REHAU®

Unlimited Polymer Solutions

DRAINAGE SYSTEM RAUPIANO PLUS

Valid as from March 2009
Subject to technical modifications
www.rehau.com

Construction
Automotive
Industry

RAUPIANO PLUS

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Applicability

This technical information is applicable for Asia , Australia and New Zealand.

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Pictograms and logos

 Safety information

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 Important information

 Information on the Internet

 Advantage

For safe usage of REHAU products, please check regularly if a newer version of the technical information is available to you.
The date of issue of your technical information is always printed at the bottom left of the cover page.
The current technical information is available from your REHAU sales office, specialist wholesaler as well as on the Internet as a download at:
www.rehau.com.sg

- Read the safety recommendations and operating instructions carefully and completely for your own safety and for the safety of other people before starting with the installation.
- Retain the operating instructions and keep them handy.
- If you do not understand the safety recommendations or installation instructions, or if they are unclear, contact your REHAU sales office.

Intended use

The drainage system RAUPIANO PLUS may only be installed and operated as described in this technical information. Any other use is unintended and therefore impermissible.

General safety measures

- Observe all applicable national and international regulations on installation, accident prevention and safety, together with the information contained in this manual.
- Keep the work place tidy and free of obstructions.
- Ensure there is always sufficient light.
- Keep children, house pets and unauthorised persons away from tools and installation area. This is especially important in cases of renovation in occupied areas.

Fire protection

Observe the applicable fire-protection regulations very carefully as well as the codes/regulations of building practice that apply in each case, especially in relation to:

- Penetrating through fire compartments.
- Rooms subject to the guideline of places of assembly places.

Personnel requirements

- Allow only authorised and trained persons to assemble our systems.
- Work on electrical systems or pipe components may only be performed by persons trained and authorised for this purpose.

Work clothing

- Wear protective glasses, suitable work clothing, safety shoes, a protective helmet and, if you have long hair, a hairnet.
- Do not wear loose clothing or jewellery. They could be caught by moving parts.
- Wear a protective helmet when performing assembly work at head level or above your head.

When assembling the system

- Always read and comply with the respective operating instructions of the tool used.
- The cutting tools have a sharp blade. The cutting tools are to be stored and handled in a safe way to prevent injuries.
- When shortening pipes, maintain a safe distance between the hand holding the object and the cutting tool.
- Never put your hands near the area where the tool is cutting or on moving parts.
- When performing service, maintenance and conversion work and when changing the place of assembly, always unplug the power plug of the tool and secure it against being switched on inadvertently.

2.1 Function

RAUPIANO PLUS is a universal sound-insulating drainage pipe system for non-pressurised site drainage in accordance with DIN EN 12056, DIN EN 752 and DIN 1986-100. It can be used as a universal drainage system for everything from one-family houses to large buildings.

RAUPIANO PLUS is available in nominal diameter DN 40 to DN 200.
A comprehensive fitting, adaptors and bracket range complete the system. They are characterised by the following features:

- High quality and attractive appearance.
- Excellent sound-insulation properties.
- Special bracket patented by REHAU that reduce the transmission of structure-borne noise.
- Excellent sound-insulation pipe and fitting material.
- Improved in airborne sound insulation elbow fittings with partially thickened walls.
- Excellent impact strength at cold temperature, fracture resistant at -10°C.
- Smooth yet abrasson-resistant inner layer to reduce the risk of deposits and scaling.
- High UV-resistance, can be stored outdoors for 2 years.
- High impact strength – robust for transport, storage and handling at the construction site.

2.1.1 House construction

RAUPIANO PLUS is the universal system for non-pressurised drainage in accordance with DIN EN 12056 and DIN 1986-100 in building construction, both as a standard drainage system without specialised sound-insulation requirements and with strict sound-insulation demands (VDI guideline 4100).
For example in:

- One-family house
- Multistorey apartment block
- Condominiums

2.1.2 Large buildings

RAUPIANO PLUS can also be installed in buildings with strict sound insulation requirements (VDI guideline 4100). Thanks to its high soundinsulation properties, RAUPIANO PLUS is especially suitable for:

- Hotels
- Office buildings
- Hospitals

RAUPIANO PLUS meets the increasing need for peace and quiet and ensures a high level of living comfort.

The pipe dimensions in accordance with DIN EN 1451 allow trouble-free transition to HT in accordance with DIN EN 1451 or KG in accordance with DIN EN 1401 with pipes and fittings of the same nominal diameter without the need for special transition pieces.

2.1.3 Underground installation

RAUPIANO PLUS is approved for underground installation both inside and outside of the building structure.

Installation must be carried out in accordance with DIN EN 12056, DIN EN 752, DIN 1986-100 and DIN EN 1610.

2.1.4 Commercial kitchens

RAUPIANO PLUS is ideal for use as a collecting and ground pipe for drainage of greasy waste water from commercial kitchens up to the grease separator.

For grease separators at a great distance, the use of pipe trace heating may be necessary. This prevents premature grease accumulation. The temperature of the pipe trace heating suitable for plastic pipes may not exceed 45 °C.

2.1.5 VACUCLEAN central vacuum cleaner system

Due to its excellent sound-insulation properties and the abrasion-resistant inner layer that is optimised for low-friction, RAUPIANO PLUS is also suitable as a pipeline system for central vacuum cleaner systems.

REHAU offer the VACUCLEAN central vacuum cleaner system, which is comprised of a central suction unit, pipelines, fittings, attachments and suction sockets. For more detailed information on this product, see technical information “VACUCLEAN central vacuum cleaner system” or go to **www.rehau.com** on the Internet.

2.2 Application

Fig. 2-1 RAUPIANO PLUS pipes and fittings

The sound-insulating drainage system RAUPIANO PLUS is suitable for gravity drainage systems in accordance with DIN EN 12056, DIN EN 752 and DIN 1986-100 in buildings and for underground installation inside and outside the building structure and is approved by the German Institute of Building Technology (DIBt) in Berlin (ABZ-42.1-223). Local national standards, code of practice and regulations must be observed during the design and installation of RAUPIANO PLUS system.

The pipes, fittings and seals can be used up to 95 °C (for brief periods). They are suitable for the drainage of chemically aggressive waste water with a pH value of 2 (acidic) to 12 (basic).
Behaviour in fire corresponds to B2 normally inflammable according to DIN 4102.
The pipe connections are leak-proof up to an internal excess water pressure of 0.5 bar (5 m water column).

Pipes and fittings may not be used for:
- installation subjected to continuous operating temperature higher than 90˚C (or higher than 95˚C for brief periods)
- carrying waste water containing petrol or benzene
- exposed installation to UV radiation directly and indirectly

If used in cold areas, where installations are commonly done under temperature below -10°C, additional tests are required according to DIN EN 1451
RAUPIANO PLUS has passed the test and therefore marked with the “ice crystal” according to DIN EN 1451 and DIN EN 1411 and can be installed in these regions.

For outlet of ventilation lines, use UV-stable pipes instead of RAUPIANO PLUS.

Observe all applicable national and international regulations on installation, accident prevention and safety, together with the information contained in this manual.

Areas of application which are not included in this technical information (special applications) require consultation with our technical department. Please contact your REHAU sales office.

2.3 Pipe structure

Modern pipe systems are constructed with multiple layers. This allows achievement of the desired pipe characteristics according to the requirements.

RAUPIANO PLUS features a three-layer wall construction. This “sandwich construction” is based on modern design principles. Each layer is of considerable importance in the overall functioning of a reliable operating pipe system. The multi-layer structure increases pipe rigidity. Technically desirable characteristics are optimised.

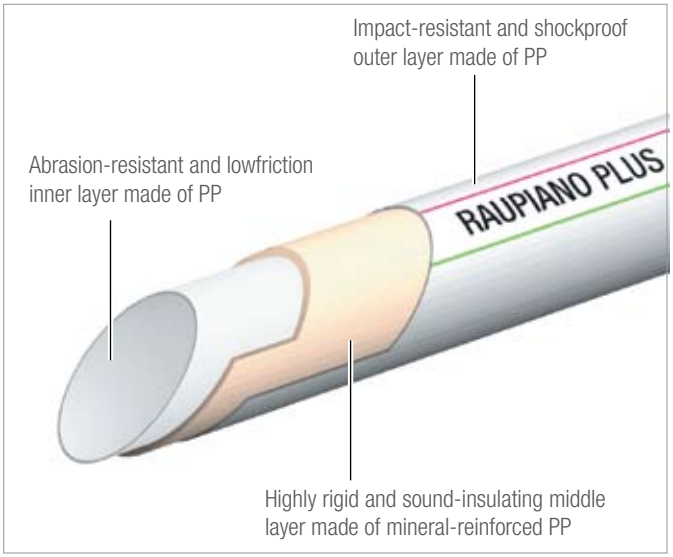

Fig. 2-2 RAUPIANO PLUS pipe structure

- RAUPIANO PLUS – robust for transport, storage and handling at the construction site
- Fracture resistant at –10 °C
- Can be stored outdoors for up to 2 years
- Optimum hydraulic characteristics. Accumulation of deposits and incrustations are reliably prevented.

These ideal characteristics are achieved thanks to the three-layer structure of the pipe and the specialised adaptation of each individual layer to its respective requirement:
- High ring stiffness
- Excellent impact strength of the outer layer at low temperature
- Increased UV-resistance
- Abrasion-resistant and smooth inner layer
- Highly rigid and sound-insulating middle layer made of mineral-reinforced PP

2.4 Pipe fittings

The pipe system can experience local vibrations at redirections due to critical drainage conditions. This can have a negative effect on sound-related properties.

To minimise this effect and counteract negative influences, targeted mass optimisation was carried out in sound-critical areas of elbows with a nominal width of DN 90 to DN 125. This stabilises the sound behaviour, reduces sound generation and thus achieves even better noise damping in the impact area.

Fig. 2-3 RAUPIANO PLUS bend with reinforced impact area

2.5 Sound insulation

The sound-insulating drainage system RAUPIANO PLUS guarantees quality, quietness and living comfort in important areas of a building. In practice-oriented measurements carried out by the officially recognised Fraunhofer Institute for Building Physics in Stuttgart, Germany, RAUPIANO PLUS reached a sound-intensity level which was below the most stringent requirements of VDI guideline 4100.

- Excellent sound insulation
- High pipe rigidity (ring stiffness > 4 kN/m2 in accordance with DIN EN ISO 9969)
- Optimum hydraulics thanks to an extremely smooth and low-friction inner layer
- Improved handleability thanks to a tough outer layer
- Excellent impact strength at extremely low temperatures (ice crystal in accordance with DIN EN 1451/1411)
- Safe to install at low temperatures
- Easy and fast installation
  - Push-fit socket joint
  - Sealing rings installed at the factory
  - Shortened with common pipe cutters or saw
- Complete pipe, fitting, adapters and bracket range
- Universal compatibility with the HT-PP system, connection to common HT and KG pipes without special adapters
- Attractive appearance in visible areas
- Sanitary white colour
- Environmentally friendly – can be recycled

2.6 System components

Pipes and fittings

- Made of mineral-reinforced RAU-PP
- Dyed white (similar to RAL 9003)
- Nominal diameter DN 40, 50, 75, 90, 110, 125, 160, 200
- Available in lengths from 150 mm to 3,000 mm
- Complete fitting range
- Bend from 15° to 87° (DN 90 to DN 125 in thicker-walled version)
- Single branch
- Double branch
- Corner double branch
- Parallel branch
- Additional special fittings

Seals

The pipes and fittings are equipped with a lip sealing ring at the factory in accordance with DIN 4060 and DIN EN 681-1.
Hardness: 60 ±5 Shore A
Material: Styrene butadiene rubber (SBR)

Fastening elements

Fig. 2-4 Patented sound dampening support bracket

- Sound dampening support bracket
- Fixing clamp
- Guiding clamp

Fire protection

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The fire behaviour is in accordance with material class B2 in accordance with DIN 4102.
REHAU fireproofing collars are available for penetration of the RAUPIANO PLUS pipe through fire-resistant ceilings or walls.
The national fire-protection regulations and the respective applicable codes/regulations of building practice are to be observed here.

Fig. 2-5 "compact" fireproofing collar

2.7 Transportation and storage

Packaging

- Pipes up to 500 mm and fittings are packed in box
- Pipes 750 mm and longer are packed in wooden crates

Transportation

RAUPIANO PLUS proves its robustness during transport and at the construction site thanks to its three-layer structure and impact-resistant and shock-proof outer layer. Ensure that pipes make firm contact over their entire length.

Storage

- Protect boxes from wetness during transport and storage.
- RAUPIANO PLUS and its seals can be stored outdoors for up to 2 years (Central Europe) due to its UV-stable characteristics.

We recommend:

- protecting RAUPIANO PLUS pipes and fittings from direct sunlight and soiling by:
  - storing in the box
  - covering them with tarpaulins (ensure proper ventilation).
- Stack no more than four wood crates on top of one another.
- Ensure that the wood frames are aligned squarely when stacking.
- Store pipes in such a way that no objects are placed on top of the sleeves and insertion ends and that these are not deformed.

2.8 Marking

Pipes and fittings are marked with the following:

- Manufacturer's mark
- Approval number
- Mark of quality
- Ice crystal (DIN EN 1451/1411)
- Nominal diameter (DN)
- Year of manufacture
- Production plant
- Material
- Angle specification (with elbows and branches)

2.9 Recycling

RAUPIANO PLUS pipes and fittings are 100 % recyclable.

3.1 Sound-insulation requirements

The applicable national regulations regarding sound insulation are to be observed.

To assess the sound-insulation behaviour of RAUPIANO PLUS, the sound-insulation requirements applicable in Germany are described in the following.

There are currently two important regulatory bodies for sound insulation in residential buildings:
- DIN 4109 (Sound insulation in buildings – Requirements and verifications, issued November 1989)
- VDI guideline 4100 (Sound insulation in residential buildings – Criteria for planning and assessment, issued September 1994)

DIN 4109

This standard regulates the sound insulation requirements against noise from outside of the building and adjacent units to limit the sound transmission level into the living areas. Sound insulation is required for protection against health risk due to noise.

Building drainage systems are to be planned under observance of DIN 4109. The rooms to be insulated include:
- Bedrooms
- Living rooms
- Classrooms
- Workspace (offices, treatment rooms, conference rooms etc.)

DIN 4109 does not specify any requirements for insulation against noise from within your own living areas.
A maximum noise level transmission of 30 dB(A) from outside of the building is stipulated fro water installations (water supply and sewer pipe systems together).

DIN 4109 represents a minimum requirement as a public law. The requirements based on this standard are no longer up-to-date.

VDI guideline 4100

VDI guideline 4100 represents more stringent sound insulation requirements. It defines three sound insulation levels and differentiates different sound insulation requirements for apartments in multistorey apartment blocks, semi-detached houses and townhouses. Unlike DIN 4109, VDI guideline 4100 also takes into consideration the noise transmission levels from within your own living areas (water supply and sewer pipe systems together (see Table 3-1)).

VDI guideline 4100 is not legally binding and only acts as a guide. It receives a high degree of recognition from both private and professional circles. Individual legal provisions of a private nature therefore allow the stipulation of these more stringent requirements.

Soundin-sulation level	Apartments in multistorey appartment blocks	Apartments in semi-detached houses and row houses	Your own living area
I	30 dB(A) (purs. to DIN 4109)	30 dB(A) (purs. to 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. 3-1 Sound-insulation requirements pursuant to VDI guideline 4100

3.2 Basics

In every area of building construction, especially the construction of multistorey appartment blocks, hospitals and rehabilitation homes, sound insulation plays an increasingly important role. One of the most significant sources of sound within buildings is the sanitation set-up and the accompanying drainage water pipe system.

Typical sources of sound include:
- Fitting noises
- Filling noises
- Draining noises
- Inlet noises
- Impact noises

Unsuitable sewer pipe system and type of brackets are considerable contributors to disturbing noise. RAUPIANO PLUS, a system-tested, universal sound-insulating drainage water system, puts things right.

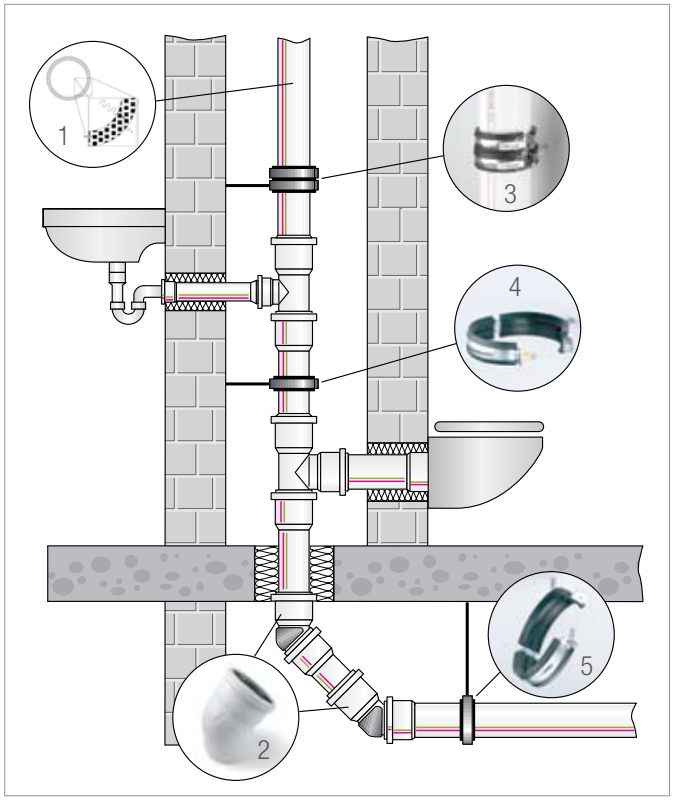


Fig. 3-1 Sound minimising

Airborne noise reduction through
1 Special pipe and fitting materials
2 Mass optimisation in the redirection area of fittings

Structure-borne noise minimisation through
3 Patented sound-proof attachment
4 Optimised guiding clamp
5 Fixing clamp with elastomer insert

A differentiation is made between airborne noise and structure-borne noise, depending on the propagation medium.

Airborne noise

Airborne noise is present if the noises of a sound source are transferred directly through the air to people.

Structure-borne noise

With structure-borne noise, the sound transfer first occurs through a solid body. This body vibrates and passes the vibrations on to people as airborne noise.

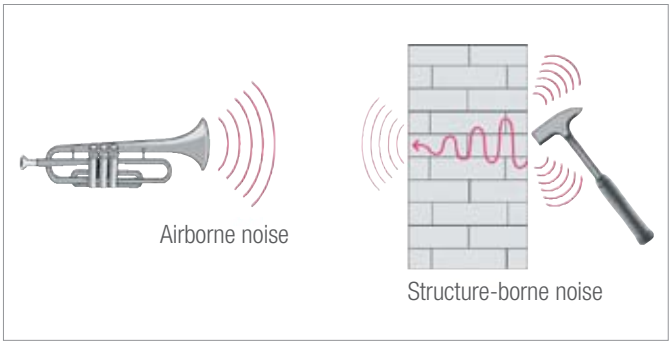


Fig. 3-2 Airborne and structure-borne noise

3.3 Sound reduction with RAUPIANO PLUS

Both structure-borne and airborne noise occur in drainage pipe systems. The wall of the pipe vibrates due to currents and flow noises. The type and intensity of these pipe vibrations depend on a variety of factors, such as the mass of the pipe, the pipe material and its inner damping.
The pipe vibrations are emitted directly from the pipe as airborne noise and are transferred as structure-borne noise via the pipe brackets to the wall.
When developing a sound-insulating drainage water system, both types of noise distribution must be taken into account.

Airborne noise insulation with RAUPIANO PLUS

Airborne noise is reduced by RAUPIANO PLUS thanks to special materials, sound-dampening fillers and increased weight of the pipe system. Targeted mass optimisation in sound-sensitive areas of fitting elbows of nominal diameter DN 90 to DN 125 provides further improvement at redirection points.

Structure-borne noise insulation with RAUPIANO PLUS

The transmission of structure-borne noise to the wall is reduced with RAUPIANO PLUS thanks to its special bracket:
- A supporting clamp with loose gap in the pipe is fastened to the wall
- A fastening clamp rests onto the supporting clamp, keeping the pipe in position

This extensive physical decoupling of the pipe, bracket and wall means that the transmission of structure-borne noise is eliminated to a high degree (see Chap. 7, Page 28).

Structure-borne noise bridges reduce the sound-insulation effect of every sound-insulation system.
- Avoid direct contact between pipes and the wall.
- Avoid structure-borne noise bridges via subsequent work from other tradesmen.
- Use only RAUPIANO PLUS brackets.

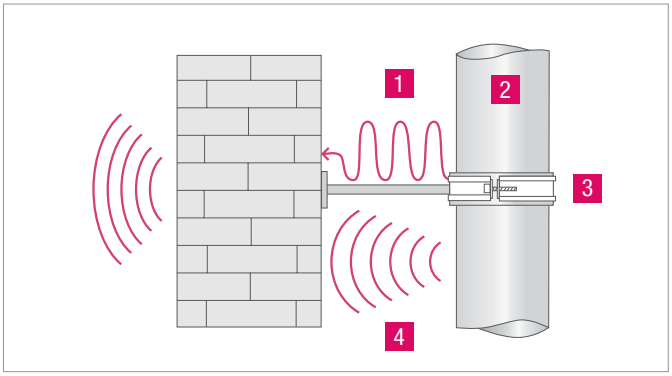


Fig. 3-3 Sound distribution with sewer pipe systems

1. Structure-borne noise
2. HT-PP pipe
3. Standard bracket (pipe clamp with/without rubber ply)
4. Airborne noise

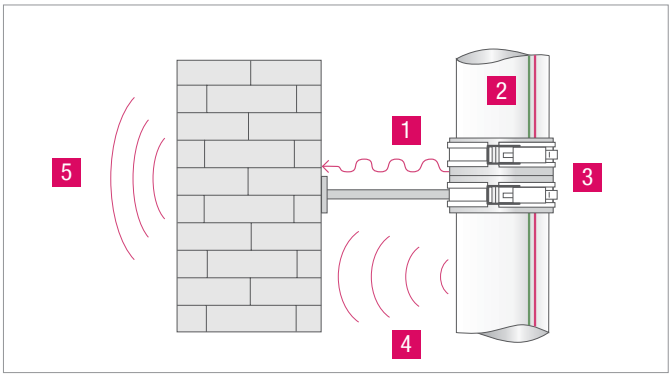


Fig. 3-4 Sound insulation with RAUPIANO PLUS

1. Reduction of structure-borne noise
2. RAUPIANO PLUS pipe with sound-dampening fillers
3. RAUPIANO PLUS bracket, patented sound-dampening support bracket
4. Reduction of airborne noise
5. Sound insulation in accordance with VDI guideline 4100

3.4 Laboratory testing of the sound-insulation behaviour

To determine the effectiveness of the sound insulation, the drainage system RAUPIANO PLUS was assessed by the officially recognised Fraunhofer Institute for Building Physics (IBP) in Stuttgart, Germany in accordance with DIN EN 14366 “Laboratory measurement of noise from waste water installations”. Sound-related examinations were carried out within the context of a standardised installation structure simulating a real situation. Measurements for different flow rates were done to represent a multi-person household realistically. It was measured here that the permissible sound level of 30 dB(A) according to DIN 4109 was undershot by far. From the measurement, RAUPIANO PLUS achieved better sound insulation level than the more stringent VDI guideline 4100 (sound-insulation level III / Apartments in semi-detached houses and row houses, water supply and drainage pipe systems together)

The schematic layout of the installation test set-up of the IBP is presented graphically (see Fig. 3-5). The system is loaded with flowrates of 1.0 / 2.0 and 4.0 L/sec. (4 L/sec. corresponds to simultaneous flushing of two 6 L toilets). The results of the examination in comparison to the common HT pipe show a clearly lower sound level behind the wall (surface weight of 220 kg/m^2, wall thickness 115 mm, plus plaster). This wall corresponds to the lightest single-layer wall according to DIN 4109 to which drainage pipes may be attached. If installation to heavier walls will occur, the sound level is reduced even further.

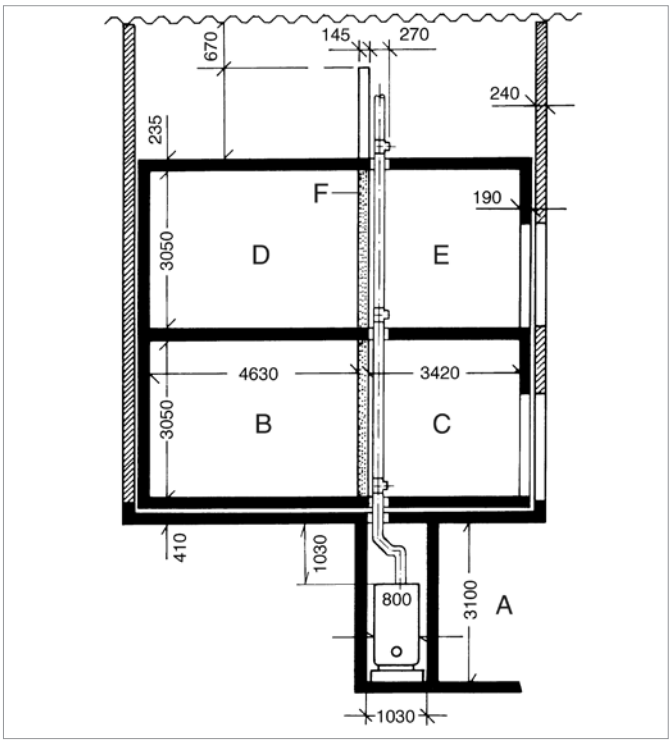


Fig. 3-5 Installation set-up of the Fraunhofer Institute for Building Physics (all measurements in mm)

A Cellar
B Basement, rear
C Basement, front
D Ground floor, rear
E Ground floor, front
F Wall fastening panel (surface weight: 220 kg/m^2)

3.5 Measurement results

Here is the impressive documentation of the excellent sound-insulation properties of the RAUPIANO PLUS drainage water system.

When the information regarding installation of sound-proof brackets provided in our technical documentation is observed and information provided in the applicable standards and rules of the technology is complied with, planning and proposal work can be carried out in accordance with VDI guideline 4100. This guideline specifies, among other things, a sound level up to 20 dB(A) for apartments in semi-detached and row houses or 25 dB(A) for apartments in multistorey apartment blocks.

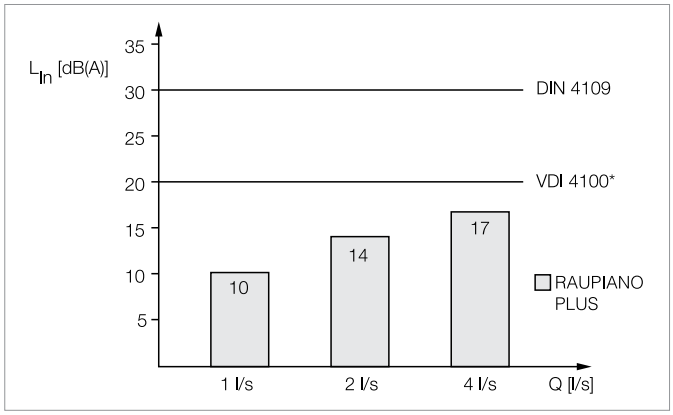


Fig. 3-6 Measurement results with a sound-dampening support bracket in the basement behind the wall fastening panel (source: Fraunhofer Institute for Building Physics, Stuttgart, Germany, Test Report P-BA 6/2006)

L_{In} Installation sound level
Q Volume flow
*) Maximum requirement of VDI guideline 4100 (Sound-insulation level III/Apartments in semi-detached and row houses, water supply and sewer pipe systems together)

If there is no stringent sound-insulation requirements, the sound-dampening support bracket does not need to be used.
When using a standard clamp (e.g. BIFIX 1301), the RAUPIANO PLUS sound-insulation properties are well below the requirements of DIN 4109. The sound-insulation properties ensure a high degree of sound insulation in single-family houses as well.

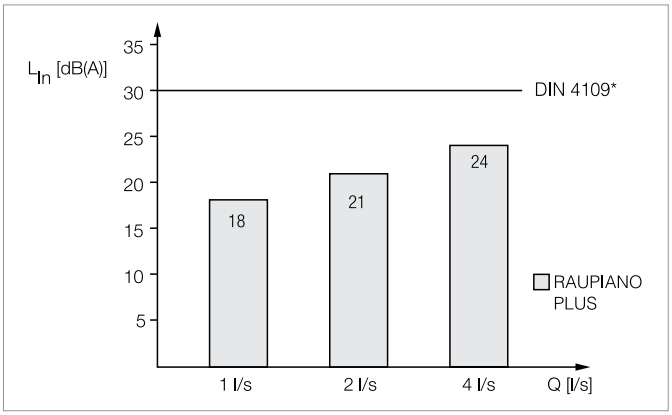


Fig. 3-7 Measurement results with standard clamp in the basement behind the wall fastening panel (source: Fraunhofer Institute for Building Physics, Stuttgart, Germany, Test Report P-BA 176/2006)

L_{In} Installation sound level
Q Volume flow
*) Maximum requirement of DIN 4109 (Sound insulation in buildings, water supply and sewer pipe systems together)

4. RAUPIANO PLUS
FIRE PROTECTION

The behaviour of RAUPIANO PLUS in a fire corresponds to material class B2 (normally inflammable) in accordance with DIN 4102, Part 1.

4.1 Fire-protection requirements

With regard to household pipes, fire-protection measurements may be necessary if pipes penetrate through walls and ceilings to a room.

With regard to fire protection, the applicable national regulations and the valid codes/regulations of building practice are to be observed.

4.2 Fireproofing collars

For fire protection of penetration through ceiling and wall using RAUPIANO PLUS pipes, the following fireproofing collars are available:

- Fireproofing collar system REHAU PLUS
  - Installation in a wall or ceiling
  - Installation on a wall or ceiling
- REHAU “compact” fireproofing collar system
  - Installation on a wall or ceiling
- REHAU angled fireproofing collar system
  - Installation on a ceiling for angled penetrations

When using fireproofing collars in the ceiling, they can be assembled immediately or subsequently, depending on their type.

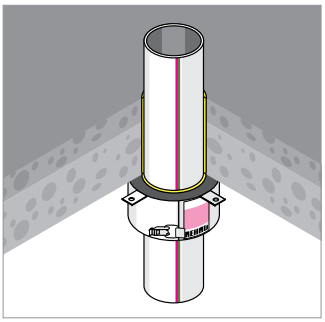


Fig. 4-1 Installation of fireproofing collar in ceiling

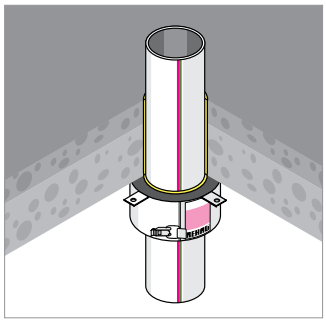


Fig. 4-2 Installation of fireproofing collar on ceiling

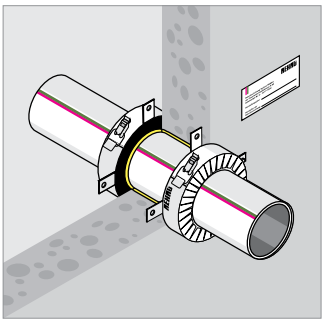


Fig. 4-3 Installation of fireproofing collar on wall

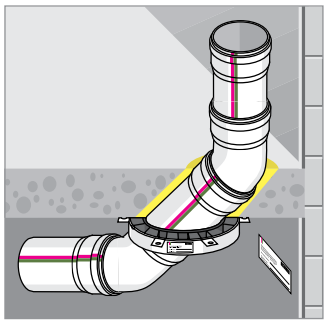


Fig. 4-4 Angled fireproofing collar (only for installation on ceiling)

Wall penetrations require two collars (on both sides of wall).

To use REHAU angled fireproofing collar system on penetration of drainage pipe through concrete ceiling at an angle, a minimum ceiling distance of 50 mm is regured for the horizontal drainage pipe running below the concrete ceiling.

When planning and assembling the fireproofing collars, the requirements of the general building construction approval and the specifications of the assembly instructions must be observed.

When using the fireproofing collars, the applicable national regulations must be observed.

We recommend always getting approval from the responsible construction authority for compliance with the respective requirements.

5. RAUPIANO PLUS
PLANNING

5.1 Measurement basics

The following standards apply for the planning and installation of RAUPIANO PLUS

- DIN 1986-100 Drainage systems on private ground
- DIN EN 12056 Gravity drainage systems inside buildings
- DIN EN 752 Drainage systems outside buildings

The goal is to ensure intended functioning of the universal drainage system RAUPIANO PLUS, i.e.

- Extraction or leaking of sealing water must be prevented
- Ventilation of the drainage system must be ensured
- Nominal diameter larger than those calculated are not to be used
- Sewage must drain with little noise
- Anaerobic digestion is to be prevented
- Gas emissions are to be lead out without harmful effects via the main ventilation system

5.2 Proposal

Drainage system comprised of hot water-resistant, soundinsulating RAUPIANO PLUS pipes and fittings DN 40 to DN 200 with push-fit sockets made of mineral-reinforced PP and accessories for installation inside and outside buildings in accordance with DIN EN 12056, DIN EN 752 and DIN 1986-100. The dimensions correspond with DIN EN 1451-1. The sound-insulating properties of the system, which are oriented toward the requirements of VDI guideline 4100 (Sound insulation in residential buildings – Criteria for planning and assessment) or DIN 4109 (Sound insulation in buildings), are verified by Test Report No. P-BA 6/2006 (with sound-damping support bracket) or P-BA 176/2006 (with standard clamp BIFIX 1301) from the Fraunhofer Institute for Building Physics, Stuttgart, Germany.

Standards

DIN EN 12056:
Gravity drainage systems inside buildings;
Part 1: General and performance requirements
Part 2: Sanitary pipework, layout and calculation
Part 3: Roof drainage, layout and calculation
Part 4: Sewerage lifting plants, layout and calculation
Part 5: Installation and testing, instructions for operation, maintenance

DIN 1986-100:
Drainage systems on private ground;
Part 100: Additional requirements for DIN EN 752 and DIN EN 12056

DIN 1986-3:
Drainage systems on private ground;
Part 3: Regulations on operation and maintenance

DIN 1986-4:
Drainage systems on private ground;
Part 4: Areas of use of sewer pipes and fittings made of various materials

DIN 1986-30:
Drainage systems on private ground;
Part 30: Service

DIN EN 752:
Drainage systems outside buildings

DIN EN 1451-1:
Plastic piping systems for soil and waste discharge (low and high temperature) within the building structure – Polypropylene (PP);
Part 1: Specifications for pipes, fittings and the pipeline systems

Technical information of drainage system RAUPIANO PLUS and VACUCLEAN central vacuum cleaner system and other included standards, directives and regulations.

Approvals, quality assurance

General building construction approval Z-42.1-223 of the German Institute for Building Technology in Berlin, Germany.
In addition to continuous self-monitoring, contractually regulated quality monitoring (external monitoring) is carried out in accordance with the building construction permit by the Süddeutsche Kunststoff-Zentrum (SKZ) Germany.
The pipes and fittings are labelled with the quality mark of the external monitoring location and approval number Z-42.1-223.

Installation

In accordance with installation regulations in this technical information in compliance with the specifications of DIN EN 12056, DIN 1986, DIN EN 752 and VDI-guideline 4100 or DIN 4109.

Quality assurance

REHAU are, among other things, certified in house and building technology in accordance with DIN ISO 9001. This certification applies for both the production and technical/commercial departments.

6. RAUPIANO PLUS

ASSEMBLY OF RAUPIANO PLUS

6.1 Shortening and tapering pipes

Fittings may not be shortened.

1. If necessary, shorten the pipes with common pipe cutters or a finetoothed saw.
2. Make a cut at 90° angle from 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 approx. 15°.
4. De-burr and break cut edges.

CAUTION

Danger of damage to property!

At low temperatures, the mineral-reinforced pipe material RAU-PP becomes brittle and thus more sensitive to impacts, like every other material.

The optimised material consistency of RAUPIANO PLUS is characterised by excellent impact strength at cold temperature.
RAUPIANO PLUS is marked with the ice crystal in accordance with DIN EN 1451/1411 to indicate this.

6.2 Joining fittings and pipes

1. Clean dirt from sealing ring, sleeve interior and spigot end.
2. Coat spigot end with lubricant and slide into the sleeve until it stops.
3. Mark inserted spigot end in this position at the sleeve edge with a pencil, pen etc.
4. With longer pipes (> 500 mm), pull the spigot end out an additional 10 mm from the sleeve to create an expansion joint for heat-related expansion.
5. With short pipes (≤ 500 mm) and fittings, insert the spigot ends fully into the sleeves.

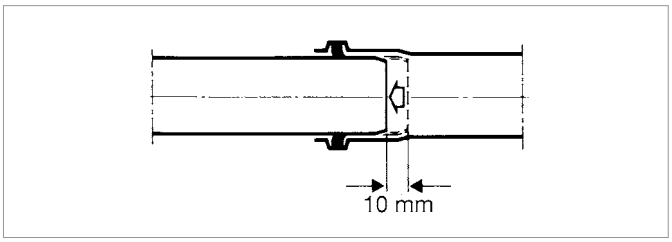


Fig. 6-1 Pulling out spigot ends for expansion joints

By pulling out the spigot ends from the sleeves, the changes in length of the pipe caused by temperature fluctuations are absorbed in the push-fit sockets.
Each RAUPIANO PLUS pipe sleeve can accept the changes in length of a waste pipe up to 3 m in length (coefficient of linear expansion in accordance with DIN 53752 averages 0.09 mm/(m·K) at 0 °C to 70 °C).

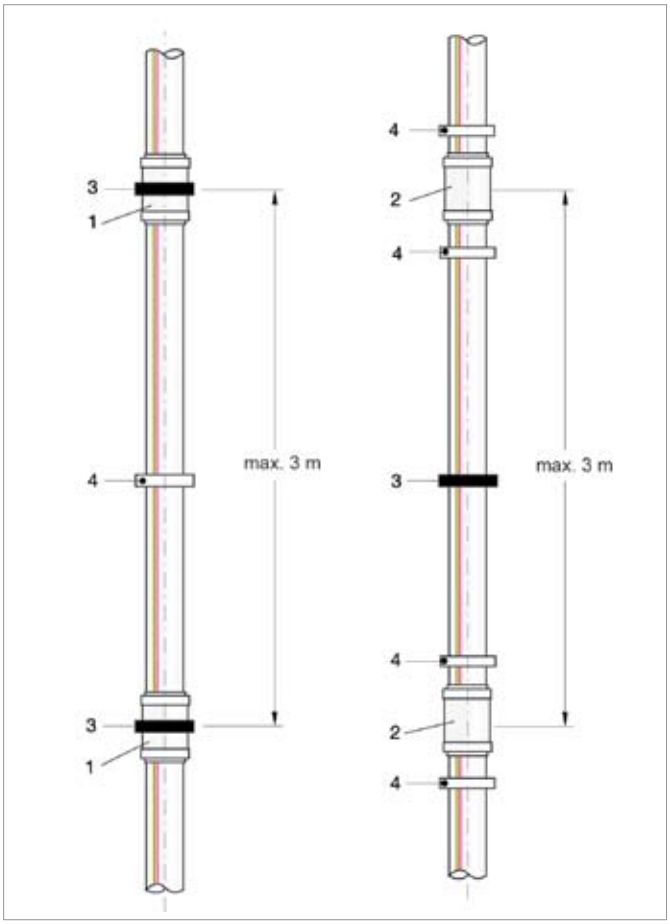


Fig. 6-2 Using double sockets and sleeve couplers

1 Double socket 3 Fixing clamp
2 Sleeve coupler 4 Guiding clamp

6.3 Handling cut lengths and remaining lengths

Cut lengths and remaining lengths (pipes with smooth ends) can be handled with double sockets and sleeve couplers up to a maximum pipe length of 3 m.
Ensure that sufficient expansion joints are present in the pipe sleeves here as well.

6.4 Installation of additional fittings

The installation of additional fittings in an existing pipeline is possible with sleeve couplers:

1. Cut out a sufficiently long section of pipe from the pipeline: fitting length + 2 x pipe outer diameter
2. De-burr pipe ends.
3. Slide sleeve coupler all the way onto one end of the pipe.
4. Slide fitting onto the other end of the pipe.
5. Fit adapter into the remaining space of the pipe and de-burr.
6. Slide second sleeve coupler all the way onto the adapter.
7. Insert adapter and close both gaps by sliding the sleeve couplers. Use lubricant liberally here.

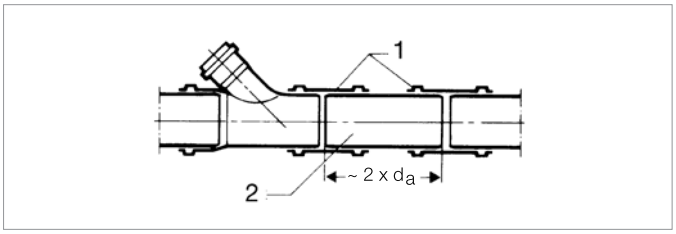


Fig. 6-3 Installing fitting

1 Sleeve coupler d_a Pipe outer diameter
2 Adapter

6.5 Connecting drain fitting

There are three options for connecting plumbing fixture drainage fittings (e.g. air traps) to RAUPIANO plus drainage pipes or fittings:

- RAUPIANO PLUS connection piece
- RAUPIANO PLUS siphon angle
- RAUPIANO PLUS fitting with beaded rubber nipple

RAUPIANO PLUS connection piece

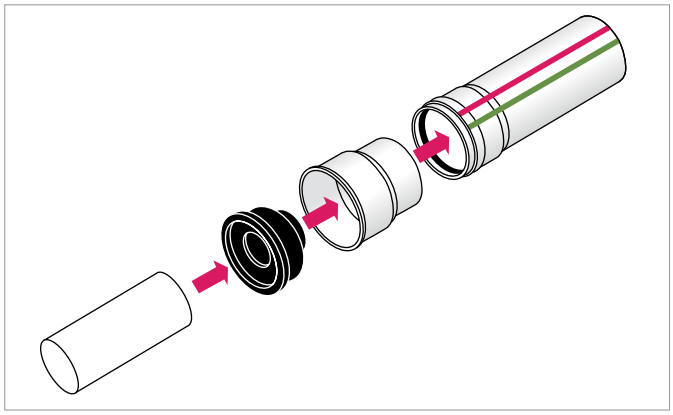


Fig. 6-4 RAUPIANO PLUS connection piece with rubber nipple

1. Insert rubber nipple in the socket of the connection piece.
2. Apply lubricant on the sealing lips of the rubber nipple.
3. Insert nozzle of drain fitting of plumbing fixture into the rubber nipple.

RAUPIANO PLUS siphon angle

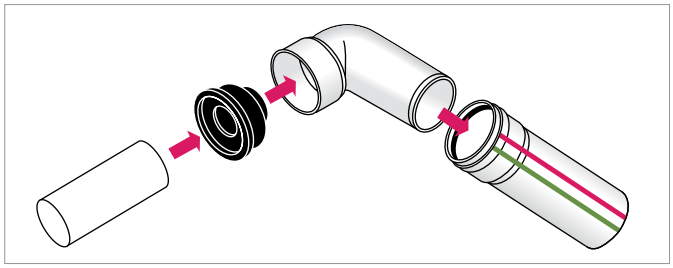


Fig. 6-5 RAUPIANO PLUS siphon angle with rubber nipple

1. Insert rubber nipple in the socket of the siphon angle.
2. Apply lubricant on the sealing lips of the rubber nipple.
3. Insert nozzle of the drain fitting of plumbing fixture into the rubber nipple.

RAUPIANO PLUS fitting with beaded rubber nipple

1. Remove the installed sealing rubber in the fitting.
2. Insert rubber nipple with bead into the fitting socket.
3. Insert nozzle of the drain fitting of plumbing fixture into the rubber nipple.

6.6 Rubber sleeve adaptor for Cast Iron pipe or other materials

Fig. 6-6 Rubber sleeve for same outer diameters DN110/DN110

Fig. 6-7 Rubber sleeve for different outer diameters DN110/DN 90

For transition from RAUPIANO PLUS pipes to Cast Iron pipes or other materials for drainage systems, rubber sleeve adaptors can be used. These rubber sleeves come with rubber seal that is attached to the pipe ends and two stainless-steel worm-gear clamps. These rubber sleeve adaptors can be used in new construction or renovation works.

Below are the properties of the rubber sleeve adaptor.

Material	Rubber
Tightening device	Stainless-steel worm-gear clamps
Recommended tightening torque	3 Nm
Pressure resistance	0.5 bar
Chemical resistance	pH 2 - 12

Table 6-1: Properties of rubber sleeve adaptor.

Installation steps:

1. Insert RAUPIANO PLUS pipe end into one end of the rubber sleeve adaptor.
2. Insert Cast Iron / other material pipe end into the other end of the rubber sleeve adaptor.
3. Tighten the worm-gear clamps on both ends of the rubber sleeve adaptor without exceeding the maximum tightening torque.

The rubber sleeve adaptor can be installed on most Cast Iron and other materials pipe sizes, the table below specifies the suitable dimensions of Cast Iron or other pipe materials.

Article No.	Description	RAUPIANO PLUS OD Size	OD of other Pipe material
125024-001	50/53-63	50	53 - 63
125034-001	75/75-89	75	75 - 89
123904-001	110/90	110	75 - 89
123914-001	110/110	110	100 - 115

Table 6-2: Suitable sizes for rubber sleeve adaptor.

6.7 Flexible connection hose to roof vent

Fig. 6-8 Flexible connection to roof vent

The flexible connection hose enables a transition from roof vents to RAUPIANO PLUS ventilation lines of a drainage system.

- No extensive fitting installation in needed due to flexibility
- Reduces installation time

The flexible combination connection made of polypropylene is ideal for connecting RAUPIANO PLUS pipes with the following nominal diameter:

- DN 75
- DN 90
- DN 110

The flexible hose connection is not to be used for water drainage purpose.

6.8 Cleaning the waste pipe system

Fig. 6-9 RAUPIANO PLUS cleaning pipe

Installing access pipes enables mechanical cleaning of the waste pipe system.

Tighten the screw cap with the rubber seal inserted after assembling the access pipe.

Do not use sharp cleaning devices for mechanical cleaning.

6.9 Socket plug

Fig. 6-10 RAUPIANO PLUS socket plug.

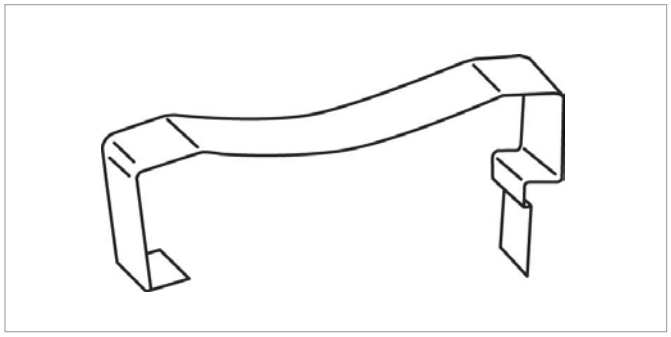


Fig. 6-11 RAUPIANO PLUS securing clip.

The socket plug can be used to plug-off the pipe ends if they are not in use. The socket plug is to be used together with the securing clip to ensure a safe and tight jointing. When the securing clip is installed, the ends grip onto the socket ring.

6.10 P-traps

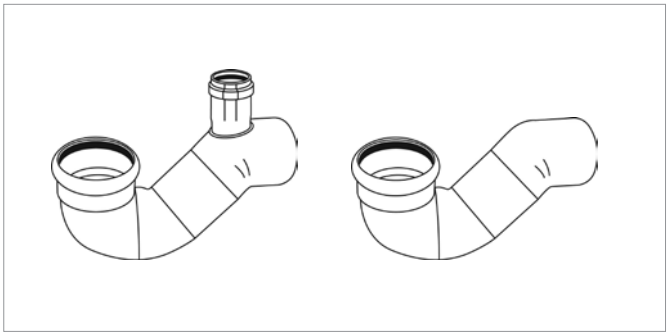


Fig. 6-12 RAUPIANO PLUS P-trap with and without venting.

RAUPIANO PLUS P-traps provides 50 mm water seal to prevent foul odour from coming out of the drainage lines. REHAU offers two types of P-traps:

- P-trap with venting line, size DN 110
- P-trap without venting line, size DN 50 and DIN 110

When installing the P-traps, it is important to install the pipe support properly to ensure safe operation of the drainage system.

- For sie 50mm, the P-traps needs no special support. The pipeline can be supported at the connecting pipe's socket right after the P-trap.
- For size 110 mm, the P-trap needs to be supported at the lowest bend of the P-trap to prevent the P-trap from being pushed apart from the socket joint.

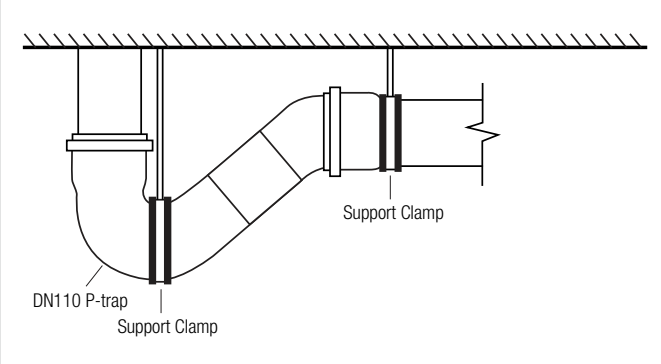


Fig. 6-13 RAUPIANO PLUS P-trap size DN 110 supported with clamp.

6.11 Puddle flange

Fig. 6-14 RAUPIANO PLUS puddle flange.

RAUPIANO PLUS puddle flange is made of rubber and comes together with two stainless-steel worm-gear clamps. This puddle flange is normally used in pipe penetration through walls to prevent water seepage into the building.

The typical installation for puddle flange can be seen in the illustration below.

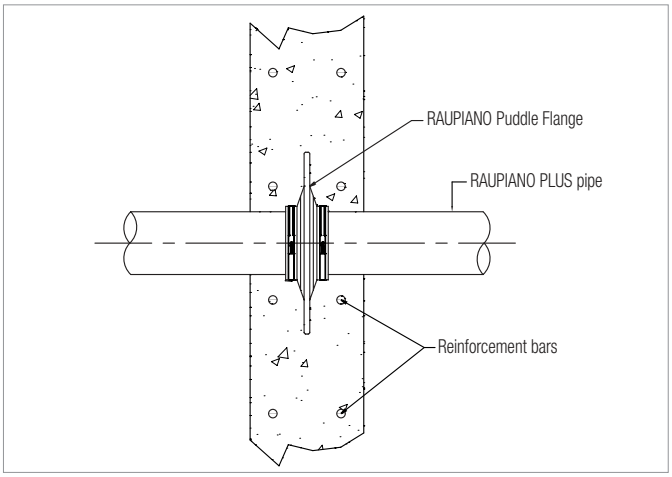


Fig. 6-15 Installation of puddle flange.

- Before installing the puddle flange, make sure that the pipe surface is clean, free of grooves or corrugations.
- Apply neutral soap on the pipe surface to facilitate easy mounting.
- Minimum depth of coverage should not fall below 30mm.

RAUPIANO PLUS puddle flange is not to be used to connect two pipe-ends together.

6.12 Installing pipes in installation shafts

The RAUPIANO PLUS waste pipes and fittings can be installed in installation shafts without additional structure-borne noise insulation. Heating and condensation-water insulations are only required in special cases (e.g. inlying roof drainage).

Construct wall and ceiling penetrations with common moisture-protected structure-borne noise insulations to acoustically decouple the pipelines.

6.13 Installing pipes in masonry

Observe the applicable national regulations for recesses and slots in the masonry.

- Make wall slots in such a way that the pipeline can be laid without tension.
- Avoid sound bridges between the masonry and the pipe.

If the pipes will be plastered directly without using a plaster board (e.g. brick rabitz, expanded metal baffle) or cladding:

- Cover pipes and fittings on all sides with flexible materials such as mineral or glass wool or commercial insulation tubes beforehand.
- If using plaster boards, close the slot beforehand with mineral wool, for example. This prevents sound bridges from forming between the pipe and masonry when applying the plaster.
- Protect pipes and fittings from the effects of high temperatures with appropriate measures for heating insulation at points at which temperatures over 90 °C are reached due to external influences.

6.14 Installing pipes in concrete

When installing in concrete, we recommend decoupling the pipelines from the main structure by using common moisture-protected structure-borne noise insulations with a thickness greater than 4 mm. A limitation of the sound-insulation effectiveness can be expected, however.

- Attach pipe components in such a way that a change in position during concrete application is prevented.
- Ensure sufficient expansion joints when installing the pipe.
- Seal off sleeve gap with adhesive strips to prevent the penetration of concrete.
- Seal off pipe openings before concrete application.

CAUTION

Danger of damage to property!

Damage to the pipelines!

- Avoid placing the weight of the concrete on the pipelines by making provisions for dissipating the load, e.g. by using:
  - Spacers in the case of reinforcing steels
  - Carrying boxes
  - Brackets
- Avoid walking on the pipes during concrete application.

6.15 Installation above suspended ceilings

Installation above suspended ceilings requires additional measures due to the special installation situation so as to ensure a high degree of sound insulation.
The insulation can be in the form of acoustically active pipe shells (e.g. combination of open-pore foam or mineral fibre mats with a thickness of approx. 30 mm and special heavy foils).
In the case of installation in complex ceiling system, the installation instructions from the ceiling manufacturer regarding sound insulation are to be obtained.

6.16 Ceiling penetrations

Ceiling penetrations must be constructed to be moisture-proof and sound-insulating.

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

6.17 Installation as an inlying rain downspout

There is a risk of dew formation on the pipes installed as a rain downpout within the building.
Condensation water appears when the temperature of the pipe walls drops below the dew point temperature of the ambient air due to cold rain water, for example. Humidity from the ambient air then condenses on the pipe surface.
For this reason, all pipelines in the building on which condensation water could form are to be provided with diffusion-proof insulation material. Insulation of the collecting pipes in the cellar can be dispensed with if there is no risk of dew formation. In general, this is the case with exposed rain downspouts in unheated cellars if temperature equalisation has occurred in the downspout.

Condensation-water insulation materials

Closed-cell materials with high water vapour diffusion resistance are recommended for use as condensation-water insulation. If open-cell or fibrous insulation materials are used, they must have an impermeable outer layer that is firmly attached to the insulation material.

- Close off all impact, groove, cut and end points of the insulation with a permanent seal.
- Cut out insulation in the bracket area.
- Pull insulation material over the bracketed section and permanently seal it to the neighbouring insulation material with adhesive.

Attachment of inlying rain downspout

To prevent the pipelines sliding apart, a security clamp is to be attached to the pipe directly below the supporting clamp.

7. RAUPIANO PLUS

BRACKETING OF RAUPIANO PLUS

To achieve optimum sound insulation, use only RAUPIANO PLUS pipe brackets during assembly.
RAUPIANO PLUS drainage pipes must be installed tension-free.

7.1 Support bracket for downspouts

The patented sound-dampening support bracket consists of a supporting clamp and a fastening clamp. In general, one sound-dampening support bracket per storey is sufficient.

1. Fit fastening clamp around the pipe and close it.
2. Assemble supporting clamp on masonry.

Fig. 7-1 supporting clamp assembled, opened

A spacer is attached at the closure of the support clamp to prevent the clamp being closed completely. This ensures that acoustic coupling is very weak.

3. Open supporting clamp, insert pipe with fastening clamp and close supporting clamp.

Fig. 7-2 Closing supporting clamp

After installation, the fastening clamp fully lies on the supporting clamp. This achieves optimum sound decoupling.

Fig. 7-3 Fully installed support bracket

7.2 Plan for the attachment of downspouts

A plan for effective bracketing of a sound-insulating downspout with RAUPIANO PLUS is displayed graphically (see Fig. 7-4).

Transition to the collecting pipe

1. Create a transition from the downspout into the collecting pipe with two 45° elbows with a relaxation section built in between them (RAUPIANO PLUS waste pipe 250 mm).
2. To minimise the distance to the ceiling, embed the socket of the top 45° elbow in the ceiling area.
3. Use a fireproofing collar if necessary.

Storey above the collecting pipe

1. Use a branch after passing through the ceiling.
2. Shorten RAUPIANO PLUS drainage pipe so that the pipe socket is positioned directly below the ceiling of the storey and insert it in the top socket of the branch.
3. Attach sound-dampening support bracket below the socket of the RAUPIANO PLUS drainage pipe.
4. Assemble a guiding clamp below this support bracket at a distance of approx. 2/3 of the pipe length.

The guiding clamp permits free longitudinal movement of the RAUPIANO PLUS drainage pipe.
It is not necessary to assemble the support bracket directly below the pipe socket.

5. Create the ceiling passage to the next storey with a short length of RAUPIANO PLUS pipe.

Following storeys

1. Use a branch after passing through the ceiling.
2. Shorten RAUPIANO PLUS drainage pipe for the ceiling passage to the next storey and insert it in the branch.
3. Attach sound-dampening support bracket below the ceiling at the RAUPIANO PLUS drainage pipe.
4. Assemble a guiding clamp below this support bracket at a distance of approx. 2/3 of the pipe length.

Additional bracket is not necessary. The storey passage with the short pipe (≤ 500 mm) and the storey branch do not require their own brackets.

Alternative for ceiling passage

Short pipes can also be used for the ceiling passage in the storeys. The bracketing plan is the same here.

Additional securing

To secure the downspout from sliding apart, additional security clamps are used directly below the sound-dampening support brackets:
- For one-family houses only on the first storey
- For multistorey buildings on every third storey

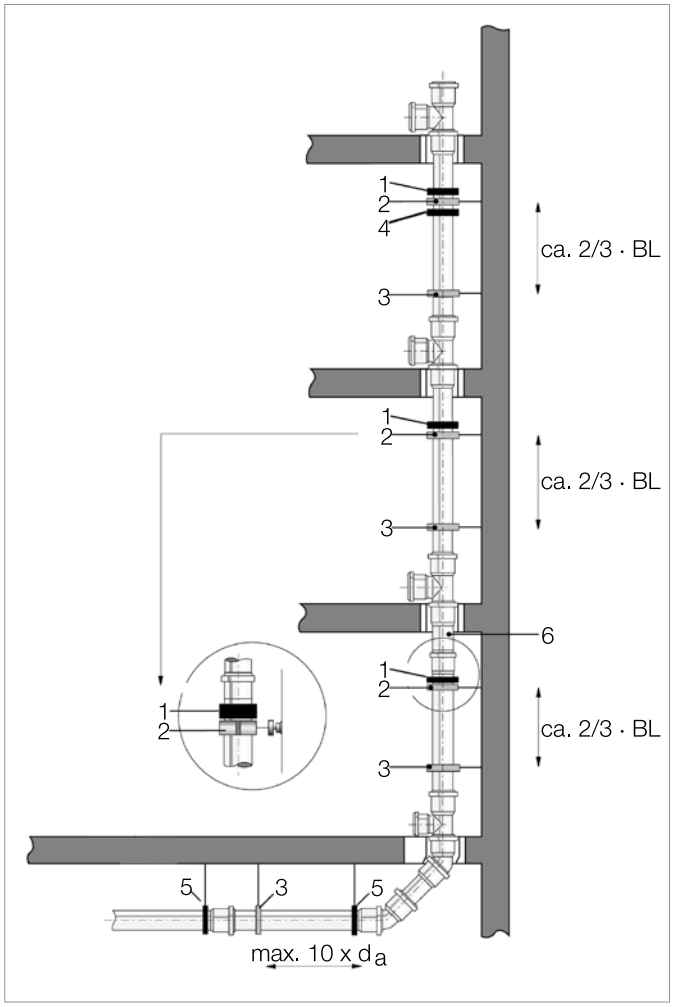


Fig. 7-4 Installation plan for downspout

1 Fastening clamp
2 Supporting clamp
3 Guiding clamp
4 Security clamp
5 Fixing clamp
6 RAUPIANO PLUS short lengths (BL ≤ 500 mm)
BL Length
d_a Pipe outer diameter

7.3 Plan for bracketing of horizontal pipes

A plan for effective bracketing of a horizontal sound-insulating pipe with RAUPIANO PLUS is displayed graphically (see Fig. 7-5).

Sound-dampening support brackets are not necessary for a horizontal pipe.

- For short horizontal pipes (length ≤ 10 x pipe outer diameter), assemble fixing clamp directly next to the pipe socket.
- For longer horizontal pipes (length > 10 x pipe outer diameter), assemble additional guiding clamps:
  - The distance between the fixing clamp and the guiding clamps may not exceed ten times the pipe outer diameter da (see Fig. 7-5): Spacing ≤ 10 x d_a.

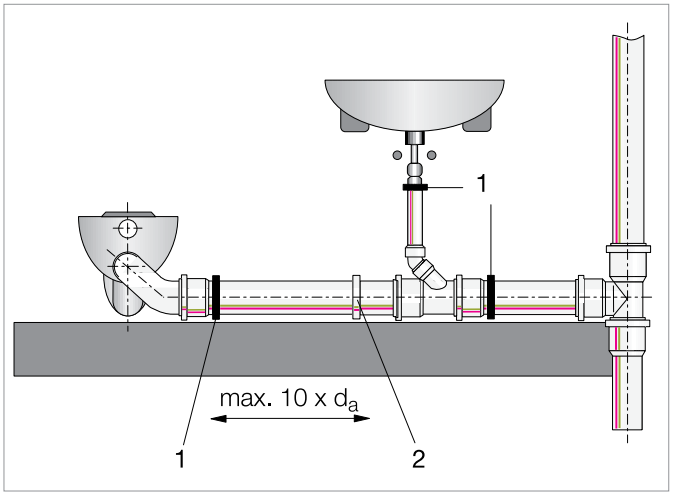


Fig. 7-5 Installation plan for horizontal pipeline

1 Fixing clamp
2 Guiding clamp
d_a Pipe outer diameter

7.4 Short pipes and fittings

If pipe sections with fittings or short pipes are formed:
- Prevent the pipe components from sliding apart with fixing clamps.
- Secure socket plug from being pushed out.

RAUPIANO PLUS
UNDERGROUND INSTALLATION

8.

RAUPIANO PLUS is ideal for installation below ground in areas without heavy loading. Installation is allowed for both inside and outside of the building structure. The installation is to be carried out in accordance to the structural requirements.

Applicable standards and test certificates

Installation below ground of RAUPIANO PLUS system has to adhere to the applicable local regulations and standards.

Besides the local regulations and standards, other standards are to be observed during pipe installation, including the standards mentioned in the Appendix, particularly DIN EN 1610. The following standards describe the installation and testing of drainage pipes and channels that are usually laid below ground and operated under free-flow conditions:

- DIN EN 1610
- DIN EN 12056
- DIN EN 752
- DIN 1986
- General building inspectorate approval Z-42.1-223
- German Association for Water, Waste Water and Waste rules, sewage worksheet A 127

8.1 General

The general applicable pipeline installation regulations are to be followed. Careful and professional handling of the pipes and fittings during transport, storage and installation must be ensured.

Only professionals with experience in installing plastic pipes should be allowed to install the pipelines.

§

Observe the following:

- Accident prevention regulations
- Road traffic regulations when installation is done in public area
- Any special project-dependent regulations
- Applicable requirements specified in the regulations or technical regulations

8.2 Pipe trench

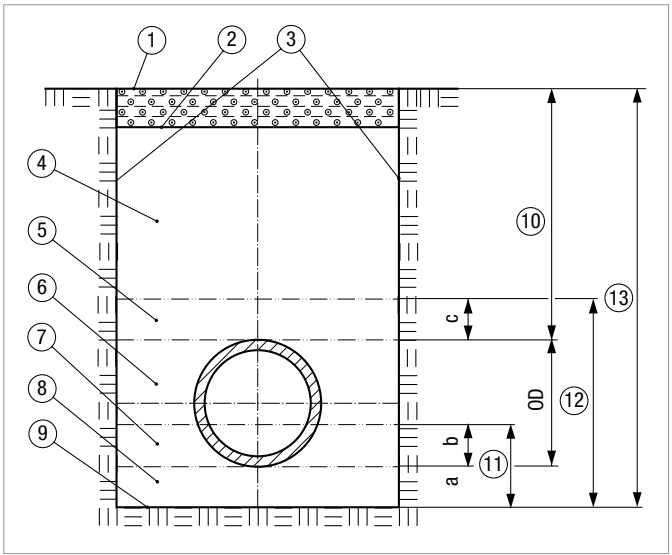


Fig. 8-1 Schematic structure of pipe trenches

1 Surface
2 Bottom edge of street or sliding construction (if present)
3 Trench walls
4 Main filling
5 Cover
6 Side filling
7 Top bedding layer
8 Bottom bedding layer
9 Trench bottom
10 Covering height
11 Thick bedding
12 Thick embedment
13 Trench depth
a Thick lower intermediate bedding layer
b Thick top bedding layer
c Thick cover
OD Outer diameter of pipe

Pipe trenches must comply with DIN EN 1610 and local standards. Please note the following:

- Ensure the structural integrity of the trench via suitable shoring (joists), scarping or other suitable measures.
- Prepare the bottom of the trench to the required gradient.
- Prepare suitable recesses in the bedding layer for the pipe sockets to ensure that the full length of the pipeline is in contact with the bedding.
- Ensure a consistent level of lie of the pipelines.
- Protect the trench bottom from the effect of frost.
- Do not use frozen material below or above the pipelines.
- Remove trench shoring material according to the structural calculations so that the pipeline is neither damaged nor repositioned.

The minimum trench depths for underground installation of RAUPIANO, depending on the loading, are specified in the table below:

Loading type	Minimum trench depth (mm)
No loading	500
Light loading	800
Heavy loading	Not applicable

Table 8-1 Minimum trench depth for underground installation.

8.3 Embedment

Embedment is the filling material around the RAUPIANO PLUS pipe. The embedment comprises of:

- Bedding material
- Side filling
- Covering material

Ensure that the ground does not sink due to unstable ground structure. The trench must be well-compacted and provides a stable support to the whole pipeline. Besides the trench, the embedment must also be created carefully as it is the main determining factor in the supportive capacity of the pipe.

The embedment is to be created in accordance to the structural calculation based on the planning documentation. The supportive capacity, structural integrity and position of the embedment may not be changed by subsequent events, such as ground water movement or removal of shoring material. In these cases, additional safety measures are required to prevent repositioning/shifting of the filling material.

8.3.1 Embedment building materials

The embedment material must comply with the planned specifications. This can also be the existing ground material, which has been checked for suitability.

When selecting the embedment material, grain size and any shoring/ joists, observe the following:

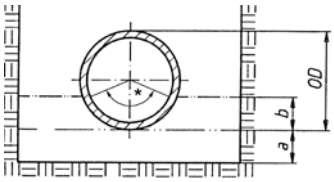
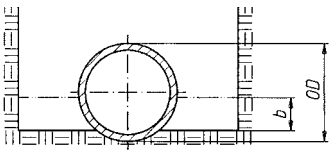
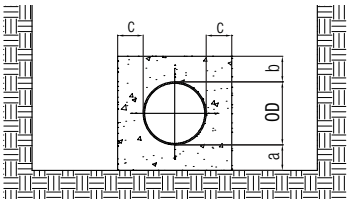
- Pipe diameter
- Pipe material
- Pipe wall thickness
- Ground characteristics

In general, embedment materials should not contain any components larger than 22 mm and must comply with local regulations and DIN EN 1610.

8.3.2 Pipe bedding

The pipe bedding consists of bottom bedding layer and top bedding layer.
The width of the pipe bedding must match the trench width.

The laying of RAUPIANO PLUS pipe can be done as per the following table:

	Pipe bedding		
	Type 1	Type 2	Type 3
Structure	 a = Bottom intermediate bedding layer b = Top bedding layer OD = Pipe outer diameter	 b = Top bedding layer OD = Pipe outer diameter	 a = Bottom haunching thickness b = Top haunching thickness c = Side haunching thickness OD = Pipe outer diameter
Application	- Suitable for any embedment - Pipe must lie securely along its entire length	- Ideal for even, relatively loose and fine-grain ground - Ground must permit support over the entire pipe length	- Ideal for heavy loading and any type of ground - Ground must provide stable support
a	- Normal ground conditions: a ≥ 100 mm - Rock or solid ground: a ≥150 mm	- Pipe lies directly on the trench bottom	100 mm
b	Specification of the thickness according to structural calculation	Specification of the thickness according to structural calculation	100 mm
c	-	-	100 mm

Tab. 8-2 Pipe bedding types

Special pipe bedding or supportive construction type

For a trench bottom with minimal supportive capacity for the pipe bedding, e.g. in the case of non-load bearing ground like turf or quicksand, special measures are required, e.g. :

- replacing the ground with other construction materials
- supporting the pipeline with posts, etc.

These types may only be used if their suitability has been verified by structural calculations.

If RAUPIANO pipe is laid on soft or yielding ground, measures must be taken to ensure the ground can provide a stable support for the whole pipe length, for example by piling.

8.3.3 Filling

To prevent the surface from sinking, side and main filling are to be put in place in accordance to planning requirements.

8.3.4 Compacting

The degree of compactness must correspond to the requirements of the pipeline according to the structural calculation.

- If necessary, compacting of the cover layer must be carried out by hand directly over the pipe.
- Mechanical compacting of the main filling cannot be carried out until the cover layer is at least 30 cm thick, measured from the top of pipe.
- Selection of the compacting equipment, the number of compacting runs and the compacting layer thickness must be appropriate for the filling material and the pipeline.
- Compacting of the main or side filling by silting is only permissible in exceptional cases with suitable cohesionless ground.

8.4 Building connections

Connections to the building (e.g. shafts) are to be made with joints. Special appropriate shaft liners are used here. The seal between the pipeline and the shaft liner is handled by the rubber sealing ring integrated in the shaft liner.

8.5 Leak test

The leak test must be carried out in accordance with DIN EN 1610 and local standards and regulations.

The leak test is carried out after the removal of the shoring material and after the trench filling.

Water pressure test

1. Carry out visual check and close all openings securely.
2. Slowly fill the pipe of the defined pipe-section with water and fully vent out the air trapped inside.
3. Once the test pressure of 0.5 bar is reached, keep it for 1 hour.
4. Then maintain the test pressure of 0.5 bar for 30 minutes. If necessary, top up with water.

The test is considered to be successful if the quantity of the water top-up per meter square of the interior surface does not exceed the following:

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

Air pressure test

Alternatively, the test can be carried out with air.

CAUTION

Danger of injury!

Due to the increased air pressure, cut-off components could detach explosively.

- Ensure firm and sealed seating of the cut-off components.

The air pressure test is carried out with two air pressure levels:

- Initial pressure: corresponds to 110% of the test pressure
- Test pressure: depends on the test method and nominal width

1. Maintain initial pressure for approximately 5 minutes.
2. Then reduce air pressure to test pressure.
3. Start test time and record drop in pressure during the test time.

The test is considered to be successful if the drop in pressure lies within the permissible range.

Test pressure P_0 (kPa)	Permissible pressure drop ΔP (kPa)	Testing time (min)	
		DN 100	DN 200
1	0.25	5	5
5	1	4	4
10	1.5	3	3
20	1.5	1.5	1.5

Table 8-3 Air pressure test table.

For the full information on pressure test for underground installation, please refer to DIN EN 1610.

RAUPIANO PLUS

CERTIFICATIONS

RAUPIANO PLUS was approved by the following certification agencies ond others:

Germany

Germany

Sweden

Norway

Finland

Russia

Denmark

Denmark

Poland

Austria

Hungary

Malaysia

10. RAUPIANO PLUS

TECHNICAL SPECIFICATIONS

Material	PP-MD mineral-reinforced (pipes and fittings)	
Size range	DN 40 – DN 200	
Area of application	Drainage pipes in buildings and underground installation inside and outside the building structure	
Chemical resistance	Polypropylene basis	in accordance with DIN 8078
	No waste water containing benzene	
	Seals made of SBR	DIN 4060, DIN EN 681-1
Application	Waste water with ph value 2 – 12	
	Waste water temperature up to 95°C (brief periods) or 90°C (continuous load)	
Density	Pipes 1.9 g/cm^3	
	Fittings 1.1 – 1.9 g/cm^3	
Coefficient of thermal expansion	0.09 mm/m-k	DIN 53752
Ring stiffness	> 4 kN/m^2	DIN EN ISO 9969
Tensile strength	> 16 N/mm^2	DIN EN ISO 527-3
Elongation before breaking	Approx. 150 %	DIN EN ISO 527-3
Modulus of elasticity	Approx. 2,700 N/mm^2	DIN EN ISO 527-2
MFR 190/5	Approx. 1.7 g/10 min.	DIN EN ISO 1133
MFR 230/2,16	Approx. 0,82 g/10 min.	DIN EN ISO 1133
Pressure resistance	0.5 bar (5 m water column)	Test certificates for up to 1 bar on request
Pipe structure	Pipes features innovative three-layer structure	
	- Impact-resistant and shock-proof PP outer layer	
	- Highly rigid middle layer made of mineral-reinforced PP	
	- Abrasion-resistant and very slick inner layer	
	Fittings	
	- Mass optimisation in redirection area for increased sound insulation	DN 90 – DN 125
Halogen contents	Halogen-free (no F, Cl, Br, J)	
Connection	Push-fit socket with factory-installed lip sealing ring	
Fire behaviour	B2 (normally inflammable)	In accordance with DIN 4102
System compatibility	No adapters for HT or KG pipes required, adapters to Cast Iron and PVC system	
Standards	System test according to DIN EN 1451-1	
	Supplemental tests as per the requirements of the Deutsches Institut für Bautechnik (DIBt) in Berlin	
Sound insulation	Test as per DIN EN 14366, test reports from the Fraunhofer Institute for Building Physics:	
	P-BA 6/2006 with support attachment Max. 17 dB(A) at 4 L/s	
	P-BA 176/2006 with standard clamp Max. 24 dB(A) at 4 L/s	
Approval	Deutsches Institut für Bautechnik (DIBt)	ABZ 42.1-223
Independent monitoring	Süddeutsches Kunststoffzentrum (SKZ), Germany	
Fire load	The RAUPIANO PLUS fire load was determined by MPA. It is	
	- 14,992 kJ/kg	
	Transferred to a DN 110 RAUPIANO PLUS pipe:	
	- 7.9 kWh/m	
	- 28,464.8 kJ/m	

Tab. 10-1 Technical specifications

RAUPIANO PLUS
CHEMICAL RESISTANCE

Pipe and fitting

The specifications are used for the initial orientation of the chemical resistance of the material (not of the possible influence of the corrosive agent) and cannot simply be applied to all usage scenarios. Mechanical behaviour can be impaired in cases where tension and the presence of chemicals occur simultaneously (tension-fracture corrosion).

Rubber sealing ring

The types of rubber used generally exhibit quite good chemical resistance, but components of esters, ketones and aromatic and chlorinated hydrocarbons in sewer water expand heavily, which can lead to damage of the connection.
If in doubt, we recommend testing the suitability of the pipe, fitting and seal material in existing systems or have them checked in a laboratory. Contact our applications department if necessary.

Table legend

r = resistant
cr = conditionally resistant
nr = not resistant
– = not tested

Reagent	Concentr. %	Temp. °C	RAUPP
2-Propen-1-ol	96	20	r
	96	60	r
Acetaldehyde + acetic acid	90/10	20	–
Acetaldehyde, aqueous	40	40	r
Acetaldehyde, concentrated	100	20	–
Acetate ether	100	20	–
Acetic acid, aqueous	up to 25	40	r
	up to 25	60	r
	25–60	60	r
	80	40	r
Acetic acid, concentrated	95	40	–
Acetic anhydride	100	20	r
	100	40	cr
	100	60	cr
Acetone	100	20	r
	100	60	r
Acetone, aqueous	traces	20	r
Acronal dispersions	com. avail.	20	–
Acronal solutions	com. avail.	20	–
Acrylic acid ethyl ester	100	20	–
Adipic acid, aqueous	saturated	20	r
	saturated	60	–
Aluminium chloride	diluted	40	r
	diluted	60	r
	saturated	60	r

Reagent	Concentr. %	Temp. °C	RAUPP
Aluminium sulfate, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Alums, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Ammonia, gas	100	60	r
Ammonia, liquid	100	20	r
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 hydroxide	warm sat.	40	r
	warm sat.	60	r
Ammonium nitrate, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Ammonium sulfate, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Ammonium sulfide, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Aniline hydrochloride, aqueous	saturated	20	r
	saturatedr	60	r

Reagent	Concentr. %	Temp. °C	RAUPP
Aniline, aqueous	saturated	20	r
	saturated	60	r
Aniline, pure	100	20	r
	100	60	r
Animal glue	custom. conc.	20	r
	custom. conc.	60	r
Anthraquinonesulfonic acid, aqueous	suspension	30	r
Antiformin, aqueous	2	20	–
Antimony chloride, aqueous	90	20	r
Arsenic acid, aqueous	diluted	40	r
	diluted	60	r
	80	40	r
	80	60	r
Beef tallow emulsion, sulphonated	com. avail.	20	–
Beer	com. avail.	20	r
Beer colouring agent	com. avail.	60	r
Benzaldehyde, aqueous	0,1	60	–
Benzene	100	20	cr
Benzoic acid, aqueous	any	20	r
	any	40	r
	any	60	r
Bisulphite solution, w/ SO_2	warm sat.	50	r
Bleaching liquour,	usage conc.	40	–
containing 12.5 % active chlorine	usage conc.	60	cr
Borax, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Boric acid, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Brandy	com. avail.	20	r
Bromine fumes	minimal	20	nr
Bromine, liquid	100	20	nr
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	cr
Butyl acetate	100	20	cr

Reagent	Concentr. %	Temp. °C	RAUPP
Butylene, liquid	100	20	–
Butylphenol	100	20	r
Butynediol	up to100	40	–
Butyric acid, aqueous	20	20	r
	concentr.	20	r
Calcium chloride, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Calcium nitrate, aqueous	50	40	r
Carbolineum, aqueous	usage conc.	20	–
Carbon dioxide, aqueous under 8 atmospheric pressures	saturated	20	–
Carbon dioxide, dry	100	60	r
Carbon dioxide, moist	any	40	r
	any	60	r
Carbon disulfide	100	20	cr
Carbon tetrachloride, technical	100	20	nr
Caustic potash solution, aqueous	up to 40	40	r
	up to 40	60	r
	50/60	60	r
Caustic soda, aqueous	up to 40	40	r
	up to 40	60	r
	50/60	60	r
Chloramine, aqueous	diluted	20	–
Chloric acid, aqueous	1	40	–
	1	60	–
	10	40	–
	10	60	–
	20	40	–
	20	60	–
Chlorine water	saturated	20	cr
Chlorine, gaseous, dry	100	20	nr
Chlorine, gaseous, moist	0,5	20	nr
	1	20	nr
	5	20	nr
Chlormethyl	100	20	–
Chloroacetic acid (mono)	100	40	r
	100	60	–
Chloroacetic acid (mono) aqueous	85	20	r
Chlorosulfonic acid	100	20	nr
Chromic acid, aqueous	up to 50	40	–
	up to 50	60	cr

Reagent	Concentr. %	Temp. °C	RAUPP
Chromic acid/Sulphuric acid/Water	50/15/35	40	nr
	50/15/35	60	nr
Cider	com. avail.	20	r
Citric acid, aqueous	up to 10	40	r
	up to 10	60	r
	saturated	60	r
Clophene	com. avail.	20	–
	com. avail.	60	–
Coconut fat alcohol	100	20	r
	100	60	cr
Copper fluoride, aqueous	2	50	r
Copper sulfate, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Cresol, aqueous	up to 90	45	–
Crotonaldehyde	100	20	r
Cyclohexanol	100	20	r
Cyclohexanone	100	20	r
Cyclohexanone	100	20	r
Densodrin W	com. avail.	60	–
Dextrin, aqueous	saturated	20	r
	18	60	r
Dextrose, aqueous	saturated	20	b
	saturated	60	b
Diethylether	100	20	cr
Diglycol acid, aqueous	30	60	r
	saturated	20	r
Dimethyl sulfate, aqueous	up to 50	20	r
	up to 50	40	r
	100	40	–
	100	60	–
Dimethylamine, liquid	100	30	–
Disulfuric acid	10	20	nr
Ethanol (fermentation mash)	common	40	r
	common	60	–
Ethanol, aqueous	any	20	r
	96	60	r
Ethanol, denatured (with 2 % tolulene)	96	20	cr
Ethanol+ acetic acid (fermentation mash)	common	20	r
Ethyl acetate	100	20	cr
	100	60	nr
Ethylene chloride	100	20	nr

Reagent	Concentr. %	Temp. °C	RAUPP
Ethylene oxide, liquid	100	20	–
Exhaust gas, w/ H_2CO_3	any	60	r
Exhaust gas, w/ HF	traces	60	r
Exhaust gas, w/ NOX	traces	60	r
	higher	60	–
Exhaust gases, w/ H_2S_2O7	lower	20	–
	higher	20	nr
Exhaust gases, w/ H_2SO_4, moist	any	60	r
Exhaust gases, w/ HCl	any	60	r
Exhaust gases, w/ SO_2	lower	60	r
	50	50	–
Fatty acids	100	60	cr
Ferric chloride, aqueous	up to 10	40	r
	up to 10	60	r
	saturated	60	r
Fertilizer salts, aqueous	up to 10	40	r
	up to 10	60	r
	saturated	60	r
Fluorsilicic acid, aqueous	up to 32	60	–
Formaldehyde, aqueous	diluted	40	r
	diluted	60	r
	40	30	r
Formic acid	100	20	r
	100	60	cr
Formic acid, aqueous	up to 50	40	r
	50	60	r
Frigen	100	20	cr
Fruit pulp	custom. conc.	20	r
Glucose, aqueous	saturated	20	r
	saturated	60	r
Glycerine, aqueous	any	60	r
Glycine, aqueous	10	40	r
Glycol, aqueous	com. avail.	60	r
Glycolic acid, aqueous	37	20	r
Hexantriol	com. avail.	60	r
Hydrobromic acid, aqueous	up to 10	40	r
	up to 10	60	r
	48	60	r
Hydrochloric acid, aqueous	up to 30	40	r
	up to 30	60	r
	over 30	20	r
	over 30	60	r

Reagent	Concentr. %	Temp. °C	RAUPP
Hydrofluoric acid, aqueous	up to 40	20	r
	40	60	r
	60	20	r
	70	20	r
Hydrogen	100	60	r
Hydrogen peroxide, aqueous	up to 30	20	r
	up to 20	50	r
Hydrogen phosphide	100	20	–
Hydrogen sulfide, dry	100	60	r
Hydrogen sulfide, aqueous	warm sat.	40	r
	warm sat.	60	r
Hydrosulfite, aqueous	up to 10	40	r
	up to 10	60	r
Hydroxylamine sulfate, aqueous	up to 12	35	r
Lactic acid, aqueous	up to 10	40	r
	up to 10	60	r
	90	60	r
Lead acetate, aqueous	warm sat.	50	r
	diluted	40	r
	diluted	60	r
	saturated	60	r
Lead tetraethyl	100	20	r
Magnesium chloride, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Magnesium sulfate, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Maleic acid, aqueous	saturated	40	r
	saturated	60	r
	35	40	r
Malic acid, aqueous	1	20	r
Mersol D	custom. conc.	40	–
Methanol	100	40	r
	100	60	r
Methyl amine	32	20	r
Methylene chloride	100	20	nr
Milk	com. avail.	20	r

Reagent	Concentr. %	Temp. °C	RAUPP
Mixed acid	48/49/3	20	nr
(Sulfuric acid/Nitric acid/Water)	48/49/3	40	nr
	50/50/0	20	nr
	50/50/0	40	nr
	10/20/70	50	cr
	10/87/3	20	nr
	50/31/19	30	nr
Molasses	custom. conc.	20	r
	custom. conc.	60	r
Molasses wort	custom. conc.	60	r
Mowilith D	com. avail.	20	–
Nekal, BX, aqueous	diluted	40	–
	diluted	60	–
Nickel sulfate, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Nicotine compounds, aqueous	usage conc.	20	–
Nicotine, aqueous	usage conc.	20	–
Nitric acid, aqueous	up to 30	50	r
	30/50	50	nr
	98	20	nr
	98	60	nr
Nitrous gasses	concentr.	20	r
	concentr.	60	–
Oils and greases	com. avail.	60	cr
Oleic acid	com. avail.	60	cr
Oleum vapour	lower	20	cr
	higher	20	nr
Oxalic acid, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Oxygen	any	60	–
Ozone	100	20	cr
	10	30	r
Palm kernel oil acid	100	60	–
Paraffin emulsions	com. avail.	20	–
	com. avail.	40	–
Perchloric acid, aqueous	up to 10	40	r
	up to 10	60	r
	saturated	60	–
Petrol	100	60	nr

Reagent	Concentr. %	Temp. °C	RAUPP
Petrol-benzene mixture	80/20	20	cr
Phenol, aqueous	up to 90	45	r
	1	20	–
Phenylhydrazine	100	20	cr
	100	60	–
Phenylhydrazine hydrochloride, aqueous	saturated	20	–
	saturated	60	–
Phosgene, aqueous	100	20	nr
Phosgene, gaseous	100	20	cr
	100	60	cr
Phosphoric acid, aqueous	up to 30	40	r
	up to 30	60	r
	40	60	r
	80	20	r
	80	60	r
Phosphorous pentoxide	100	20	r
Phosphorous trichloride	100	20	r
Photographic developers	com. avail.	40	r
Photographic emulsions	any	40	–
Photographic fixers	com. avail.	40	r
Picric acid, aqueous	1	20	r
Potash, aqueous	saturated	40	–
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 cyanide, aqueous	up to 10	40	r
	up to 10	60	r
	saturated	60	r
Potassium dichromate, aqueous	40	20	r
Potassium ferrocyanide	diluted	40	r
Potassium ferrocyanide, aqueous	diluted	60	r
	saturated	60	r

Reagent	Concentr. %	Temp. °C	RAUPP
Potassium nitrate, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Potassium permanganate, aqueous	up to 6	20	r
	up to 6	40	r
	up to 6	60	r
	up to 18	40	–
Potassium persulfate, aqueous	diluted	40	r
	diluted	60	r
	saturated	40	r
	saturated	60	r
Propane, gaseous	100	20	–
Propane, liquid	100	20	–
Propargyl alcohol, aqueous	7	60	r
Pure acetic acid	100	20	r
	100	40	r
Ramasite	com. avail.	20	–
	com. avail.	40	–
Roaster gases, dry	any	60	r
Seawater	–	40	r
	–	60	r
Silicic acid, aqueous	any	60	r
Silver nitrate, aqueous	up to 8	40	r
	up to 8	60	r
Soap solution, aqueous	concentrated	20	r
	concentrated	60	r
Soda, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Sodium benzoate, aqueous	up to 10	40	r
	up to 10	60	r
	36	60	r
Sodium chlorate, aqueous	up to 10	40	r
	up to 10	60	r
	saturated	60	r
Sodium chlorite, aqueous	50	20	r
	diluted	60	nr
Sodium hydrosulfite, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Sodium hypochlorite, aqueous	diluted	20	r

Reagent	Concentr. %	Temp. °C	RAUPP
Sodium sulfide, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Spirits	com. avail.	20	r
Starch syrup	custom. conc.	60	r
Starch, aqueous	any	40	r
	any	60	r
Stearic acid	100	60	cr
Sulphur dioxide, aqueous under 8 atmospheric pressures	saturated	20	–
Sulphur dioxide, liquid	100	–10	–
	100	20	r
	100	60	r
Sulphur dioxide, moist and aqueous	any	40	r
	50	50	r
	any	60	r
Sulphur dixode, dry	any	60	r
Sulphuric acid, aqueous	up to 40	40	r
	up to 40	60	r
	70	20	r
	70	60	cr
	80–90	40	cr
	96	20	r
	96	60	nr
Table salt, aqueous	diluted	40	r
	diluted	60	r
	saturated	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	–
Tanning extracts, cellul.	common	20	r
Tanning extracts, natural	common	20	r

Reagent	Concentr. %	Temp. °C	RAUPP
Tartaric acid, aqueous	up to 10	40	r
	up to 10	60	r
	saturated	60	r
Thionyl chloride	100	20	nr
Tin (II) chloride, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Toluene	100	20	nr
Trichloroethylene	100	20	nr
Triethanolamine	100	20	r
Trilone	com. avail.	60	–
Trimethylolpropane, aqueous	up to 10	40	–
	up to 10	60	–
	com. avail.	40	r
	com. avail.	60	r
Urea, aqueous	up to 10	40	r
	up to 10	60	r
	33	60	r
Urine	normal	40	r
	normal	60	r
Vinegar (wine vinegar)	com. avail.	40	r
	com. avail.	50	r
	com. avail.	60	r
Vinyl acetate	100	20	r
Water	100	40	r
	100	60	r
Wax alcohol	100	60	cr
Wine, red and white	com. avail.	20	r
Xylene	100	20	nr
Yeast wort	custom. conc.	40	r
	custom. conc.	60	r
Zinc chloride, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r
Zinc sulphate, aqueous	diluted	40	r
	diluted	60	r
	saturated	60	r

RAUPIANO PLUS 12.

STANDARDS, REGULATIONS AND GUIDELINES

DIN 1054
Ground – Verification of the safety of earthworks and foundations

DIN 1055 Part 2
Design loads for buildings; soil characteristics; specific weight, angle of friction, cohesion, angle of wall friction

DIN 1986
Drainage systems on private ground

DIN 4060
Pipe joint assemblies with elastomer seals for use in drains and sewers, requirements and tests

DIN 4102
Fire behaviour of building materials and elements

DIN 4109
Sound insulation in buildings

DIN 4124
Excavations and trenches – Slopes, planking and strutting, breadths of working spaces

DIN EN 476
General requirements for components used in discharge pipes, drains and sewers for gravity systems

DIN EN 681
Elastomeric seals
Material requirements for pipe joint seals used in water and drainage applications

DIN EN 752
Drain and sewer systems outside buildings

DIN EN 1451
Plastic piping systems for soil and waste discharge (low and high temperature) within the building structure – Polypropylene (PP)

DIN EN 1610
Construction and testing of drains and sewers

DIN EN 12056
Gravity drainage systems inside buildings

VDI guideline 4100
Sound insulation in residential buildings – Criteria for planning and assessment

General building construction approval from the German Institute of Building Technology (DIBt)
Approval Z-42.1-223
RAUPIANO PLUS waste pipes and fittings
Approval Z-19.17-1662
REHAU PLUS fireproofing collar system
Approval Z-19.17-1363
REHAU “kompakt” fireproofing collar system
Approval Z-19.17-1268
REHAU angled fireproofing collar system

Assembly times - sanitation
German Plumbing, Sanitation and Heating Guild in Munich
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RAUCAD software from REHAU EN 12056

ATV-DVWK-A 127
Guideline for static calculation of waste water pipework

Construction

Automotive

Industry

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