessary to mount the bracket directly underneath a socket.

Installation procedure

1. Fix the support bracket to the wall.

Fig. 12-2 Support bracket fixed to wall and opened

2. Open the support bracket and place the pipe into the bracket. Close the support bracket. If required, pull the pipe 10 mm out of the bracket (see section 10.15 on page 63).
3. Place the fixing bracket above the support bracket around the pipe and close it. Ensure both quick-snap buckles are aligned and above each other (see Fig. 12-3).

Fig. 12-3 Fully installed sound-dampening support bracket

In general, the support bracket is used on the upper section of the vertical stack and the guiding clamp on the lower section of any given floor (max. 3 m) (see Fig. 12-4). In the case of greater floor height, it may be necessary to install additional support brackets and guiding clamps.

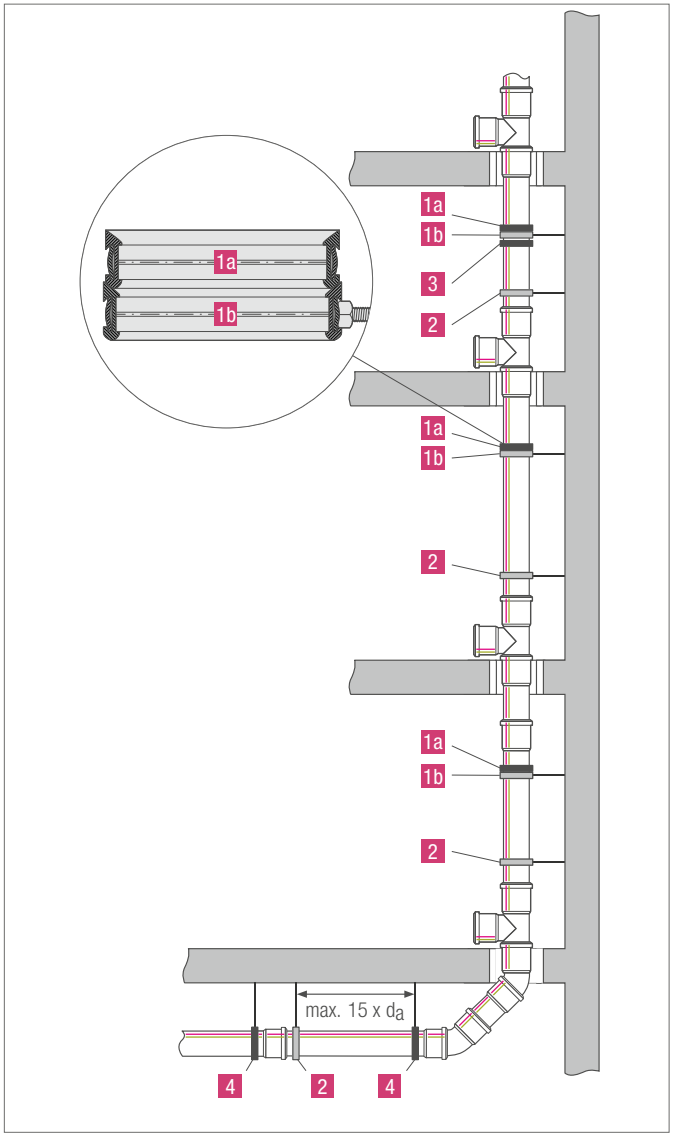


Fig. 12-4 Installation scheme, downpipe

- 1a *Structure-borne sound-dampening support bracket: fixing bracket*
- 1b *Structure-borne sound-dampening support bracket: support bracket fixed to the wall*
- 2 *Guiding clamp*
- 3 *Fixing/security clamp as security clamp*
- 4 *Fixing/security clamp as fixing clamp*
- d_a *Outer pipe diameter*

If necessary, the sound-dampening bracket can be rotated by 180°. The orientation of the rubber lining will then need to be changed accordingly so that the positions of the rubber linings 1a and 1b are as shown in Fig. 12-5 (see below). It is important that the self-centring function is maintained. The lower pipe bracket which is fixed to the wall has the larger internal diameter.

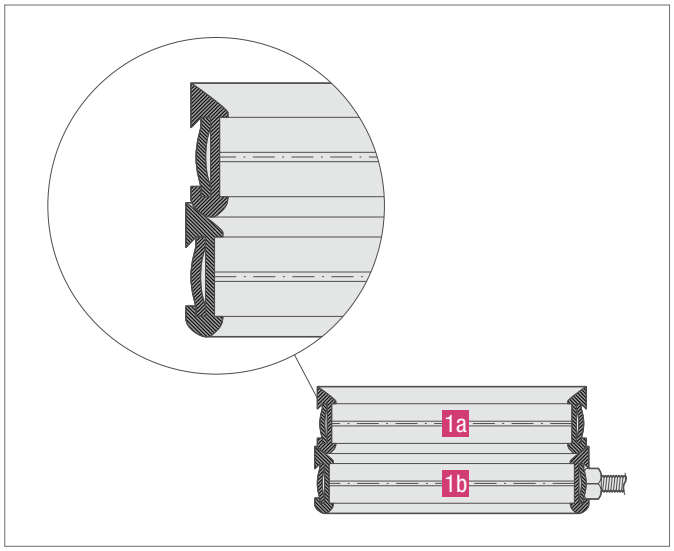


Fig. 12-5 Correct position for the rubber linings

1a *Structure-borne sound-dampening support bracket: fixing bracket*

1b *Structure-borne sound-dampening support bracket: support bracket fixed to the wall*

Structure-borne sound-dampening support brackets are not required in horizontal installation.

To secure the downpipe against sliding apart, additional fixing/security clamps are placed directly beneath the support brackets:
- Only on the upper floor of detached house
- On every 3rd floor in high-rise buildings

To prevent brackets from being opened unintentionally, insert metal pins through the provided holes of the quick clasp.

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

The illustration below (see Fig. 12-6) depicts an efficient way to support a horizontal acoustic drainage line with RAUPIANO PLUS.

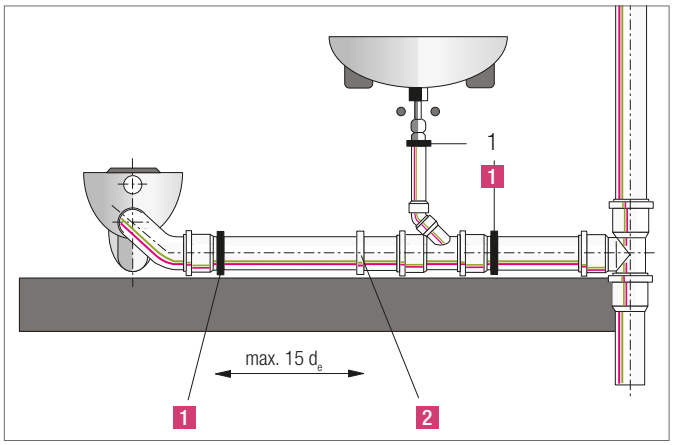


Fig. 12-6 Installation layout for a horizontal pipe

1 *Fixing/security clamp*

2 *Guiding clamp*

d_e *Outer pipe diameter*

- For shorter horizontal pipe line (length ≤ 15 x external pipediameter), install the fixing clamps right behind the pipe socket.
- For longer horizontal pipe line (length > 15x external pipe diameter), install additional guiding clamps. The distance between the clamps must not exceed 15 times the external pipe diameter. Certain structural conditions my require closer spacing of brackets.

Maximum spacing of brackets

DN	horizontal pipe line 15 x d_a [mm]	vertical pipe line [mm]
40	600	1500
50	750	1500
75	1125	2000
90	1350	2000
110	1650	2000
125	1875	2000
160	2400	2000
200	3000	2000

Tab. 12-1 Maximum distance between pipe brackets

12.2 Short pipes and fittings

When pipeline sections are formed with fittings or short pipes:
- Prevent the pipe parts from sliding away from each other with fixing clamps.
- Use socket plugs to secure them against getting pushed out.

12.3 Use of double sockets

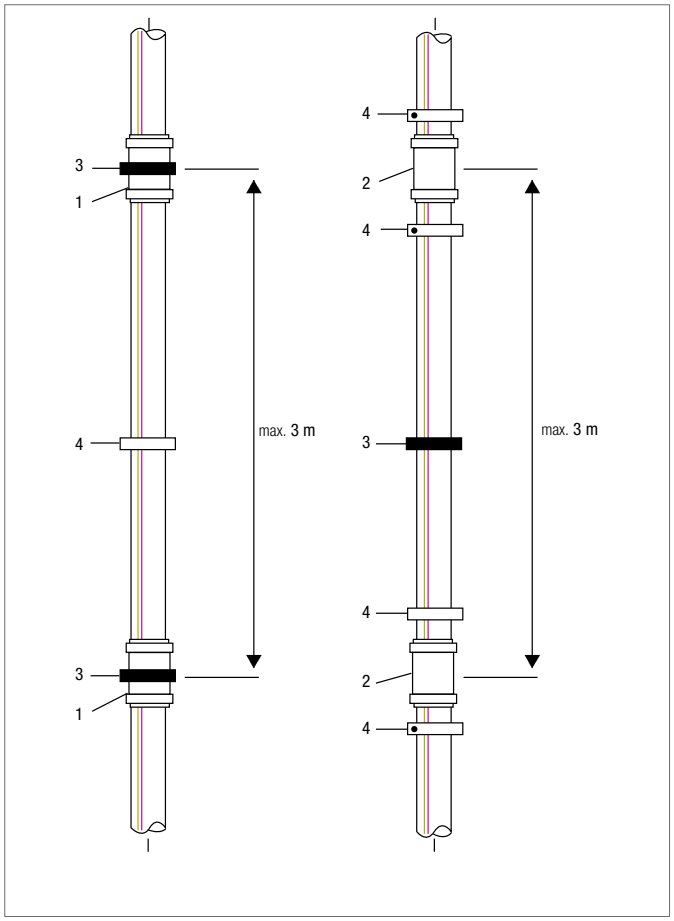


Fig. 12-7 Use of double sockets or slip-on sockets

1 Double sleeve
2 Slip-on socket
3 Fixing clamp
4 Guiding clamp

The use of double sockets and slip-on sockets is depicted graphically in the Fig. 12-7.

13 RAUPIANO PLUS BELOW GROUND INSTALLATIONS

All dimensions of RAUPIANO PLUS are suitable for installation in the ground. Installation is permissible inside and outside the building structure. The installation is done according to the statics requirements with the corresponding certification.

Other applicable standards/test certificates

For installation, attention must be paid to the following standards and those quoted in the annex, especially ÖNORM EN 1610. This standard describes the installation and testing of sewer pipes and canals that are usually laid underground and are operated under gravity conditions.

- ÖNORM EN 1610
- ÖNORM EN 12056
- ÖNORM EN 752
- ÖNORM B 2501
- General building authority approval Z-42.1-223

13.1 General

The rules generally familiar from pipeline construction must be followed. Careful and technically correct handling of the pipes and fittings during transport, storage and installation must be ensured.

Only qualified persons who have experience with installing polymer pipes may be entrusted with the installation of the pipelines.

§ Points to consider include:
- The accident prevention regulations of the Employer's Liability Insurance Association
- Rules of the road
- If applicable, project-related special specifications
- Relevant regulations that are given in specifications or technical rules

13.2 Installations below the ground slab

RAUPIANO PLUS is approved for below ground installations within and below the building (application designation "BD" - Building/Drainage).

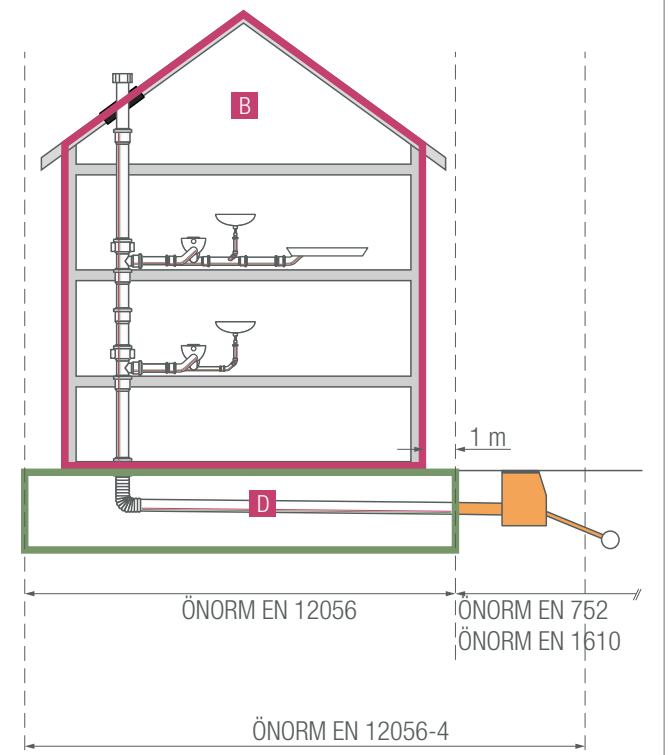


Fig. 13-1 Installation of RAUPIANO PLUS inside and below the building structure
B Applications within the building (Building)
D Applications below the building (Drainage)

The regulations of ÖNORM EN 1610 must be observed when installing and testing the pipes.
The static load analysis of imposed loads must be carried out in accordance with work sheet ATV-DVWK-A 127.

For installations of sewer, storm- and surface- and mixed water drainage below ground directly below the building's footprint or next to it, the pipes and fittings of the REHAU AWADUKT PP range can be used. You can find more information on the internet at www.rehau.com or from your REHAU sales office.

13.3 Pipe trenches

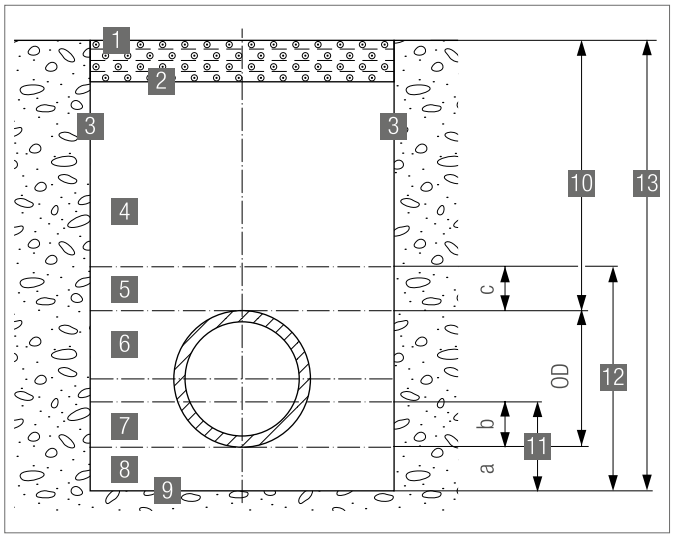


Fig. 13-2 Schematic layout of pipe trenches

1 Surface
2 Lower edge of road or rail (where present)
3 Trench walls
4 Main filling
5 Cover
6 Side filling
7 Top layer of bedding
8 Bottom layer of bedding
9 Trench base
10 Top fill height
11 Thickness of bedding
12 Thickness of pipe zone
13 Trench depth
a Thickness of bottom intervening layer of bedding
b Thickness of top layer of bedding
c Thickness of cover
OD Outer pipe diameter

Pipe trenches must conform to ÖNORM EN 1610 . Please note the following:
- Stability of the trench should either be achieved by means of a suitable stope support (shuttering), or by banking or other suitable measures.
- Prepare the trench base according to the required slope.
- At the pipe joints, make suitable recesses in the lower pipe bedding layer or in the trench base, so that the entire length of the pipe is resting and in contact.
- Ensure a continuously straight flow of the pipes
- Protect the trench base from the action of frost.
- Do not use frozen material above or below the pipeline.
- The trench sheeting should, in compliance with the static calculations, be removed in such a way that the pipe is neither damaged or its position changed.

13.4 Pipe zone

The pipe zone involves the backfilling in the area of the RAUPIANO PLUS pipe.

The pipe zone consists of:
- Pipe cradle
- Side filling
- Cover zone

Attention must be paid to careful construction of the pipe zone, since it essentially determines the load bearing capacity of the pipe.

The pipe zone must be constructed in accordance with the statics calculation on the basis of the planning documents. The load bearing capacity, stability or position of the pipe zone may not be changed by subsequent events such as ground water or removal of the sheeting. In these cases, additional securing measures are required to prevent a displacement/dislocation of the filler material.

13.4.1 Construction materials for the pipe zone

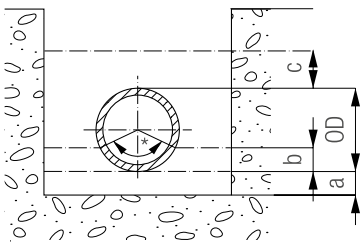
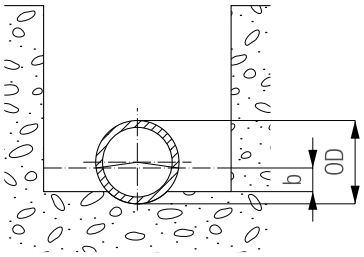
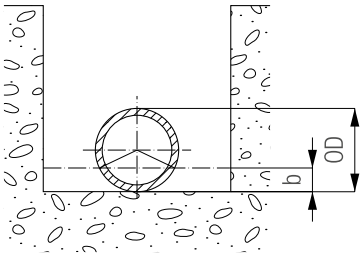
The construction materials must correspond to the planning documents. There can also be natural ground whose suitability has been tested.

Building materials for the pipe zone as well as their grain size and any stope support (shuttering) are to be selected taking into account:
- Pipe diameter
- Pipe material
- Pipe wall thickness
- Ground properties

For the pipe zone, in general, construction materials may not contain any components that are greater than 22 mm. ÖNORM EN 1610 must be followed.

13.4.2 Pipe cradle

The pipe cradle consists of the upper and lower bedding layer. The width of the bedding must be the same as the width of the trench. According to ÖNORM EN 1610, a distinction is made between three bedding types:

	Pipe bedding Type 1	Pipe bedding Type 2	Pipe bedding Type 3
Set-up	 *) bedding angle 2α		
	a Bottom intermediate bedding layer *b Top layer of bedding* *c Cover layer* *OD Outer pipe diameter*	*b Top layer of bedding* *OD Outer pipe diameter*	*b Top layer of bedding* *OD Outer pipe diameter*
Use	- Suitable for any pipe zone - The pipe must be resting and firmly in contact over the entire length	- Suitable for uniform, relatively loose and fine-grain ground - The ground must facilitate support over the entire pipe length	- Suitable for uniform, relatively fine-grain ground - The ground must facilitate support over the entire pipe length
Lower bedding layer a	- Normal ground conditions: a ≥ 100 mm - Rock or firmly set, consolidated ground: a ≥ 150 mm	- Pipe is located directly on the trench base	- Pipe is located directly on the trench base
Upper bedding layer b	Determination of the thickness according to statics calculation	Determination of the thickness according to statics calculation	Determination of the thickness according to statics calculation

Tab. 13-1 Pipe bedding types

Custom design of pipe bedding or load-bearing structure

Special measures are required for a trench base with a low load bearing capacity for the pipe bedding, for example, if the ground does not have sufficient load-bearing capacity, like peat or quicksand, special measures are required, for example

- Replacing the ground with other construction materials
- Supporting the piping with poles etc.

These versions may only be used if their suitability has been proven with statics calculations.

13.4.3 Backfilling

To avoid surface settling, the side and main filling must be done in accordance with the planning requirements.

13.4.4 Compaction

The degree of compaction must conform to the requirements for the pipe in accordance with the statics calculation.

- If required, compaction of the covering must be carried out manually directly above the pipe.
- The mechanical compaction of the main filling can only start once a layer with a minimum thickness of 30 cm has been placed over the apex of the pipe.
- The selection of compaction equipment, the number of compaction feedthroughs and the thickness of the layer to be compacted should be adapted to the material to be compressed and the pipe.
- The compaction of the main or side filling by washing-in is only permitted in exceptional cases for suitable non-cohesive soils.

13.5 Building connections

Connections to buildings (for example, shafts) should be flexible in construction. Suitable shaft chucks are employed here. The rubber sealing ring integrated in the shaft chuck takes care of the sealing between the pipe and the shaft chuck.

13.6 Leak test

§ The leak test must be carried out in accordance with ÖNORM EN 1610.

The leak test is carried out after removing the sheeting and the trench filling.

Testing with water

1. Carry out a visual inspection and secured closing of all openings.
2. Slowly fill the pipe or the defined pipe section with water and vent it completely.
3. When the test pressure of 0.5 bar is reached, keep to the full filling time of 1 h.
4. Then, maintain the test pressure of 0.5 bar for 30 min. If necessary, replenish the lost water.

The test is said to have been passed when the replenished water quantity per square metre inner surface does not exceed the following values:

- Pipelines	0.15 litres
- Pipelines with shafts	0.2 litres
- Pipelines with shafts and inspection openings	0.4 litres

Testing with air

Alternatively, the test can be performed with air.

⚠ - Owing to the increased air pressure, shut-off elements can get released in an explosive manner.
- Ensure firm and tight seating of the shut-off elements.

The test with air is carried out at two air pressures:

- Starting pressure corresponds to 110% test pressure
- Test pressure depending on the test method and nominal diameter

1. Maintain the starting pressure for approx. 5 minutes.
2. Then, reduce the air pressure to the test pressure.
3. Start the testing time and record the pressure drop within the testing time.

The test is said to have been passed if the pressure drop is within the permissible range. The test parameters can be obtained from ÖNORM EN 1610/Table 3.

14 CERTIFICATIONS

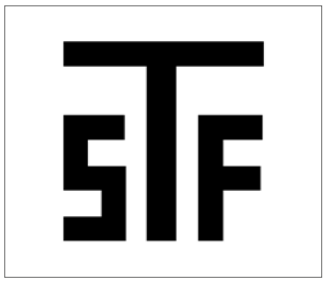
RAUPIANO PLUS has been certified by the following test institutes and many more:

Germany

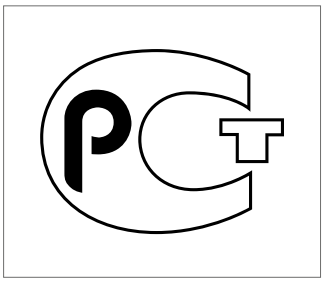
Germany

Sweden

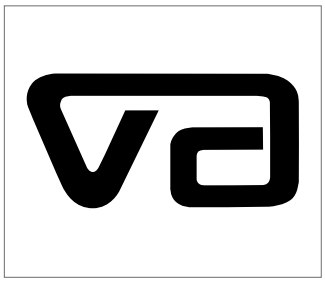
Norway



Finland



Russia



Denmark

Denmark

Poland

Austria

Hungary

Malaysia

Australia

15 TECHNICAL DATA OF RAUPIANO PLUS

RAUPIANO PLUS has been designed as a soil and waste 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		White, similar to RAL 9003
Dimensions		DN 32, DN 40, DN 50, DN 75, DN 90, DN 110, DN 125, DN 160, DN 200
Range of application		Pressureless domestic waste water with pH value 2 – 12
Temperature resistance	Continuously short-term	max. 70 °C max. 95 °C [2]
Trace heating		max. 45 °C
Pressure-resistance[1]	Drainage pipe Stormwater drainage pipe at a negative pressure	up to 1 bar (10 m water head) up to 2 bar (20 m water head) with adequate push-fit lock[1] up to 0.5 bar
Density	Pipes Fittings	1.5 – 1.9 g/cm³ 1.1 – 1.9 g/cm³
Coefficient of linear expansion		0.09 mm/m x K
Min. installation temperature		–10 °C
Tensile strength		> 16 N/mm²
Elongation at break		approx. 150 %
Flexural modulus of tension		approx. 2,700 N/mm²
MFR 230/2.16		approx. 0.82 g/10 min.
Fire load	 per 1 m DN 110	4.16 KWh/kg (14,992 KJ/kg) 7.9 KWh/m
Parts containing halogen		Halogen-free (no F, Cl, Br, J)
Fire behaviour		D-s2, d0 (normal flammable) according to EN 13501-1
Acoustic performance as per DIN EN 14366	with acoustic support bracket with standard bracket	P-BA 274/2016 Fraunhofer-Institut: 17 dB(A) at 4 l/s P-BA 275/2016 Fraunhofer-Institut: 24 dB(A) at 4 l/s
Ultraviolet resistance		UV-stabilised, but not resistant (see also chapter 4.9 on page 17)
Certificate of usability	German general building approval Z-42.1-223	German general building approval (German Institute of Civil Engineering)
Tests		System test on the basis of DIN EN 1451-1 "Ice crystal" as per DIN EN 1451 and DIN EN 1411
Approval		Technisches Gewerbemuseum TGM Wien (Technical Industrial Museum Vienna), TGM KU 24988
External quality control		Technisches Gewerbemuseum TGM Wien (Technical Industrial Museum Vienna)

[1] 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.

[2] Temperature collective:

Continuous temperature	70 °C	8 h / day	146,000 h in 50 years
Short periods of time	95 °C	10 min / day	3,000 h in 50 years
Short periods of time	98 °C	40 s / day	200 h in 50 years
Remaining time at room temperature (< 30 °C)			

16 TECHNICAL DATA OF RAUPIANO LIGHT

RAUPIANO LIGHT has been designed for draining domestic waste water. 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		White, similar to RAL 9003
Dimensions		DN 32, DN 40, DN 50, DN 75, DN 110, DN 125, DN 160
Range of application		residential soil and waste, pressureless with ph value 2 – 12
Temperature resistance	Continuously short-term	max. 70 °C max. 95 °C [2]
Trace heating		max. 45 °C
Pressure-resistance[1]	Drainage pipe Stormwater drainage pipe at a negative pressure	up to 0,5 bar (5 m water head) up to 2 bar (20 m water head) with adequate push-fit lock[1] up to 0.5 bar
Density	Pipes Fittings	1.2 g/cm³ 1.0 – 1.25 g/cm³
Coefficient of linear expansion		0.09 mm/m x K
Min. installation temperature		–10 °C
Tensile strength		> 16 N/mm²
Elongation at break		approx. 150 %
Flexural modulus of tension		approx. 2,100 N/mm²
MFR 230/2.16		approx. 0.5 g/10 min.
Parts containing halogen		Halogen-free (no F, Cl, Br, J)
Fire behaviour		E (normal flammable) according to EN 13501-1
Acoustic performance as per DIN EN 14366	with acoustic support bracket with standard bracket	P-BA 278/2016 Fraunhofer-Institut: 22 dB(A) at 4 l/s P-BA 225/2012 Fraunhofer-Institut: 26 dB(A) at 4 l/s
Ultraviolet resistance		UV-stabilised, but not resistant (see also chapter 4.9 on page 17)
Certificate of usability	German general building approval Z-42.1-508	German general building approval (German Institute of Civil Engineering)
Approval		Technisches Gewerbemuseum TGM Wien (Technical Industrial Museum Vienna), ISTITUTO ITALIANO DEI PLASTICI S.r.l (IIP), TGM KU 24645, Piip 442
External quality control		Technisches Gewerbemuseum TGM Wien (Technical Industrial Museum Vienna), ISTITUTO ITALIANO DEI PLASTICI S.r.l (IIP)

[1] *The tightness only describes 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.*

[2] *Temperature collective:*

Continuous temperature	70 °C	8 h / day	146,000 h in 50 years
Short periods of time	95 °C	10 min / day	3,000 h in 50 years
Short periods of time	98 °C	40 s / day	200 h in 50 years
Remaining time at room temperature (< 30 °C)			

17 CHEMICAL RESISTANCE

Pipe and fitting

The information provided is meant as an initial orientation concerning the chemical resistance of the material (not as a possible effect on the attacking agent) and are not readily transferable to all applications. In situation where mechanical stresses and chemical agents are present at the same time, the mechanical performance can be compromised (stress corrosion cracking).

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 damage to the connection.
In this case it may be necessary to change the sealing material from SBR to NBR.

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-Propene-1-ol	96	20	r
	96	60	r
Exhaust gases, containing H_2CO_3	any	60	r
Exhaust gases, containing $H_2S_2O_7$	lower	20	–
	higher	20	nr
Exhaust gases, containing H_2SO_4, moist	any	60	r
Exhaust gases, containing HCl	any	60	r
Exhaust gases, containing HF	Traces	60	r
Exhaust gases, containing NO_X	Traces	60	r
	higher	60	–
Exhaust gases, containing SO_2	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

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
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

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
Cider	comm. form	20	r
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	comm. form	60	r
Alkaline bisulfite solution, containing SO_2	Warm saturated	50	r
Lead acetate, aqueous	Warm	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	–

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
(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
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

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
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
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	–

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
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
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

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
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,	Norm. conc.	40	–
12.5% active chlorine	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	–
Phenylhydrazine	100	20	lr
	100	60	–
Phenylhydrazine hydrochloride,	Saturated	20	–
aqueous	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	–

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
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	40	r
	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	–
Tanigan F, aqueous	Saturated	60	–
Tanigan U, aqueous	Saturated	40	–
	Saturated	60	–
Carbon tetrachloride, technical	100	20	nr
Thionyl chloride	100	20	nr

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
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	Up to 10	40	r
	Up to 10	60	r
	Saturated	60	b

18 DISCHARGE CAPACITY

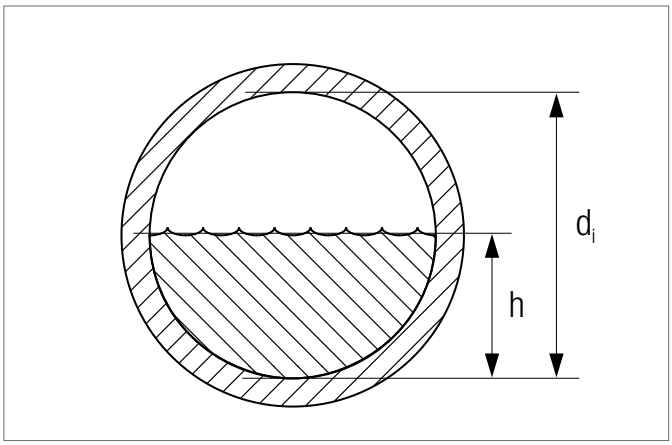


Fig. 18-1 Cross cut of a partly filled pipe
d_i pipe inside diameter
h Degree of filling

Discharge capacity at $h/d_i = 0.5$

J	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		DN 200 d_i = 187.6	
	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v
cm/m	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	l/s	m/s
0.5									2.2	0.5	3.1	0.6	6.0	0.7	10.5	0.8
0.6					0.9	0.4	1.4	0.5	2.4	0.6	3.4	0.6	6.6	0.7	11.5	0.8
0.7					0.9	0.5	1.5	0.5	2.6	0.6	3.7	0.7	7.1	0.8	12.5	0.9
0.8					1.0	0.5	1.6	0.6	2.8	0.7	3.9	0.7	7.6	0.8	13.3	1.0
0.9					1.1	0.5	1.7	0.6	3.0	0.7	4.2	0.8	8.1	0.9	14.2	1.0
1.0					1.1	0.6	1.8	0.6	3.1	0.7	4.4	0.8	8.6	0.9	14.9	1.1
1.1					1.2	0.6	1.9	0.7	3.3	0.8	4.6	0.8	9.0	1.0	15.7	1.1
1.2			0.4	0.5	1.2	0.6	2.0	0.7	3.4	0.8	4.8	0.9	9.4	1.0	16.4	1.2
1.3			0.4	0.5	1.3	0.6	2.1	0.7	3.6	0.8	5.0	0.9	9.8	1.1	17.0	1.2
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	17.7	1.3
1.5			0.4	0.5	1.4	0.7	2.3	0.8	3.9	0.9	5.4	1.0	10.5	1.2	18.3	1.3
2.0	0.3	0.5	0.5	0.6	1.6	0.8	2.6	0.9	4.5	1.0	6.3	1.1	12.1	1.3	21.2	1.5
2.5	0.3	0.6	0.6	0.7	1.8	0.9	2.9	1.0	5.0	1.2	7.0	1.3	13.6	1.5	23.7	1.7
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	26.0	1.9
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	28.1	2.0
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	30.0	2.2
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	2.0	31.8	2.3
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	33.6	2.4

Discharge capacity at $h/d_i = 0.7$

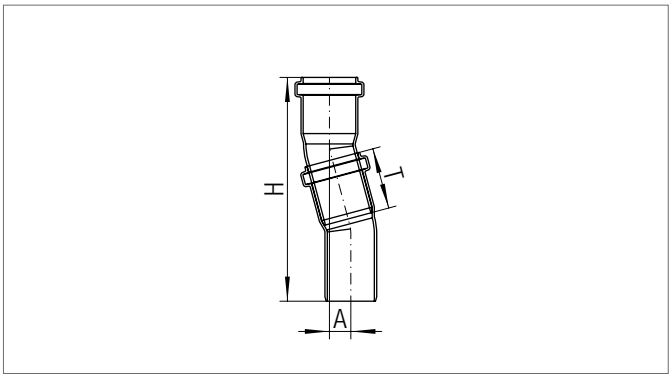
J	DN 40 d_i = 36.4		DN 50 d_i = 46.4		DN 75 d_i = 71.2		DN 90 d_i = 85.6		DN 110 d_i = 104.6		DN 125 d_i =118.8		DN 160 d_i = 152.2		DN 200 d_i = 187.6	
	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v
cm/m	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s
0.5							2.2	0.5	3.7	0.6	5.2	0.6	10.1	0.7	17.6	0.9
0.6					1.5	0.5	2.4	0.6	4.1	0.6	5.7	0.7	11.1	0.8	19.3	0.9
0.7					1.6	0.5	2.6	0.6	4.4	0.7	6.2	0.7	12.0	0.9	20.9	1.0
0.8					1.7	0.6	2.8	0.6	4.7	0.7	6.6	0.8	12.8	0.9	22.3	1.1
0.9					1.8	0.6	2.9	0.7	5.0	0.8	7.0	0.8	13.6	1.0	23.7	1.1
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	25.0	1.2
1.1			0.6	0.5	2.0	0.7	3.2	0.8	5.5	0.9	7.8	0.9	15.0	1.1	26.2	1.3
1.2			0.7	0.5	2.1	0.7	3.4	0.8	5.8	0.9	8.1	1.0	15.7	1.2	27.4	1.3
1.3	0.4	0.5	0.7	0.5	2.1	0.7	3.5	0.8	6.0	0.9	8.5	1.0	16.3	1.2	28.5	1.4
1.4	0.4	0.5	0.7	0.6	2.2	0.7	3.7	0.8	6.2	1.0	8.8	1.1	17.0	1.2	29.6	1.4
1.5	0.4	0.5	0.7	0.6	2.3	0.8	3.8	0.9	6.5	1.0	9.1	1.1	17.6	1.3	30.6	1.5
2.0	0.4	0.6	0.8	0.7	2.7	0.9	4.4	1.0	7.5	1.2	10.5	1.3	20.3	1.5	35.4	1.7
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	39.6	1.9
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	43.4	2.1
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	2.0	46.9	2.3
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	50.1	2.4
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	2.0	32.2	2.4		

Discharge capacity at $h/d_i = 1.0$

J	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		DN 200 d_i = 187.6	
	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v
cm/m	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	l/s	m/s
0.5									4.4	0.5	6.2	0.6	12.1	0.7	21.0	0.8
0.6							2.8	0.5	4.9	0.6	6.8	0.6	13.2	0.7	23.1	0.8
0.7					1.9	0.5	3.1	0.5	5.2	0.6	7.4	0.7	14.3	0.8	24.9	0.9
0.8					2.0	0.5	3.3	0.6	5.6	0.7	7.9	0.7	15.3	0.8	26.7	1.0
0.9					2.1	0.5	3.5	0.6	6.0	0.7	8.4	0.8	16.2	0.9	28.3	1.0
1.0					2.2	0.6	3.7	0.6	6.3	0.7	8.8	0.8	17.1	0.9	29.9	1.1
1.1					2.4	0.6	3.9	0.7	6.6	0.8	9.3	0.8	18.0	1.0	31.3	1.1
1.2			0.8	0.5	2.5	0.6	4.0	0.7	6.9	0.8	9.7	0.9	18.8	1.0	32.7	1.2
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	34.1	1.2
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	35.4	1.3
1.5			0.9	0.5	2.8	0.7	4.5	0.8	7.7	0.9	10.8	1.0	21.0	1.2	36.6	1.3
2.0	0.5	0.5	1.0	0.6	3.2	0.8	5.2	0.9	8.9	1.0	12.5	1.1	24.3	1.3	42.4	1.5
2.5	0.6	0.6	1.1	0.7	3.6	0.9	5.8	1.0	10.0	1.2	14.0	1.3	27.2	1.5	47.4	1.7
3.0	0.6	0.6	1.2	0.7	3.9	1.0	6.4	1.1	11.0	1.3	15.4	1.4	29.8	1.6	51.9	1.9
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	56.1	2.0
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	60.0	2.2
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	2.0	63.7	2.3
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	67.1	2.4

19 FITTING COMBINATIONS

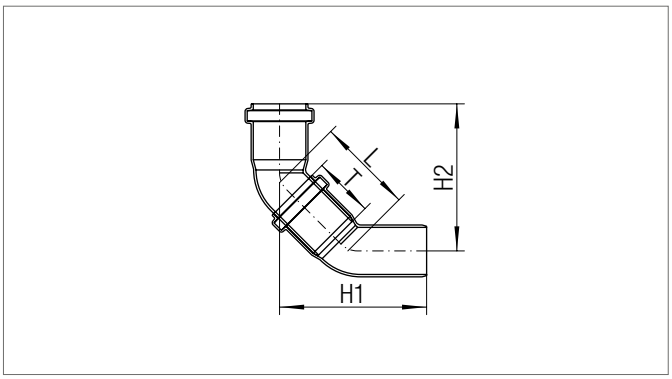
RAUPIANO PLUS bend
Stage with bends 15°–87°



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

RAUPIANO PLUS bend

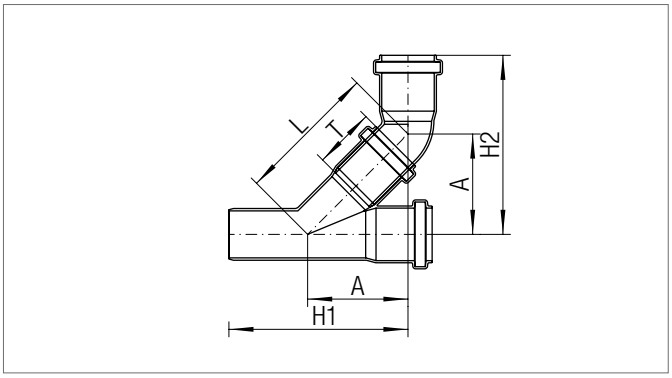
Deflection 90° with two elbows 45°



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

RAUPIANO PLUS single branch with bend

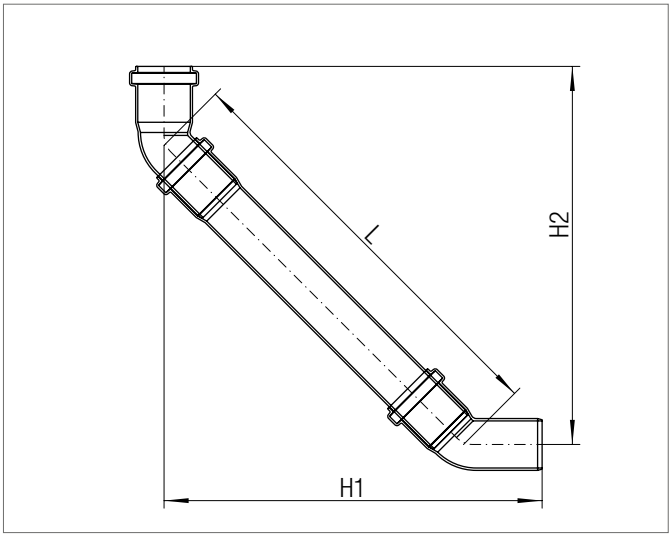
Branch 45° with bend 45°



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

RAUPIANO PLUS bend

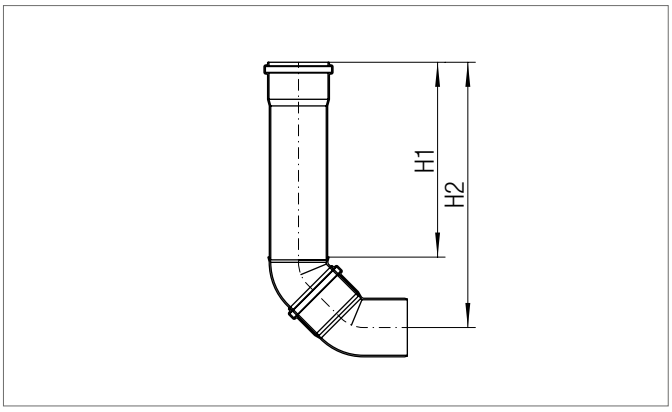
Deflection with two elbows 45° + 250 mm settling path



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

RAUPIANO PLUS deflection bends

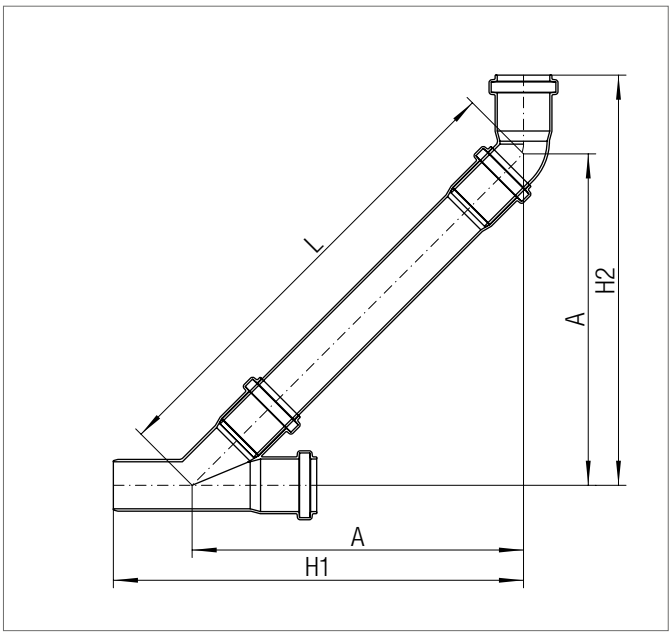
Deflection 90° with 1 bend 45° + 1 deflection bend 45°



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

RAUPIANO PLUS bend

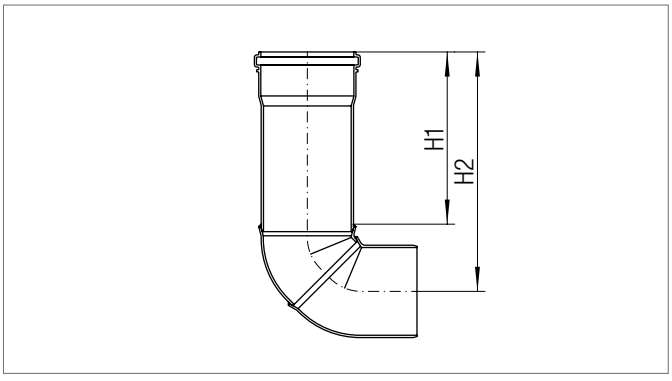
Branch 45° with bend 45° + 250 mm settling path



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

RAUPIANO PLUS deflection bends

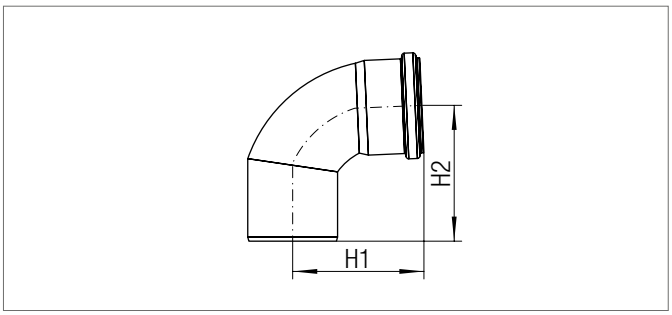
Deflection 87° without appendage



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

RAUPIANO PLUS long bend

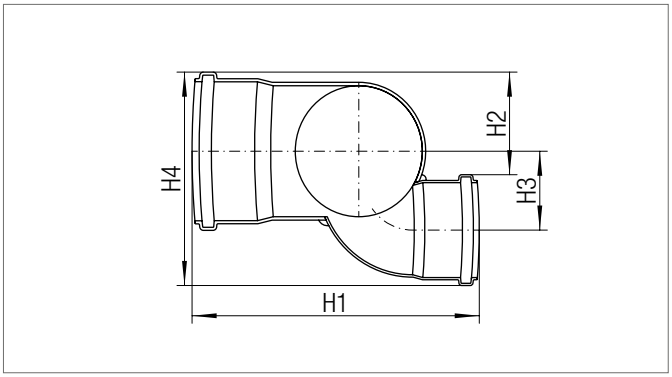
Long bend 87°

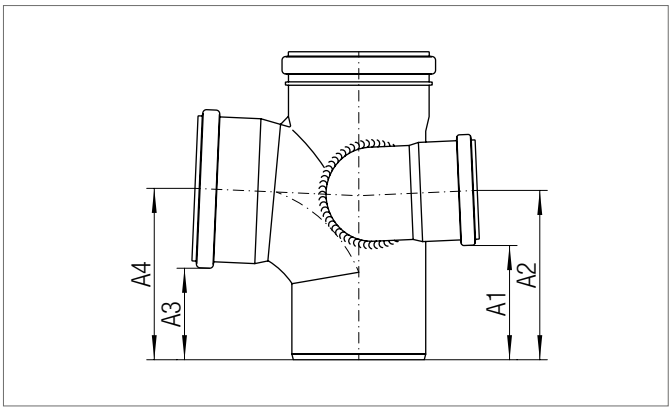


Angle	DN	H1 [mm]	H2 [mm]
87°	110	139	148

RAUPIANO PLUS shaft branch

Shaft branch dimensioned left
(Shaft branch correspondingly on the right)

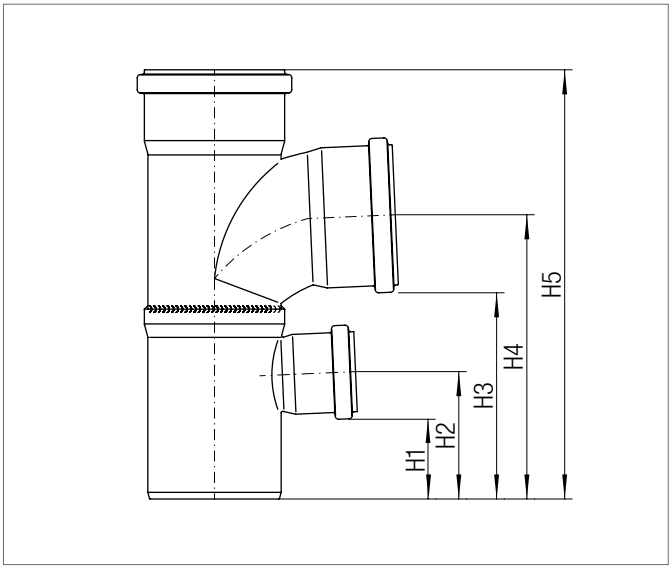




Angle	DN/OD	H1	H2	H3	H4	A1	A2	A3	A4
87°	110/75/110	236	74	63	162	91	135	73	137
	90/75/90	222	60	59	148	69	114	63	115

RAUPIANO PLUS double branch

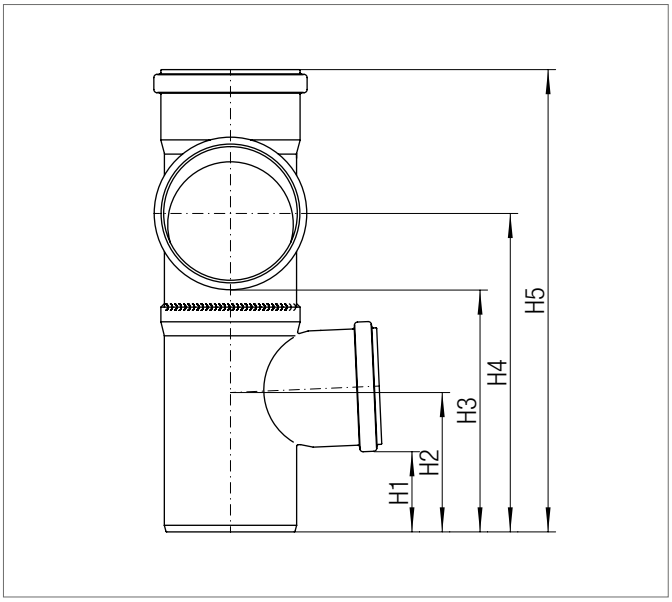
Double branch, one side



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

RAUPIANO PLUS 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

20 STANDARDS, REGULATIONS AND GUIDELINES

The technical information refers to the following standards, specifications and directives (the latest one is always the one to refer to):


The following list does not claim to be complete:

ÖNORM H 6036
Ventilation systems – requirement-dependent ventilation of dwellings or individual residential areas

ÖNORM B 2501
Drainage systems for buildings

DIN 1986-100
Drainage systems for buildings and property

EN 13501-1
Fire classification of construction products and construction types

DIN 4109
Sound insulation in building construction

DIN 4109-10 (E)
Increased sound insulation in dwelling construction

ÖNORM B 8115
Sound insulation and acoustics in building construction

OIB directives

ÖNORM EN 476
General requirements for components for sewer pipes and channels for gravitation drainage systems

DIN EN 681
Elastomer gaskets
Material requirements for pipe seals for water supply and drainage applications

ÖNORM EN 752
Drain and sewer systems outside buildings

ÖNORM EN 1451
Polymer pipe systems for draining waste water (low and high temperature) within the building structure – polypropylene (PP)

ÖNORM EN 1610
Installation and testing of sewer pipes and channels

ÖNORM EN 12056
Gravitation drainage units within buildings

German general building approval of the German Institute of Civil Engineering (DIBt)

Leaflet and technical information relating to sound insulation (German Central Association for plumbing, heating and air conditioning)

RAUCAD software from REHAU EN 12056

VDI Directive 4100:2007
Sound insulation of apartments, criteria for planning and assessment

REHAU®
Unlimited Polymer Solutions

REHAU FIRE STOP COLLAR FP

Technical information

CONTENT

1 INFORMATION AND SAFETY INSTRUCTIONS

Notes regarding this technical information

Validity
This technical information is applicable to Austria.

This technical information “REHAU fire stop collar FP” is valid from June 2018.

Other applicable technical information:
- Technical information “RAUPIANO PLUS and LIGHT Waste Water System”

Our current technical documentation is available for download from www.rehau.com.

All dimensions and weights are reference values. Subject to errors and changes.

Navigation
At the beginning of this chapter, you will find a detailed table of contents with the hierarchical headings and the corresponding page number.

Pictograms and logos

Safety warnings

Legal information

Important information that must be taken into account

Information on the Internet

Your benefits

For your own safety and for the correct application of our products, please check regularly whether a newer version of your technical information is available.
The publication date of your technical information is always found on the bottom left of the cover page.
You can obtain the current technical information from your REHAU sales office, specialist wholesaler or you can download it from the internet at **www.rehau.com**

- For your own safety and the safety of other people, please read through all safety instructions and operating instructions carefully and completely before 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.

General precautions
- Observe the generally applicable regulations relating to safety and the prevention of accidents when installing pipe connections.
- Keep your workplace clean and free of obstructions.
- Ensure that your work space has adequate lighting.
- Keep children, pets and unauthorised persons away from tools and installation areas. This particularly applies to renovations in occupied areas.
- Use only the components intended for the respective 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 risks.

Fire protection
Please closely observe the relevant fire protection regulations and the relevant applicable building codes/construction regulations.

Prerequisites for personnel
- Our systems must only be installed by authorised and trained personnel.
- Work on electrical equipment or wiring may only be carried out by qualified and authorised individuals.

Working clothes

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

During installation

- Read and always follow the operating instructions of the REHAU installation tool being used.
- Cutting tools have a sharp blade. Store and handle them in such a way that there is no risk of injury from the cutting tools.
- When cutting the pipes to length, keep a safe distance between the hand holding the pipe and the cutting tool.
- Never reach into the cutting zone of the tool or touch moving parts during the cutting process.
- During maintenance, upkeep or retooling work and when changing the assembly area, always unplug the tool and prevent it from being switched on accidentally.

2 GENERAL FIRE PROTECTION INFORMATION

2.1 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.

2.2 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.

2.3 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.

2.4 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

Building class gradation according to the OIB definition of terms (OIB-BB)					
Escape level	**GK 1**	**GK 2**	**GK 3**	**GK 4**	**GK 5**
≤ 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[5] 1 BE/1 WE (dwelling unit) ≤ 400 m² BGF (gross floor area)	≤ 3 floors ≤ 7 m[5] ≤ 5 BE/5 WE ≤ 400 m² BGF Terraced houses	≤ 3 floors ≤ 7 m[5]	≤ 4 floors ≤ 11 m[5] 1 BE/1 WE/∞ m² X BE/X WE ≤ 400 m² BGF	≤ 22 m[5]
Schedule line	**GK 1**	**GK 2**	**GK 3**	**GK 4**	**GK 5**
Illustration					
1 Load-bearing component (except ceilings and fire-compartmentalising walls)					
1.1 In the uppermost floor	-	R 30	R 30	R 30	R 60[1]
1.2 In the other above-ground floors	R 30[2]	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
2 Partitioning walls (except walls of staircases)					
2.1 In the uppermost floor	not applicable	REI 30 EI 30	REI 30 EI 30	REI 60 EI 60	REI 60[1] EI 60[1]
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
3 Walls and ceilings forming fire compartments					
3.1 Walls forming fire compartments on the premises or construction site limit	REI 60 EI 60	REI 90[3] EI 90[3]	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
4 Ceilings and pitch roofs with a slant < 60°					
4.1 Ceilings above the uppermost floor	-	R 30	R 30	R 30	R 60[1]
4.2 Partition ceilings above the uppermost floor	-	REI 30	REI 30	REI 60	REI 60[1]
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[2]	R 30	R 30	R30	REI 90[1] and A2
4.5 Ceilings above the underground floors	R 60	REI 60[4]	REI 90 and A2	REI 90 and A2	REI 90 and A2
3 Walls and ceilings forming fire compartments				**R 30 or A2**	**R 30 and A2**

[1] 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

[2] Not required for buildings that serve only for living or office use or office-like use

[3] 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

[4] 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

[5] Escape level

BGF . Gross floor area

BE . . Operating unit

WE . . Living unit

2.5 Construction products in Austria

2.5.1 Acceptance of the construction product directive of the EU

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.

2.5.2 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 ETAG 026 – part 2 "Fire stopping and fire sealing products"
- 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.

2.6 Harmonised European construction product flammability classes and fire resistance classes

2.6.1 European construction product flammability classes – EN 13501 part 1

Construction product flammability class according to ÖN EN 13501-1	Requirement level for construction products (except flooring and pipe insulation)	Classification comparison with the previous construction product flammability class in accordance with ÖN B 3800-1*
A1	**"No contribution to fire"** There is no contribution to the fire in any phase, including the fully developed fire.	**Non-flammable** **A**
A2	**"Negligible contribution to the fire"** 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 vaporisation (PCS value).	
B	**"Very limited contribution to the fire"** Flame exposure period 30 seconds with a vertical flame spread of max. 150 mm above the flame exposure point after 60 sec. Testing for determining the release of heat: $FIGRA_{0.2\ MJ} \leq 120$ W/s $THR_{600\ s} \leq 7.5$ MJ	**Slow burning** **B1**
C	**"Limited contribution to the fire"** Flame exposure period 30 seconds with a vertical flame spread of max. 150 mm above the flame exposure point after 60 sec. Testing for determining the release of heat: $FIGRA_{0.4\ MJ} \leq 250$ W/s $THR_{600\ s} \leq 15$ MJ	
D	**"Acceptably low contribution to the fire"** Flame exposure period 30 seconds with a vertical flame spread of max. 150 mm above the flame exposure point after 60 sec. Testing for determining the release of heat: $FIGRA_{0.4\ MJ} \leq 750$ W/s	**Normal flammability** **B2**
E	**"Acceptable fire behaviour"** Flame exposure period 15 seconds with a vertical flame spread of max. 150 mm above the flame exposure point after 20 sec.	
F	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

Additional classification for smoke formation (smoke)	Requirement level
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).

Additional classification for dripping/dropping while burning (droplets)	Requirement level
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

2.6.2 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.

2.6.3 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.

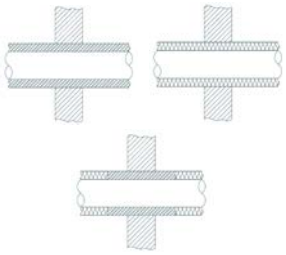
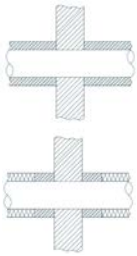
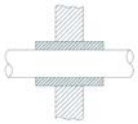
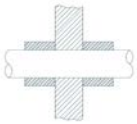
Characteristic performance properties of components according to ÖNORM EN 13501 part 2 are:

Identification alphabet according to ÖN EN 13501-2	Designation/performance property
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_1, I_2)	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_a, S_m)	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_1, K_2)	Fire protection action Fire protection function of a fire protection clothing for a fixed time

Other codes	Designation/performance/requirement
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	uncapped	uncapped	Polymer: Stormwater, waste water vented (disposal pipe)
U/C	uncapped	capped	Polymer: Unventilated waste water, gas, tap water, hot water, (supply pipe) Metal: non-fireproof suspension/ joining systems
C/U	capped	uncapped	Metal: fireproof suspension/joining systems
C/C	capped	capped	---

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).

2.7 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

2.8 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_1: Products for sealing for use at temperatures below 0 °C with UV exposure, but without being subject to rain. **Type Y_2:** Products for sealing for use at temperatures below 0 °C without UV exposure and rain.
Type Z_1: Products for sealing for use in interiors with high humidity, but without temperatures below 0 °C. **Type Z_2:** Products for sealing for use in interiors with other humidity classes than Z_1, but without temperatures below 0 °C.

2.9 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 Osterreichisches Institut fur Bautechnik (Austrian Civil Engineering Institute), Schenkenstrase 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 Osterreichisches Institut fur Bautechnik (Austrian Civil Engineering Institute), http://www.oib.or.at/BPV.pdf

3 FIRE STOP COLLARS FOR POLYMER PIPES

3.1 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).

3.2 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
Fire stop collar FP 6.0 / 200	210	242	5

Tab. 3-1 Technical data

3.3 Application area

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 RAUPIANO PLUS 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, angled pipe breakthroughs and pipe diameter up to 200 mm

3.4 Customer benefits

- Simple and quick installation
- Zero distance possible
- Usage category Y_1
- Collar heights: 32 and 62 mm

3.5 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

3.6 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

3.7 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.

3.8 Safety instructions

Please see the current technical information for safety instructions. You can obtain this document in our sales offices or at www.rehau.com.

4 VARIANTS OF POLYMER PIPE SEALING

4.1 General information

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

Load-bearing structures	Component thickness	Number of pipe collars
Shaft wall	≥ 50 mm	1
Light partition wall	≥ 100 mm	2
Solid wall	≥ 100 mm	2
Solid ceiling	≥ 150 mm	1

Tab. 4-1 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.

4.1.1 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:
  1. With fire protection mortar (e.g. PROMASTOP-VEN)
  2. With gypsum plaster
  3. 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

4.2 Shaft wall

The minimum thickness of the shaft wall construction must be ≥ 50 mm.

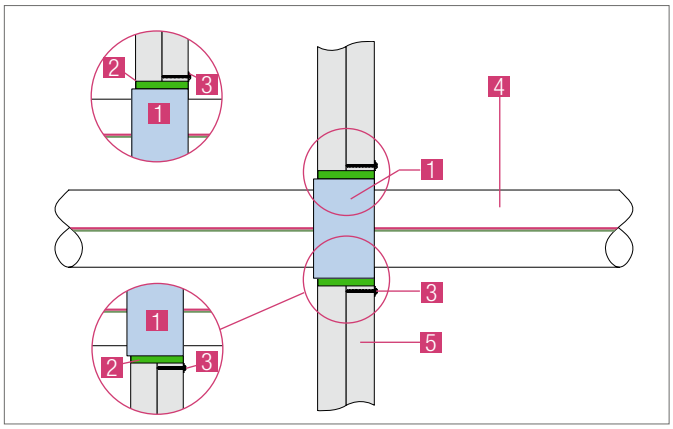


Fig. 4-1 REHAU fire stop collar FP 6.0 in a shaft wall

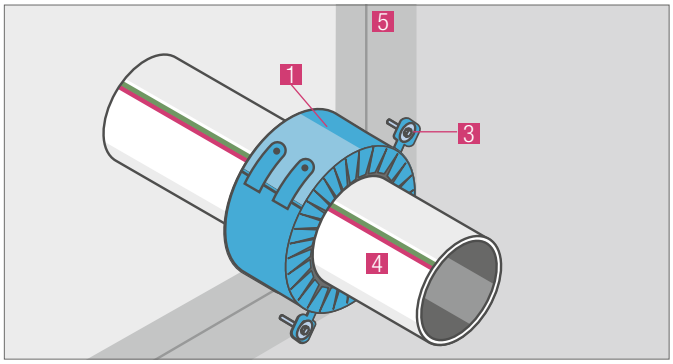


Fig. 4-2 REHAU fire stop collar FP 6.0 in a shaft wall

Position list	
1	REHAU fire stop collar FP
2	Annular gap, see installation procedure
3	Suitable fastening material
4	RAUPIANO PLUS
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. 4-2 Position list

Mounting

In shaft walls, the REHAU fire stop collar FP 6.0 is inserted the other way round with a construction height of 62 mm and fixed with the commonly available dry wall screws or the accompanying fastening material.

4.3 Light partition wall

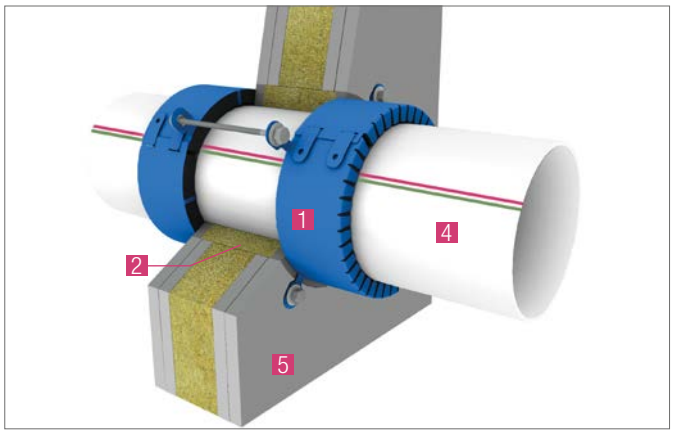


Fig. 4-3 REHAU fire stop collar FP on a light partition wall

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.

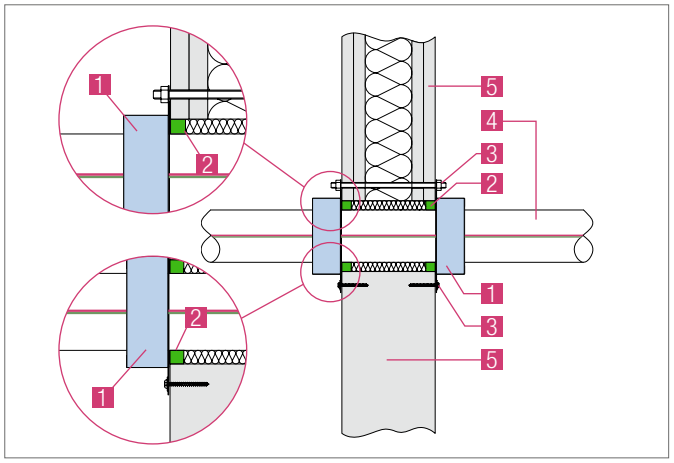


Fig. 4-4 REHAU fire stop collar FP on a light partition wall and solid wall

4.3.1 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.

4.3.2 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.

4.4 Solid ceiling

Ceilings in solid construction must be ≥ 150 mm thick and have a density of ≥ 450 kg/m³. For ceiling constructions, the fire stop collars are fitted only on one side (fitted-on or embedded in the mortar).

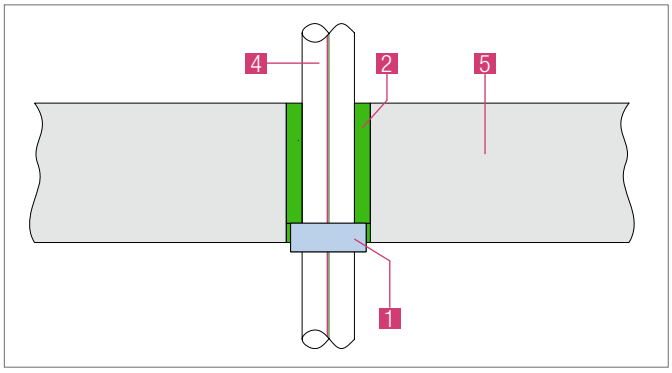


Fig. 4-5 Polymer pipe sealing in solid ceiling construction

4.5 Solid wall

Walls in solid construction must be ≥ 100 mm thick and have a density of ≥ 450 kg/m³. (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).

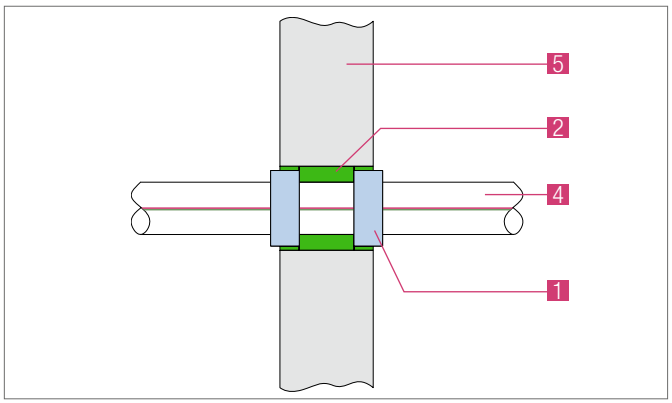


Fig. 4-6 Polymer pipe sealing in solid wall construction

4.5.1 Mounting

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. 4-5 and Fig. 4-6).
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.

4.6 Special applications in light partition wall or solid wall

4.6.1 REHAU fire stop collar FP 6.0 for slanted pipe application

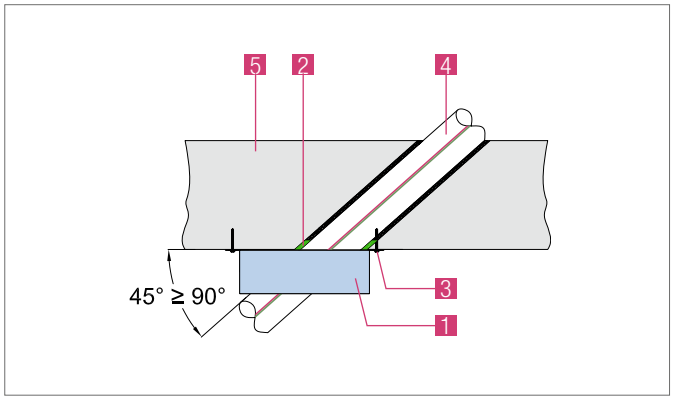


Fig. 4-7 REHAU fire stop collar FP 6.0 for slanted pipe application

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

4.6.2 REHAU fire stop collar FP 6.0 for collar application

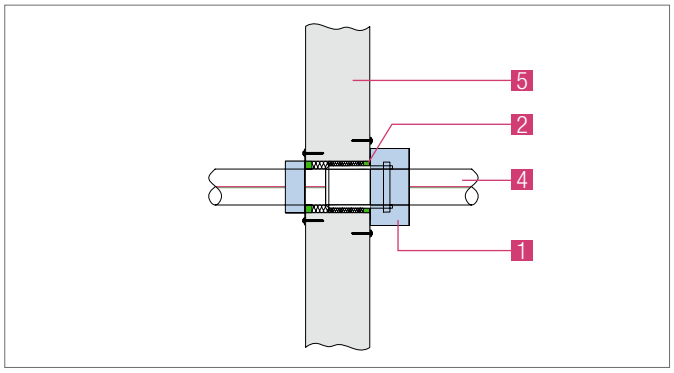


Fig. 4-8 REHAU fire stop collar FP 6.0 for collar application

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. 4-3 Information about minimum distance

5 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 RAUPIANO PLUS in the sizes 32 to 200 mm – see Tab. 5-3.

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.

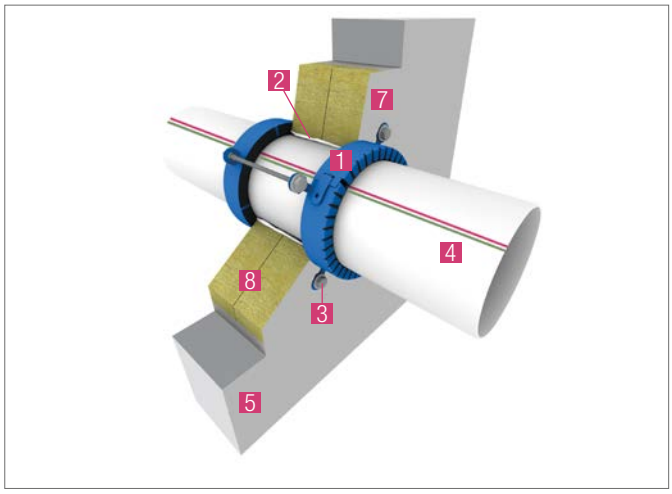


Fig. 5-1 Polymer pipe sealing in solid wall with soft firestop

Position list	
1	REHAU fire stop collar FP
2	Annular gap, see installation procedure
3	Suitable fastening material
4	RAUPIANO PLUS
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. 5-1 Position list

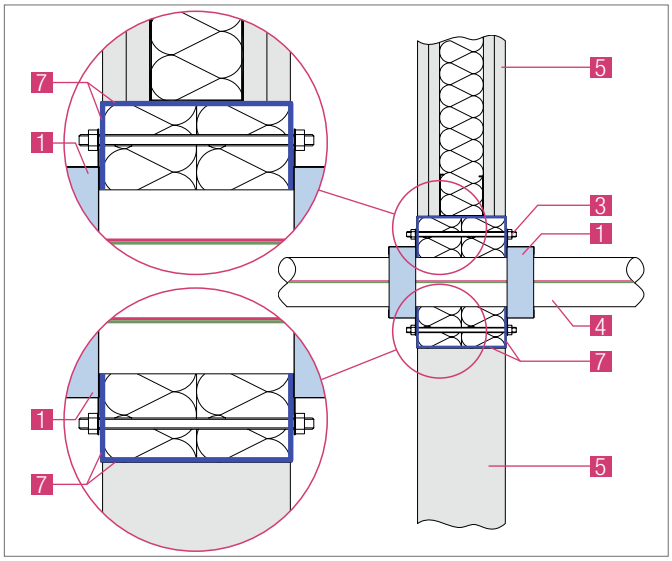


Fig. 5-2 Polymer pipe sealing in a light partition wall and solid wall

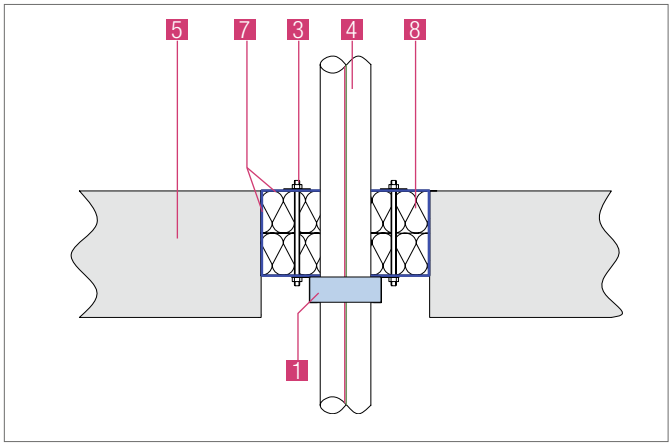


Fig. 5-3 Polymer pipe sealing in a solid ceiling

Project	Distance (mm)
REHAU fire stop collar FP – non-flammable pipe with insulation	0
REHAU fire stop collar FP – cable duct	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. 5-2 Information about minimum distance

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

5.1 Overview of pipe material, dimensions, installation situations and classifications

Designation	Range of sizes	Soft firestop	Direction	Collar types	Classification
	Ø…pipe diameter (mm)	(mm)	D…ceiling W...wall	FP 3.0 / FP 6.0	
RAUPIANO PLUS	Ø 40 – Ø 200	1 x 50	D	FP 6.0	EI60-U/U
RAUPIANO PLUS	Ø 40 – Ø 200	1 x 80	D	FP 6.0	EI90-U/U
RAUPIANO PLUS	Ø 40 – Ø 200	2 x 50	D	FP 6.0	EI90-U/U
RAUPIANO PLUS (+collar)	Ø 40 – Ø 125	1 x 50	D	FP 6.0	EI60-U/U
RAUPIANO PLUS (+collar)	Ø 40 – Ø 125	1 x 80	D	FP 6.0	EI90-U/U
RAUPIANO PLUS (+collar)	Ø 40 – Ø 125	2 x 50	D	FP 6.0	EI90-U/U
RAUPIANO PLUS (+collar)	Ø 40 – Ø 125	1 x 50	W	FP 6.0	EI60-U/U
RAUPIANO PLUS (+collar)	Ø 40 – Ø 125	1 x 80	W	FP 6.0	EI90-U/U
RAUPIANO PLUS (+collar)	Ø 40 – Ø 125	2 x 50	W	FP 6.0	EI120-U/U

Tab. 5-3 Overview of pipe material, dimensions, installation situations and classifications

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

6 COMBINATION FIRESTOP FOR PIPES AND CABLES

Benefits

- Sealing size up to 3.75 m^2 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

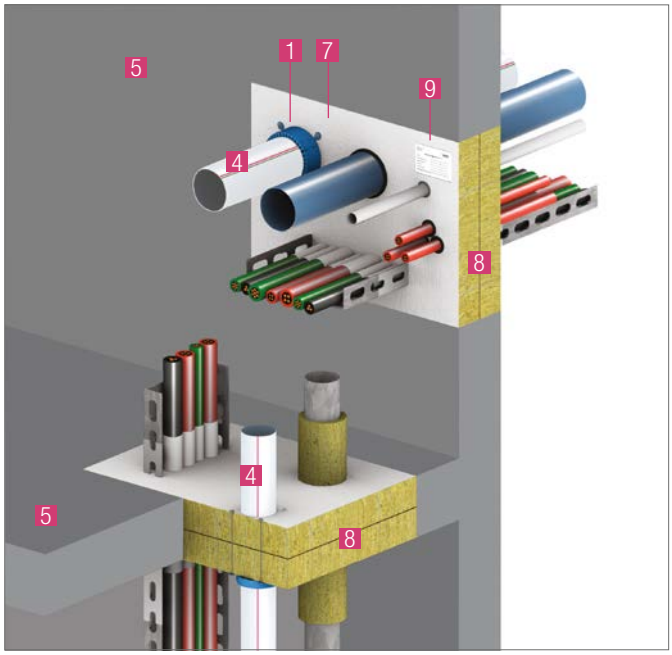


Fig. 6-1 Combination firestop in solid wall and solid ceiling

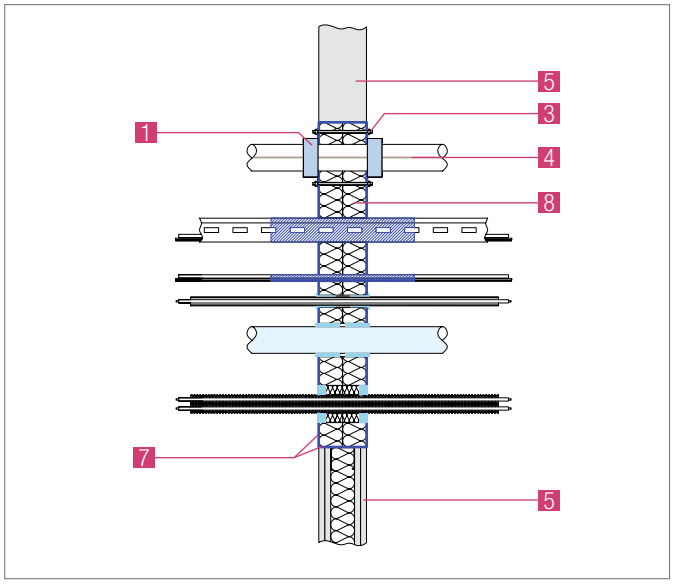


Fig. 6-2 Combination firestop in a light partition wall and solid wall

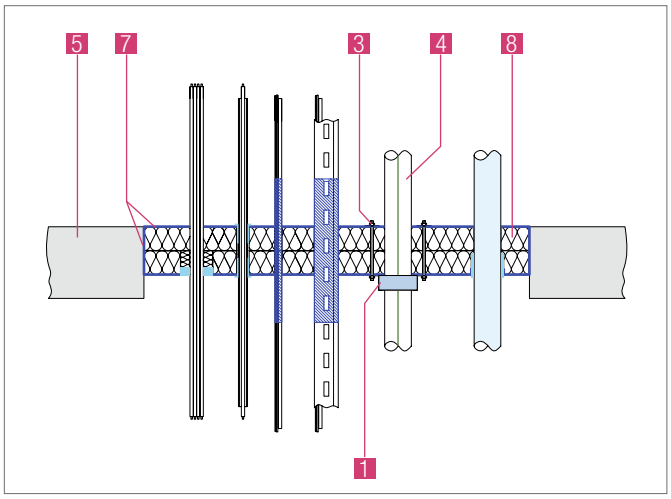


Fig. 6-3 Combination firestop in solid ceiling

Position list	
1	REHAU fire stop collar FP
2	Annular gap, see installation procedure
3	Suitable fastening material
4	RAUPIANO PLUS
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. 6-1 Position list

6.1 Installation procedure

- Use boards of non-flammable mineral wool (A1 according to EN 13501-1), with a melting point of ≥ 1000 °C and a weight per unit volume of ≥ 140 kg/m^3, unless otherwise defined (see Tab. 6-2).
- In case of a double layer, distance between the mineral wool plates: ≥ 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.

6.1.1 Tested and approved mineral wool

The Tab. 6-2 contains a list of the mineral wools tested and approved in the system (bulk density ≥ 140 kg/m³, melting point ≥ 1000 °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. 6-2 Tested and approved mineral wool

6.1.2 Positioning possibilities for the mineral wool plates

In Fig. 6-4 , there are three possibilities shown for fitting a mineral wool sealing in solid ceiling and/or solid wall constructions ≥ 100 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

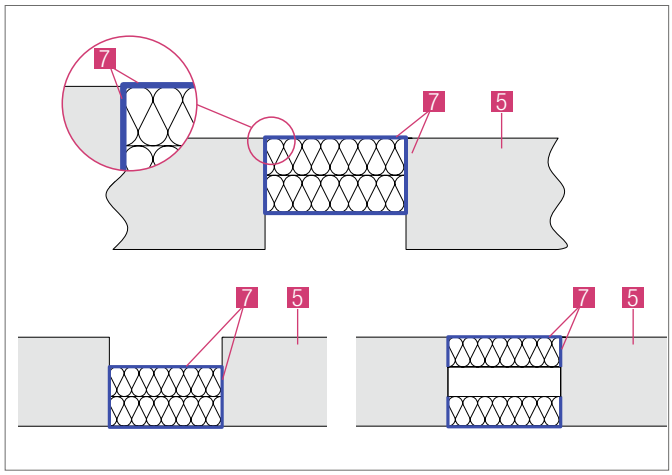


Fig. 6-4 Positioning possibilities for the mineral wool plates

6.2 Jamb formation

The sealant may be fitted in walls and ceilings in accordance with Tab. 6-3 (when using PROMASTOP®-CC) or Tab. 6-4 (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 ≥ 100 mm	1,80 m²	1,80 m²	3,75 m²
Solid wall ≥ 100 mm	1,80 m²	1,80 m²	3,75 m²
Solid ceiling ≥ 150 mm	1,95 m²	1,95 m²	3,75 m²
Consumption	1.35 kg/m²	1.35 kg/m²	1.35 kg/m²

Tab. 6-3 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	≤ 1.44 m²	EI120
Solid wall	≤ 1.44 m²	EI120
Solid ceiling	≤ 1.44 m²	EI90

Tab. 6-4 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.

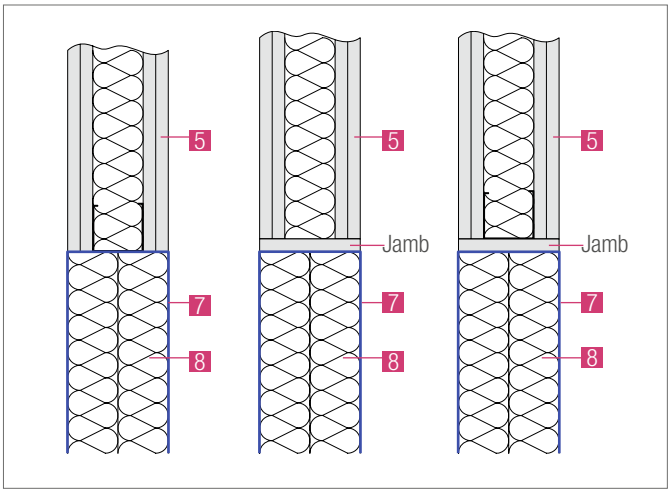


Fig. 6-5 Jamb formation with a light partition wall

6.3 Range of application

In Tab. 6-3 and Tab. 6-4 , 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.

6.3.1 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 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.

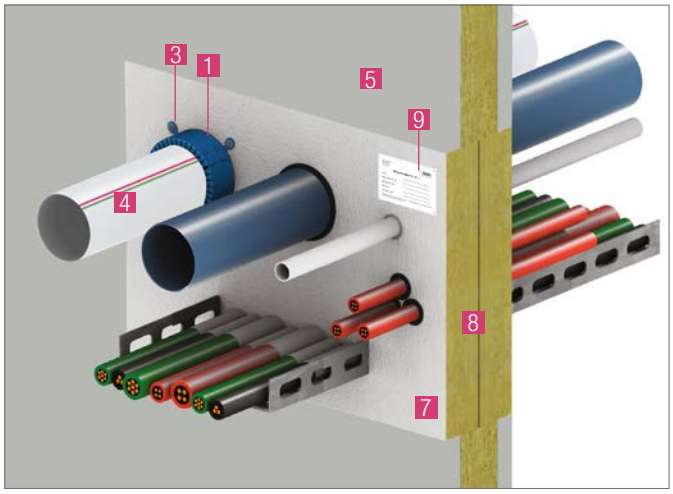


Fig. 6-6 Combination sealing in a light partition wall

6.3.2 Solid wall

The wall, in solid construction, must be ≥ 100 mm thick and have a density of ≥ 450 kg/m^3. 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.

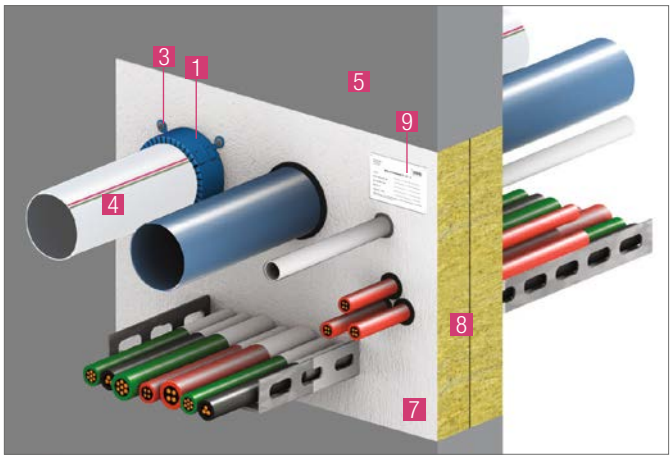


Fig. 6-7 Combination firestop in solid wall

6.3.3 Solid ceiling

The ceiling must be ≥ 150 mm thick and have a density of ≥ 450 kg/m^3.

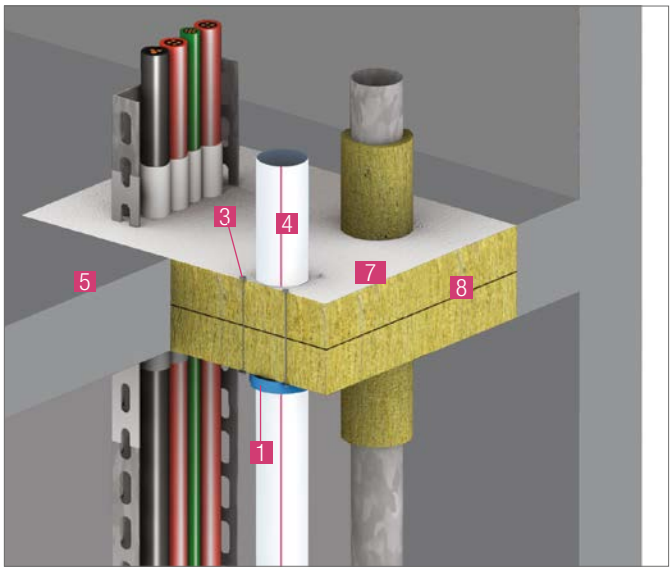


Fig. 6-8 Combination firestop in solid ceiling

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

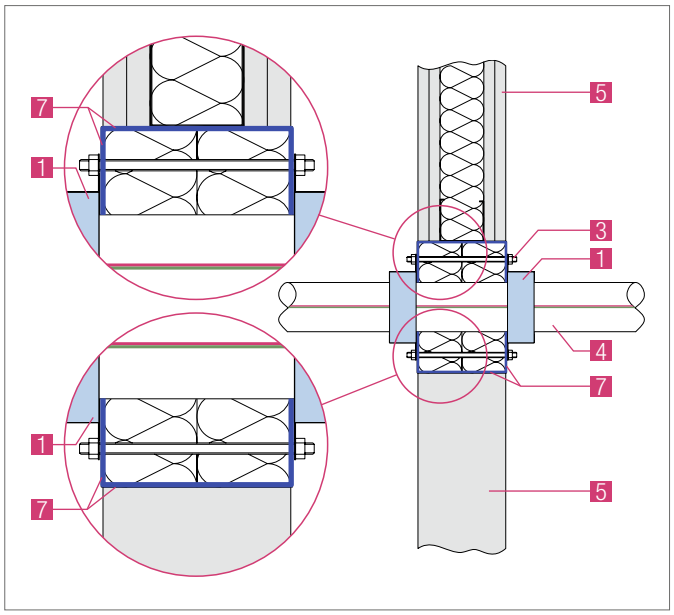


Fig. 6-9 Polymer pipe sealing in a light partition wall and solid wall in soft firestop

- 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.

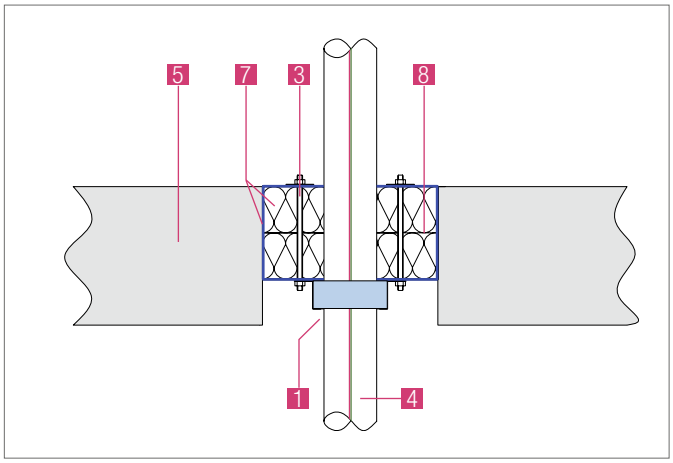


Fig. 6-10 Polymer pipe sealing in solid ceiling with soft firestop

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. 6-5 Information about minimum distance

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

Designation	Range of sizes	Soft firestop	Direction	Collar type	Classification
	Ø…pipe diameter	[mm]	D…ceiling W...wall	FP 3.0 / FP 6.0	
RAUPIANO PLUS	Ø 40 – Ø 200	2 x 50	D	FP 6.0	EI 90-U/U
RAUPIANO PLUS (+collar)	Ø 40 – Ø 125	2 x 50	D	FP 6.0	EI 90-U/U
RAUPIANO PLUS (+collar)	Ø 40 – Ø 125	2 x 50	W	FP 6.0	EI 120-U/U

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

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

7 INSTALLATION SITUATIONS OF THE PIPE SYSTEMS

RAUPIANO PLUS					
Specification	Thickness (mm)	Dimensions 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 200	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 200	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. 7-1 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

Our verbal and written advice with regard to usage is based on years of experience and standardised assumptions and is provided to the best of our knowledge. The intended use of REHAU products is described comprehensively in the technical product information. The latest version can be viewed at www.rehau.com/TI. We have no control over the application, use or processing of the products. Responsibility for these activities therefore remains entirely with the respective user/processor. Where claims for liability nonetheless arise, they shall be governed exclusively according to our terms and conditions, available at www.rehau.com/conditions, insofar as nothing else has been agreed upon with REHAU in writing. This shall also apply for all warranty claims, with the warranty applying to the consistent quality of our products in accordance with our specifications. Subject to technical changes..

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