



RAUPIANO PLUS SOIL & WASTE SYSTEM

Technical information

This technical information pertaining to the "RAUPIANO PLUS Domestic Soil & Waste System" is valid from February 2018 onwards.

With the publication of this document, the previous Technical Information 850623 (July 2016) is no longer valid.

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All dimensions and weights are approximate and subject to mistakes and modifications.



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1 INFORMATION AND SAFETY WARNINGS

Validity

This technical information is valid for Germany.

Navigation

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

Icons and logos



Safety warnings



Legal information



Important information that must be observed



Information on the internet



Your benefits

Validity of the Technical Information

For your own safety and for the correct application of our products, please check at regular intervals whether a newer version of your technical information is available. The publication date of your Technical Information can always be found in the lower right hand corner on the back cover of the document.

The latest version of the technical information is available from your REHAU sales office, specialist wholesaler and it can be downloaded via the Internet at www.rehau.de or www.rehau.com/downloads

Intended use

The RAUPIANO plus system must only be planned, installed and operated as described in this Technical Information. Any other use that does not fall within the intended use of the system is prohibited.

Safety warnings and operating instructions

- For your own safety and the safety of other people, please read through all safety and operating instructions carefully and completely prior commencing installation.
- Keep the operating instructions safe and have them at hand when needed.
- If you have not understood the safety instructions or any individual installation instructions or find them unclear, please contact your REHAU sales office.
- **Failure to observe the safety information/instructions can result in damage to property and persons.**

Observe the applicable national and international regulation on installation, accident prevention and safety when installing piping systems, as well as the instructions in this Technical Information.

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

Please contact your REHAU sales office for more detailed advice.

Personnel requirements

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

General safety precautions

- Keep your workplace clean and free of obstructions.
- Make sure there is always sufficient light in your workplace.
- Keep children, pets and unauthorised persons away from tools and the installation areas. This applies in particular to renovations in occupied areas.
- Only use the components intended for the particular REHAU pipe system. The use of components from other systems or the use of tools that are not from the relevant REHAU installation system can result in accidents or other hazards.

Working clothes

- Wear safety glasses, appropriate working clothes, safety shoes, a protective helmet and, if you have long hair, a hairnet.
- Do not wear loose-fitting clothing or jewellery as they may get caught in moving parts.
- Wear a hard hat when carrying out assembly work at head height or above your head.

During installation

- Always read and follow the operating instructions for the REHAU system tool used.
- REHAU pipe cutters have a sharp blade. Store and handle these in such a way that there is no risk of injury from the REHAU pipe cutters.
- When cutting the pipes to length, maintain a safe distance between the hand holding the pipe and the cutter.
- During the cutting procedure, never reach into the cutting zone of the tool or touch moving parts.
- During all maintenance or refitting work and when switching installation areas, always unplug the tool and make sure that it cannot be switched on unintentionally.

Fire safety

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

2 SYSTEM DESCRIPTION FOR THE RAUPIANO PLUS

2.1 Standards and approvals

RAUPIANO PLUS is an acoustic soil and waste system and meets the requirements of the German general building approval 42.1-223 and the standards DIN EN 12056 and DIN 1986-100.

In the case of pipes and mouldings with the same nominal bores, the pipe dimensions pursuant to DIN EN 1451 allow for a trouble-free transition to pipes and fittings made of PP (HT) as per DIN EN 1451 or KG as per DIN EN 1401 without the need for special adaptors.



- Top quality and aesthetically pleasing

- Superb acoustic properties
 - Unique and patented REHAU acoustic brackets for reducing structure-borne sound transmission
 - Specially formulated materials for pipe and fittings
 - Pipe elbows with partly thicker wall reduce the airborne sound
- Optimum slip properties of the abrasion-resistant inner layer reduce the risk of blockage
- Excellent cold impact resistance, verified down to $-10\text{ }^{\circ}\text{C}$ as per DIN EN 1451
- High level of ultraviolet resistance, can be stored outside for up to 2 years

2.2 Scope of application

Overview

Residential buildings	Construction as per DIN EN 12056 and DIN 1986-100 Detached dwellings Multi-occupancy developments 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 "10.1 Installations below the floor tile" on page 45
Commercial kitchens	Collecting, main and connecting pipes	see section "10.2 commercial kitchens" on page 45
Internal roof drainage	as a gravity system up to a total height of 20 m	see chapter "4 Internal roof drainage" on page 12
Mechanical ventilation	in detached and semi-detached dwellings for decentralised and centralised ventilation of bathrooms, toilet rooms and kitchens as per DIN 18017-3	see section "10.3 Mechanical ventilation" on page 46

2.3 Pipe structure

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.

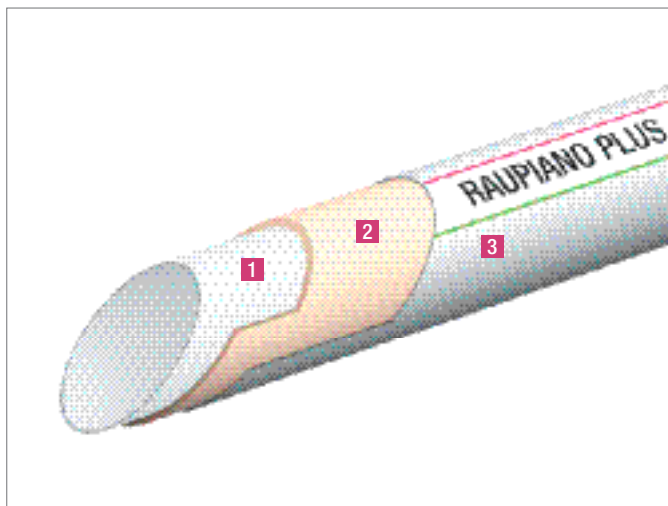


Fig. 2-1 Pipe structure of the RAUPIANO PLUS

- 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

3 SYSTEM COMPONENTS



3.1 Pipes and fittings



Fig. 3-1 Pipes and fittings



Fig. 3-2 RAUPIANO PLUS elbow with reinforced area of impact

-  - Superb acoustic properties
-  - Optimised 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 DIN EN 1451/1411)
- Reliable installation at low temperatures
- Easy and efficient installation
 - Push-fit connection
 - Factory-fitted ring seals
 - Pipes can be trimmed using plastic pipe cutters or saws with fine tooth blades
- Universally compatible with metric HT-PP system, connection to conventional metric HT and KG pipes without special adaptors
- Attractive design
- Clean white colour
- Eco-friendly as it can be recycled

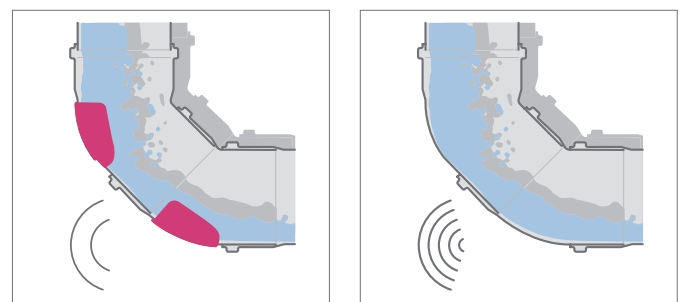


Fig. 3-3 Noise reduction with reinforced area of impact (left) compared to non-reinforced area of impact (right)

3.2 Sealing rings

The pipes and fittings are fitted with a ring seal in the factory in accordance with DIN 4060 and DIN EN 681-1.

Hardness: 60 ±5 Shore A

Material: styrene-butadiene-rubber (SBR)

Any redirection of high flow volumes always carries the risk, that the pipe system will begin to vibrate locally. This may have a negative effect on the noise-related performance.

To minimise this risk and counteract the negative impact, the elbows in the size range DN 90 to DN 160 have undergone a focused weight optimisation in the critical impact sound sections. This stabilises the noise-related behaviour, reduces noise generation and thus achieves an even greater sound insulation in the area of impact.

For waste water with a greater proportion of oils and greases (e.g. from commercial kitchens with grease separators), it may be necessary to replace the SBR seals with ones made of nitrile-butadiene (NBR) to provide a higher chemical resistance.

3.3 Brackets



Fig. 3-4 Patented acoustic bracket

The patented acoustic bracket consists of a support bracket with a spacer (closes loosely around the pipe and is anchored firmly to the wall) and a fixing bracket (closes tightly around the pipe without any contact to the wall). The toggle latch always ensures the perfect fit around the pipe. It is not necessary to mount the bracket directly underneath a socket.



Acoustic brackets are not required in horizontal installation.

Installation procedure

1. Fit the support clamp to the wall.



Fig. 3-5 Support bracket fixed to wall and opened

2. Open the support clamp, guide the pipe through it and into the pipe socket below and close the support bracket. If required, pull the pipe 10mm back out of the pipe socket (see chapter 6.3 on page 14).
3. Place the fixing bracket above the support bracket around the pipe and close it. Ensure both toggle latches are aligned and above each other (see Fig. 3-6).



Fig. 3-6 Fully installed acoustic bracket

In general an acoustic bracket is used in the upper section and a

guide bracket in the lower section of any given floor (max. 3 m) (see Fig. 3-7). In the case of greater floor heights, it may be necessary to use additional support and guide brackets (see Tab. 3-2).

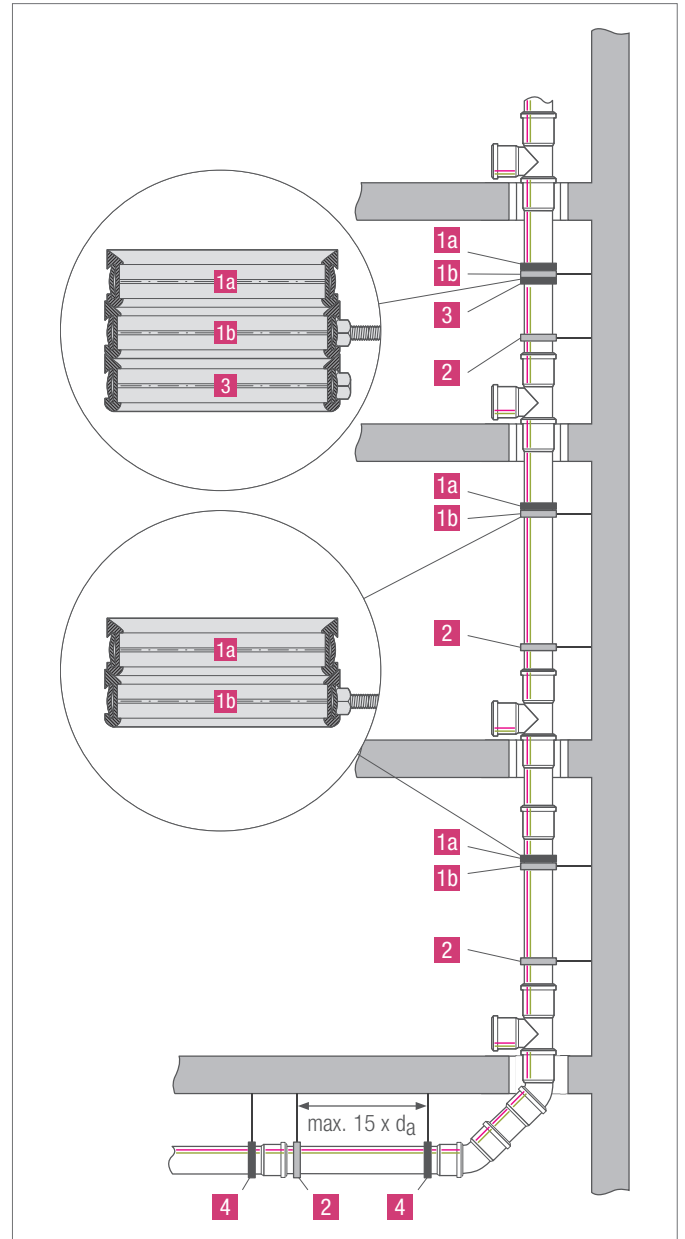


Fig. 3-7 Fastening scheme

- 1a** Acoustic bracket: fixing bracket (tight)
 - 1b** Acoustic bracket: support bracket (loose) for anchoring to the wall
 - 2** Guide bracket
 - 3** Anchor bracket as a safety bracket (not anchored to the wall)
 - 4** Anchor bracket as an anchoring bracket
- d_{ex} External pipe diameter

If necessary, the acoustic bracket can be rotated by 180°. When doing so, the positioning of the rubber linings needs to be changed and must correspond to the positioning of the inserts 1a and 1b in the section of Fig. 3-8 (see below). It is important that the self-centering function is maintained. The lower pipe bracket which is fixed to the wall has the larger inner diameter.

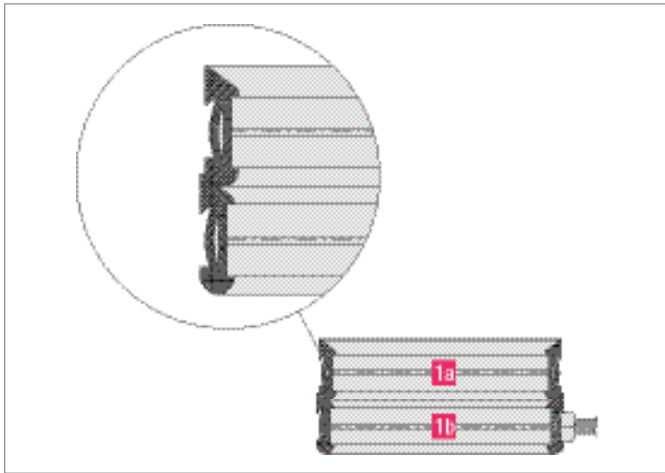


Fig. 3-8 Correct position for the rubber linings

1a Acoustic bracket: fixing bracket

1b Acoustic bracket: support bracket anchored to the wall

Additional fixed/safety brackets directly beneath the acoustic brackets prevent the discharge pipe from sliding apart, see 3 in Fig. 3-7:

- only on the upper floor in the case of detached dwellings
- on every 3rd floor in other buildings

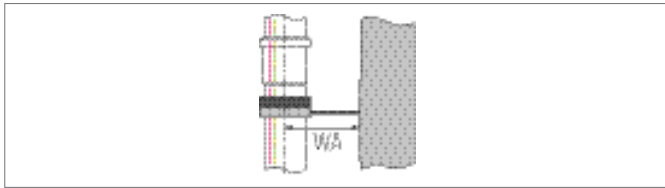


Fig. 3-9 Centre of pipe - wall distance, see table below

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

Tab. 3-1 Max. wall distance with threaded rods (guide values)

Fig. 3-10 shows an effective way on how to support a horizontal acoustic branch connection with RAUPIANO PLUS (see Fig. 3-10).

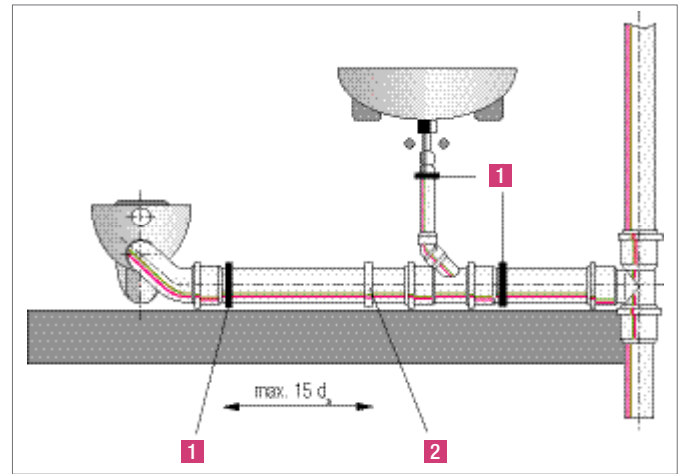


Fig. 3-10 Supporting a horizontal pipe

1 Anchor bracket (tight)

2 Guide bracket (loose)

d_{ex} External pipe diameter

- For horizontal pipe runs (length $\leq 15 \times$ external pipe diameter), fit the anchor bracket right behind the pipe socket.

- For longer horizontal pipe runs (length $> 15 \times$ external pipe diameter), fit additional guiding brackets: the distance between the brackets must not exceed 15 times the external pipe diameter.

Certain structural conditions may call for closer spacing of brackets.

Maximum spacing of brackets

DN	horizontal pipe runs	vertical pipe runs
	$15 \times d_{ex}$ [mm]	[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. 3-2 Max. distance between pipe bracket (recommended values)

3.4 Push-fit lock



Fig. 3-11 RAUPIANO push-fit lock

The RAUPIANO push-fit lock prevents the push-fit connection from being pulled out in case of internal pressures of up to 2 bar.

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

i Prior to installing the RAUPIANO push-fit lock onto fittings, the spigot end of the fitting must be pulled back out of the push-fit socket by 10 mm to create sufficient space for the push-fit lock.

Scope of application

- Internal roof drainage with a maximum height above the main drain of 20m
- Waste water pipes that span several floors without any branch
- In areas where it's possible for foul water inside the pipes to back up
- Secure the socket plug into place

! RAUPIANO PLUS is not approved for use on the pump outlet of sewage lifting stations.

Vertical roof drainage pipes which are open at the top, are not subject to any axial forces created by a water head. They do, however, require measures to prevent from buckling. Push-fit locks must be fitted onto all joints where there is a change in direction (offsets, etc). All push-fit joints along the entire offset as well as the last vertical joint before and the first vertical one after the change in direction, must be fitted with a push-fit lock. Push-fit locks can also be used to secure a slip-on socket preventing it from shifting during later operation. The RAUPIANO push-fit lock can also be fitted temporarily to aid the

installation process by providing extra stability to the discharge stack and preventing sections from coming apart. The RAUPIANO push-fit lock is easily, quickly and reliably fitted using the provided nuts and screws.

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

3.5 Soil and Waste Manifold



Fig. 3.5 Soil and Waste Manifold

PVC-U Manifold for push-fit soil and waste connections. Fitted with rubber Waste Inlet Seals for connection to DN32, 40 or 50 pipe or fittings, and three waste inlet Blanking Plugs. Also fitted with a DN110 Soil Inlet for connection to 110mm pipe or fitting.

- Prevents Cross-Flow
- Helps reduce syphonage of waste
- Allows low-level waste pipe connection
- No additional bosses or solvent welding required
- Designed to allow installation in the corner of a room
- Suitable for installation in high-rise / multi-occupancy buildings when used with a suitable Firestop Device

! A suitable FIRESTOP DEVICE must always be used in conjunction with the RAUPIANO Manifold. Always refer to Firestop manufacturers installation instructions prior to use.

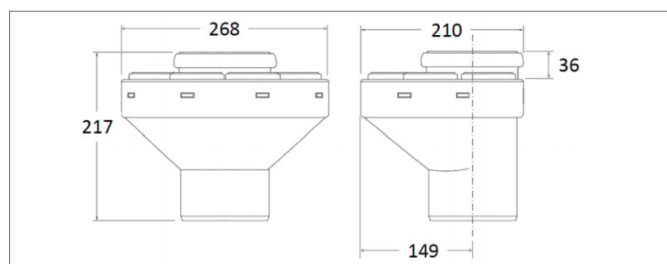


Fig. 3.6 Manifold Dimensions

4 INTERNAL ROOF DRAINAGE

An example of a roof drainage pipe arrangement with off-set is shown in Fig. 4-1.

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

REHAU fire collars (3) are available for passive fire protection. If a pipe socket is located within the area of the fire collar or the pipe penetrates the ceiling at an angle (up to 45°), then the REHAU fire collar system for angled penetrations should be used.

For ceiling penetrations follow the advice given in the installation instruction as well as in the issued general construction approval (abZ) (7).

All socket connections must be secured against coming apart by using push-fit locks (LKV) (1). Push-fit locks are not required for vertical pipe runs that are open at the top (see marking in Fig. 4-1).

If the pipes require protection against condensation (8), keep the following in mind:

- Use closed-cell insulation material with a high water vapour diffusion resistance factor ($\mu > 3000$).
- Select the insulation thickness based on the air humidity and temperatures.
- Seal any butt or mitre joints and any slits permanently.
- Fit the insulation all the way up to the fire collars. The insulation must not enclose the fire collar.

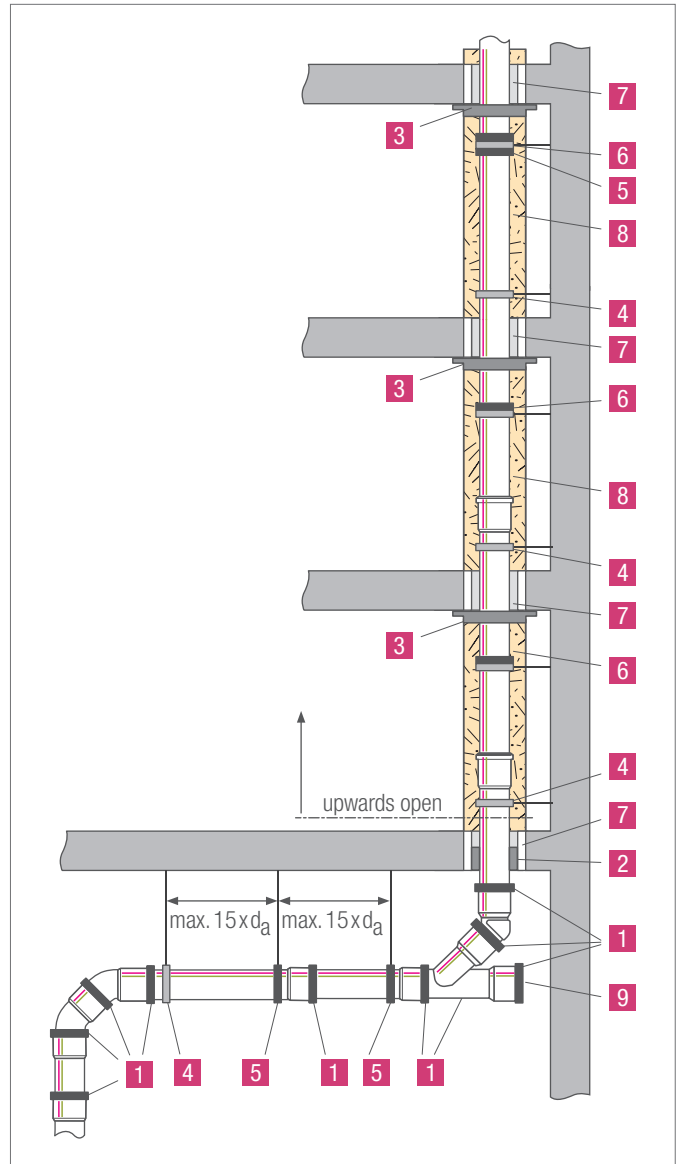


Fig. 4-1 Internal drainage pipe

- 1 Push-fit lock
- 2 REHAU fire stop pipe wrap
- 3 REHAU fire stop collar
- 4 Guide bracket
- 5 Fixing / Safety bracket
- 6 Acoustic bracket
- 7 Ceiling penetration(see German general building approval)
- 8 Insulation against condensation
- 9 Inspection / Rodding eye

5 PLANNING

5.1 Planning guidelines

The following standards are applicable for the design and installation of RAUPIANO PLUS:

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

The objective is to ensure the intended function of the universal RAUPIANO Plus acoustic soil and waste system, i. e.

- Back siphoning 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

5.2 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 soil and waste pipes with push-fit sockets and are taken from the association Spengler, Sanitär- und Heizungstechnik in Munich.

	Pipe (running metres)	Adaptor and fitting Pieces	Bracketing Pieces
DN 40	15	5	7
DN 50	15	5	7
DN 75	19	7	7
DN 90 ¹⁾	20	8	7
DN 110	22	9	7
DN 125	26	12	7
DN 160	33	14	12

1) interpolated

Tab. 5-1 Installation times in single minutes (SM)

Source: Sanitary installation times, Innung Spengler Sanitär- und Heizungstechnik, Munich, 7. fully revised and expanded edition 2015

5.3 Specification and Design

Specification phrases

- Example specification phrases
- Specification phrases with comprehensive article data
- System descriptions with images
- Export as PDF, WORD, GAEB, ÖNORM

www.rehau.de/ausschreibungstexte

Datanorm

- Master data in the DATANORM 4.0 format or with product images as DATANORM 5.0

www.rehau.de/stammdaten

Design software

RAUCAD soil and waste system design

- Design according to DIN EN 12056/DIN 1986-100
- Roof drainage incl. rainfall intensity table
- Data import via KOSTRA-DWD

www.rehau.de/raucad

6 INSTALLATION

6.1 Delivery, handling and storage

Delivery

- Pipes up to 750 mm and fittings in cartons
- Pipes measuring 1000 mm and above in timber frame crates

Handling

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

Storage

- Protect 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 protection (Central Europe).
- Protecting RAUPIANO PLUS pipes and fittings from soiling by
 - storing 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 pipes in such a way that no objects are placed on top of or in the sockets and spigot ends and that no deformation occurs.

6.2 Bevelling and cutting pipes to length



At low temperatures, the mineral-reinforced pipe material RAU-PP becomes more brittle and, as such, more sensitive to impact. Observe the minimum installation temperature of $-10\text{ }^{\circ}\text{C}$.



Fittings shall not be cut.

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

6.3 Joining pipe and fittings

1. Clean dirt off the sealing ring, the inside of the socket and the spigot end and ensure that the sealing ring is seated correctly.
2. Lubricate the spigot or pipe end with REHAU lubricant and push it into the socket all the way to the stop.
3. If necessary, mark the inserted pipe at the socket edge and pull it back out of the socket by 10 mm to allow for thermal expansion (ΔL).

Sample calculation ΔL :

Pipe length:	$L_0 = 3\text{ m}$
Installation temperature:	$T_1 = 10\text{ }^{\circ}\text{C}$
Max. waste water temperature:	$T_2 = 70\text{ }^{\circ}\text{C}$
Linear expansion coefficient:	$\alpha = 0.09\text{ mm/m x K}$

$$\Delta L = L_0 \times \alpha \times \Delta T$$

$$\Delta L = 3\text{ m} \times 0.09\text{ mm}/(\text{m} \times \text{K}) \times 60\text{ K}$$

$$\Delta L = 16\text{ mm}$$

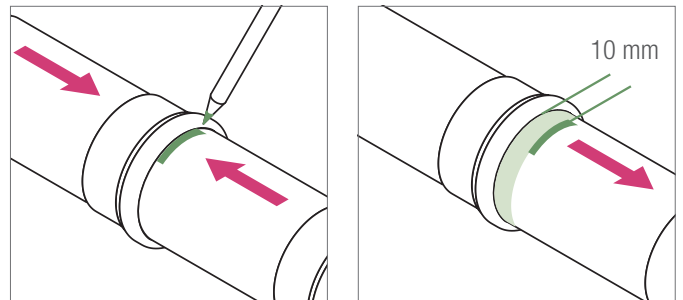


Fig. 6-1 Marking the spigot/ pipe ends and pull back to allow for thermal expansion



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

The printed scale on the pipe assists with trimming the pipe accurately to length and checking the pipe has been pulled back by 10 mm to accommodate thermal expansion.

6.4 Connecting to other pipe systems

6.4.1 Push fit adaptors (UK imperial pipe sizes)

Pipe Connection Schematic

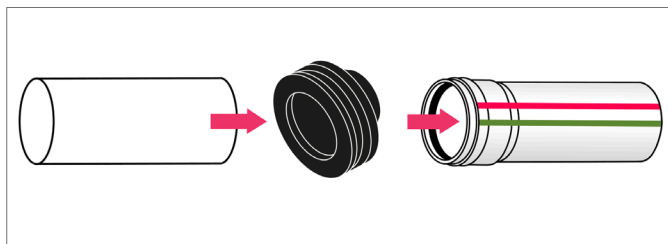


Fig 6.4.1

Pipe OD	Rubber Nipple		RAUPIANO Plus
	Size	Art	
34-36	40/30	122923	40*
	50/30	122933	
41-43	50/40	122933	50*

*Use with seal removed

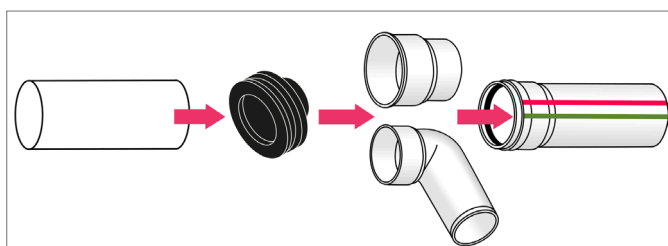


Fig 6.4.1

Pipe OD	Rubber Nipple		Adaptor		RAUPIANO Plus	
	Size	Art	Size	Straight		Angled
34-36	50/40	126253	40/40-30	123164	123174	40
			50/40-30	121414	122694	
54-56	50/50	121913	50/50	121424	121444	50

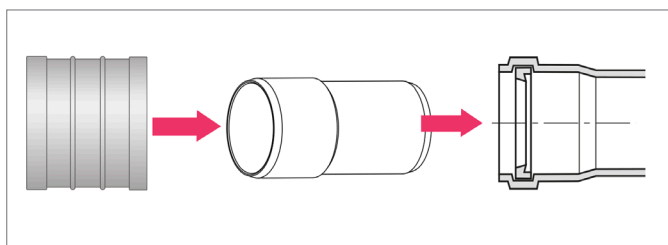


Fig 6.4.1

Pipe OD	Rubber Nipple		RAUPIANO Plus
	Size	Art	
36	30/30	tbc	32
43	40/40	123009	40
56	50/50	122933	50
69	65/75**	123016	75

**Adapter orientation reversed

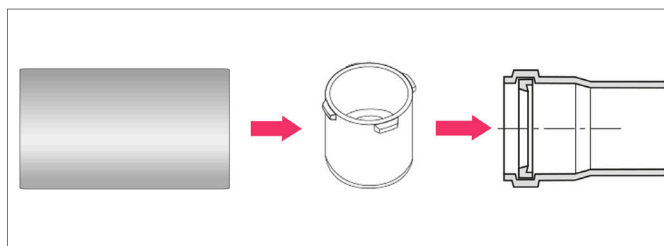


Fig 6.4.1

Pipe OD	Rubber Nipple		RAUPIANO Plus
	Size	Art	
36	40/30	tbc	40
43	50/40	103525	50

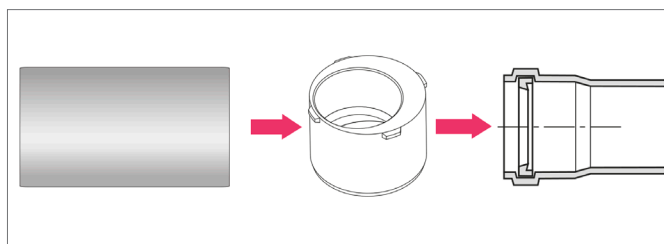


Fig 6.4.1

Pipe OD	Rubber Nipple		RAUPIANO Plus
	Size	Art	
56	75/50	103526	75



Fig 6.4.1

DN	PVC - ABS	PP	RAUPIANO Plus	
	OD MM	OD MM	DN	OD MM
32	36	34	32	32
40	43	41	40	40
50	56	54	50	50
65	69	-	75	75
100	110	-	110	110
150	160	-	160	160

Pipe sizing taken from:

RAUPIANO / PP BS EN 145-1: 2000
 PVC DIN EN 1329-1:2014
 ABS DIN EN 1455-1:2000

6.4.2 Connecting to rubber sleeve connectors or other pipe systems



Fig. 6-2 Adaptor for same external diameter DN 110/DN 110

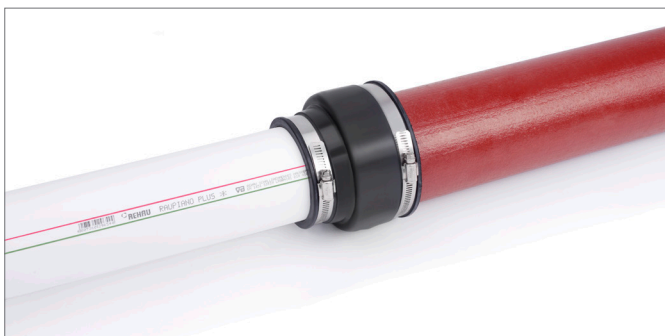


Fig. 6-3 Adaptor for different external diameter DN 110/DN 90

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

Adaptors are available in the following options:

Rubber sleeve adaptor description	RAUPIANO Plus OD size (mm)	Other pipe material OD size (mm)
50/53-63	50	53-63
75/75-89	75	75-89
110-90	110	75-89
110/110	110	110-115

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



When it comes to mixed installations and depending on local conditions, it is advisable to consult the responsible consultant for fire protection in buildings/building authority in advance as there are different solutions for different installation situations.

A uniform installation using the RAUPIANO PLUS soil and waste system is recommended to allow for the straightforward and reliable allocation of fire protection solutions, certifications and installation guidelines.

6.5 Soil and waste manifold



Fig 6.5 Flexible roof vent adaptor

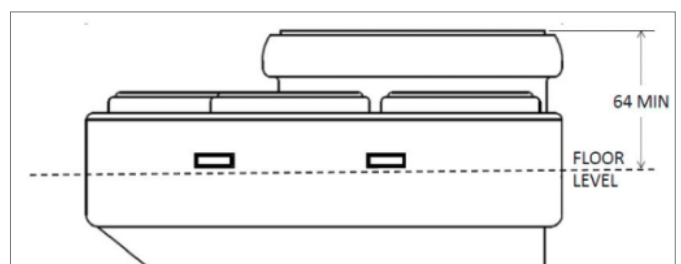
Fitted with rubber Waste Inlet Seals for connection to DN32, 40 or 50 pipe or fittings, and three waste inlet Blanking Plugs. Also fitted with a DN110 Soil Inlet Seal for connection to 110mm pipe or fitting.

Designed to allow installation in the corner of a room. Suitable for installation in high-rise / multi - occupancy buildings when used with a suitable Firestop Device.



A suitable FIRESTOP device must always be used in conjunction with the RAUPIANO Manifold. Always refer to Firestop manufacturers installation instructions prior to use.

For walk-in showers and wet rooms, the Manifold can be installed into the floor allowing additional drop for drainage. The maximum insertion depth is given below.



In construction involving a concrete slab, one possible Fire-stop solution is using a Cast-In device as shown below. To maximise the benefit of this solution, the concrete should be shuttered to allow the Manifold to sit as low as possible in relation to floor level.

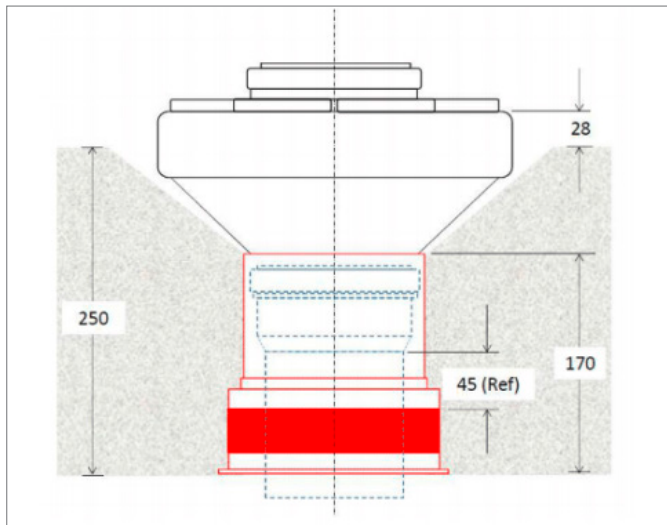


Fig 6.5 Manifold Installation in 250mm Concrete slab

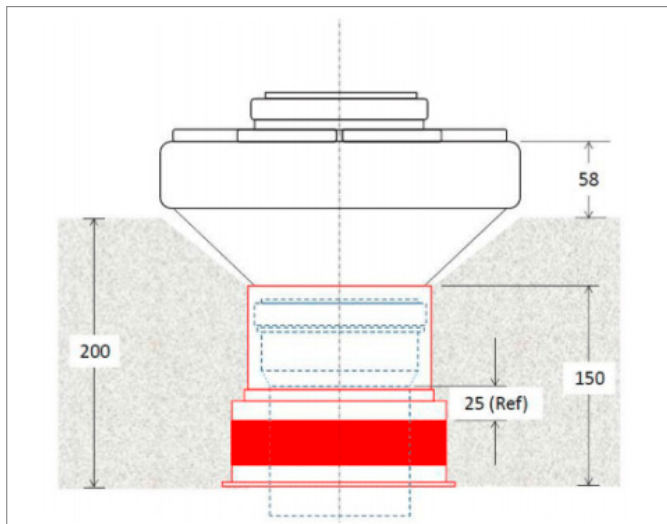


Fig 6.5 Manifold Installation in 150mm Concrete slab

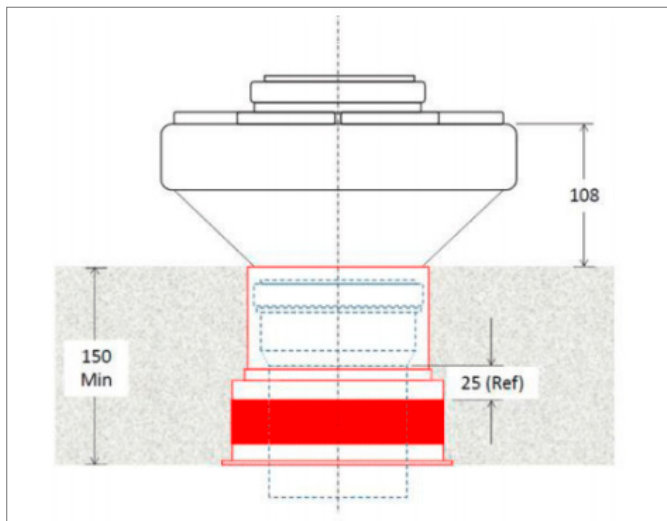


Fig 6.5 Manifold Installation in 150mm Concrete slab

6.6 Flexible roof vent adaptor

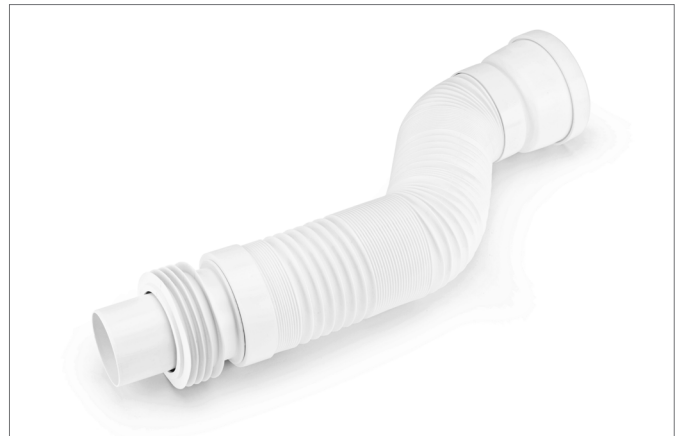


Fig. 6-4 Flexible roof vent adaptor

The flexible roof vent adaptor connects roof vents with the RAUPIANO plus vent stack to a soil & waste system.



- No need for complex fitting combinations
- Reducing installation time

-The flexible roof vent adaptor made from PP is suitable for the following RAUPIANO PLUS sizes:

- DN 75
- DN 90
- DN 110

Maximum length when fully extended: 1.10m



DIN 1968 does limit the length of flexible components between the pipe end and next pipe section to a maximum of 1m.

7 INSTALLATION SITUATIONS

7.1 Installing pipes in installation shafts

It is possible to install RAUPIANO PLUS 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).

- Acoustically isolate the pipes for any wall or ceiling penetrations using commonly available moisture resistant sound insulation.
- Avoid any sound bridges between the pipe and shaft wall.

7.2 Installing pipes in masonry

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



For wall chasing and recessing DIN EN 1996 shall apply.

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

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

- Wrap the 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.

7.3 Installing pipes in concrete



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

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



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

7.4 Installations above suspended ceilings

For installation above suspended ceiling, additional measures are required to ensure a high level of sound insulation. Such specific measures must be specified separately in the tender documents in accordance with the contracting rules for award of public work, part C, DIN 18380/DIN 18381.

Possible acoustic solutions are described in chapter „8 Sound insulation with RAUPIANO PLUS“, p. 19.

7.5 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.

8 SOUND INSULATION WITH RAUPIANO PLUS

8.1 Fundamentals

In every area of building construction, especially the construction of multi-storey apartment blocks, hospitals and care homes, noise reduction plays an increasingly important role. One of the most significant sources of sound within buildings are the sanitary installations and in particular the soil and waste system.

Most common sources of noise are:

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

Unsuitable soil and waste systems and the bracketing of such systems are contributing significantly to noise disturbance. The comprehensively tested RAUPIANO PLUS soil and waste system is the solution.

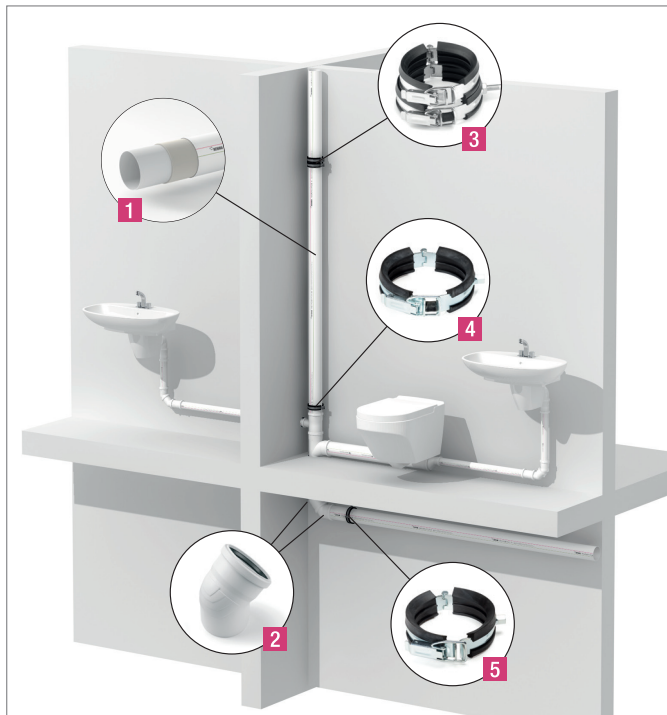


Fig. 8-1 Minimisation of noise

Reduction in airborne sound by way of:

- 1 Specially formulated pipe and fitting materials
- 2 Pipe elbows with partly thicker wall reduce the airborne sound

Minimisation of structure-borne noise by way of:

- 3 Patented acoustic bracket
- 4 Optimised guiding bracket
- 5 Fixing bracket with rubber inlay

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

Air-borne sound propagation

Sound from a source of noise is transmitted directly to the human ear through the air.

Structure-borne sound propagation

Sound is generated through vibrations in a wall or ceiling and transmitted to the human ear as air-borne noise.

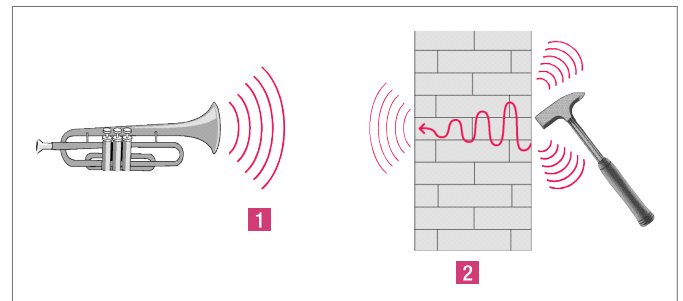


Fig. 8-2 Air-borne and structure-borne sound

- 1 Air-borne sound
- 2 Structure-borne sound

8.2 Sound reduction with RAUPIANO PLUS

Both structure-borne and air-borne sound occur in soil and waste systems. Flow processes and flow noises induce vibrations in the pipe wall of the sewer pipe. 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 an acoustic soil and waste system, both types of noise transmission must be considered.

Air-borne noise reduction

Airborne noise is reduced by RAUPIANO PLUS due to specially formulated materials, sound-dampening fillers and increased weight of the pipe. Pipe elbows in sizes DN 90 to DN160 with partly thicker walls in the critical areas where noise is generated further improve the acoustic performance.

Structure-borne noise reduction

The transmission of structure-borne noise into the wall is reduced with RAUPIANO PLUS with the use of patented, acoustic brackets:

- A supporting bracket with loose fit around the pipe is fixed to the wall
- A fixing bracket with a tight fit rests on the supporting bracket, locks the pipe into position

By largely decoupling the pipe, brackets and wall mechanically from each other, the transmission of structure-borne noise is disrupted substantially.

Sound bridges negatively impact the sound reduction of any sound insulating system.

- Prevent the pipes from coming into direct contact with the wall.
- Prevent possible sound bridges through other trades.
- Only use brackets that are optimised for RAUPIANO PLUS.

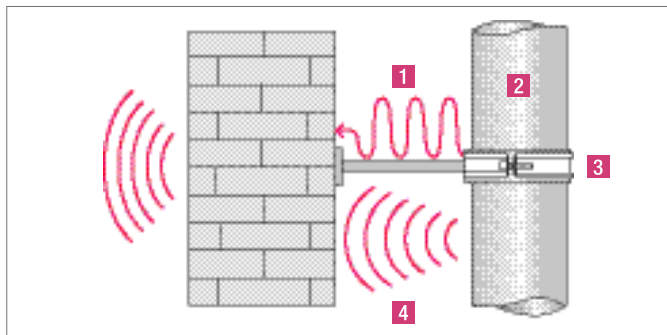


Fig. 8-3 Sound propagation in waste water systems

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

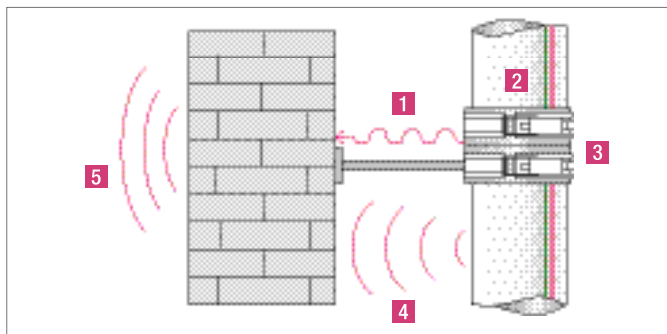


Fig. 8-4 Sound insulation with RAUPIANO PLUS

- 1 Structure-borne noise
- 2 RAUPIANO PLUS pipe with sound-dampening fillers
- 3 RAUPIANO PLUS patented sound-dampening support bracket
- 4 Air-borne noise
- 5 Sound performance in accordance with the VDI Directive 4100:2012 or DIN 4109

8.3 Sound insulation requirements

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

- DIN 4109 (Sound insulation in building construction; edition July 2016)
- VDI Directive 4100 (Sound insulation in building construction
 - apartments - assessment and proposals relating to increased sound insulation, edition October 2012)

DIN 4109

DIN 4109 must be taken into account when planning building drainage systems. DIN 4109 defines the minimum requirements for rooms requiring insulation located in another apartment. These include:

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

There are no requirements for one's own living space.

A maximum of 30 dB(A) is stipulated for sanitary installations (water supply and soil and waste systems combined).

This standard stipulates sound insulation requirements that aim to protect people in living spaces from the nuisance from noise. It sets maximum limits for noise, which must be observed to protect against health risks associated with noise.



In terms of public law, DIN 4109 constitutes a minimum requirement. Greater noise 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 noise insulation levels and makes a distinction between apartments in multi-family dwellings, semi-detached dwellings and terraced houses and, unlike DIN 4109, also takes one's own living space into account (water supply and soil & waste systems combined).



The VDI Directive 4100 is not legally binding, but it provides guidance and, as such, enjoys a high degree of recognition amongst experts and in general. Individual contractual agreements under private law therefore allow for these tighter requirements to be included.

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 ($L_{AFmax,n}$), VDI 4100:2012 does take the geometry of the space (spatial volume and partition wall area) and a defined reverberation time into account ($L_{AFmax,nT}$). As such, they deal with fundamentally different

assessment principles and performance indicators. In addition, rooms can be divided into those that require noise protection and those that do not depending on their size rather than their use if an agreement pertaining to VDI 4100:2012 is agreed. Noise at 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 noise protection 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 noise protection.

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

Standards / guidelines	$L_{AFmax,n}$ component-related performance indicator		$L_{AFmax,nT}$ space related performance indicator (taking reverberation into account)	
	Room requiring sound insulation diagonally below in other flat	Same flat	Room requiring sound insulation diagonally below in other flat	Same flat
Sound insulation in 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 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 same flat				35 dB(A)
SIL OOS II same flat				30 dB(A)

8.4 Sound measurement in accordance with DIN EN 14366

With soil and waste systems, there is a good comparison base thanks to a standardised test setup to a European standard.

To determine its acoustic performance, the soil & waste system RAUPIANO PLUS 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 realistic installation. Several different volume flows representing a realistic cross-section for a household with several family members were tested.

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 acoustic brackets were very low indeed. Using this bracket option the system produced sound levels that were well below the maximum limits detailed in supplement 2 (DIN 4109).

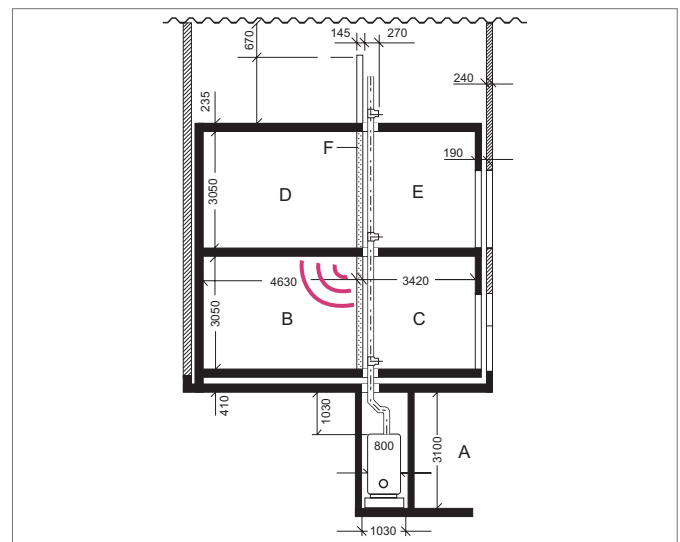


Fig. 8-5 Test facility of the Fraunhofer Institute for Building Physics (all dimensions in mm)

- 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)

8.5 Measurement results

The values measured in the noise protected room (room B in Fig. 8-5) are shown in the following chart (source: test report P-BA 274/2016 and P-BA 275/2016).

By following the recommendation given in our technical information

and using acoustic brackets, as well as following the applicable standards and technical guidelines, RAUPIANO PLUS is able to fulfill the requirements of VDI 4100 guideline.

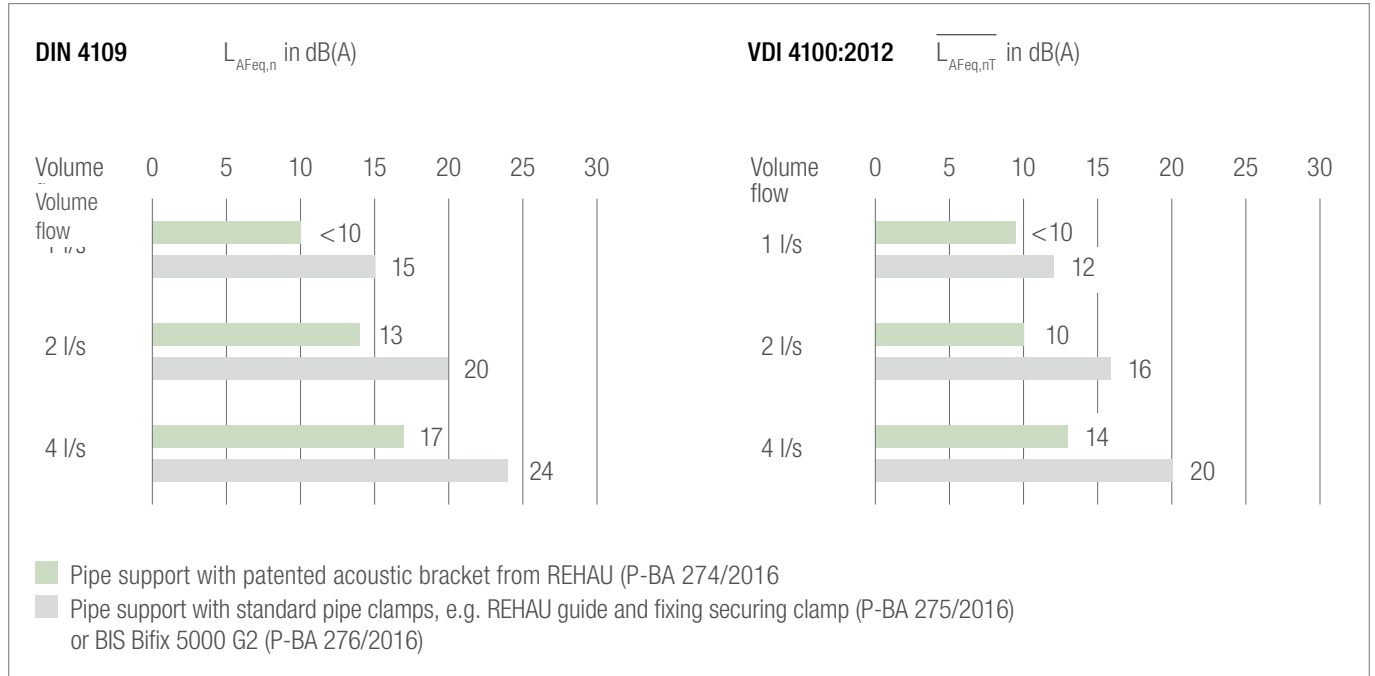


Fig. 8-6 Measurement results

Difference between L_{AFmax} and L_{AFeq}

The sound insulation requirements for noise produced from building service installations specified in DIN 4109 and VDI 4100 refer to the maximum level L_{AFmax} . At the test facility all tests measuring noise from a soil&waste systems according to EN 14366 record 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.

8.6 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)
- Concrete slab thickness of 19 cm
- 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)
- RAUPIANO PLUS DN 110 size for vertical stack
- Transition from vertical stack to horizontal line using 2x 45 degree bend with no pipe in between
- Vertical stack supported by acoustic brackets



Wall hung WC on metal stud prewall with metal stud wall (Knauf W 112)

Installation sound level incl. Flushing technology	$L_{AFmax,n} = 19 \text{ dB(A)}$	$\overline{L}_{AFmax,nT} = 15 \text{ dB(A)}$
DIN 4109 / A1	<input checked="" type="checkbox"/>	
DIN 4109 supplement 2	<input checked="" type="checkbox"/>	
VDI 4100-2012 SIL I		<input checked="" type="checkbox"/>
VDI 4100: 2012 SIL II		<input checked="" type="checkbox"/>
VDI 4100: 2012 SIL III		<input checked="" type="checkbox"/>

Test report number P-BA 43-1/2012



Wall hung WC on metal stud wall (Knauf W 116)

Installation sound level incl. Flushing technology	$L_{AFmax,n} = 22 \text{ dB(A)}$	$\overline{L}_{AFmax,nT} = 19 \text{ dB(A)}$
DIN 4109 / A1	<input checked="" type="checkbox"/>	
DIN 4109 supplement 2	<input checked="" type="checkbox"/>	
VDI 4100-2012 SIL I		<input checked="" type="checkbox"/>
VDI 4100: 2012 SIL II		<input checked="" type="checkbox"/>
VDI 4100: 2012 SIL III		<input checked="" type="checkbox"/>

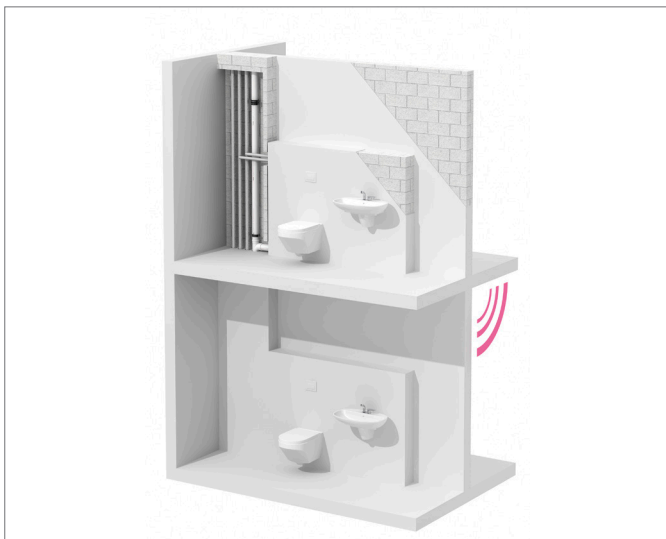
Test report number P-BA 44-1/2012



Wall hung WC on metal stud prewall with solid wall

Installation sound level	$L_{AFmax,n} = 25 \text{ dB(A)}$	$\overline{L}_{AFmax,nT} = 22 \text{ dB(A)}$
DIN 4109 / A1	<input checked="" type="checkbox"/>	
DIN 4109 supplement 2	<input checked="" type="checkbox"/>	
VDI 4100-2012 SIL I		<input checked="" type="checkbox"/>
VDI 4100: 2012 SIL II		<input checked="" type="checkbox"/>
VDI 4100: 2012 SIL III		<input checked="" type="checkbox"/>

Test report number P-BA 42-1/2012



Wall hung WC on solid prewall with solid wall

Installation sound level	$L_{AFmax,n} = 30 \text{ dB(A)}$	$\overline{L}_{AFmax,nT} = 27 \text{ dB(A)}$
DIN 4109 / A1	<input checked="" type="checkbox"/>	
DIN 4109 supplement 2	<input checked="" type="checkbox"/>	
VDI 4100: 2012 SIL I		<input checked="" type="checkbox"/>
VDI 4100: 2012 SIL II		<input checked="" type="checkbox"/>
VDI 4100: 2012 SIL III		<input checked="" type="checkbox"/>

Test report number P-BA 41-1/2012

8.7 Sound measurement of suspended ceiling installations

In order to provide guidance for installing the RAUPIANO PLUS in a suspended ceiling void above a noise 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).

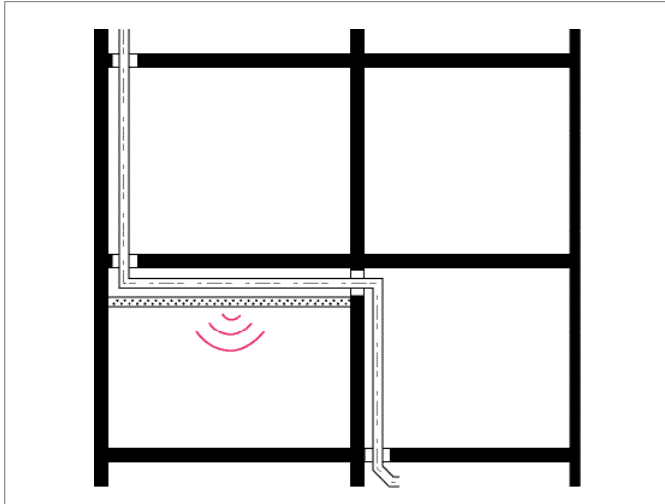
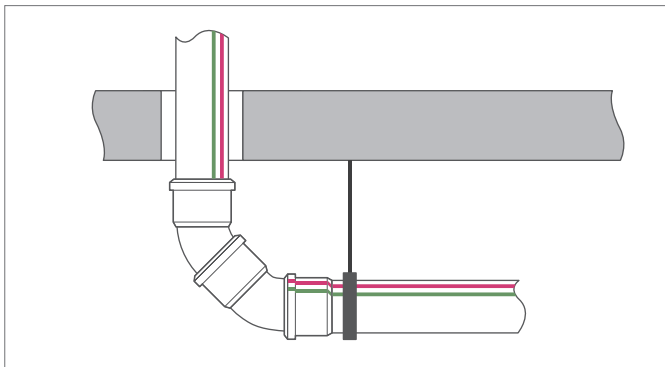


Fig. 8-7 Schematic for the test facility at the Fraunhofer Institute for Building Physics

The tests were carried out at several flow rates and the measurement results were calculated in $L_{AFeq,n}$ in dB(A) according to DIN EN 14366.

Test report number P-BA 72/2017

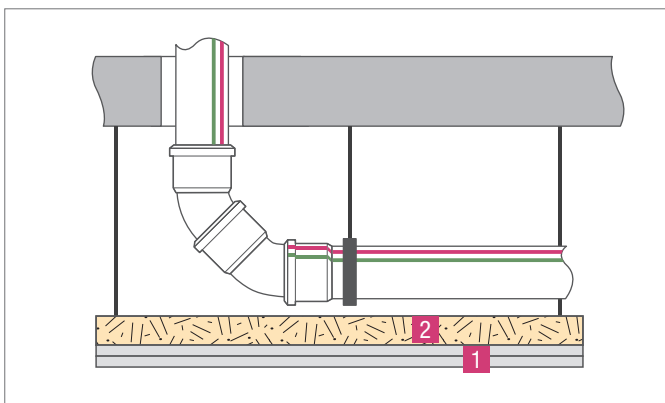


Without suspended ceiling (exposed soffit)

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)
$L_{AFeq,nT}^{2)}$	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

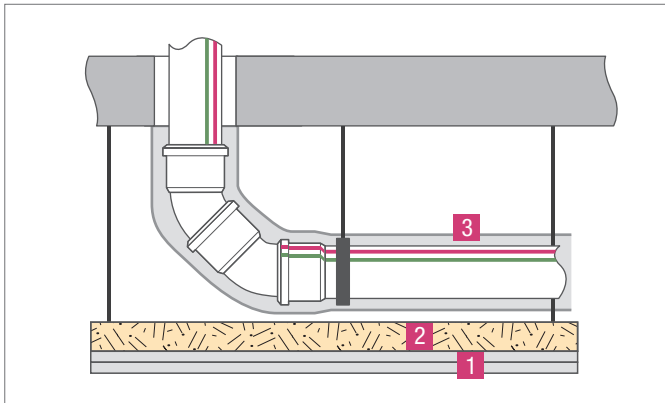
Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{AFeq,n}^{1)}$	10 dB(A)	17 dB(A)	20 dB(A)	23 dB(A)
$L_{AFeq,nT}^{2)}$	< 10 dB(A)	17 dB(A)	20 dB(A)	23 dB(A)

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
$L_{A_{\text{Feq},n}}^{1)}$	< 10 dB(A)	< 10 dB(A)	12 dB(A)	16 dB(A)
$L_{A_{\text{Feq},nT}}^{2)}$	< 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

8.8 Sound measurements of pipe enclosures

Tailored room designs always demand specialised solutions for soil and waste systems. One such example is the installation of a discharge stack through a noise protected room in the same or in another apartment. Such cases require pipe enclosures. The differences in the acoustic performance of different enclosure configurations are detailed below. The tests were carried out at several flow rates and the measurement results were calculated in $L_{A_{\text{Feq},n}}$ in dB(A) according to DIN EN 14366..

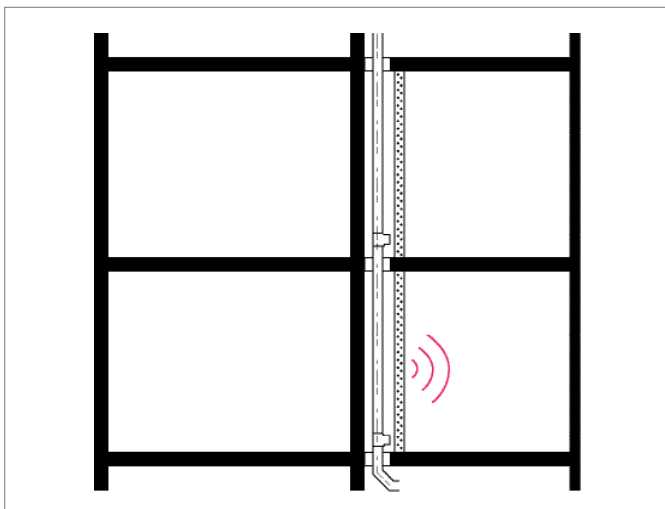
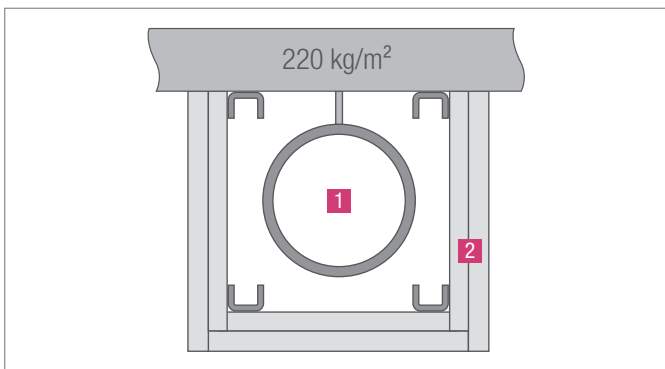


Fig. 8-8 Schematic for the test facility at the Fraunhofer Institute for Building Physics

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

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

Stud wall: Test report number P-BA 71/2017



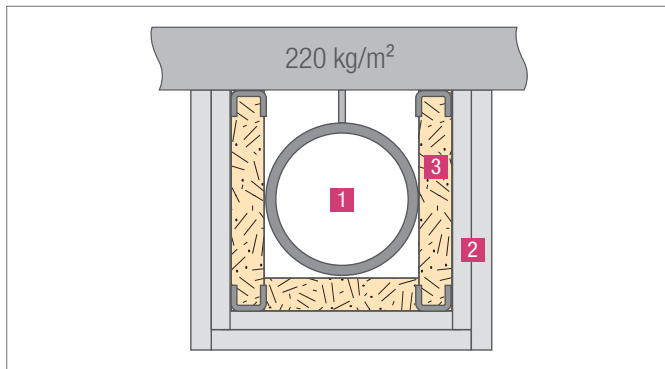
- 1 RAUPIANO PLUS
- 2 2 x 12.5 mm Knauf wall board 12.5

Solid wall: enclosure with Knauf Wallboard

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{A_{\text{Feq},n}}^{1)}$	19 dB(A)	22 dB(A)	25 dB(A)	28 dB(A)
$L_{A_{\text{Feq},nT}}^{2)}$	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



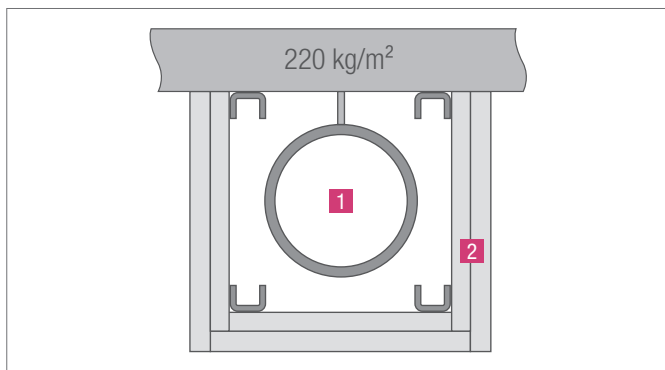
- 1** RAUPIANO PLUS
- 2** 2 x 12.5 mm Knauf wallboard 12.5
- 3** 40mm Mineral wool slab Knauf TP 115

Solid wall: enclosure with Knaufwallboard and mineral wool

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{A, \text{Freq}, n}^{1)}$	< 10 dB(A)	13 dB(A)	15 dB(A)	20 dB(A)
$L_{A, \text{Freq}, nT}^{2)}$	< 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



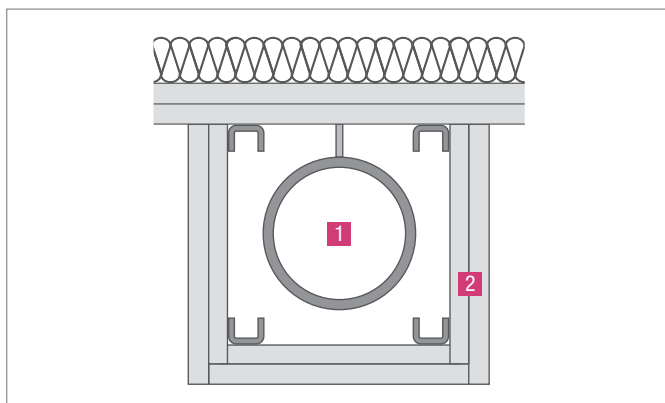
- 1** RAUPIANO PLUS
- 2** 2 x 12.5 mm Knauf Silentboard 12.5

Solid wall: enclosure with Knauf Silentboard

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{A, \text{Freq}, n}^{1)}$	13 dB(A)	17 dB(A)	20 dB(A)	23 dB(A)
$L_{A, \text{Freq}, nT}^{2)}$	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



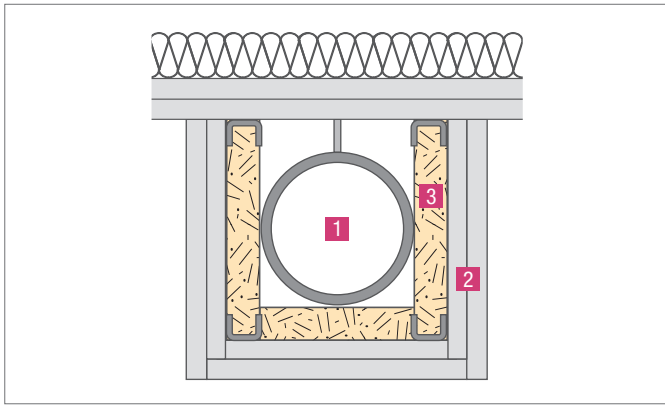
- 1** RAUPIANO PLUS
- 2** 2 x 12.5 mm Knauf Wallboard 12.5

Knauf stud wall W 112: enclosure Knauf Wallboard

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{A, \text{Freq}, n}^{1)}$	21 dB(A)	26 dB(A)	28 dB(A)	31 dB(A)
$L_{A, \text{Freq}, nT}^{2)}$	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



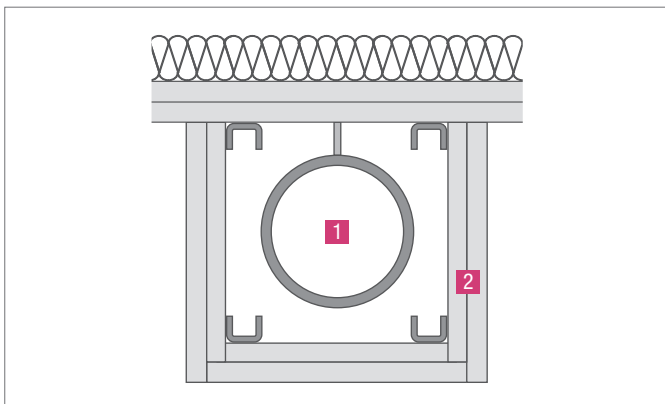
- 1** RAUPIANO PLUS
- 2** 2 x 12.5 mm Knauf wallboard 12.5
- 3** 40 mm Mineral wool slab Knauf TP 115

Knauf stud wall W 112: enclosure with Knauf wallboard and mineral wool

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{Aeq,n}^{1)}$	13 dB(A)	18 dB(A)	23 dB(A)	27 dB(A)
$L_{Aeq,nT}^{2)}$	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 Silentboard 12.5

Knauf stud wall W 112: enclosure with Knauf Silentboard

Flow rate	0.5 l/s	1.0 l/s	2.0 l/s	4.0 l/s
$L_{Aeq,n}^{1)}$	17 dB(A)	22 dB(A)	24 dB(A)	27 dB(A)
$L_{Aeq,nT}^{2)}$	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

9 FIRE STOP SOLUTIONS FOR RAUPIANO PLUS



The model building code (MBO) or the building codes of each state (LBO) require effective measures to prevent the spread of fire and smoke across building compartments. For competent designs and installations do check the details and guidance given in the German general test certificates / approvals from the building authorities as well as the installation instructions.



Always coordinate with the responsible building control / fire safety engineer prior to starting the design and install.



Fixing the REHAU firestop collars onto the ceiling or solid walls can be done using steel dowels as detailed in legend 6 or 7 and schematics from page p. 35 onwards) or as an alternative with universal metal dowels and suitable screws that have the required fire resistance classification.

Suitable metal dowels are, e.g.:

- Würth type W-MG
- Fischer type FMD

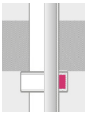





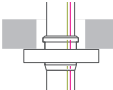




There are several different fire stop solutions available for the RAUPIANO PLUS soil & waste system dependent on penetration type, i.e. wall or ceiling.

Always take into account the relevant installation instructions and the General German Construction Product Approval.



The General German Construction Product Approval for our fire stop solutions are available at www.rehau.de.

Overview of fire stop solutions for RAUPIANO PLUS

Penetration Type	Fire stop solution	Installation options	DN 40	DN 50	DN 75	DN 90	DN 110	DN 125	DN 160	DN 200	VACUCLEAN	[mm]
Ceiling 	RAUPIANO PLUS with fire collar REHAU Plus German general building approval no. Z-19.17-1662 	- surface mounted - cast in	✓	✓	✓	✓	✓	✓	✓	✓		
	RAUPIANO PLUS with fire collar REHAU kompakt German general building approval no. Z-19.17-1363 	Surface mounted		✓	✓	✓	✓	✓			✓	
	RAUPIANO PLUS with REHAU pipe wrap German general building approval Z-19.17-2139 	cast in	✓	✓	✓	✓	✓					
	RAUPIANO PLUS with REHAU Fire stop collar for angled pipes German general building approval no. Z-19.17-1268  0–45° angled  on joint sockets 	Surface mounted			✓	✓	✓	✓				
Wall 	RAUPIANO PLUS with fire collar REHAU Plus German general building approval no. Z-19.17-1662 	- surface mounted - cast in	✓	✓	✓	✓	✓	✓				max. 500
	RAUPIANO PLUS with fire collar REHAU kompakt German general building approval no. Z-19.17-1363 	Surface mounted		✓	✓	✓	✓	✓			✓	max. 500
	RAUPIANO PLUS with REHAU pipe wrap German general building approval Z-19.17-2139 	cast in	✓	✓	✓	✓						max. 350

Overview of materials for joint construction

Penetration type	Fire stop solution	Gap Filler			Sound decoupling strip
		Armaflex AF DIN 4102 - B 2	Mineral fibre Building material class DIN 4102- A Melt temperature > 1000 °C	PE soft foam strips DIN 4102 - B 2	PE soft foam strips DIN 4102 - B 2
 Ceiling	RAUPIANO PLUS with fire stop REHAU Plus German general building approval no. Z-19.17-1662  Insulation thickness	<input checked="" type="checkbox"/> max. 15 mm	<input checked="" type="checkbox"/> max. 15 mm	<input checked="" type="checkbox"/> 5 mm	<input checked="" type="checkbox"/> 5 mm DN 40: 2-layer (2 x 5 mm)
	RAUPIANO PLUS with fire stop REHAU kompakt system German general building approval no. Z-19.17-1363  Insulation thickness	<input checked="" type="checkbox"/> max. 15 mm	<input checked="" type="checkbox"/> max. 15 mm	<input checked="" type="checkbox"/> max. 5 mm	<input checked="" type="checkbox"/> max. 5 mm
	RAUPIANO PLUS with REHAU pipe wrap German general building approval Z-19.17-2139  Insulation thickness			<input checked="" type="checkbox"/> max 5 mm	<input checked="" type="checkbox"/> max. 5 mm
	RAUPIANO PLUS with REHAU Fire stop collar for angled pipes German general building approval no. Z-19.17-1268  Insulation thickness	<input checked="" type="checkbox"/> max. 15 mm	<input checked="" type="checkbox"/> max. 10 mm		<input checked="" type="checkbox"/> max. 5 mm
 Wall	RAUPIANO PLUS with fire stop REHAU Plus German general building approval no. Z-19.17-1662  Insulation thickness	<input checked="" type="checkbox"/> max. 15 mm	<input checked="" type="checkbox"/> max. 15 mm	<input checked="" type="checkbox"/> 5 mm	<input checked="" type="checkbox"/> 5 mm
	RAUPIANO PLUS with fire stop REHAU kompakt system German general building approval no. Z-19.17-1363  Insulation thickness	<input checked="" type="checkbox"/> max. 15 mm	<input checked="" type="checkbox"/> max. 15 mm		<input checked="" type="checkbox"/> max. 5 mm
	RAUPIANO PLUS with REHAU pipe wrap German general building approval Z-19.17-2139  Insulation thickness			<input checked="" type="checkbox"/> max. 5 mm	<input checked="" type="checkbox"/> max. 5 mm

Expert's report no. GA-2017/117c

Certificate of usability	Fire stop Solution	Pipe designation/type of pipe	Approved external pipe diameter
German general building approval no. Z-19.17-1662	REHAU Plus system	RAUPIANO PLUS soil & waste	DN 40 – DN 200
German general building approval no. Z-19.17-1363	Kompakt fire stop collar	RAUPIANO PLUS soil & waste	DN 50 – DN 125
German general building approval no. 19.17-1268	Fire stop collar for angled pipes	RAUPIANO PLUS soil & waste	DN 75 – DN 125
German general building approval Z-19.17-2139	Pipe wrap	RAUPIANO PLUS soil & waste	DN 40 – DN 110
German general building test certificate no. P-3494/1820- MPA BS	RAUTITAN stabil pipe Intumescent fire-sleeve	RAUTITAN stabil multilayer pipe <div style="background-color: #cccccc; padding: 2px; text-align: center;">stabil</div> - Rock wool insulation - melting point ≥ 1000 °C - density ≥ 90 Kg/m ³ - thickness 30 mm e.g. Rockwool RS 800	16 mm – 40 mm
German general building test certificate no. P-3726/4140-MPA BS	Intumescent firesleeve for combustible pipes (Rockwool Conlit® 150 U)	RAUTITAN stabil multilayer pipe <div style="background-color: #cccccc; padding: 2px; text-align: center;">stabil</div> RAUTITAN flex PE-X pipe <div style="background-color: #cccccc; padding: 2px; text-align: center;">flex</div>	≤ 110 mm
German general building test certificate no. P-3725/4130-MPA BS	Intumescent firesleeve for non-combustible pipes	Non-combustible pipes	≤ 108 mm

Tab. 9-1 Compilation of the certificates of usability and the characteristic values of the pipe systems

9.1 REHAU fire stop pipe tape/wrap



- German general building approval Z-19.17-2139
- for floor penetrations: RAUPIANO PLUS DN 40 – DN 110
- for wall penetrations: RAUPIANO PLUS DN 40 – DN 90
- Pipes must be installed so they are perpendicular to the ceiling/wall surface

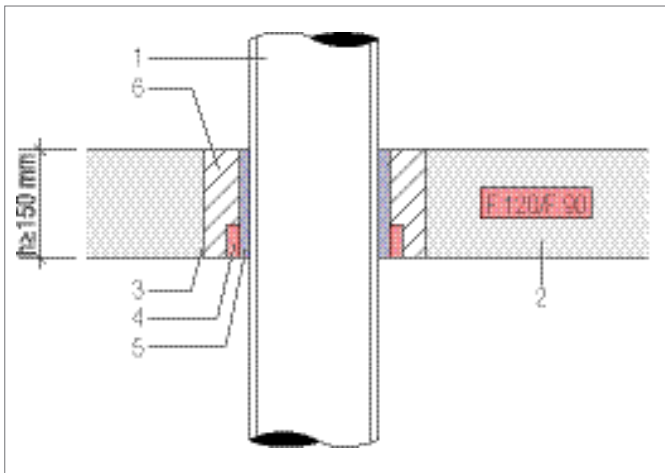
Required diameter for core drilling in rigid walls/ceilings:

RAUPIANO PLUS	Diameter Pipe d_{ex} [mm]	Diameter pipe + insulation + fire stop pipe tape [mm]	Diameter of core drill hole [mm] ¹⁾
		- PE strips 5 mm	Annular gap for sealant 20 mm
DN 40	40	60	100
DN 50	50	70	110
DN 75	75	106	150
DN 90	90	121	160
DN 110	110	141	180

1) An extra 40 mm is recommended for a smoke-proof and complete seal of the annular gap, individual values rounded up to common core drill diameters

9.1.1 R 120/R 90 fire stop collar REHAU Fire stop Pipe Tape for RAUPIANO PLUS floor penetration, rigid floors (German general building approval no. Z-19.17-2139)

Installation in rigid ceiling F 120/F90, opening or core drill hole



- 1 RAUPIANO PLUS DN 40 – DN 110
- 2 Rigid ceiling $h \geq 150$ mm at least F 90-AB as per DIN 4102-2, concrete or reinforced concrete as per DIN 1045, aerated concrete as per DIN 4223
- 3 Ceiling opening or core drill hole
- 4 R 90 fire stop collar REHAU fire stop pipe tape in accordance with German general building approval
- 5 Structure-borne sound insulation with PE soft foam strips of building material class DIN 4102 B2, 5 mm insulation thickness in accordance with German general building approval
- 6 Concrete, cement or plaster mortar of building material class DIN 4102-A
- h Ceiling thickness

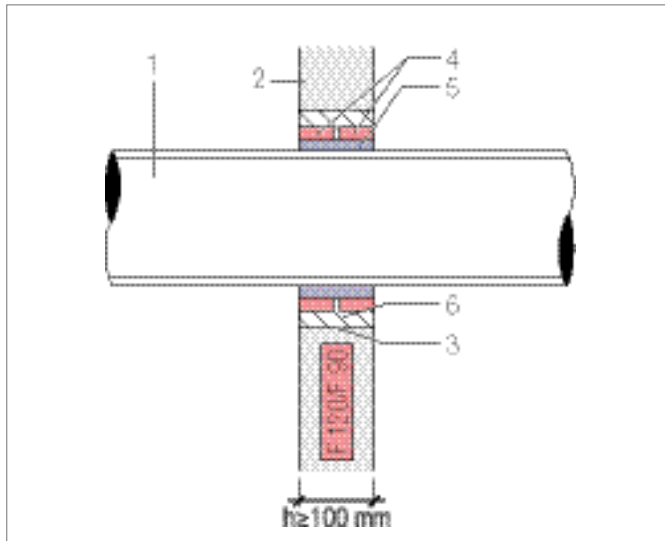
The distance to other fire stop collars or openings can be found in the relevant German general building approvals.

The installation must be in full compliance with the requirements of the German general building approval no. Z-19.17-2139.

Refer to instructions for use.

9.1.2 R 120/R 90 fire stop collar REHAU Fire stop pipe tape for RAUPIANO PLUS wall penetrations, rigid and flexible walls (German general building approval no. Z-19.17-2139)

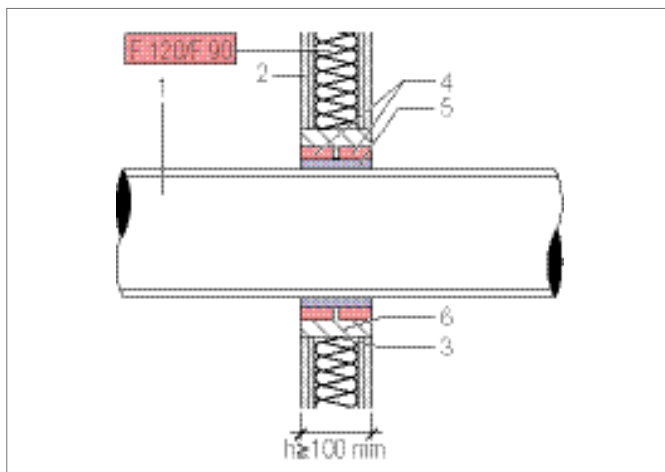
Installation in rigid wall F 120/F90, opening or core drill hole



- 1 RAUPIANO PLUS DN 40–DN 90
- 2 Rigid wall $h \geq 100$ mm at least F 90-AB as per DIN 4102-2, masonry as per DIN 1053-1, concrete or reinforced concrete as per DIN 1045, aerated concrete building panels as per DIN 4166
- 3 Wall opening or core drill hole
- 4 R 90 fire stop collar REHAU fire stop pipe tape in accordance with German general building approval
- 5 Structure-borne sound insulation with PE soft foam strips of building material class DIN 4102 B2, 5 mm insulation thickness in accordance with German general building approval
- 6 Concrete, cement or plaster mortar of building material class DIN 4102-A
- h Wall thickness

The first pipe brackets must be fitted on both sides of the wall within 350 mm apart on both sides of the wall. They must be largely non-combustible (building material class DIN 4102-A).

Installation in flexible wall F 120/F 90, wall opening



The distance to other fire stop collars or openings can be found in the relevant German general building approvals.

The installation must be in full compliance with the requirements of the German general building approval no. Z-19.17-2139.

Refer to the instructions for use!

Wall construction F 120/F 90 with fire resistant plasterboards as per DIN 4102-4



For use in wall penetrations, the fire stop pipe tape must be installed on both sides of the wall.

9.2 REHAU fire stop collar REHAU kompakt



- German general building approval no. Z-19.17-1363
- for surface mounted installations onto ceilings and walls
- Pipes for non-combustible liquids and for non-combustible gases (with the exception of ventilation pipes), for pneumatic pipe systems and vacuum cleaner systems
- Pipe dimensions for RAUPIANO PLUS DN 50–DN 125
- Pipes must be installed so they are perpendicular to the wall or floor

Required diameter for core drill holes in rigid wall / floors:

In wall or floor:

RAUPIANO PLUS	Diameter Pipe d_{ex} [mm]	Diameter of core drill hole [mm] ¹⁾	
		Mineral fibre, stuffed ≤ 15 mm	Armaflex ≤ 15 mm
DN 50	50	80	120
DN 75	75	100	150
DN 90	90	120	160
DN 110	110	140	180
DN 125	125	150	200

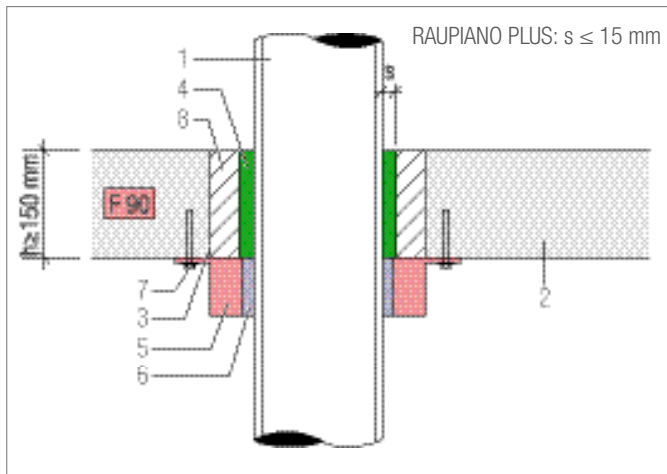
In the wall:

RAUPIANO PLUS	Diameter Pipe d_{ex} [mm]	Diameter pipe + insulation [mm]	Diameter of core drill hole [mm] ¹⁾
		- PE strips 5 mm	Annular gap for sealant 20 mm
DN 50	50	60	100
DN 75	75	85	125
DN 90	90	100	140
DN 110	110	120	160
DN 125	125	135	180

1) An extra 40 mm is recommended for a smoke-proof and complete seal of the annular gap, individual values rounded up to common core drill diameters

**9.2.1 R 90 fire stop collar REHAU kompakt for RAUPIANO PLUS floor penetrations, rigid floors
(German general building approval no. Z-19.17-1363)**

Surface mounted against rigid ceiling F 90, ceiling opening or core drill hole



- 1 RAUPIANO PLUS DN 50 – DN 125
- 2 Solid ceiling $h \geq 150$ mm at least F 90-AB as per DIN 4102-2, concrete or reinforced concrete as per DIN 1045, aerated concrete as per DIN 4223
- 3 Ceiling opening or core drill hole
- 4 Part of the annular gap can be filled in accordance with German general building approval:
 - Mineral fibre (building material class DIN 4102-A, melt temperature > 1000 °C) max. 15 mm or
 - AF Armaflex (German general building test certificate no. P-MPA-E-03-510) max. 15 mm
 - In case of floor penetrations a 5mm thick PE soft foam strip (building material class DIN 4102-B2) can be used.
- 5 R 90 REHAU kompakt fire stop collar system in accordance with German general building approval
- 6 Structure-borne sound insulation with PE soft foam strips of building material class DIN 4102 B2, 5 mm insulation thickness in accordance with German general building approval
- 7 Steel raw plug with M6 or M8 screws in accordance with German general building approval
- 8 Concrete, cement or plaster mortar of building material class DIN 4102-A
- h Ceiling thickness
- s Maximum permissible gap width between ceiling/mortar and pipe

§ The use of a 5mm PE soft foam strip (building material class DIN 4102-B2) together with the REHAU kompakt fire stop collar is only permitted for floor penetrations. The German general building approval or test certificate for the any adjacent non REHAU fire stop collars must be checked for any impact on the required minimum installation distance.

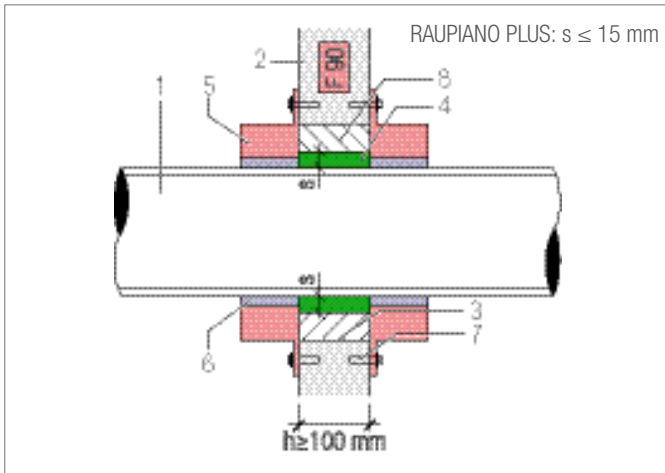
i In case of floor penetrations, the fire stop collar must be mounted on the underside of the ceiling.

The distance to other fire stop collars or openings can be found in the relevant German general building approvals. The installation must be in full compliance with the requirements of the German general building approval no. Z-19.17-1363.
Refer to the instructions for use!

§ For central vacuum cleaner systems, the only system approved for use with the RAUPIANO PLUS suction and exhaust air pipes is the REHAU kompakt fire stop collar system.

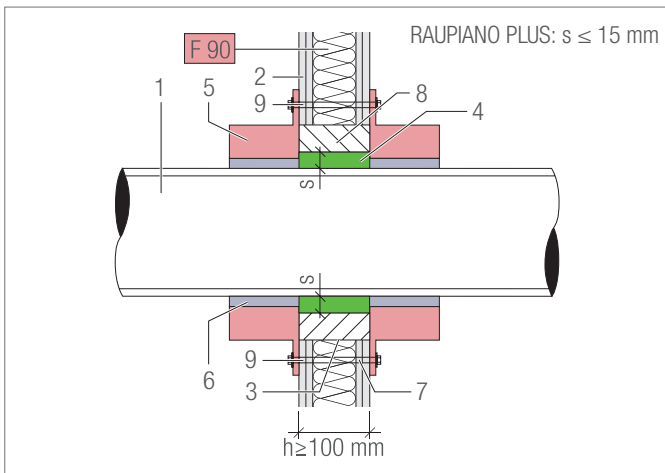
9.2.2 R90 REHAU fire stop collar REHAU kompakt for RAUPIANO PLUS wall penetrations, rigid and flexible walls (German general building approval no. Z-19.17-1363)

Surface mounted onto rigid wall F 90, wall opening or core drill hole



- 1 RAUPIANO PLUS DN 50 – DN 125
- 2 Rigid wall $h \geq 100$ mm at least F 90-AB as per DIN 4102-2, masonry as per DIN 1053-1, concrete or reinforced concrete as per DIN 1045, aerated concrete building panels as per DIN 4166
- 3 Wall opening or core drill hole
- 4 Part of the annular gap can be fill in accordance with German general building approval:
 - Mineral fibre (building material class DIN 4102-A, melt temperature > 1000 °C) max. 15 mm
 - or
 - AF Armaflex (German general building test certificate no. P-MPA-E-03-510) max. 15 mm

Surface mounted onto flexible wall F 90, wall opening



- 5 R 90 REHAU kompakt fire stop collar system in accordance with German general building approval
- 6 Structure-borne sound insulation with PE soft foam strips of building material class DIN 4102 B2, 5 mm insulation thickness in accordance with German general building approval
- 7 Steel raw plug with M6 or M8 screws in accordance with German general building approval
In the case of flexible walls, with M6 or M8 threaded rods with washers
- 8 Concrete, cement or plaster mortar of building material class DIN 4102-A
- 9 Threaded rod M6 or M8, nut with washer
- h Wall thickness
- s Maximum permissible gap width between wall opening/mortar and pipe

Wall construction F 90 for fire resistant plasterboards as per DIN 4102-4

The first pipe brackets must be fitted on both sides of the wall within 500mm. They must be largely non-combustible (building material class DIN 4102-A).



For use in wall penetrations, a fire stop collar must be installed on both sides of the wall.

The distance to other fire stop collars or openings can be found in the relevant German general building approvals.

The installation must be in full compliance with the requirements of the German general building approval no. Z-19.17-1363.

Refer to the instructions for use!

9.3 REHAU PLUS Fire Stop Collar



- German general building approval no. Z-19.17-1662
- for surface mounted installations onto floors and walls
- for casting into floors and walls
- for RAUPIANO PLUS pipes
- Pipe dimensions DN 40 – DN 160 surface mounted/cast-in for walls and floors, DN 200 (surface mounted/cast-in for floors only)
- Pipes must be installed so they are perpendicular to the wall or floor

Required diameter for core drill holes in rigid wall/floors:

Surface mounting:

RAUPIANO PLUS	Diameter Pipe d_{ex} [mm]	Diameter pipe + insulation [mm] - PE strips 5 mm	Diameter of core drill hole [mm] ¹⁾ Annular gap for sealant 20 mm
DN 40	40	50	90
DN 50	50	60	100
DN 75	75	85	125
DN 90	90	100	140
DN 110	110	120	160
DN 125	125	135	180
DN 160	160	170	220
DN 200	200	210	250

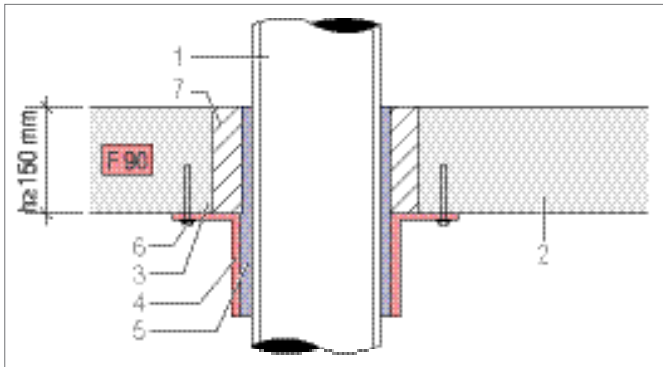
Cast-in:

RAUPIANO PLUS	Diameter Pipe d_{ex} [mm]	Diameter of collar [mm] - PE strips 5 mm	Diameter of core drill hole [mm] ¹⁾
DN 40	40	67	100
DN 50	50	67	100
DN 75	75	98	130
DN 90	90	117	150
DN 110	110	137	170
DN 125	125	160	190
DN 160	160	197	250
DN 200	200	247	300

1) An extra 40 mm is recommended for a smoke-proof and complete seal of annular gap, individual values rounded up to common core drill diameters

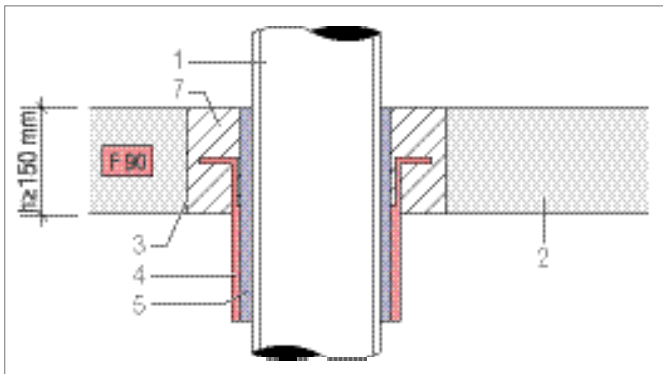
9.3.1 R 90 Fire stop collar REHAU PLUS for RAUPIANO PLUS floor penetrations, rigid floors
(German general building approval no. Z-19.17-1662)

Surface mounted onto rigid ceiling F 90, ceiling opening or core drill hole



- 1 RAUPIANO PLUS DN 40 – DN 200
- 2 Rigid ceiling $h \geq 150$ mm at least F 90-AB as per DIN 4102-2, concrete or reinforced concrete as per DIN 1045, aerated concrete as per DIN 4223
- 3 Ceiling opening or core drill hole
- 4 R 90 REHAU PLUS fire stop collar system in accordance with German general building approval
- 5 Structure-borne sound insulation with PE soft foam strips of building material class DIN 4102 B2, 5 mm insulation thickness in accordance with German general building approval
- 6 Steel raw plug with M6 or M8 screws in accordance with German general building approval
- 7 Plaster or mortar MG III
- h Ceiling thickness

Cast into rigid ceiling F 90, ceiling opening



The distance to other fire stop collars or openings can be found in the relevant German general building approvals.

The installation must be in full compliance with the requirements of the German general building approval. Refer to the instructions for use!



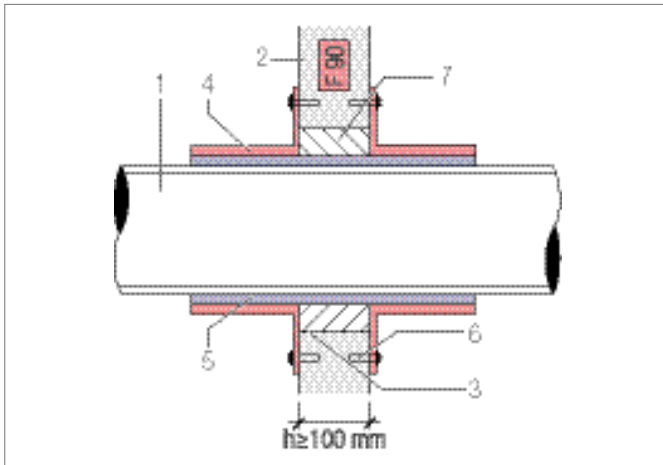
Observe the required installation depth of the collars.



In case of floor penetrations, the fire stop collar must be mounted on the underside of the ceiling.

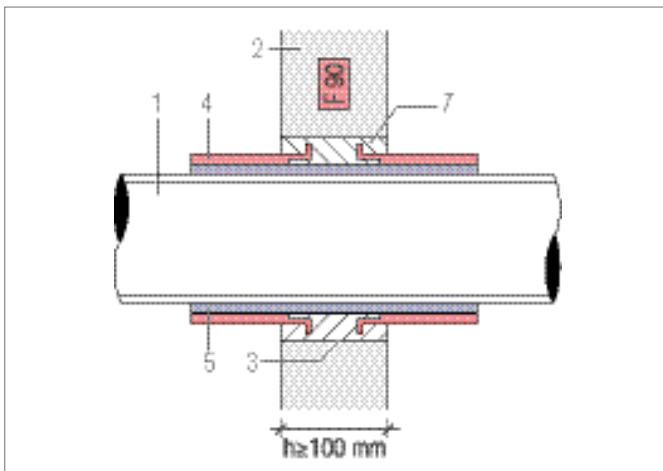
**9.3.2 R 90 fire stop collar REHAU PLUS for RAUPIANO PLUS wall penetrations, rigid walls
(German general building approval no. Z-19.17-1662)**

Surface mounted onto rigid wall F 90, wall opening or core drill hole



- 1 RAUPIANO PLUS DN 40 – DN 160
- 2 Rigid wall $h \geq 100$ mm at least F 90-AB as per DIN 4102-2, masonry as per DIN 1053-1, concrete or reinforced concrete as per DIN 1045, aerated concrete building panels as per DIN 4166
- 3 Wall opening or core drill hole
- 4 R 90 REHAU PLUS fire stop collar system in accordance with German general building approval
- 5 Structure-borne sound insulation with PE soft foam strips of building material class DIN 4102 B2, 5 mm insulation thickness in accordance with German general building approval
- 6 Steel raw plug with M6 or M8 screws in accordance with German general building approval
- 7 Plaster or mortar MG III
- h Wall thickness

Cast into rigid wall F 90, wall opening/core drill hole



The first pipe pipe brackets must be fitted on both sides of the wall within 500mm. They must be largely non-combustible (building material class DIN 4102-A).

The distance to other fire stop collars or openings can be found in the relevant German general building approvals. The installation must be in full compliance with the requirements of the German general building approval.

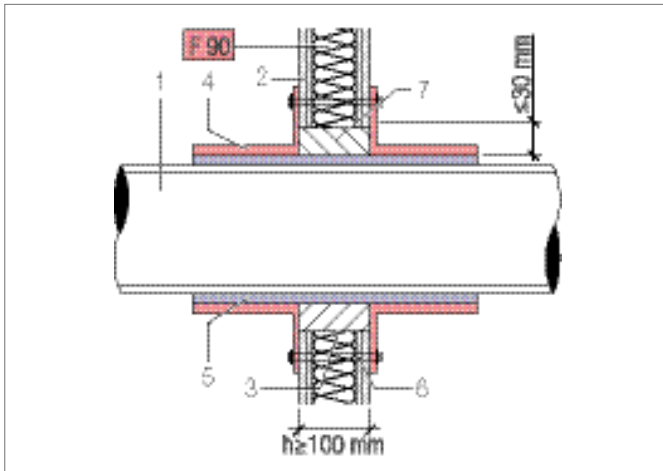
Refer to the instructions for use!



For use in wall penetrations, a fire stop collar must be installed on both sides of the wall.

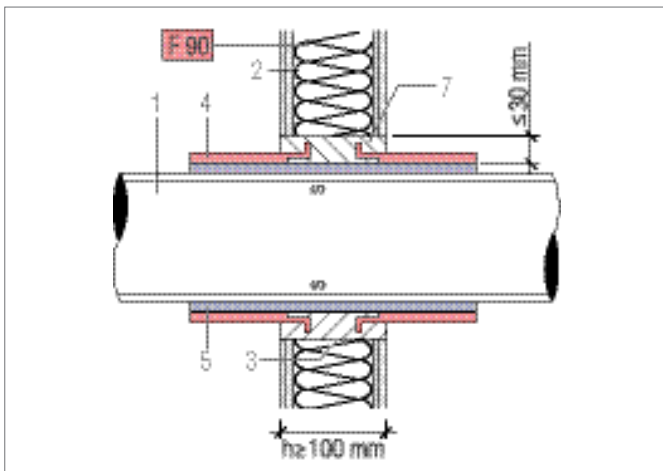
**9.3.3 R 90 fire stop collar REHAU PLUS for RAUPIANO PLUS wall penetrations, flexible walls
(German general building approval no. Z-19.17-1662)**

Surface mounted onto flexible wall F 90



- 1 RAUPIANO PLUS DN 40 – DN 160
- 2 At least two fire-resistant plasterboard on each side as per DIN 18180, board thickness ≥ 12.5 mm, building material class DIN 4102-A
- 3 Wall opening
- 4 R 90 REHAU PLUS fire stop collar system in accordance with German general building approval
- 5 Structure-borne sound insulation with PE soft foam strips of building material class DIN 4102 B2, 5 mm insulation thickness in accordance with German general building approval
- 6 Threaded rod M6 or M8, nut with washers
- 7 Plaster or mortar MG III
- h Wall thickness

Cast into flexible wall F 90



The first pipe pipe brackets must be fitted on each side of the wall within 500mm. They must be largely non-combustible (building material class DIN 4102-A).

Wall construction F 90 fire resistant plasterboards as per DIN 4102-4.

The distance to other fire stop collars or openings can be found in the relevant German general building approvals.

The installation must be in full compliance with the requirements of the German general building approval are binding.

Refer to the instructions for use!

i For use in wall penetrations, a fire stop collar must be installed on both sides of the wall.

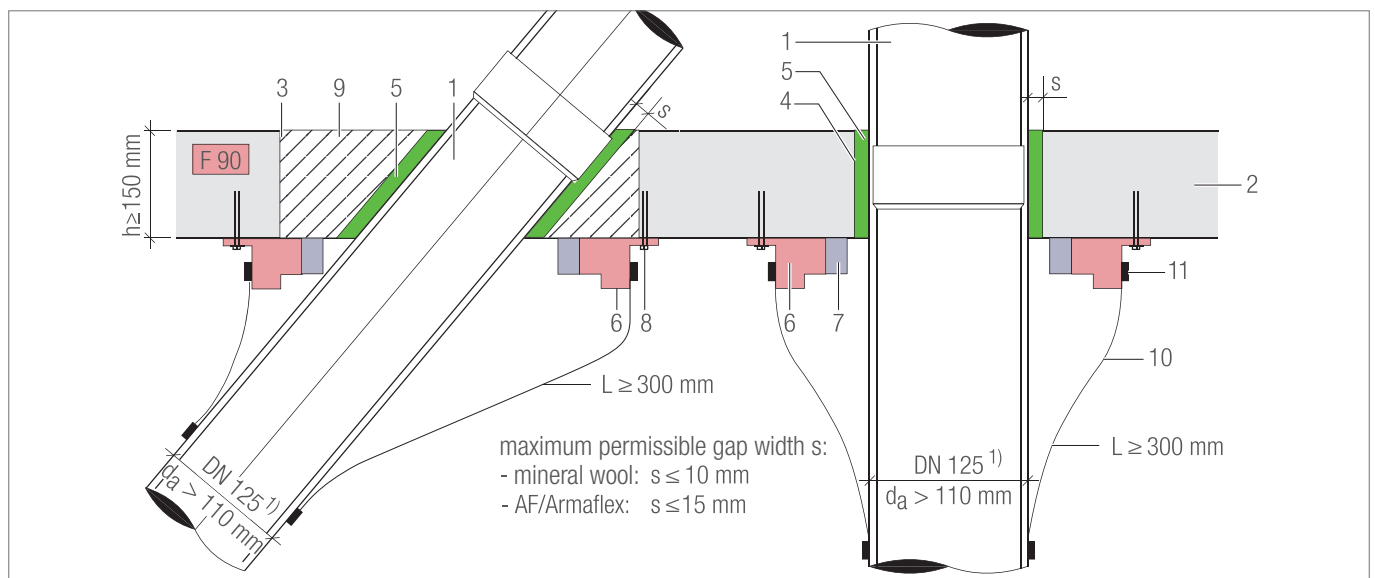
9.4 REHAU Fire Stop Collar for Angled Pipe Penetrations



- German general building approval no. Z-19.17-1268
- for surface mounting onto ceilings
- for RAUPIANO PLUS pipes
- Pipe dimensions DN 75–DN 125
- Pipes can be installed so they are perpendicular to the ceiling or can penetrate the floor at an angle of up to 45°
- may be fitted within the area of the pipe push-fit socket

9.4.1 R 90 REHAU fire stop collar for angled RAUPIANO PLUS floor penetrations (German general building approval no. Z-19.17-1268)

Surface onto rigid ceiling F 90, as ceiling opening



1) For pipe dimension DN125 the glass fibre sleeve and steel clips provided with the collar must be fitted. Refer to the instructions for use.

- | | |
|---|--|
| <ol style="list-style-type: none"> 1 RAUPIANO PLUS 2 Rigid floor $h \geq 150$ mm at least F 90-AB as per DIN 4102-2, concrete or reinforced concrete as per DIN 1045, aerated concrete as per DIN 4223 3 Ceiling opening 4 Core drill hole 5 Mineral wool structure-borne sound insulation, building material class DIN 4102-A, melt temperature > 1000 °C or AF/Armaflex (German general building test certificate P-MPA-E-03-510) 6 R 90 REHAU fire stop collar for angled penetrations in accordance with German general building approval 7 Sound decoupling strip based on PE foam in accordance with German general building approval | <ol style="list-style-type: none"> 8 Steel raw plug with M6 or M8 screws or threaded rods in accordance with German general building approval 9 Concrete, cement or plaster mortar of building material class DIN 4102-A 10 Hose made of glass fibre fabric, surface weight 220 ± 20 g/m²
RAUPIANO PLUS ≤ 110 mm: no glass fibre fabric hose required
RAUPIANO PLUS > 110 mm: glass fibre fabric hose required 11 Metal clips <p>h Ceiling thickness
s Maximum permissible gap between ceiling opening/mortar and pipe
L Length of the glass fibre fabric sleeve: $L \geq 300$ mm</p> |
|---|--|

Distance between two mounted collars ≥ 100 mm

Refer to the instructions for use!

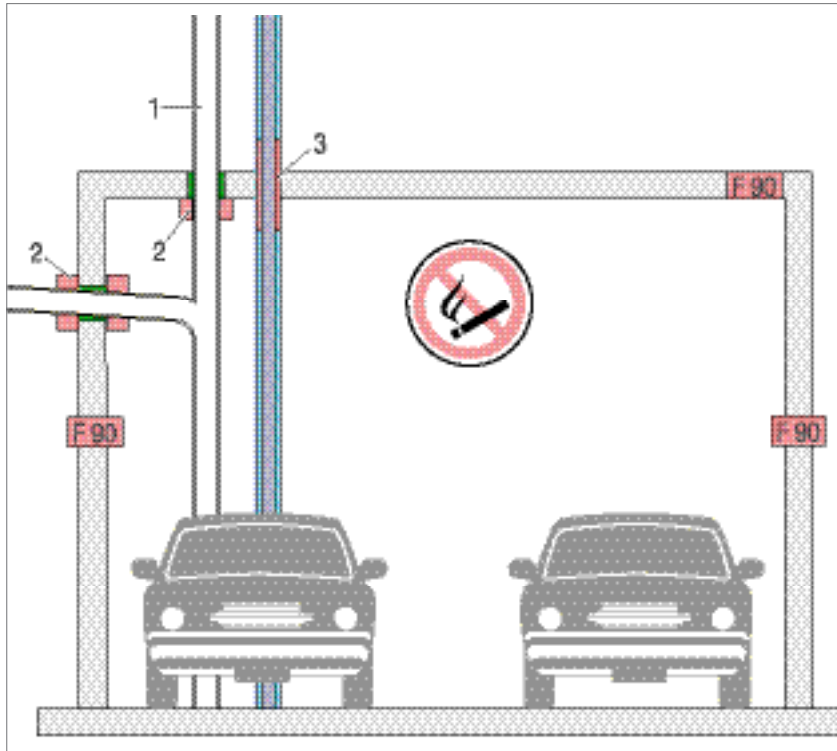
The distance to other fire stop collars or openings can be found in the relevant German general building approvals.

The installation must be in full compliance with the requirements of the German general building approval no. Z-19.17-1268.



When pipes are closed off using ceilings, the fire stop collar must be mounted on the underside of the ceiling.

9.5 Underground car park



Legend

- 1 RAUPIANO PLUS
- 2 R 90 fire stop collar for RAUPIANO PLUS
- 3 R 90 fire sleeve for combustible RAUTITAN stabil pipes

The underground car park is a fire compartment in itself. The wall and ceiling cladding must be made of non-combustible materials.

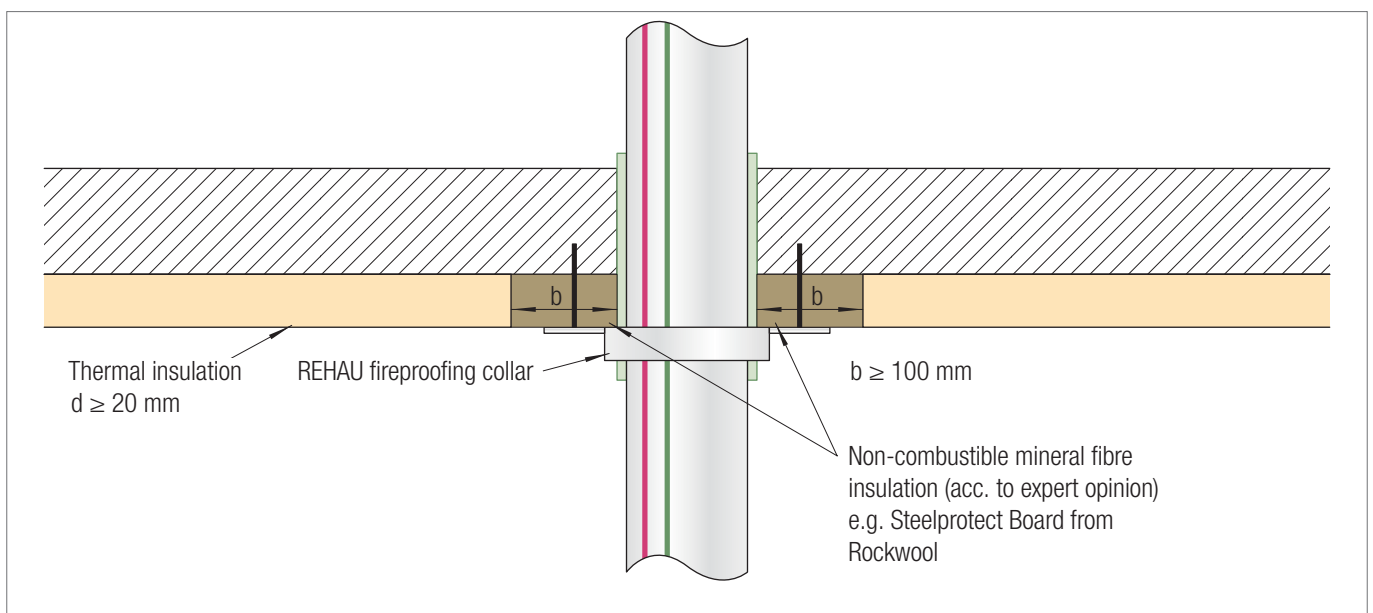
Meeting thermal insulation and fire safety requirements for insulated ceilings

In buildings with unheated underground car parks, which are open to the outside, it is often the case that suitable thermal insulation must be installed on the underside of the ceiling in accordance with the German energy saving regulation. Until now it was not possible to meet safety requirements with combustible drainage pipes without compromising the performance of the thermal insulation. With RAUPIANO PLUS, this issue has been addressed, thus

facilitating a fully compliant planning. According to the expert's report GA-2013/161-Mey dated 05/08/2013, it is possible to meet both fire safety and thermal insulation requirements using appropriate insulation materials.



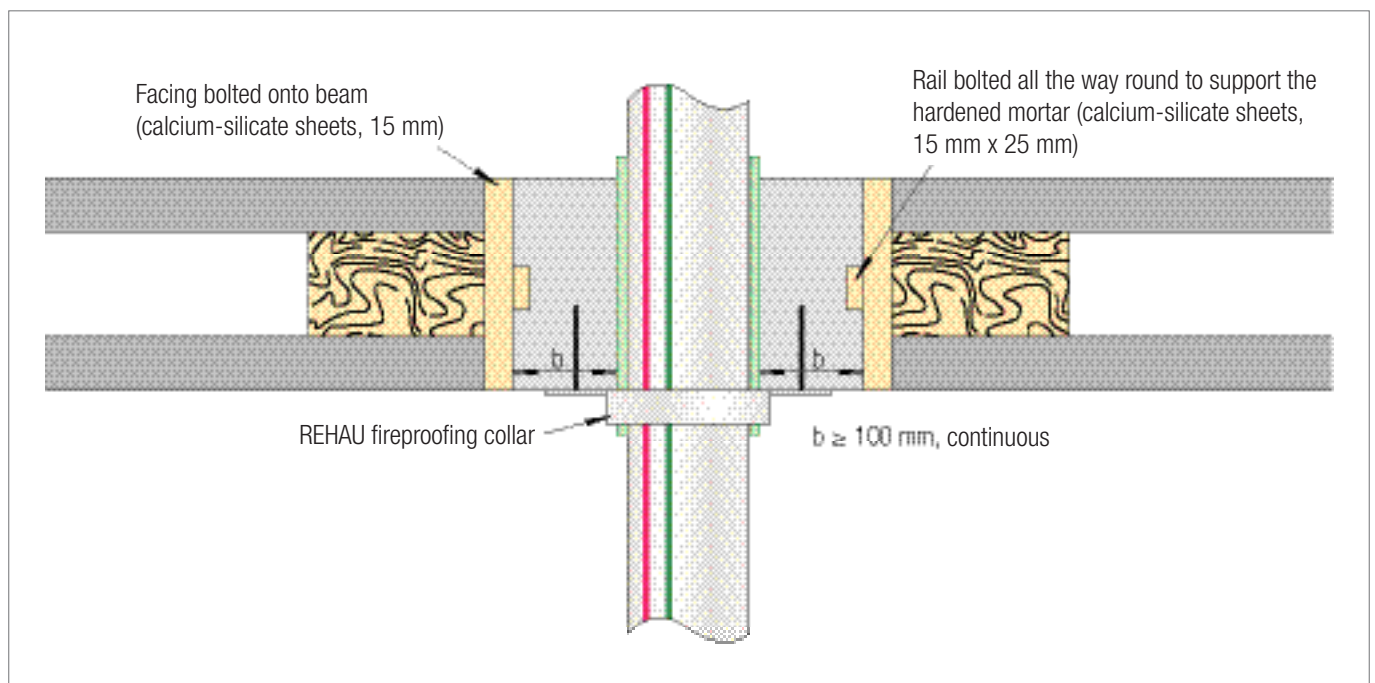
In such cases only the REHAU fire stop collars can be used.



9.6 Special floor constructions

When it comes to fire stopping pipe penetrations through existing and special-purpose ceilings/components, the planning and execution recommendations detailed in the commentary of the model guideline for pipe services (MLAR) must be followed. In the absence of a certificate of usability (abZ, abP), any normally certified fire stop device (R30/60/90) must be assessed for its suitability for special floor constructions as part of a fire risk assessment. The installation of the classified fire stop collar is carried out within a classified opening of twice the normal size (at least 100 mm all the way round) and sealed with fire mortar (at least 100 mm all the way round with a floor thickness of 150 mm) then it can be classified as a permissible deviation from the certificate of usability.

As an example, one solution for a timber joist floor (as per DIN 4102-4) is shown here.



9.7 Mixed installations

A mixed installation is one in which combustible plastic pipes are connected to non-combustible soil and waste pipes.

If the mixed installation is subject to construction-related fire safety requirements, the following must be observed:

- The reduced requirements of the model guideline for service pipes do not apply.
- Since 01/01/2013, fire stopping solutions with the German general building test certificate are no longer approved for use (see DIBT newsletter 2/2012).

Instead, only solutions with the German general building approval and/or European Technical Approval can be used to demonstrate their suitability.

The responsible fire safety engineer must always be consulted prior to the start of construction if floor constructions are penetrated.

The applicable construction regulations for timber joist floors are included in the fire safety model construction guideline for highly fire resistant timber components (M-HFHolzR). This means that such penetrations can usually be considered a minor deviation from the certificate of usability.

When it comes to mixed installations and depending on local conditions, it is advisable to consult the responsible fire safety engineer or/building authority in advance as there are different solutions for different installation situations.

A uniform installation using the RAUPIANO PLUS soil and waste system is recommended to allow for the straightforward and reliable allocation of fire stop solutions, certifications and installation guidelines.

10 SPECIAL APPLICATIONS

10.1 Installations below the ground slab

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

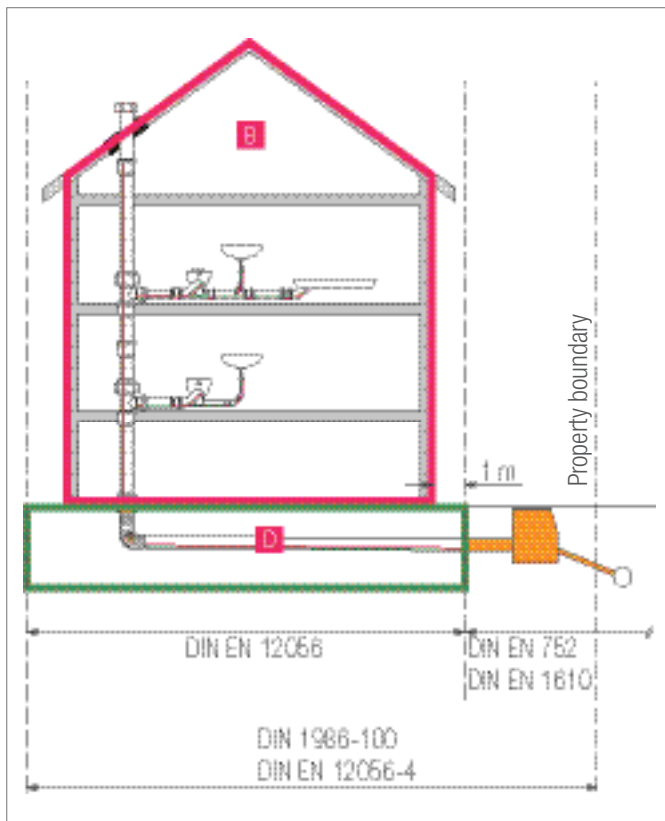


Fig. 10-1 Installation of RAUPIANO PLUS inside and below the building structure

- B** Applications within the building (Building)
- D** Applications below the building (Drainage)

i The regulations of DIN 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.

i 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.de/tiefbau or from your REHAU sales office.

10.2 Commercial kitchens

As collecting, main and connecting pipe, RAUPIANO PLUS is suitable for transporting grease containing waste away from the commercial kitchen to the grease trap. Separate venting pipes are required.

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 plastic 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 the material nitrile-butadiene (NBR) to achieve the required higher chemical resistance.

10.3 Mechanical ventilation



RAUPIANO PLUS can be used in detached and semi-detached dwellings (building class 1+2 as per MBO/LBO) for the decentralised and centralised extract ventilation of bathrooms, toilet rooms and kitchens as per DIN 18017-3. These building classes are not typically subject to any specific requirements with regard to fire safety for these application. There are construction-related fire safety requirements from building class 3 upwards. This also needs to be taken into consideration for ventilation pipes when planning buildings.

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

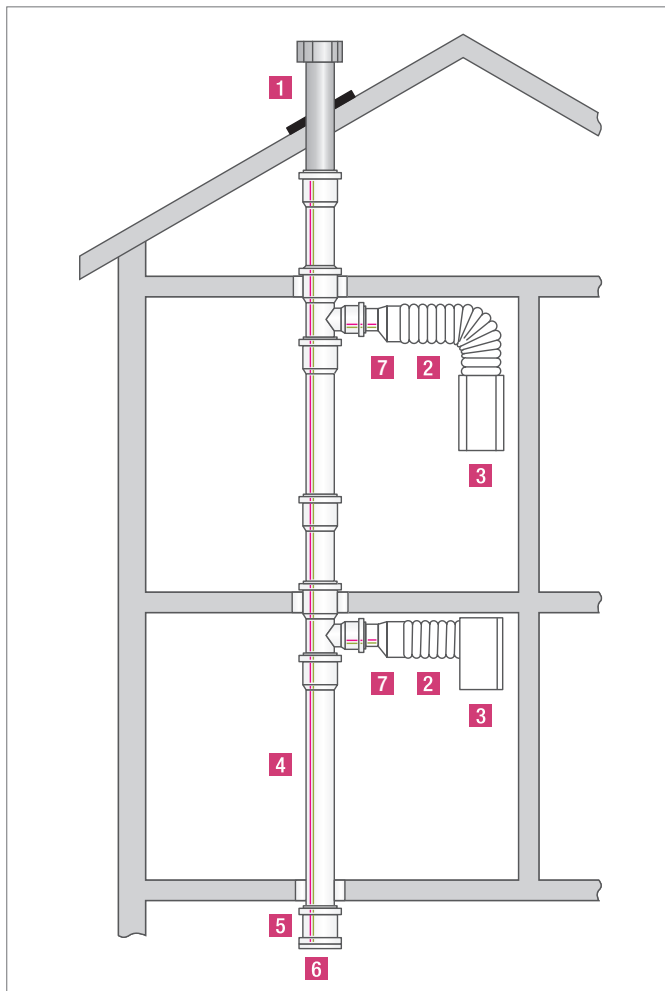


Fig. 10-2 Decentralised ventilation with RAUPIANO PLUS

- 1 Exhaust outlet
- 2 Flexible tubing
- 3 Extraction fan
- 4 RAUPIANO PLUS
- 5 RAUPIANO PLUS double insert
- 6 RAUPIANO PLUS socket plug
- 7 RAUPIANO PLUS adaptor DN 75 to DN 80

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 push-fit 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 adaptor 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 adaptor and is fixed in place using hose clamps available from fitting suppliers, thus forming an air-tight connection.

Alternatively, a suitable sealing strip based on butyl rubber can be used for securing connection into place.



If flexible steel tubing is used, a suitable sealing strip based on 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).



Any radial extraction fans (connection diameter 80 mm) with the German general building approval can be used as part of the individual ventilation systems in accordance with DIN 18017-3. The appliances must be equipped with an air-tight check valve.

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 buildup of condensation must be prevented by way of appropriate measures (see chapter "4 Internal rainwater pipe" on page 12).

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 dwellings.

11 OVERVIEW TABLES

11.1 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 40, DN 50, DN 75, DN 90, DN 110, DN 125, DN 160, DN 200
Scope 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⁾	Soil and waste pipe at a negative pressure	up to 10 m water head up to 20 m water head with push-fit lock ¹⁾ up to 0.5 bar
Density	Pipes Fittings	1.5 – 1.9 g/cm ³ 1.1 – 1.9 g/cm ³
Coefficient of linear expansion		0.09 mm/m x K
Min. installation temperature		-10 °C
Tensile strength		> 16 N/mm ²
Elongation at break		approx. 150 %
Flexural modulus of tension		approx. 2,700 N/mm ²
MFR 190/5		approx. 1.7 g/10 min.
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		B2 (normal flame-resistance) as per DIN 4102
Acoustic performance as per DIN EN 14366	with acoustic support bracket with standard bracket	PB-A274/2016 Fraunhofer Institute: 17 dB(A) at 4 l/s PB-A275/2016 Fraunhofer Institute: 24 dB(A) at 4 l/s
UV resistance		UV-stabilised, but not resistant (see also chapter "6.1 Supply form, handling and storage" on page 14)
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

1) The tightness only describes the leak tightness status. There is always the risk here that the pipes are pushed 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)			

11.2 Discharge capacity

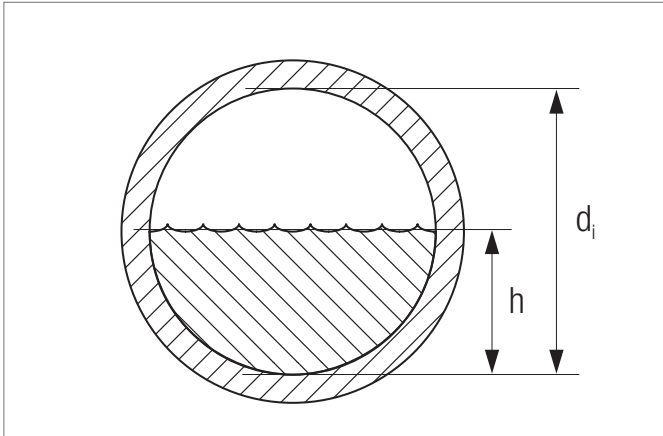


Fig. 11-1 Cross cut of a partly filled pipe

d_i pipe inside diameter

h Degree of filling

Discharge capacity at $h/d_i = 0.5$

J	DN 40		DN 50		DN 75		DN 90		DN 110		DN 125		DN 160		DN 200	
	$d_i = 36.4$		$d_i = 46.4$		$d_i = 71.2$		$d_i = 85.6$		$d_i = 104.6$		$d_i = 118.8$		$d_i = 152.2$		$d_i = 187.6$	
cm/m	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v
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		DN 50		DN 75		DN 90		DN 110		DN 125		DN 160		DN 200	
	$d_i = 36.4$		$d_i = 46.4$		$d_i = 71.2$		$d_i = 85.6$		$d_i = 104.6$		$d_i = 118.8$		$d_i = 152.2$		$d_i = 187.6$	
	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		DN 50		DN 75		DN 90		DN 110		DN 125		DN 160		DN 200	
	$d_i = 36.4$		$d_i = 46.4$		$d_i = 71.2$		$d_i = 85.6$		$d_i = 104.6$		$d_i = 118.8$		$d_i = 152.2$		$d_i = 187.6$	
	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

11.3 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).

Key to tables

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

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
1,2 dichloroethane	100	20	nr
2-Propen-1-ol	96	20	r
	96	60	r
Exhaust gases, containing H ₂ CO ₃	any	60	r
Exhaust gases, containing H ₂ S ₂ O ₇	lower	20	–
	higher	20	nr
Exhaust gases, containing H ₂ SO 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
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 saturated	40	r
	Warm saturated	60	r

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.

Reagent	Concent.	Temp.	RAU-PP
	%	Deg/C	
Ammonium chloride, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Ammonium fluoride, aqueous	up to 20	20	r
	up to 20	60	r
Ammonium nitrate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Ammonium sulphate, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Ammonium sulphide, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Aniline, pure	100	20	r
	100	60	r
Aniline, aqueous	Saturated	20	r
	Saturated	60	r
Aniline hydrochloride, aqueous	Saturated	20	r
	Saturated	60	r
Anthraquinone sulphonic acid, aqueous	Suspension	30	r
Antiformin, aqueous	2	20	–
Antimony chloride, aqueous	90	20	r
Malic acid, aqueous	1	20	r
Cider	comm. form	20	r
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

Reagent	Concent. %	Temp. Deg/C	RAU-PP
Lead acetate, aqueous	Warm saturated	50	r
	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Tetraethyl lead	100	20	r
Borax, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Boric acid, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Brandy	comm. form	20	r
Bromine, liquid	100	20	nr
Bromine vapours	Low	20	nr
Hydrobromic acid, aqueous	Up to 10	40	r
	Up to 10	60	r
	48	60	r
Butadiene	100	60	–
Butane, gaseous	50	20	r
Butanediol	Up to 100	20	–
Butanediol, aqueous	Up to 10	20	r
	Up to 10	40	r
	Up to 10	60	r
Butanol	Up to 100	20	r
	Up to 100	40	r
	Up to 100	60	lr
Butynediol	Up to 100	40	–
Butyric acid, aqueous	20	20	r
	Concent.	20	r
Butyl acetate	100	20	lr
Butylene, liquid	100	20	–
Butylphenol	100	20	r
Calcium chloride, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Calcium nitrate, aqueous	50	40	r
Chlorine, gaseous, moist	0.5	20	nr
	1	20	nr
	5	20	nr
Chlorine, gaseous, dry	100	20	nr
Chloramine, aqueous	Diluted	20	–
(Mono) chloroacetic acid	100	40	r
	100	60	–
(Mono) chloroacetic acid aqueous	85	20	r
Chloromethyl	100	20	–
Chloric acid, aqueous	1	40	–
	1	60	–
	10	40	–
	10	60	–
	20	40	–
	20	60	–
Chlorosulphonic acid	100	20	nr
Chlorinated water	Saturated	20	lr
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

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

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

Reagent	Concent. %	Temp. Deg/C	RAU-PP
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
Sodium chlorate, aqueous	Up to 10	40	r
	Up to 10	60	r
	Saturated	60	r
Sodium chlorite, aqueous	50	20	r
	Diluted	60	nr
Sodium hydrogen sulphite, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Sodium hypochlorite, aqueous	Diluted	20	r
Sodium hypochlorite solution, 12.5% active chlorine	Norm. conc.	40	–
	Norm. conc.	60	lr
Sodium sulphide, aqueous	Diluted	40	r
	Diluted	60	r
	Saturated	60	r
Caustic soda, aqueous	Up to 40	40	r
	Up to 40	60	r
	50/60	60	r
Nekal, BX, aqueous	Diluted	40	–
	Diluted	60	–

Reagent	Concent. %	Temp. Deg/C	RAU-PP
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, aqueous	Saturated	20	–
	Saturated	60	–
Phosgene, liquid	100	20	nr
Phosgene, gaseous	100	20	lr
	100	60	lr
Phosphorous pentoxide	100	20	r
Phosphoric acid, aqueous	Up to 30	40	r
	Up to 30	60	r
	40	60	r
	80	20	r
	80	60	r
Phosphorous trichloride	100	20	r
Hydrogen phosphide	100	20	–
Picric acid, aqueous	1	20	r
Potash, aqueous	Saturated	40	–
Propane, liquid	100	20	–
Propane, gaseous	100	20	–
Propargyl alcohol, aqueous	7	60	r
Ramasite	comm. form	20	–
	comm. form	40	–
Beef tallow emulsion, sulphurised	comm. form	20	–
Roasting gases, dry	any	60	r
Nitric acid, aqueous	Up to 30	50	r
	30/50	50	nr
	98	20	nr
	98	60	nr
Hydrochloric acid, aqueous	Up to 30	40	r
	Up to 30	60	r
	above 30	20	r
	above 30	60	r
Oxygen	any	60	–
Sulphur dioxide, moist and aqueous	any	40	r
	50	50	r
	any	60	r

Reagent	Concent. %	Temp. Deg/C	RAU-PP
Sulphur dioxide, liquid	100	–10	–
	100	20	r
	100	60	r
Sulphur dioxide, dry	any	60	r
Sulphur dioxide, aqueous below 8 atm	Saturated	20	–
Carbon disulphide	100	20	lr
Sulphuric acid, aqueous	Up to 40	40	r
	Up to 40	60	r
	70	20	r
	70	60	lr
	80–90	40	lr
	96	20	r
	96	60	nr
Hydrogen sulphide, dry	100	60	r
Hydrogen sulphide, aqueous	Warm saturated	40	r
	Warm saturated	60	r
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
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

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

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

11.4 Certifications

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



Germany



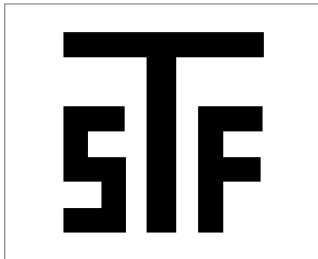
Germany



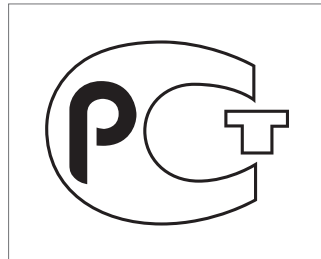
Sweden



Norway



Finland



Russia



Denmark



Denmark



Poland



Austria



Hungary



Malaysia



Australia

11.5 Applicable standards, regulations and instructions



Observe all national and international pipelaying, installation, accident prevention and safety regulations, as well as the notes in this technical information, when installing pipe systems.

Please also observe the presently valid laws, norms, instructions, regulations (e.g. DIN, EN, ISO, DVGW, VDE and VDI) as well as regulations regarding environmental protection, Employer's Liability Insurance Association regulations and regulations from local utility companies.

Applications which are not covered by this Technical Information (special applications) require consultation with our Technical Applications Department.
Please contact your REHAU sales office for more detailed advice.

The design and installation instructions relate directly to the relevant REHAU product. Some sections refer to generally applicable standards or regulations.

Please ensure that the instructions, standards and regulations in use are the valid version in each case.

More specific standards, regulations and instructions relating to the design, installation and operation of sewer pipes must also be taken into account and do not form part of this Technical Information.

DIN 1054

Subsoil – admissible stress on the subsoil

Supplement – explanations

DIN 1055, Part 2

Design loads for buildings; Soil characteristics, specific weight, angle of friction, cohesion, angle of wall friction

DIN 18017-3

Ventilation of bathrooms and toilet rooms without an external window with ventilators

DIN 18300

VOB contracting rules for award of public work
Part C: General technical specifications in construction contracts (ATV); Earthworks

DIN 18303

VOB contracting rules for award of public work
Part C: General technical specifications in construction contracts (ATV); Sheet piling works

DIN 18305

VOB contracting rules for award of public work
Part C: General technical specifications in construction contracts (ATV); drainage works

DIN 18306

VOB contracting rules for award of public work
Part C: General technical contractual specifications for contract works (ATV), sewerage channel works

DIN 18381

VOB contracting rules for award of public work
Part C: General technical specifications in construction contracts; Gas, water and drainage systems inside buildings

DIN 1960

VOB contracting rules for award of public work
Part A: General provisions relating to the award of public work

DIN 1961

VOB contracting rules for award of public work
Part B: General conditions of contract relating to the execution of construction work

DIN 1986

Drainage systems for buildings and property

DIN 4045

Fundamental concepts of waste water technology

DIN 4060

Sealant material made from elastomers for pipe connections for sewers and pipes, requirements and tests

DIN 4102

Fire behaviour of building materials and components

DIN 4109

Sound insulation in buildings

DIN 4124

Excavation pits and trenches; slopes, sheet piling, working space widths

DIN EN 476

General requirements for components for sewer pipes and channels for gravitation drainage systems

DIN EN 681

Elastomer gaskets

Material requirements for pipe gaskets for water supply and drainage applications

DIN EN 1451

Plastic pipe systems for draining waste water (low and high temperature) within the building structure – polypropylene (PP)

DIN EN 1610

Installation and testing of sewer pipes and channels

DIN EN 1996

Dimensioning and design of masonry structures

DIN 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 5: Installation and testing, operation and maintenance instructions

German general building approval of the German Institute of Civil Engineering

Certification Z-42.1-223: RAUPIANO PLUS waste pipes and fittings

Certification Z-19.17-2139: REHAU fire protection tape

Certification Z-19.17-1662: REHAU PLUS fireproofing collar system

Certification Z-19.17-1363: REHAU kompakt angled fireproofing collar system

Certification Z-19.17-1268: REHAU angled fireproofing collar system

ATV-DVWK-A 127

Instructions for the static load analysis of sewers and pipelines

German Energy Savings Regulation (EnEV)

Regulation on energy-saving thermal insulation and low-energy process equipment in buildings (German Energy Savings Regulation - EnEV)

KRV process sheet A 2.4.1/8

Pipes and fittings made of PP (polypropylene) with or without push-fit sockets for sewer pipes (domestic waste water), insert dimensions

Regional building code of the states of the Federal Republic of Germany

Currently applicable versions

Model Building Code for the Federal Republic of Germany

Code of practice and technical information relating to sound insulation

(German Central Association for plumbing, heating and air conditioning)

Code of practice relating to central vacuum units

(German Central Association for plumbing, heating and air conditioning)

Plumbing installation times

Innung Spengler, Sanitär- und Heizungstechnik, Munich

Specimen firing installations order (German designation: Muster-Feu-VO)

Specimen instructions for fire protection requirements pertaining to highly fire-retardant building components in timber constructions (German designation: M-HFHolzR)

Specimen instructions for fire protection requirements in pipe systems (German designation: MLAR)

RAUCAD software from REHAU EN 12056

VDI Directive 4100

Sound insulation in apartments - criteria for planning and assessment

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 Plastics Center 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 DIN EN 12056, DIN 1986, DIN EN 752 and VDI Directive 4100 or 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.

Liability acceptance agreement

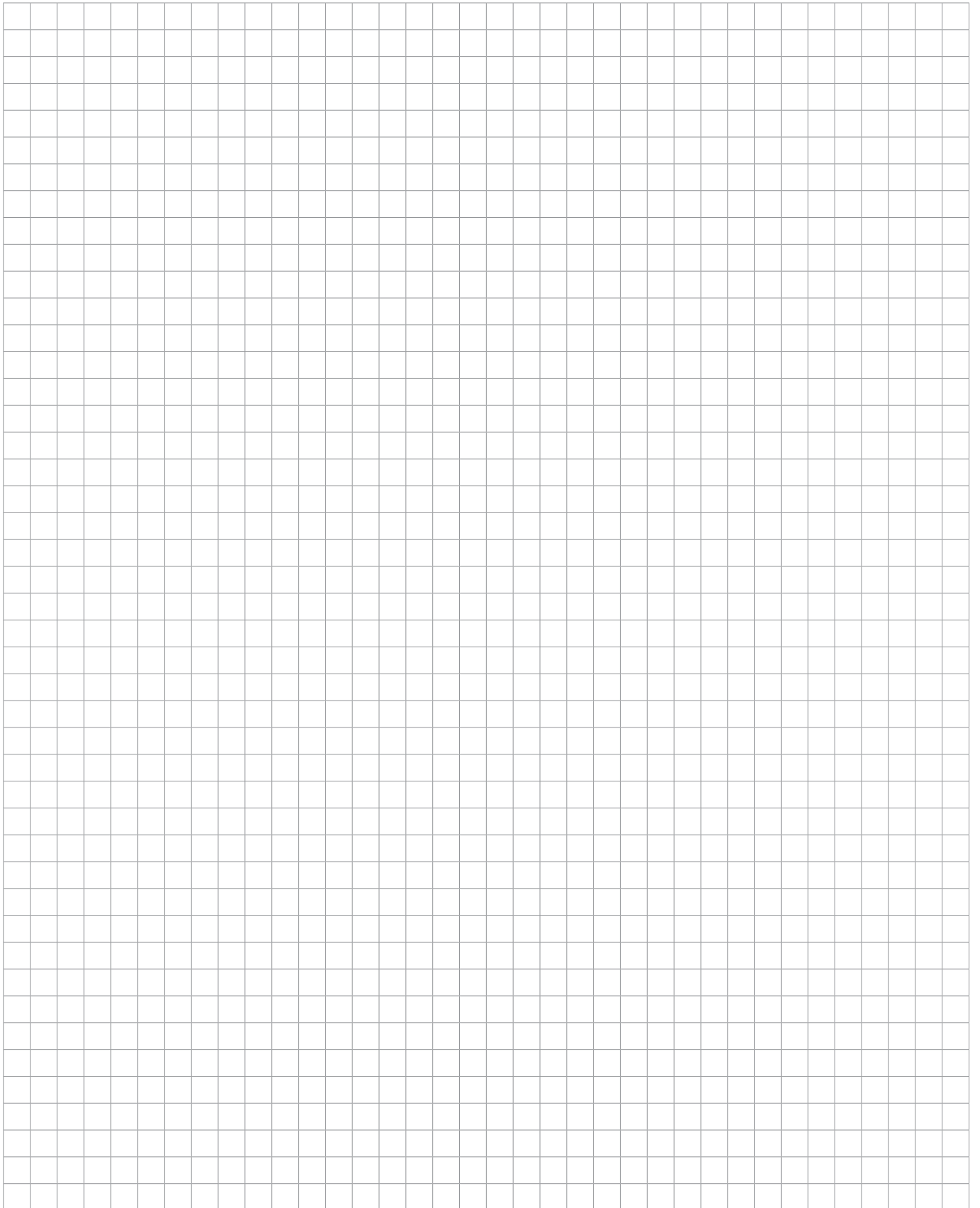
The RAUPIANO PLUS domestic waste water system is also subject to a liability acceptance agreement with the German Central Association Plumbing, Heating and Air Conditioning (German designation: ZVSHK).

11.6 Abbreviations

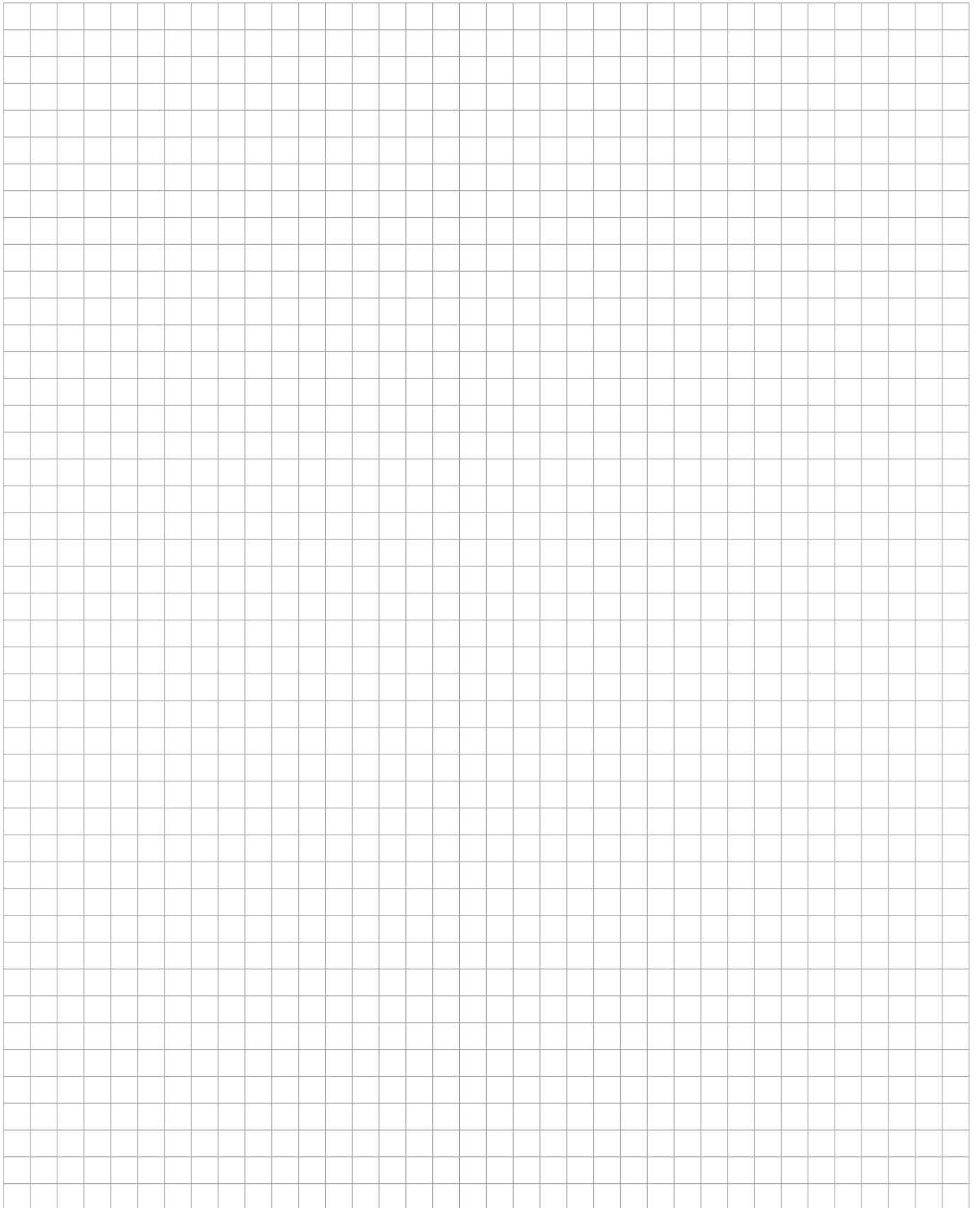
Abbreviation	Explanation
abP	German general test certificate from the building authorities
abZ	German general building approval
EnEV	German Energy Savings Regulation
GK	Building class
LBO	Regional building code of the states of the Federal Republic of Germany
MBO	Model Building Code for the states of the Federal Republic of Germany
MG	Mortar group
MLAR	Model wiring guideline
MPA BS	Material testing institute in Braunschweig
OK	Upper edge
OKFFB	Upper edge of finished floor
VO	Regulation

Tab. 11-1 Abbreviations

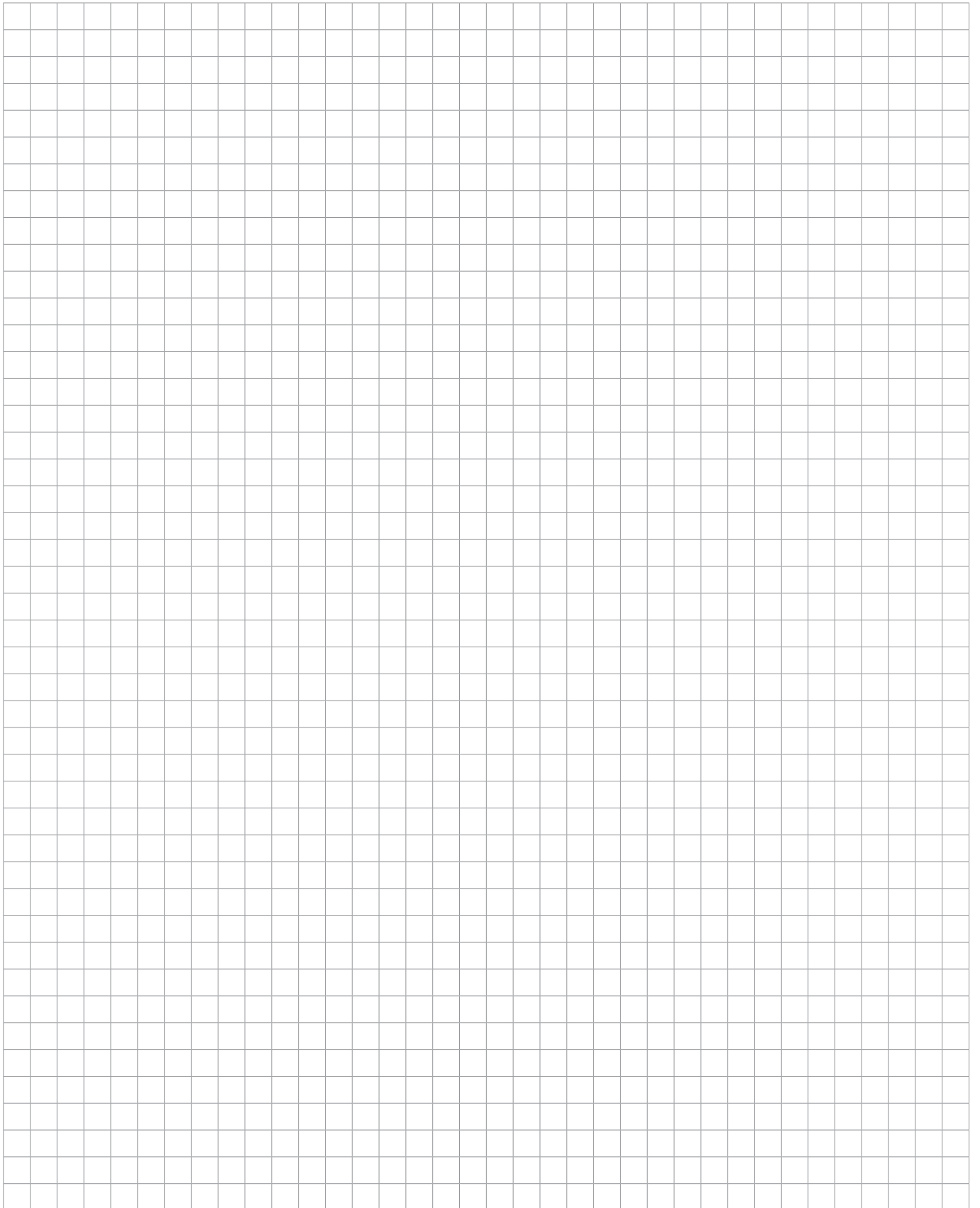
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Our verbal and written advice with regard to usage is based on years of experience and standardised assumptions and is provided to the best of our knowledge. The intended use of REHAU products is described comprehensively in the technical product information. 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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