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Plumbing system RAUTITAN

Technical Information

REHAU

This Technical Information "Plumbing system RAUTITAN" is valid from March 2022.

Its publication means that the previous Technical Information 893621 (as of April 2019) is no longer valid.

Our current technical documentation can be found at **www.rehau.uk/rautitan** for download.

All measures and weights are approximate values. Errors and changes excepted.

Contents

For installations using RAUTITAN flex pipes in size 50 x 6.5 or 63 & 8.6 please also refer to the Addendum section at the end in addition to the main document.

Universal system RAUTITAN
Introduction

Contents

01 Information and safety advice

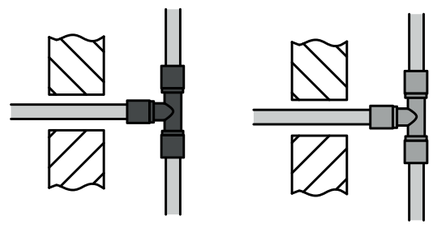
Validity
This Technical Information is valid for United Kingdom & Ireland.

Further applicable Technical Informations
- Underfloor Heating and Cooling
- Industrial pipe system RAUPEX
- Pre-insulated industrial pipe system RAUFRIGO

Navigation
Each section of this Technical Information is designed with a grey register on the right side and begins with a table of contents, including the hierarchical titles and the corresponding page numbers.

Definitions
- **Supply lines or piping**
  consist of pipes and their joints (e.g. compression sleeves, fittings, threads, or similar). This applies to gas piping, drinking water and heating piping and all other pipes in this Technical Information.
- **Piping systems, installations, systems**, etc. consist of the pipes and the necessary components.
- **Connection components**
  consist of fittings with the corresponding compression sleeves and pipes as well as seals and screw connections.

Illustration
Illustrations for individual subsystems are listed in the corresponding pipe, fitting and compression sleeve colours.
Illustrations, which apply system-wide for drinking water, heating, and gas installation are illustrated with grey piping and white fittings/compression sleeves.



Sub-system illustration with RAUTITAN PX fitting

System-wide illustration

Fig. 01-1 Example: Illustration for sub-systems with RAUTITAN PX fittings (left) and example: System-wide illustration for multiple sub-systems (right)

Explanation of symbols

Safety information

Legal information

Important information, which needs to be taken into account

Your benefits/advantages

Information on the Internet

Updated Technical Information
For your own safety and the correct use of our products, check regularly whether the Technical Information which you have is available in a latest version. The date of issue of your Technical Information is always printed on the bottom left of the cover.
The latest Technical Information can be found at your REHAU sales office, specialist wholesaler or online for download at **www.rehau.uk/rautitan**

Piping network calculation
In addition to the information contained in this technical document various services are offered for the sizing of drinking water and heating systems by REHAU.
For extensive advice, please consult your REHAU sales office.

Intended use
The RAUTITAN 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 advice and operating instructions
- For your own safety and other's, read the safety instructions and the operating instructions carefully and completely before beginning installation.
- Store the operating instructions in a safe place and make sure it is available when needed..
- In case you did not understand the safety advice or the individual assembly situations, or if they are not clear to you, 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.

Also observe the applicable laws, standards, guidelines and regulations (e.g. BS, EN, ISO, DVGW, NEN, VDE and VDI) as well as regulations on environmental protection, provisions of professional associations and regulations of the local public utility companies.

Areas of application not contained in this Technical Information (special applications) require consultation with our Applications Department.
For detailed advice, please contact your REHAU sales office.

The design and installation instructions related solely to the specific REHAU product. Occasionally, references are made to parts of applicable standards and directives.
Always observe the current version of any guidelines, standards or directives. Further directives, regulations and guidelines related to the design, installation and operation of drinking water, heating and buildings services systems must also be referred but these do not form part of this Technical Information.

Staff requirements
- The system shall only be installed by authorised and trained persons.
- The work on electrical systems shall only be carried out by suitably trained and authorised people.

General safety precautions
- Keep your workplace clean and free of obstructions.
- Ensure adequate lighting at your workplace.
- Keep children, household pets and unauthorised people away from tools and the installation places. This applies particularly to refurbishment in occupied places.
- Only use those components in the corresponding piping system, which have been generally approved by REHAU. Using components which are not part of the system or tools which do not originate from the respective REHAU installation system can lead to accidents or other hazards.

Work clothing
- Wear eye protection, adequate work clothing, protective shoes, a helmet and a hair net if you have long hair.
- Do not wear loose clothing or jewellery which can be caught by moving parts.
- A safety helmet has to worn during installations work at face level or overhead.

Follow the assembly instructions
- Always read and observe the available operating instructions of the REHAU system tool.
- Incorrect handling of tools can cause cuts and crushing or sever limbs.
- Incorrect handling of tools can damage connection components and bring about leaks.
- The REHAU pipe cutters have sharp blades. Store and handle them in such a way that they will not create any risk of injury.
- When cutting the pipes, keep a safety distance between the holding hand and the cutting tool.
- When cutting do not reach into the cutting zone of the tool or near its moving parts.
- After the expansion process, the expanded end of the pipe returns to its original shape (memory effect). During this time, do not put any other objects into the expanded end of the pipe.
- Keep your hands away from movable parts or the tools pressing area during jointing.
- Before the joint is completed, the fitting may fall out of the pipe. Risk of injury!
- Always disconnect the power from a tool prior to carrying out maintenance work, changing over any moveable parts (e.g. compression jaws) or when moving the tool to a new location on site.

Operating parameter
If the operating parameters are exceeded, the pipes and joints may become overstrained. Not adhering to the operating parameters is thus not allowable. Keeping within the operating parameters must be ensured by safety/control equipments (e.g. pressure reducers, safety valves, etc.).

Fire protection
Pay careful attention to the applicable fire protection regulations and the correspondingly valid building regulations/regional building regulations/ building codes, especially when:
- penetrating ceilings and walls
- working in rooms with particular/more demanding requirements of preventative fire protection measures (observe national regulations)

02 System components overview

Plumbing system RAUTITAN

	Size 12	Size 16–40	Size 50–63
	RAUTITAN for heating	**RAUTITAN universal system for drinking water and heating**	
Pipe	Universal pipe RAUTITAN flex	Universal pipe RAUTITAN stabil	
Compression sleeve	RAUTITAN LX sleeve Standard brass	RAUTITAN PX PVDF	RAUTITAN PX stabil PVDF
Fitting	RAUTITAN LX Brass	RAUTITAN PX PPSU RAUTITAN RX+ Gunmetal RAUTITAN SX Stainless steel	RAUTITAN RX+ stabil Gunmetal

03 System description

03.01 RAUTITAN pipes

Fig. 03-1 RAUTITAN pipes

- Corrosion resistance of the RAUTITAN pipes: No pitting
- Acoustic insulation properties of the RAU-PE-Xa pipe material
- No tendency to deposits or encrustation
- High impact toughness of the RAU-PE-Xa pipe material
- Good resistance to abrasion
- Optional pre-insulation in the factory in various shapes and insulation thicknesses
- Optional protective sleeving in the factory
- Application-oriented delivery packaging of the pipes as coils or cut lengths

stabil **Universal pipe RAUTITAN stabil**

- Universally suitable for drinking water and heating installation
- Aluminium layer to prevent oxygen diffusion
- WRAS or KIWA UK Reg4 approval
- Sizes 16–63
- Rigid and resistant to deformation

flex **Universal pipe RAUTITAN flex**

- Universally suitable for drinking water and heating installation
- Oxygen diffusion-tight according to DIN 4726
- WRAS or KIWA UK Reg4 approval
- Sizes 12–40
- Flexible

03.02 REHAU compression sleeve jointing technique

Fig. 03-2 Compression sleeve jointing technique

Fig. 03-3 Possible combinations with RAUTITAN

- RAUTITAN fittings can be used universally in drinking water and heating installation
- Universal and robust jointing technique, highly suitable for the construction site
- Connection without o-ring (piping material seals itself)
- Simple visual check
- Cavity-free / Stagnation-free compression sleeve connection technology with the pipes RAUTITAN
- Good hydraulic properties, pipe is expanded at the joint
- Joint can be immediately pressurised
- Pipe need not be calibrated or deburred
- Same jointing technique and tools in the drinking water, heating and gas installation
- Permanently sealing compression sleeve jointing technique according to DIN EN 806, DIN 1988, DVGW-worksheet W 534 and EN ISO 17484-1
- Approved for flush-mounted installation according to DIN 18380 (VOB)

03.03 Other system components

Fig. 03-4 Insulating box for RAUTITAN elbow with passage

Fig. 03-5 RAUTOOL tools

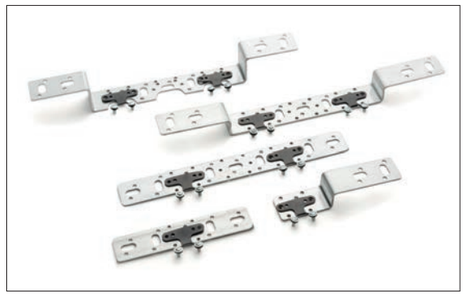


Fig. 03-6 Bracket range

Fig. 03-7 Pipe bend bracket

Fig. 03-8 RAUTOOL tools

Fig. 03-9 RAUTOOL tools

Fig. 03-10 Pipe support channel

RAUTITAN universal system for drinking water

Contents

04 Area of application

04.01 RAUTITAN connection components for drinking water installation

Fig. 04-1 RAUTITAN pipes for drinking water installation

RAUTITAN connection components for drinking water installation

Size	Pipes	Fittings	Compression sleeves
16	stabil Universal pipe RAUTITAN stabil	flex Universal pipe RAUTITAN flex	 RAUTITAN PX  RAUTITAN RX+  RAUTITAN SX	 RAUTITAN PX
20				
25				
32				
40				
50		–	 RAUTITAN RX+ stabil	 RAUTITAN PX stabil
63				

04.02 Standards and guidelines

§

The RAUTITAN universal system for drinking water and heating must be designed, installed and operated according to BS EN 806, BS EN 1717 and the national amendments DIN 1988, BS 8558 and the acknowledged technical rules.

Operating parameters
Application:
Hot water supply at 70 °C / 1 MPa (10 bar)
(Application class 1-2 acc. ISO 10508)

Design temperature T_D	/ Time T_D	70 °C / 49 years
Short-term maximal temperature T_{max}	/ Time T_{max}	80 °C / 1 year
Short-term malfunction temperature T_{mal}	/ Time T_{mal}	95 °C / 100 h
	Total	50 years

Tab. 1-1 Operating parameters according to BS EN 806-2, DIN 1988-200 and ISO 10508 (Application classes 1 and 2)

The following legislation, standards and guidelines are met:

DVGW
- DVGW registration for pipes and jointing techniques (all sizes).
- Permanently leak proof compression sleeve jointing technique according to DIN EN 806, DIN 1988 and DVGW-worksheet W 534 with DVGW registration.
- Suitable for applications with special hygiene requirements according to DVGW worksheet W270 (Reproduction of micro-organisms on materials for the drinking water area).

Standards, legislation, guidelines
- Universal pipes RAUTITAN stabil and RAUTITAN flex as well as RAUTITAN PX fittings have been tested to BS 6920.
- RAUTITAN fittings, which are in contact with drinking water, are made of PPSU.
  The compression sleeve metal fittings for drinking water applications provided by REHAU comply with the requirements according to the respectively valid issue of DIN 50930-6 (Corrosion of metals – Corrosion of metallic under corrosion load by water inside of Tubes, tanks and apparatus - Part 6: Influence of the composition of drinking water) and the used alloys are registed on the 4MS Common Composition List of accepted metallic materials published by UBA in Germany.

Approvals
- Universal pipes RAUTITAN stabil and RAUTITAN flex as well as RAUTITAN LX, RX RX+ and PX fittings carry WRAS or KIWA UK Reg4 approval.

04.03 Requirements of the drinking water

The drinking water must comply with the currently valid limits of the following standards:
- BS 6700
- National water supply regulations[1)]
- Council directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption

The fittings RAUTITAN RX+ are made of gunmetal and therefore especially corrosion resistant.
Nonetheless, there is no universal material which can be used for every application. Thus, different factors can influence the corrosion in the drinking water installation, regardless of the material used.

With the DZR fitting RAUTITAN MX, that was sold until 2013, corrosion can occur in some specific cases even though the water quality is within the permitted range of the drinking water regulation. The chloride concentration and the hydrogen carbonate concentration of the water have considerable influence on how aggressive the corrosion of brass is. High chloride concentrations combined with low hydrogen carbonate concentrations can negatively influence the corrosion behaviour. In such water supply regions we recommend the use of the stainless steel fittings RAUTITAN SX or RAUTITAN RX+ of gunmetal.
However, the interaction under the following factors, according to BS EN 12502-1:2004, also influence the corrosion resistance:
- Material properties (chemical composition, surface integrity)
- Water quality (physical and chemical properties, solid matter)
- Planning and execution (geometry, mix installation, connections)
- Leak test and initial start-up (purging, drainage, disinfection)
- Operating conditions (temperature, temperature changes, flow conditions)

1) The maximum allowed limits for disinfectants detailed in the drinking water regulation are not to be interpreted as permanent, lasting application concentrations. They represent the maximum short term limits defined under hygienic and toxicological aspects. Key principle of the drinking water regulation is to avoid any unnecessary addition of chemicals. Only if a chemical additive is required due to contamination may the minimum amount required be added.

The application of any water conditioning, like, for example, water softening, in principle, changes the corrosive-chemical behaviour of the water. To avoid corrosion damage due to an incorrect use and operation of a water treatment system, we explicitly recommend that you have your individual situation examined beforehand by an expert or, for example, by the system manufacturer.

In addition any existing practical experience about the water supplied in the area and its corrosion behaviour should be taken into account for assessing the likelihood of corrosion.

It is the responsibility of the system designer that the above-mentioned factors and parameters are taken into account when it comes to corrosion protection and stone formation in actual application.

Our Applications Department for RAUTITAN provides support if needed.

If the drinking water quality is outside the limits of the drinking water regulation, evaluation and approval must be obtained from our Applications Department prior to the installation / use of RAUTITAN.

In this case, please contact your REHAU sales office.

05 Drinking water hygiene

To comply with the requirements of the Water supply regulations and to avoid drinking water contamination several standards, directives and the generally recognized rules of technology have to be considered.

Different factors affect the drinking water installation hygiene. These factors , some basic rules and important advices for the correct design, execution and operation of a drinking water installation will be explained / described in the following chapter.

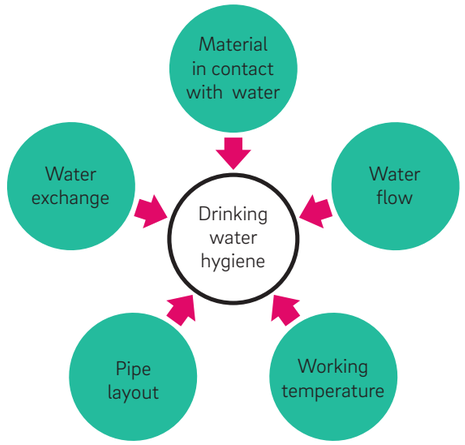


Fig. 05-1 Factors mainly affecting the drinking water hygiene

05.01 Hygienic properties of the plumbing system

Only use system components approved for drinking water applications.

This specifically means:
- use metals, which are in accordance with the DIN 50930-6 in the current edition and are listed in the 4MS Common Composition List of accepted metallic materials published by UBA in Germany.
- use polymeric materials, which do not negatively affect potable water or promote the proliferation of micro-organisms BS 6920.

All RAUTITAN components fulfil these requirements, which are part of the 3rd party approval schemes.

The o-ring free RAUTITAN compression sleeve jointing system, which is considered as cavity free / stagnation-free supports the drinking water hygiene.

05.02 Avoid water contamination

05.02.01 Important information on routing and designing the RAUTITAN system

Special concepts to maintain the drinking water hygiene are required for installations with more stringent hygienic requirements (hospitals, nursing homes etc.) or for public areas in which the intended working parameters cannot be continuously ensured (schools, hotels etc.). This may be e.g. the introduction of hygiene plans or more frequent inspections of the drinking water system.

A preventive, permanent or regular disinfection of a drinking water system is not allowed (see also chapter „05.03 Water contamination - Basic rules for a disinfection“, page 25).

- According to DIN 1988-200 if the volume of piping between the water heater outlet and the most distant draw-off point is > 3 l, a circulation system is to be provided (pipe length see Tab. 1-2).
- Branch and/or main branch pipes with a water volume ≤ 3 l, can be designed without circulation.
- The installation user has to be informed about the intended working parameters of the installation design.
- If the system operation is interrupted or in case of a permanent change to the system, the requirements according VDI/DVGW 6023 apply.
- Tab. 1-3, page 20, contains general, useful information about the design and execution of small plants or storey pipes.
  For detailed specifications and project-specific information, in particular for large-scale plants according DVGW W 551 please consult your sales office.

Diameter	Universal pipe RAUTITAN stabil stabil	Universal pipe RAUTITAN flex flex
16	ca. 31 m	ca. 28 m
20	ca. 19 m	ca. 18 m
25	ca. 12 m	ca. 12 m
32	ca. 7 m	ca. 7 m
40	ca. 5 m	ca. 4 m

Tab. 1-2 Length of RAUTITAN pipes with a water content of 3 l

Optimal water flow though the drinking water pipe

	Possible installation on the storey			
	T-piece-installation Execution example: see Fig. 05-2	Daisy-chain installation Execution example: see Fig. 05-3	Loop installation	Manifold installation
Selection criteria	▪ Regular and frequent use of each draw-off point	▪ Regular and frequent use of the last draw-off point	▪ Regular and frequent use of any draw-off point within the ring	▪ Regular and frequent use of each draw-off point
Useful information	▪ Design branch and main branch pipes as short and small as possible. ▪ Place draw-off points with an increased water consumption (such as e.g. “wellness shower”) close to the riser. ▪ Connect regularly used draw-off points (such as e.g. toilet with a flushing cistern) at the end of the storey pipe distribution.	▪ The allowed upper pipe volume of 3 l limits the available pipe length and is often critical in series installations (see Tab. 1-2). ▪ Place draw-off points with an increased consumption close to the riser (such as e.g. “wellness shower”). ▪ Connect regularly used draw-off point (such as e.g. toilet with a flushing cistern) at the end of the storey distribution. ▪ Place the connection pipe of rarely or infrequently used draw-off point (such as e.g. bidet) within the series installation.	▪ Due to the long pipe runs of this kind of installation, the max. time of 30 s to reach the allowed water temperature at the draw-off point (≥ 55 °C for hot water and ≤ 25 °C for cold water) has to be critically considered during the design. ▪ Flexible place of draw-off points in the loop is possible, as the entire loop is flushed during any drawing process.	▪ Design branch and main branch pipes as short and small as possible.

Prevent cold water pipes from excessive heating up
(The drawn cold water temperature must be ≤ 25 °C within 30 s)

In risers, suspended ceilings, in front-wall installations or in the floor place cold water pipes as far away as possible or in a separated area from hot-water and circulating pipes.
Avoid circulation pipes on a floor level, in order to reduce the permanent heat transfer into the building structure.
Ensure sufficient insulation of the cold water pipes (see chapter).

If mixer taps are directly connected to pipes permanently provided with warm water (e.g. circulating water),
do not use a double wall-mounted elbow to connect the mixer taps
connect the warm water main branch to the mixer tap using a single pipe with a sufficient length to avoid an excessive heating up of the mixer tap and the nearby cold water pipe (possible connection of mixer taps: see Fig. 05-4, page 22).

Avoid stagnation in the connecting pipe of rarely used draw-off points

Regularly flush out the branch pipe to rarely used draw-off points (such as e.g. garden water connection or the heating water refill connection) or ensure that the water is regularly flow through the pipe e.g. by laying the pipes as series or ring installation.
A simple solution for cold water in residential buildings will be explained in chapter 05.02.02, page 22.

Tab. 1-3 General and useful information about the design and execution of small plants or storey pipes

Fig. 05-2 T-piece installation witch branch pipe water content < 3 l: Example kitchen

Fig. 05-3 Daisy-chain installation with water content < 3 l: Example bath room

X Recommended values see table below

Fig. 05-4 Connection of mixer taps to pipe continuously provided with warm water - Example: Connection from top

Recommended values x[1)]

Connection from above	≥ 15 cm
Connection from side	≥ 30 cm
Connection from below	≥ 45 cm

1) Recommended values based on REHAU in-house measurements

05.02.02 Special application: Infrequently used outlets

Laying pipes as a ring installation is the commonly used solution to avoid stagnation in drinking water installation. As soon as water is drawn at an outlet, the water in the ring is set in motion. Even so, stagnation can occur in this kind of installation if water is not or at least rarely drawn. For example in the connection pipe to exterior garden tap or to a filling unit for heating installation.

In small installations this can be avoided connecting the ring to the cold water riser in a special manner. This solution requires only two T-pieces RAUTITAN PX or two bend t-pieces RAUTITAN RX+.

- Drinking water hygiene improvement when tapping points are not regularly used
- Used in combination with the wall mounted elbow with passage, enable the improvement of the water flow in ring installation
- Water is flushed through in the loop during water circulation in the riser without using moving parts
- Maintenance-free according to DIN EN 806-5 (no requirements concerning inspection)

05.02.02.01 Working principe

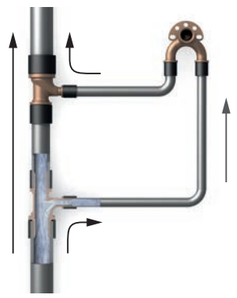


Fig. 05-5 Working principe of a loop installation with bend t-piece RAUTITAN RX+

At a defined minimal water flow in the riser the bypass pipe with a specified length between two t-pieces causes a pressure loss which generates the water circulation in the loop.

Other possible connections of the loop pipe

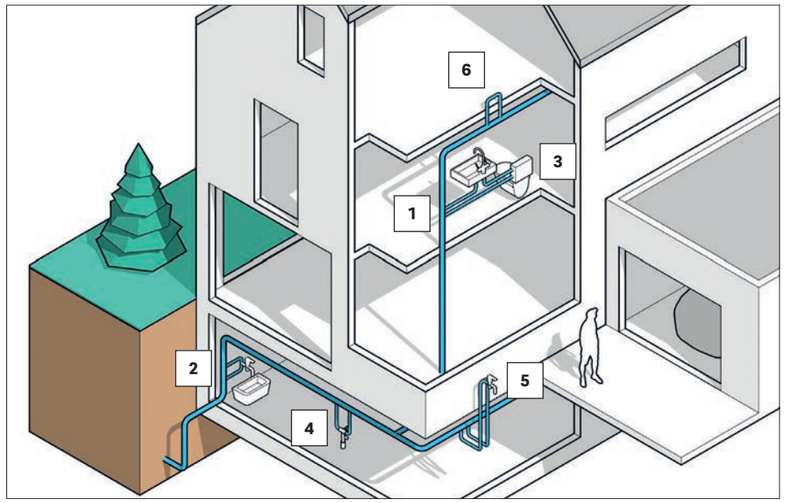
Fig. 05-6 Possible connections of the ring pipe

The loop pipe is joined to the riser with T-pieces (RAUTITAN RX+, RAUTITAN PX). Depending on the max. calculated water flow the riser diameter can be reduced or not.

05.02.02.02 Example of „infrequently used outlets“ in residential building

The solution from REHAU is particularly aimed at the water supply of infrequently used outlets in cold water installions in small residential buildings.

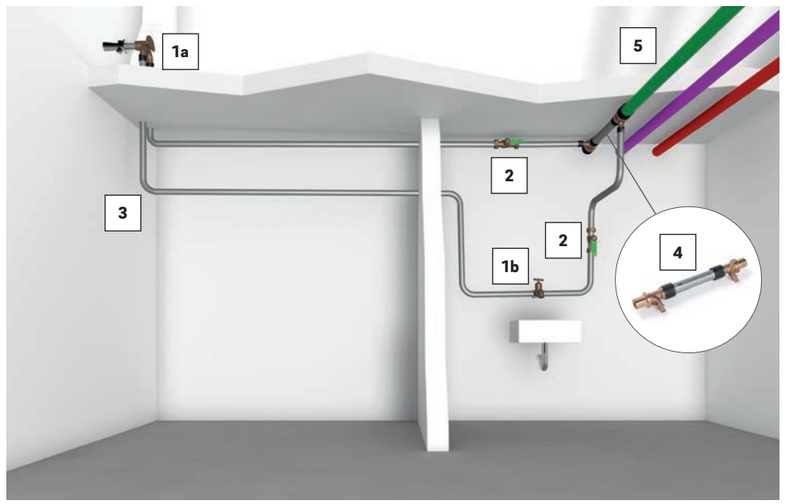
In larger buildings, like e.g. sport facilities, hotels, hospitals or schools the water supply and circulation of cold and hot water have to be independent from the effective water consumption. For that, special fittings or automatic flushing devices have to be used.
For detailed information about these solutions and their use please contact your sales office.



1 Standard T-piece
2 Utility room
3 Guest WC
4 Top-up Heating System
5 Garden tap
6 Possible future system extension

Fig. 05-7 „Infrequently used outlets“ in residential building

05.02.02.03 „Not regularly used tapping points“: Application in detail



1 Infrequently used outlet
1a Exterior water tap (frost protected tap)
1b Sink
2 Low pressure isolation valve (ball valve)
3 Pipe elbow
4 Swept Tee pieces with smaller bypass piece
5 Distribution line (cold water)

Fig. 05-8 Laying of an exterior water tap and a sink in cellar

05.02.02.04 Application limitations and boundary conditions of use

- Application for max. 2 outlets in the loop.
- Keep the pressure loss in the loop as low as possible.
- Only bend the pipe (without fitting).
- Use of low pressure isolation valves (e.g. ball valve instead of valve).
- Available only for cold water application.
- Observe the max. ring loop length. If necessary the size diameter of the loop has to be increased (considering the response time!) or the loop has to be split.

The sizing tables (see Chapter „05.02.02.05 Design") don't replace the sizing and design of the drinking water installation with a suitable design programm like RAUCAD. They only attempt to enable the correct choice and use of the system components considering the size of the loop and the riser.

The correct use of the riser including a sufficient flow rate has to be ensured. With this in mind, the design parameters have to be observed:
Flow rate in the riser > 1 m/s during at least 90 seconds per day

The volume flow rates given in Tab. 1-4 correspond to a flow rate of 1 m/s:

Riser size	Min. volume flow rate
20	0.16 l/s
25	0.25 l/s
32	0.42 l/s
40	0.66 l/s

Tab. 1-4 Riser size and min. volume flow rate

If necessary automatic flushing devices with programmable hygienic flushing or sanitary devices with a high and regular water consumption (like e.g. shower or WC-flush) have to the installed at the end of the riser.

05.02.02.05 Design

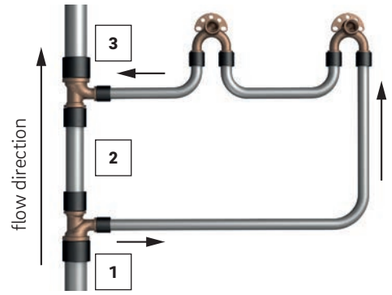


Fig. 05-9 working principe: pipe loop with swept-t-piece RAUTITAN RX+

1 Bypass entry
2 Bypass pipe
3 Bypass exit outlet

Ring
The max. loop length shall not exceed following values:

Ring size	Max. length
16	15 m
20	20 m

Tab. 1-5 Max. loop length

Bypass pipe and fitting sizes
Following parameters apply:

Bypass entry	Bypass pipe		Bypass outlet
Size	Size	Length [mm]	Size
20	16	100	16 or 20
25	20	100	20 or 25
32	25	150	25 or 32
40	32	200	32 or 40

Tab. 1-6 Bypass pipe and fitting sizes

05.03 Water contamination - Basic rules for a disinfection

Due to incorrect design, installation and operation, through prolonged stagnation or substandard water quality (e.g. wastewater, floodwater, maintenance works on the piping network), contamination can occur. Furthermore, damage to the piping network, e.g. a supply line with external water inflow, can be the cause of possible contamination. The requirements of the work sheets DVGW W551, DVGW W556, W557 as well as BS PD 855468:2015 and HSG274 Part 2:2014 have to be considered while desinfecting a drinking water installation.

The disinfection of a drinking water installation is only necessary in exceptional cases (in the case of contamination) and all operational and structurally engineered system deficiencies are to be rectified first. Repeated or constant bacterial contamination of the water in a domestic installation is often caused by the method of installation (e.g. dead legs) or by the method of operation (e.g. long stagnation periods) and does not justify continuous disinfection.

05.03.01 Thermal disinfection in the case of contamination

For drinking water installations in compliance with the latest technical standards dirt can be removed by flushing thoroughly with water as long as the dirt is water-soluble or remains soluble in water.

If contamination is suspected, an additional thermal shock disinfection as per DVGW worksheet W 551 or HSG274 Part 2 is both possible as an urgent measure and sensible. According to the latest technical standards, water temperatures of at least 70 °C are most likely to kill off germs and bacteria, including legionella, found freely in water. It is important that appropriate measures are taken to ensure people are not scalded.

All piping of the RAUTITAN universal system for drinking water and heating are suitable for repeated thermal disinfection according to the DVGW-worksheet W 551 at 70 °C. It must be ensured that the allowable operating pressure is not exceeded during thermal disinfection.

05.03.02 Chemical disinfection in case of contamination

Decontamination processes include alongside thermal disinfection also more and more chemical disinfection. Chemical and thermal disinfection measures always put the materials used in the drinking water installation under stress. It is industry wide accepted, that some disinfection methods are not suitable for materials commonly used in plumbing/heating installations. This also applies to materials, for which it was previously assumed that they were sufficiently corrosion-resistant, e.g. non-rusting steel, copper and some synthetic materials.

Before introducing these types of measures, it needs to be ensured that all parts of the installation system are thermally and chemically suited for the corresponding measure. This is regulated by the DVGW worksheet W 551. If necessary, please have the suitability of the disinfectant approved by the disinfectant's manufacturer for all system parts of the installation.

05.03.02.01 Discontinuous chemical disinfection

For short-term chemical disinfections (discontinuous) only special biocides may be used which are specified in corresponding rules and standards.

Carrying out the disinfection process according to the specifications of the DVGW worksheet W 557 or BS PD 855468:2015 and HSG274 Part 2:2014 can be done without affecting the functionality of a REHAU drinking water installation if the agents, concentrations, application durations and maximum temperatures, as listed in Tab. 1-7, are observed.

It should be noted that combined thermal-chemical disinfection at temperatures of higher than 25 °C, as well as permanent or regular disinfection cycles (e.g. monthly), are not permitted. In relation to the life span of the piping, the total number of disinfection cycles is limited to five discontinuous cycles. Otherwise, it cannot be guaranteed that the specified lifespans will be achieved.

The person carrying the disinfection out must guarantee that water is not used for human consumption (e.g. as drinking water) at any time during the disinfection phase, including the subsequent rinsing phase.

Description	Commercial size and packing	Storage	Safety advice[1)]	Max. application concentration[2)] application duration and temperature in the piping
Hydrogen peroxide H_2O_2	Hydrous solution in various concentrations	Light-protected, cool, avoid contamination at all costs	With >5 % solutions, protective equipment necessary	150 mg/l H_2O_2 Max. 24 h T_{max} ≤ 25 °C
Sodium hypochlorite NaOCl	Hydrous solution with maximum 150 g/l chlorine	Light-protected, cool, sealed and in a collecting reservoir	Alkaline, corrosive, toxic, protective equipment necessary	50 mg/l chlorine Max. 12 h T_{max} ≤ 25 °C
Chlorine dioxide ClO_2	Two components (Sodium chloride, sodium peroxide sulphate)	Light-protected, cool and sealed	Oxidizing effect, do not inhale chlorine dioxide, protective equipment necessary	6 mg/l ClO_2 Max. 12 h T_{max} ≤ 25 °C

1) The corresponding notes in the safety data sheets of the manufacturer must be considered.
2) REHAU approval; this value must not be exceeded at any time anywhere in the installation during the entire disinfection process.
Tab. 1-7 Discontinuous disinfection, active agents and concentrations according to for example DVGW W557

05.03.02.02 Continuous chemical disinfection

We cannot recommend using continuous dosing systems for chemical disinfection in domestic installations, especially as a measure for legionella prevention, due to the possible material damages of installation components which may occur. We cannot provide any guarantees in such cases.

Sometimes it may be the case that chemical disinfection is necessary for a prolonged period of time, until any structural refurbishment work has been completed. These disinfection measures may only be carried out if a permitted method is used. The parameters listed in Tab. 1-8 must be monitored and documented for the full duration of the disinfection process, immediately after the dosing point. The parameters according to Tab. 1-8 can be applied to the system RAUTITAN for drinking water applications.

Description1[)]	Max. application concentration[2)]	Max. application duration in the piping[3)]	Application temperature in the piping
Chlorine Cl_2	Max. 0.3 mg/l Free chlorine	4 months	60 °C
Chlorine dioxide ClO_2	Max. 0.2 mg/l ClO_2	4 months	60 °C

1) The corresponding notes in the safety data sheets of the manufacturer must be considered.
2) REHAU approval; must not be exceeded at any time anywhere in the installation during the entire disinfection process.
3) Maximum application duration, accumulated over the entire system life span

Tab. 1-8 Prolonged chemical desinfection, active agent and concentration according to drinking water regulation 2011

In relation to the life span of the pipe, the total disinfection time is limited to four months. In case of longer times the life span of the pipes can be reduced. We generally exclude disinfecting agents other than those listed for use with our pipes, particularly strong oxidizing agents (e.g. ozone).

ⓘ

Chemical and thermal disinfection procedures which are carried out incorrectly can permanently damage components in the drinking water installation.
Prior to commencing any such procedures, all parts of the installation must be checked if they are thermally and chemically suited to the selected method. If in doubt please obtain the confirmation from the manufacturer of the disinfecting agent.
With thermal disinfection, it is important that the appropriate measures be taken to ensure that people are not scalded.
When carrying out discontinuous chemical disinfection it must be guaranteed that water is not used for human consumption (e.g. as drinking water) at any time during the disinfection phase, including the subsequent flushing phase.
The safety advice of the disinfectant manufacturers must be observed.

06 Assembly components

⚠

Installing incorrect connection components can lead to damage or destruction of the connection components.
- Do not mix up the RAUTITAN connection components with the underfloor heating/cooling connection components (e.g. system transitions made of stainless steel).
- Please note the dimensions on the connection components.
- Do not use any RAUTITAN system fittings, which are marked on the packaging as heating fittings, in the drinking water installation (e.g. radiator elbow connection sets, radiator tee connection sets, cross fittings).
- You can find the precise allocation of the connection components in the current price list.

06.01 Flush-mounted and surface mounted installation

Fig. 06-1 Bracket range

Bracket range for RAUTITAN elbows and fitting connections
- With noise insulating plate
- Rigid and flexible execution
- Galvanised steel
- Easy handling
- Brackets pre-bent in the factory
- For various applications
- Universal bracket as a universal solution for special bracket shapes

Connections in surface mounted installation with RAUTITAN elbows
- For the connection to the assembly elements
- For gypsum plasterboards
- For flush-mounted flushing cisterns
- For wood particle boards

Fig. 06-2 RAUTITAN elbow with insulating box Rp½

RAUTITAN elbow for fitting onto the bracket range
- In various sizes and lengths
- With different connecting threads
- Each attachable with 45° left or right offset
- Insulating box for RAUTITAN Rp ½ elbows

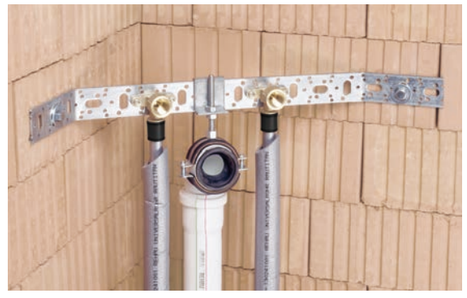


Fig. 06-3 Installation example: Universal bracket

06.02 Surface mounting

Fig. 06-4 Pipe support channel

Fig. 06-5 Universal pipe RAUTITAN flex clipped into pipe support channel

- The universal pipe RAUTITAN stabil is particularly suitable for surface mounting:
  - Easy to bend
  - Resistant to deformation
- For surface mounting of RAUTITAN flex pipes, we recommend the use of REHAU pipe support channels.

Benefits of using the pipe support channel with RAUTITAN flex pipes:

- Increased resistance to deformation of the flexible pipes
- Uniform spacing of the pipe fastenings for all pipe sizes at intervals of 2.0 m
- Reduction of the thermal expansion/contraction
- Stabilises pipes against sagging and sideways bending
- Visually attractive installation in exposed areas
- Simple assembly
- Self-supporting, is clipped onto the pipe
- No additional fastening (e.g. cable ties, insulating tape) required

06.03 Bracket range examples

06.03.01 Example: Bathroom

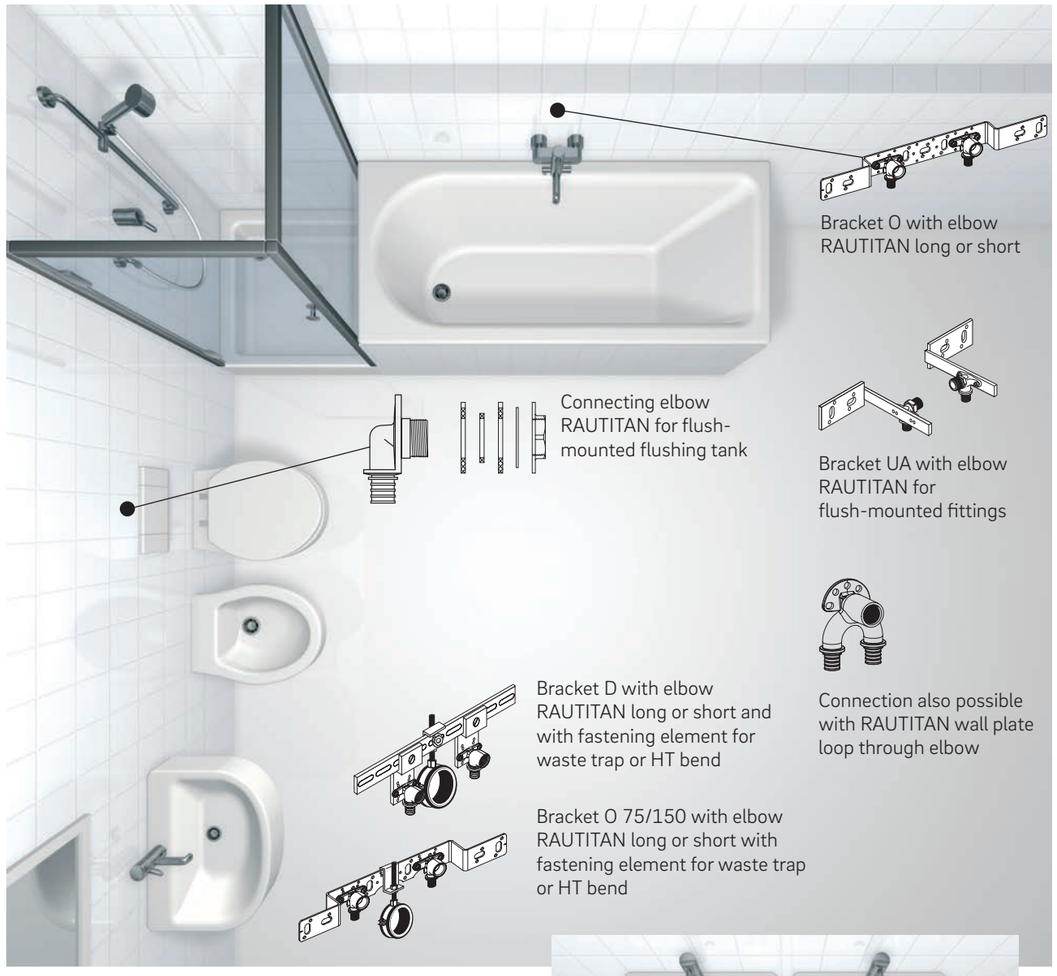


Fig. 06-6 Bracket range in the bathroom and WC

With the bracket range, connections for fittings or plumbing items can be secured in place quickly, reliably and easily.

06.03.02 Example: Kitchen

Fig. 06-7 Bracket range in the kitchen

06.03.03 Example: Guest bathroom

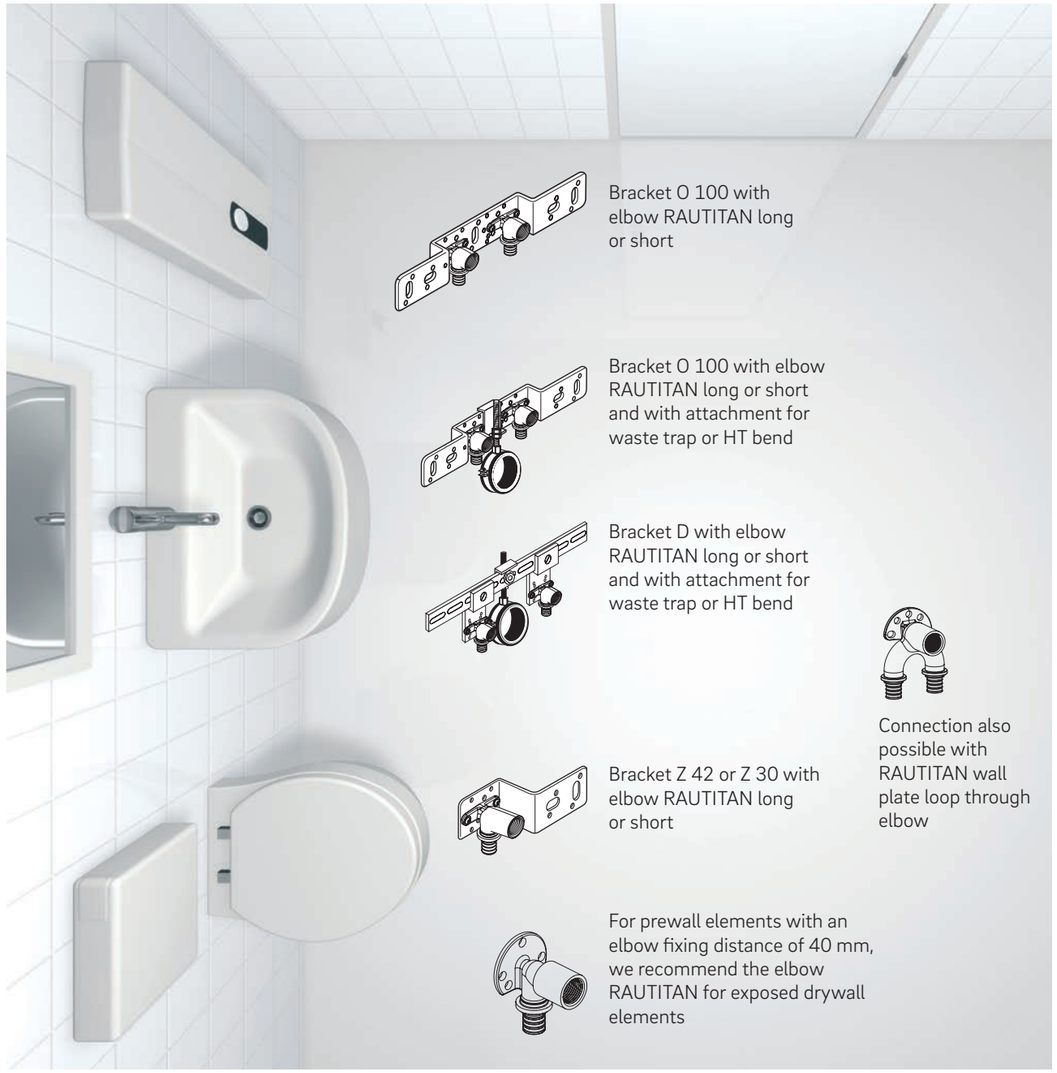


Fig. 06-8 Bracket range in the guest bathroom

07 Connecting to water heaters

07.01 Instantaneous electrical water heaters

The listed electrical instantaneous water heaters (see Tab. 1-9) can be combined with the RAUTITAN system according to the manufacturer's specifications. Please note the technical data of the respective device manufacturer (maximum pressure and maximum temperature during operation as well as when there are faults) and the maximum operating parameters of the RAUTITAN system.

Manufacturer	Description	Power [kW]				Control/ Regulation
AEG	DDLE XX*	18	21	24	27	electronic
CLAGE	DBX	18	21	24	27	electronic
CLAGE	DCX	18	21	24	–	electronic
CLAGE	DEX	18	21	24	27	electronic
CLAGE	DSX	18	21	24	27	electronic
Junkers	ED XX*-2 S	18	21	24	–	hydraulic
Siemens	Typ DE XX* 415	18	21	24	27	electronic
Siemens	Typ DE XX* 515	18	21	24	27	electronic
Siemens	Typ DE XX* 555	18	21	24	27	electronic
Stiebel Eltron	DEL XX* SL	18	21	24	27	electronic
Stiebel Eltron	DHE XX* SL	18	21	24	27	electronic
Vaillant	e VED	18	21	24	27	electronic
Vaillant	e VED plus	18	21	24	27	electronic
Vaillant	e VED exclusive	18	21	24	27	electronic

XX* = The respective power rating in kW is indicated here in the product description

Tab. 1-9 Electrical instantaneous water heaters suitable for RAUTITAN, version July 2015, provided for initial selection without obligation, subject to technical modification from appliance provider

07.02 Instantaneous gas water heaters

Not all Instantaneous gas water heaters are suitable for direct connection to plastic pipes. With these units, inadmissibly high pressures and temperatures can arise if a fault occurs.

Always observe the specifications of the equipment manufacturer.

Approval for the connection of gas instantaneous water heaters to the RAUTITAN universal system for drinking water and heating can only be issued by the equipment manufacturer.

07.03 Hot water tanks

The RAUTITAN universal system for drinking water and heating can be used for hot water tanks with a maximum water temperature of 70 °C in continuous operation.

Instantaneous electrical or gas water heaters and other water heaters which are not approved in this Technical Information for use with the RAUTITAN universal system for drinking water and heating, must be approved by the respective manufacturer. The selected type of pipe and its field of application must be observed.

07.04 Solar thermal systems

The RAUTITAN universal system for drinking water and heating can be used for water heating with solar thermal systems at a maximum water temperature of 70 °C in continuous operation.

Suitable measures must be taken (e.g. mixer for regulating the hot water temperature) to ensure the temperature cannot be exceeded.

For this reason, the RAUTITAN system is only suitable for conveying drinking water with a regulated hot water temperature (max. 70 °C) from the mixer outlet.

08 Pressure testing and flushing

08.01 Guidelines for pressure testing

The successful execution and documentation of a pressure test is a prerequisite for any claims under the REHAU warranty.

Deviations to BS EN 806 concerning the pressure and leak tightness test have to be agreed with the building owner and if necessary have to be stipulated by contract.

According to BS EN 806-4, a pressure test must be conducted on the completed but not yet concealed piping before commissioning.

Conclusions as to the leak tightness of the system can only be drawn in a limited way from the actual pressure test curve (steady, dropping, rising).

- The leak-tightness of the system can only be checked by performing a visual examination of unconcealed lines.
- Micro leaks can only be located by performing a visual examination (water outlet or leak detection agent) at high pressure.

Subdividing the piping system into smaller test sections increases the test accuracy.

All completed pipe and thread connections that remain permanently inaccessible or concealed shall be tested during the pressure test.

Following the pressure test, only fittings and connection components with their sealing surface still accessible in front of the finished wall (e.g. tiles, plaster) may be connected. These fitting connections must be checked for leaks after commissioning.

The following instructions are based on the information sheet „Dichtheitsprüfung von Trinkwasser-Installationen mit Druckluft; Inertgas oder Wasser" from ZVSHK.

08.02 Leak test of drinking water installations with water

08.02.01 Preparing for pressure test with water

1. Pipes need to be accessible and shall not be concealed.
2. Disconnect safety devices and meters as necessary and replace with pipes or pipe stoppers.
3. Fill the pipes at the lowest point of the system with filtered drinking water until free of air.
4. Vent the outlets until water runs free of air.
5. Use a pressure pump with a measurement precision of 100 hPa (0.1 bar) for the pressure test.
6. Connect the pressure testing device to the lowest point on the drinking water installation.
7. Close all outlets carefully.

The pressure test can be significantly influenced by temperature fluctuations in the piping system, e.g. a temperature change of 10 K can cause a pressure change of 500 hPa to 1000 hPa (or 0.5 to 1 bar).

Due to the pipe material properties (e.g. pipe elongation when there is increased pressurisation), the pressure can fluctuate during the pressure test.

The test pressure as well as the pressure changes which occur during testing do not permit any sufficient conclusions as to the leak-tightness of the system. For this reason, the entire drinking water installation, as required in the standards, must be visually checked for leaks.

8. Ensure that the temperature remains as constant as possible during the pressure test.
9. Prepare the pressure test certificate (see page 37) and note the system data.

08.02.02 Pressure test for installations with RAUTITAN stabil and installations with RAUTITAN stabil pipes mixed with metal pipes

stabil

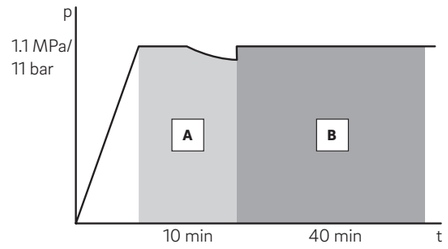


Fig. 08-1 Pressure test based on ZVSHK-information sheet for RAUTITAN stabil

[A] Adaptation time (if necessary restore the pressure)
[B] Pressure test for installations with RAUTITAN stabil and installations with RAUTITAN stabil pipes mixed with metal pipes

1. Build up slowly the test pressure of 1.1 MPa (11 bar) in the drinking water installation.
2. If the difference between ambient temperature und water temperature is higher than 10 k than the pressure test can only begin after a waiting time of 30 minutes to achieve the temperature balance between the room and the water installation.
3. After 10 minutes read the test pressure and if necessary restore the pressure of 1.1 MPa (11 bar).
4. Note down the test pressure in the pressure test certificate.
5. After a test period of 30 more minutes, note down the test pressure in the pressure test certificate.
6. Perform visual checks for leaks on the entire drinking water installation, especially on the connection area.

In case of a pressure drop:
- Repeat a thorough visual inspection of the intslla-tion, outlets and joints.
- After resolving the cause of the pressure drop, repeat the pressure test (steps 1 – 6).

7. If no leaks are found during the visual check, than the pressure test is complete.

08.02.03 Pressure test for installations with RAUTITAN flex and installations with RAUTITAN flex pipes mixed with RAUTITAN stabil pipes or metal pipes

flex

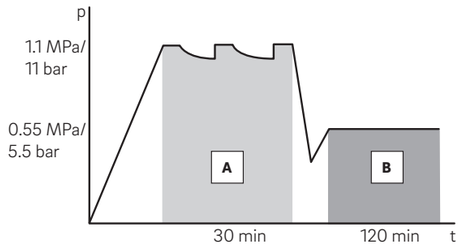


Fig. 08-2 Pressure test based on ZVSHK-information sheet for RAUTITAN flex

[A] Adaptation time (if necessary restore the pressure)
[B] Pressure test for installations with RAUTITAN flex and installations with RAUTITAN flex pipes mixed with metal pipes

1. Build up slowly the test pressure of 1.1 MPa (11 bar) in the drinking water installation.
2. The test pressure has to be maintained at 11 bar during 30 minutes. If necessary restore the test pressure regularly.
3. After 30 minutes, note down the test pressure in the pressure test record.
4. Check the entire drinking water installation, particularly the joints, for leaks by visual inspection.
5. Slowly lower the test pressure from 1.1 MPa (11 bar) to 0.55 MPa (5.5 bar) and note it down in the pressure test certificate.
6. After a waiting time of 2 hours note down the test pressure in the pressure test certificate.
7. Check the entire drinking water installation, particularly the joints, for leaks by visual inspection.

In case of a pressure drop:
- Repeat a thorough visual inspection of the piping, outlets and joints.
- After resolving the cause of the pressure drop, repeat the pressure test (steps 1 – 7).

8. If no leaks are found during the visual check, than the pressure test is complete.

08.02.04 Completion of the pressure test with water

After completion of the pressure test:
1. Confirm the pressure test in the pressure test certificate by the installer and client.
2. Disconnect the pressure test unit.
3. After the pressure test, thoroughly flush the drinking water pipes for hygiene purposes (see chapter 08.04, page 36).
4. Reinstall all removed safety devices and meters.

08.03 Pressure test with oil free compressed air or inert gas

Important information on tests with compressed air and inert gas:
- Small leaks can only be detected using leak detection agents at high test pressures (load test) and the corresponding visual inspection.
- Temperature fluctuations can affect the test result (pressure drop or increase).
- Compressed air and inert gas are compressed gases. This means that thepipe volume has a significant impact on the recorded test pressure. A large pipe volume reduces the chances of detecting small leaks base don a pressure drop.

⚠

Leak detection sprays
Only use leak detection sprays (e.g. foaming agents) with current DVGW registration, which were also approved by the respective manufacturers for the PPSU and PVDF materials.

08.03.01 Preparing for pressure test with oil free compressed air or inert gas

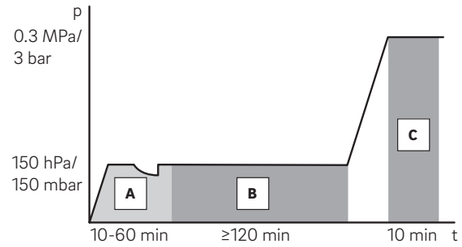


Fig. 08-3 Pressure test for pressure test with compressed air or inert gas

[A] Adaption time, see Tab. 1-10
[B] Leak test
[C] Load test

Pipe volume	Adaption time[1)]	Test time[1)]
< 100 l	10 min	120 min
≥ 100 < 200 l	30 min	140 min
≥ 200 l	60 min	+ 20 min per 100 l

1) Approximate values, depending on the pipe volume
Tab. 1-10 Pipe volume, adaption time and test time

1. Pipes need to be accessible and shall not be concealed.
2. Disconnect safety devices and meters as necessary and replace them with pipes or pipe stoppers
3. Install enough air vents in appropriated places to allow a safe drain of the compressed air.
4. Use a pressure testing device with a measurement precision of 1 hPa (1 mbar) for the pressure test.
5. Close all outlets carefully.

ⓘ

The test pressure as well as the pressure curve during testing do not permit any sufficient conclusions as to the leak-tightness of the system. For this reason, the entire drinking water installation, as required in the standards, must be visually checked for leaks with leak detection sprays.

6. Ensure that the temperature remains as constant as possible during the pressure test.
7. Prepare the pressure test certificate (see page 37) and note the system data.

08.03.02 Leak test

1. Choose the adaption and test time according to Tab. 1-10.
2. Build up slowly the test pressure of 150 hPa (150 mbar) in the drinking water installation. If necessary restore the test pressure after adaptation time.
3. The leak test begins after the adaptation time: Note down the test pressure and the test time in the pressure test certificate.
4. After the test time, note down the test pressure in the pressure test certificate.
5. Check the entire drinking water installation, particularly the joints, for leaks by visual inspection with leak detection sprays.

In case of a pressure drop:
- Repeat a thorough visual inspection of the pipes, outlets and joints.
- After resolving the cause of the pressure drop, repeat the pressure test.

6. If no leaks are found during the visual check, than note the visual inspection in the pressure test certificate.

08.03.03 Load test

1. Build up slowly the test pressure of 0.3 MPa (3 bar) in the drinking water installation.
2. If necessary restore the test pressure after stabilisation of the pressure of 0.3 MPa (3 bar).
3. Note down the test pressure in the pressure test certificate.
4. After 10 minutes, note down the test pressure.
5. Perform visual checks for leaks on the entire drinking water installation, especially on the connection area.

If a leak has been detected during the visual inspection:
- Repare the pipe and repeat the leak and load tests.

6. If no leak has been found during the visual check, than note the visual inspection in the pressure test certificate.
7. After the load test, release the compressed air in a safe way.

08.03.04 Completion of the pressure test with compressed air or inert gas

After completion of the pressure test:
1. Confirm the pressure test in the pressure test certificate by the installer and the client.
2. Disconnect the pressure test unit.
3. After the pressure test, thoroughly flush the drinking water pipes for hygiene purposes (see chapter 08.04, page 36).
4. Reinstall all removed safety devices and meters.

08.04 Flushing drinking water pipes

According to BS EN 806-4 , BS PD 855468-2015 the ZVSHK-information sheet “Flushing, disinfection and commissioning of drinking water installations” dirt from the storage and construction phase has to be flushed out. For that all outlets have to be opened in a defined order and for several minutes.

According to BS EN 14291, residues of leak detection sprays must be rinsed off with water.

According to BS EN 806-4, the time-consuming flushing of the piping with a mixture of air and water is an alternative to a flush with drinking water. But according to ZVSHK information sheet “Flushing, disinfection and commissioning of drinking water installations” it only applies if the flushing with drinking water isn’t enough efficient or if coarse dirt is visible in the piping.

For hygiene reasons or if frost can occur we recommend to fully drain the drinking water installation, if it can not be immediately put into operation. Flush the drained system thoroughly before commissioning. According to BS EN 806-4, the flushing of the installation has to be periodically repeated for hygiene reasons if water remains in the piping a long time before commissioning.

08.05 Pressure test certificate: REHAUS’s RAUTITAN system (drinking water installation)

The templates for pressure test certificate for a pressure test of a drinking water installation can be found on the following pages.

Pressure test certificate: REHAU’s RAUTITAN system (drinking water installation). Test based on the ZVSHK information sheet

Form: Pressure test with water

1. System data

Building projekt: _____

Client: _____

Adress/House No.: _____

Post Code/Town/City: _____

2. Pressure test

stabil **Installation with RAUTITAN stabil (also mixed with metal pipes)**		flex **Installation with RAUTITAN flex (also mixed with RAUTITAN stabil or metal pipes)**	
ΔT	_____ K ($\Delta T = T_{ambient} - T_{water}$)	Test pressure	_____ MPa (maximal operating pressure 1 MPa x 1.1 = 1.1 MPa (11 bar))
Test pressure	_____ MPa (maximal operating pressure 10 MPA x 1.1 = 1.1 MPA (11 bar))	Waiting time	_____ min (min. waiting time 30 minutes)
Adaption time	_____ min 10 minutes if ΔT ≤ 10 K 40 minutes if ΔT > 10 K	Test pressure	_____ MPa (maintain the test pressure of 1.1 MPa (11 bar), if necessary restore the test pressure regularly)
Test pressure	_____ MPa (if necessary restore the test pressure of 1.1 MPA (11 bar))		
☐ Visual inspection on the entire drinking water installation, especially on the connection area completed and no leak detected		☐ Visual inspection on the entire drinking water installation, especially on the connection area completed and no leak detected	
Test time	_____ min (min. test time = 30 minutes)	Leak test	
Pressure after 30 min	_____ MPa	Test pressure	_____ MPa (0.55 MPa (5.5 bar))
		Test time	_____ min (120 min.)
		Pressure after 120 min	_____ MPa

3. Comments

_____

_____

☐ Entire drinking water installation, especially joints, checked visually for leak-tightness and no leaks found.

☐ The entire drinking water installation is leak-tight.

4. Confirmed

For the client: For the contractor:

Town/City: Date:

Attachments:

Pressure test certificate: REHAU's RAUTITAN system (drinking water installation). Test based on the ZVSHK information sheet

Form: Pressure test with air or inert gas

1. System data

Building projekt: _____

Client: _____

Adress/House No.: _____

Post Code/Town/City: _____

2. Leak test

Test medium: ☐ Oil free compressed air ☐ Azote ☐ Carbon dioxyde ☐ _____

2.1 Test pressure _____ mbar (150 mbar = 150 hPa)

2.2 Pipe volume _____ l

2.3 Adaption time _____ min.

2.4 Current pressure _____ mbar (150 mbar = 150 hPa)

2.5 Test time _____ min.

2.6 Current pressure _____ mbar (150 mbar = 150 hPa)

Pipe volume	Adaption time[1)]	Test time[1)]
< 100 l	10 min	120 min
≥ 100 < 200 l	30 min	140 min
≥ 200 l	60 min	+ 20 min per 100 l

1) Approximate values, depending on the pipe volume

☐ Visual inspection with leak detection sprays on the entire drinking water installation, especially on the connection area completed and no leak detected.

3. Load test

3.1 Test pressure _____ MPa (0.3 MPa (3 bar))

3.2 Current pressure after 10 min _____ MPa

3.3 Comments:

_____

_____

☐ Visual inspection with leak detection sprays on the entire drinking water installation, especially on the connection area completed and no leak detected.

☐ The entire drinking water installation is leak-tight.

4. Confirmed

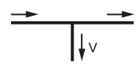
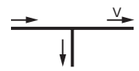
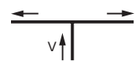
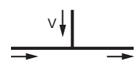
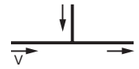
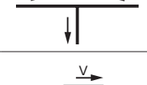
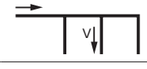
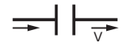
For the client: For the contractor:

Town/City: Date:

Attachments:

09 Resistance coefficients and Pressure loss tables

09.01 Resistance coefficients (zeta values ζ) of the REHAU RAUTITAN fittings according to DVGW W 575 (extract)

No.	Fittings[1)]	Short sign acc. DVGW W 575	Graphica[2)], simplified representation	Resistance coefficient ζ						
				Pipe outer diameter d_a [mm]						
				16	20	25	32	40	50	63
				DN 12	DN 15	DN 20	DN 25	DN 32	DN 40	DN 50
1	Equal Tee RAUTITAN Splitting branch flow	TA		3.8	3.6	4.4	3.8	4.2	1.3	1.4
2	Equal Tee RAUTITAN Through flow with splitting branch flow	TD		1.0	0.9	1.1	0.9	1.0	0.2	0.2
3	Equal Tee RAUTITAN Reverse branch flow splitting	TG		3.9	3.8	4.5	3.9	4.4	1.1	1.3
4	Equal Tee RAUTITAN Reverse branch flow joining	TVA		9.0	8.0	8.6	6.3	7.2	1.7	1.7
5	Equal Tee RAUTITAN Through-flow with joining branch flow	TVD		17.3	13.5	16.4	12.2	14.2	2.9	3.1
6	Equal Tee RAUTITAN Counter flow combined in branch	TVG		9.8	9.2	9.6	7.3	8.5	1.9	1.8
7	Elbow 90°	W90		3.7	3.6	4.1	3.6	4.2	0.7	0.6
8	Elbow 45°	W45		–	1.2	1.8	1.1	1.7	0.4	0.4
9	Reducing coupling (reduced by one dimension)	RED		0.6	0.6	0.6	0.6	0.5	0.2	–
10	Wall plate elbow	WS		1.5	1.6	1.5	–	–	–	–
11	Loop through elbow - through flow	WSD		1.4	1.1	2.8	–	–	–	–
12	Loop through elbow - outlet	WSA		1.8	1.9	3.5	–	–	–	–
13	Manifold with compression sleeve ports	STV		1.0	1.1	–	–	–	–	–
14	Straight coupling (unreduced)	K		0.6	0.6	0.7	0.6	0.6	0.2	0.1

1) For reduced T-piece, the resistance coefficient of a T-piece equal with the smallest size is used

2) The symbol v for flow velocity indicates the reference flow in the fitting

The resistance coefficients (ζ values) of the table are only an extract of the RAUTITAN fitting product range. The resistance coefficients of the complete product range have been integrated to the REHAU design software. The resistance coefficients of individual fittings RAUTITAN PX, RAUTITAN RX+ and RAUTITAN SX are available on request.

09.02 Pressure loss table: Drinking water installation RAUTITAN stabil 16–40

stabil

RAUTITAN stabil	16.2 x 2.6		20 x 2.9		25 x 3.7		32 x 4.7		40 x 6.0	
V̇	R	v	R	v	R	v	R	v	R	v
l/s	hPa/m	m/s	hPa/m	m/s	hPa/m	m/s	hPa/m	m/s	hPa/m	m/s
0.10	16.5	1.1	4.9	0.6	1.8	0.4	0.5	0.2	0.2	0.2
0.15	33.7	1.6	9.9	0.9	3.6	0.6	1.1	0.4	0.4	0.2
0.20	56.2	2.1	16.5	1.3	5.9	0.8	1.8	0.5	0.6	0.3
0.25	83.8	2.6	24.4	1.6	8.7	1.0	2.6	0.6	1.0	0.4
0.30	116.4	3.2	33.8	1.9	12.0	1.2	3.6	0.7	1.3	0.5
0.35	153.8	3.7	44.5	2.2	15.8	1.4	4.8	0.9	1.7	0.6
0.40	196.0	4.2	56.6	2.5	20.1	1.6	6.0	1.0	2.2	0.6
0.45	243.0	4.7	70.0	2.8	24.8	1.8	7.4	1.1	2.7	0.7
0.50	294.7	5.3	84.6	3.2	29.9	2.1	9.0	1.2	3.2	0.8
0.55	351.1	5.8	100.6	3.5	35.5	2.3	10.6	1.4	3.8	0.9
0.60	412.1	6.3	117.8	3.8	41.5	2.5	12.4	1.5	4.4	1.0
0.65	477.7	6.8	136.3	4.1	47.9	2.7	14.3	1.6	5.1	1.1
0.70	–	–	156.1	4.4	54.8	2.9	16.3	1.7	5.8	1.1
0.75	–	–	177.0	4.7	62.1	3.1	18.5	1.9	6.6	1.2
0.80	–	–	199.3	5.1	69.8	3.3	20.8	2.0	7.4	1.3
0.85	–	–	222.7	5.4	77.9	3.5	23.2	2.1	8.2	1.4
0.90	–	–	247.4	5.7	86.5	3.7	25.7	2.2	9.1	1.5
0.95	–	–	273.3	6.0	95.4	3.9	28.3	2.4	10.0	1.5
1.00	–	–	300.5	6.3	104.8	4.1	31.0	2.5	11.0	1.6
1.10	–	–	–	–	124.8	4.5	36.9	2.7	13.1	1.8
1.20	–	–	–	–	146.3	4.9	43.2	3.0	15.3	1.9
1.30	–	–	–	–	169.5	5.3	49.9	3.2	17.7	2.1
1.40	–	–	–	–	–	–	57.1	3.5	20.2	2.3
1.50	–	–	–	–	–	–	64.8	3.7	22.9	2.4
1.60	–	–	–	–	–	–	72.9	4.0	25.7	2.6
1.70	–	–	–	–	–	–	81.5	4.2	28.7	2.8
1.80	–	–	–	–	–	–	90.4	4.5	31.8	2.9
1.90	–	–	–	–	–	–	99.9	4.7	35.1	3.1
2.00	–	–	–	–	–	–	109.8	5.0	38.5	3.2
2.20	–	–	–	–	–	–	–	–	45.8	3.6
2.40	–	–	–	–	–	–	–	–	53.7	3.9
2.60	–	–	–	–	–	–	–	–	62.2	4.2
2.80	–	–	–	–	–	–	–	–	71.3	4.5
3.00	–	–	–	–	–	–	–	–	80.9	4.9
3.20	–	–	–	–	–	–	–	–	91.2	5.2

09.03 Pressure loss table: Drinking water installation RAUTITAN stabil 50–63

stabil

RAUTITAN stabil	50 x 4.5		60 x 6.0	
V̇	R	v	R	v
l/s	hPa/m	m/s	hPa/m	m/s
1.00	1.8	0.8	0.6	0.5
1.20	2.4	0.9	0.9	0.6
1.40	3.2	1.1	1.1	0.7
1.60	4.1	1.2	1.4	0.8
1.80	5.0	1.4	1.8	0.9
2.00	6.1	1.5	2.1	1.0
2.20	7.2	1.7	2.5	1.1
2.40	8.4	1.8	2.9	1.2
2.60	9.7	2.0	3.4	1.3
2.80	11.1	2.1	3.9	1.4
3.00	12.6	2.3	4.4	1.5
3.20	14.2	2.4	4.9	1.6
3.40	15.8	2.6	5.5	1.7
3.60	17.6	2.7	6.1	1.8
3.80	19.4	2.9	6.7	1.9
4.00	21.3	3.0	7.4	2.0
4.20	23.3	3.2	8.1	2.1
4.40	25.3	3.3	8.8	2.2
4.60	27.5	3.5	9.5	2.3
4.80	29.7	3.6	10.3	2.3
5.00	32.0	3.8	11.1	2.4

09.04 Pressure loss table: Drinking water installation RAUTITAN flex 16–25

flex

RAUTITAN flex	16 x 2.2 DN 12		20 x 2.8 DN 15		25 x 3.5 DN 20	
V̇ l/s	R hPa/m	v m/s	R hPa/m	v m/s	R hPa/m	v m/s
0.05	3.9	0.5	1.4	0.3	0.5	0.20
0.10	12.8	0.9	4.6	0.6	1.6	0.4
0.15	26.1	1.4	9.3	0.9	3.2	0.6
0.20	43.5	1.9	15.4	1.2	5.3	0.8
0.25	64.8	2.4	22.8	1.5	7.8	1.0
0.30	89.9	2.8	31.6	1.8	10.8	1.2
0.35	118.8	3.3	41.6	2.1	14.2	1.4
0.40	151.3	3.8	52.9	2.5	18.0	1.6
0.45	187.4	4.3	65.4	2.8	22.2	1.8
0.50	227.2	4.7	79.1	3.1	26.8	2.0
0.55	270.5	5.2	94.0	3.4	31.8	2.2
0.60	317.3	5.7	110.1	3.7	37.2	2.4
0.65	367.7	6.2	127.3	4.0	43.0	2.6
0.70	–	–	145.8	4.3	49.2	2.8
0.75	–	–	165.3	4.6	55.7	2.9
0.80	–	–	186.1	4.9	62.6	3.1
0.85	–	–	208.0	5.2	69.9	3.3
0.90	–	–	231.0	5.5	77.5	3.5
0.95	–	–	255.2	5.8	85.5	3.7
1.00	–	–	280.5	6.1	93.9	3.9
1.10	–	–	–	–	111.8	4.3
1.20	–	–	–	–	131.1	4.7
1.30	–	–	–	–	151.8	5.1

09.05 Pressure loss table: Drinking water installation RAUTITAN flex 32–40

flex

RAUTITAN flex	32 x 4.4 DN 25		40 x 5.5 DN 32	
V̇ l/s	R hPa/m	v m/s	R hPa/m	v m/s
0.1	0.5	0.2	0.2	0.2
0.5	7.9	1.2	2.7	0.8
1.0	27.3	2.4	9.3	1.5
1.5	52.0	3.5	19.3	2.3
2.0	96.5	4.7	32.5	3.0
2.2	115.0	5.2	38.6	3.3
2.4	–	–	45.3	3.6
2.6	–	–	52.4	3.9
2.8	–	–	60.1	4.2
3.0	–	–	68.2	4.5
3.2	–	–	76.8	4.8
3.4	–	–	85.8	5.1

RAUTITAN universal system for heating

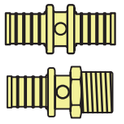
Contents

10 Area of application

10.01 RAUTITAN connection components for heating installation

Fig. 10-1 RAUTITAN pipes for the heating installation

RAUTITAN connection components for heating installation

Size	Pipes			Fittings	Compression sleeves
12		flex Universal pipe RAUTITAN flex		 RAUTTIAN LX Standard brass	 RAUTTIAN LX Standard brass
16 20 25 32 40	stabil Universal pipe RAUTITAN stabil			 RAUTITANPX  RAUTITAN RX+  RAUTITAN SX	 RAUTITAN PX
50 63		–	–	 RAUTITAN RX+ stabil	 RAUTITAN PX stabil

10.02 Oxygen-tightness

- The universal pipe RAUTITAN stabil is made oxygen-tight by its layer of aluminium.
- The universal pipe RAUTITAN flex consist of RAU-PE-Xa with an oxygen diffusion barrier and is oxygen-tight in accordance with DIN 4726.

10.03 Standards and guidelines

DIN CERTCO
DIN CERTCO registration confirms the suitability of RAU-PE-Xa pipes in the heating installation in accordance with DIN 4726/ BS EN ISO 15875 – application class 5 and the necessary tightness against oxygen diffusion for:
- Universal pipe RAUTITAN flex

Compression sleeve jointing technique
- Permanently sealing compression sleeve jointing technique according to BS EN 806, DIN 1988 and DVGW worksheet W 534 with WRAS approval
- Suitable for flush-mounted installation or concealed in screed without inspection hatch or similar facilities as per DIN 18380 (VOB/C)

⚠

Do not mix up the RAUTITAN connection components with the underfloor heating/cooling connection components.
- Only use connection components of the RAUTITAN system in the heating installation.
- Please note the dimensions on the fittings.
- You can find the precise allocation of the fittings to their applications in the current product book.

10.04 Requirements of the heating water

Properties of the heating water as specified in VDI 2035

⚠

The piping can be damaged when using inhibitors, antifreeze additives or other heating water additives. Approval must be obtained from the respective manufacturer and from our Applications Department.

In this case, please consult your REHAU sales office.

10.05 Requirements of the hot water heating systems

- Heating systems in buildings according to BS EN 12828
- BS EN 14336 heating systems in buildings – Installation and commissioning of water based heating systems

10.06 Solar thermal systems

The RAUTITAN universal system for drinking water and heating must not be used between the cylinder and the solar collectors (primary circuit) due to the expected high temperatures.

11 System parameters

11.01 Supply and return temperatures

According to the rules for heating technology (e.g. BS EN 442, radiators and convectors), the standard heat output is determined on the basis of a supply temperature of 75 °C and a return temperature of 65 °C for the heating water.
Due to switching differences in thermostats, losses in the pipe network and the reduction of the temperatures in the heating circuit to save energy, a maximum supply temperature of 70 °C has become common practice. This is taken into account in the design tables of many renowned radiator manufacturers.

⚠

Radiator connection system skirting
Do not exceed the maximum supply temperature of 70 °C.

11.02 Variable heating mode

Heating systems are not normally operated at a constant temperature over the entire service life of the system. The different operating parameters, e.g. due to summer and winter operation, are taken into account in the BS EN ISO 15875 standard (Plastic piping systems for hot and cold water installations – crosslinked polyethylene PE-X) and BS EN ISO 21003 (Multilayer piping systems for hot and cold water installations inside buildings). The assumed service life is divided in this standard into several periods of operation at different temperatures.

The following realistic assumptions are taken into account:
- Summer and winter operation
- Weather compensation during the heating periods
- Service life: 50 years

The assumptions are shown below for the operating periods at different temperatures for an overall service life of 50 years by the example of a high-temperature radiator connection (application class 5 acc. ISO 10508).

Design temperature T	Service life Time T_D	Pressure	
		stabil	flex
[°C]	[years]	[MPa / bar]	[MPa / bar]
20	14	1 / 10	0.8 / 8
60	+ 25	1 / 10	0.8 / 8
80	+ 10	1 / 10	0.8 / 8
90	+ 1	1 / 10	0.8 / 8
Total	50 years		

Tab. 1-11 Temperature-pressure combinations for 50 years summer/winter operation (application class 5 acc. ISO 10508)

For the weather compensated summer and winter operation, this results in the following maximum operating values:

- Short-term maximum temperature T_{max}: 90 °C (1 year within 50 years)
- Short-term malfunction temperature T_{mal}: 100 °C (100 hours in 50 years)
- Maximal operating pressure
  - stabil: 1 MPa / 10 bar
  - flex: 0.8 MPa / 8 bar
- Service life: 50 years

A typical field of operation for variable heating is a low-temperature heating system.

11.03 Constant heating mode

For constant operation without the influence of summer and winter operation, the following system parameters must not be exceeded:

Parameters	Value
Design temperature T_D	Maximum 70 °C
Operating pressure	Maximum 1 MPA /10 bar
Service life	50 years

Tab. 1-12 System parameters for constant operation

11.04 Maximum operation (special applications)

For heating systems not designed for a service life of 50 years, the REHAU pipes can be operated at their maximum temperature and pressure combinations.

Pipe	Design temperature [C°]	Operating pressure (maximum) [MPa / bar]	Service life [years]
Universal pipe RAUTITAN stabil stabil	95	1 / 10	5
Universal pipe RAUTITAN flex flex	90	0.8 / 8	10

Tab. 1-13 Service life as combination of maximum temperature and pressure

12 Radiator connection from the floor

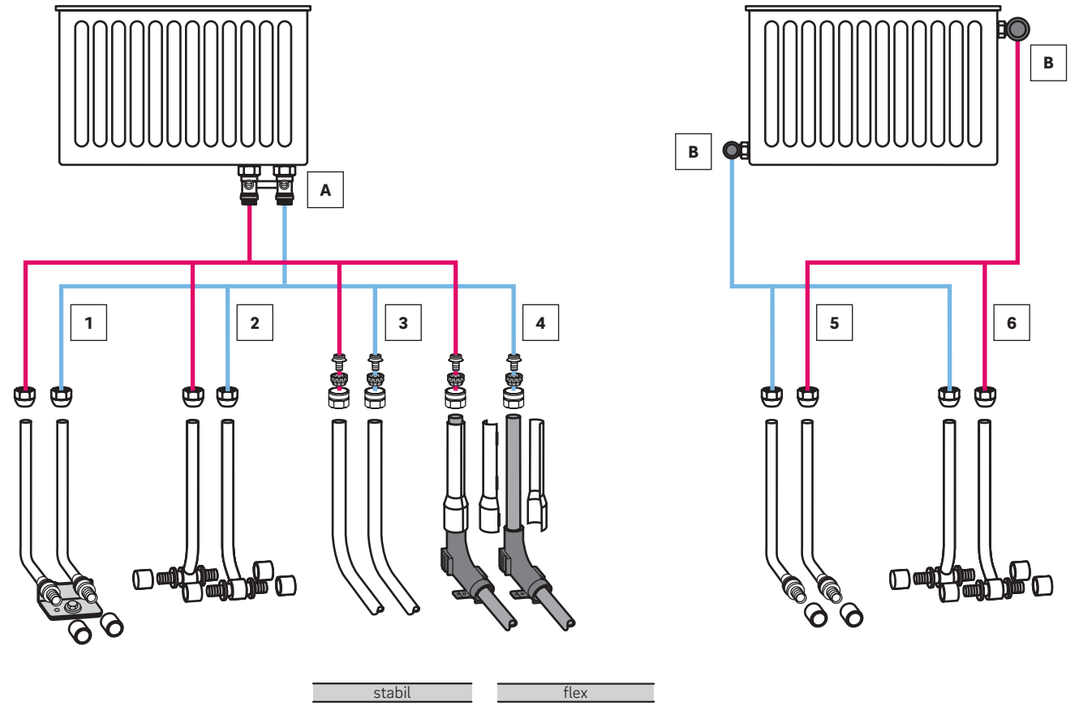


Fig. 12-1 Overview: Radiator connection from the floor

A Inlets underneath - no TRV, etc. - straight valve connection

B Inlets on the side, e.g. TRV, lockshields, etc.

Connection to valve-regulated radiators

1 Radiator elbow connection set RAUTITAN
- made of stainless steel (see chapter 12.01, page 52)
- made of copper (see chapter 12.02, page 52)

2 Radiator tee connection set RAUTITAN (see chapter 12.03, page 53)

3 Direct connection with the universal pipe RAUTITAN stabil (see chapter 12.04, page 54)

4 Direct connection with the universal pipe RAUTITAN (see chapter 12.05, page 54)

Connection to compact radiators

5 Radiator elbow connection set RAUTITAN (see chapter 12.06, page 55)

6 Radiator tee connection set RAUTITAN (see chapter 12.07, page 55)

12.01 Stainless steel radiator elbow connection set RAUTITAN for inlets underneath

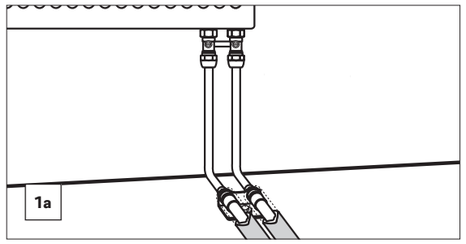


Fig. 12-2

Fig. 12-3

12.02 Copper radiator elbow connection set RAUTITAN for inlets underneath

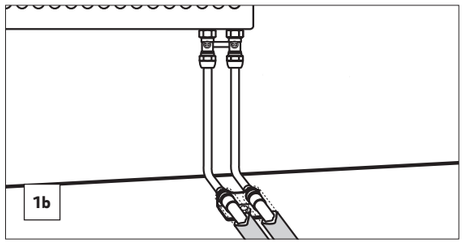


Fig. 12-4

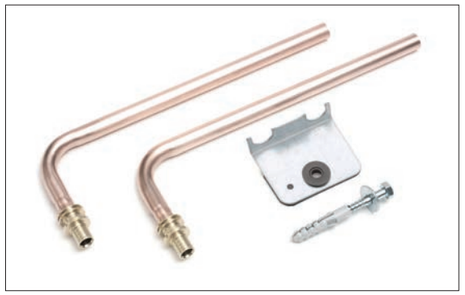
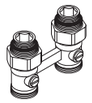
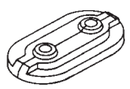
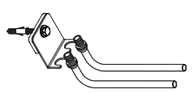
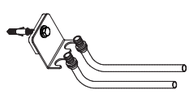


Fig. 12-5

Article		Amount	Article description	Article no.
1		1	Ball valve block with connection nipple G ½ x G ¾, straight	240727-001
1		2	Screw connection G ¾ - 15	240601-003
1		1	Double rosette to cover radiator connecting pipes from the floor or from the wall, two-part, distance between centres: 50 mm Colour: White RAL 9010, size 15	268674-001
1		2 or 2	Compression sleeve 16 RAUTITAN PX Compression sleeve 20 RAUTITAN PX	160001-001 160002-001
1a		1 or 1	Radiator elbow connection set RAUTITAN, including fixing unit, sizes 16/250 Radiator elbow connection set RAUTITAN, including fixing unit, sizes 20/250	266372-001 266392-001
1b		1	Radiator copper/brass elbow connection set RAUTITAN including fixing unit, size 16/250	266412-001

Tab. 1-14

12.03 Radiator tee connection set RAUTITAN for inlets underneath

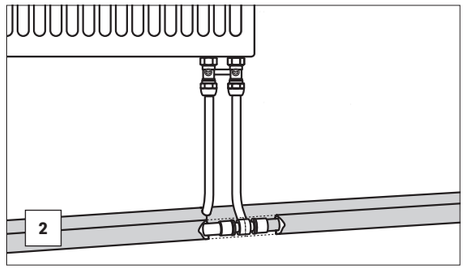


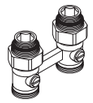
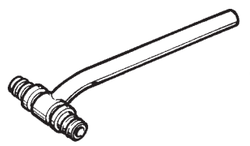
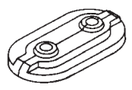
Fig. 12-6

Fig. 12-7

§

In some cases pipe runs in the floor may have to be offset from the wall by a minimum distance set by regulation or other.

With the RAUTITAN radiator tee connection set, it may not be possible to observe this offset. It is recommended that this is addressed early in the project and a written exemption/approval is obtained from the client.

Article		Amount	Article description	Article no.
2		1	Ball valve block with connection nipple G ½ x G ¾, straight	240727-001
2		2	Screw connection G ¾ - 15	240601-003
2		2 or 2	Radiator tee connection set RAUTITAN 16 Length: 250 mm Length: 500 mm Length: 1000 mm Radiator tee connection set RAUTITAN 20 Length: 250 mm Length: 500 mm Length: 1000 mm	 266282-001 240851-001 266292-001 266302-001 240861-001 266312-001
2		1	Double rosette to cover radiator connecting pipes from the floor or from the wall, two-part, distance between centres: 50 mm Colour: White RAL 9010, size 15	268674-001
2		4 or 4	Compression sleeve 16 RAUTITAN PX Compression sleeve 20 RAUTITAN PX	160001-001 160002-001

Tab. 1-15

12.04 Direct connection with the RAUTITAN stabil universal pipe for inlets underneath

stabil

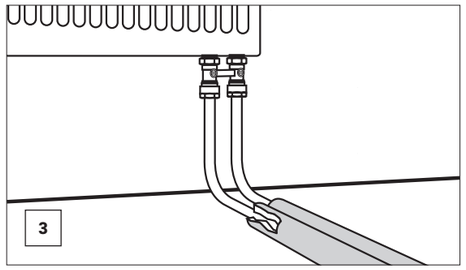


Fig. 12-8

Fig. 12-9

12.05 Direct connection with the universal pipe RAUTITAN flex and radiator connection set for inlets underneath

flex

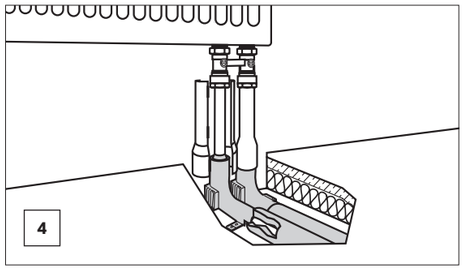
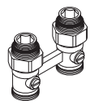
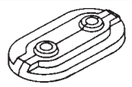
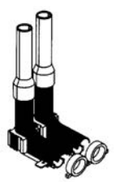


Fig. 12-10

Fig. 12-11

	Article	Amount	Article description	Article no.
3 4		1	Ball valve block with connection nipple G ½ x G ¾, straight	240727-001
3		2 or 2	Compression nut RAUTITAN stabil 16.2 x 2.6 Compression nut RAUTITAN stabil 20 x 2.9	266452-003 266462-003
3		1	Double rosette to cover radiator connecting pipes from the floor or from the wall, two-part, distance between centres: 50 mm Colour: White RAL 9010, size 16/20	240777-001
4		2	Compression union fitting RAUTITAN flex 16 x 2.2	266352-003
4		1	Radiator connection set	265879-001

Tab. 1-16

12.06 Radiator elbow connection set RAUTITAN for inlets on the side

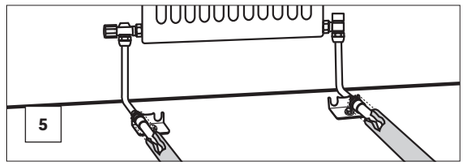


Fig. 12-12

Fig. 12-13

12.07 Radiator tee connection set RAUTITAN for inlets on the side

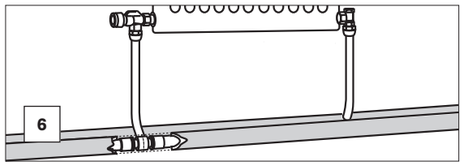
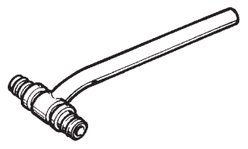


Fig. 12-14

Fig. 12-15

§

Legal information: refer to page 53.

	Article	Amount	Article description	Article no.
5 6		1	Connection nipple set G ½ x G ¾	240711-001
5 6		2	Screw connection G ¾ - 15	240601-003
5 6		2 (4 for version 6) or 2 (4 for version 6)	Compression sleeve 16 RAUTITAN PX Compression sleeve 20 RAUTITAN PX	160001-001 160002-001
5		2 or 2	Radiator elbow connection set RAUTITAN 16 Length: 250 mm Length: 500 mm Length: 1000 mm Radiator elbow connection set RAUTITAN 20 Length: 250 mm Length: 500 mm Length: 1000 mm	 266242-001 240931-001 266252-001 266262-001 240941-001 266272-001
5		2	Fixing unit, distance between centres 50 mm, with noise buffer, dowel 10 mm, galvanised hex screw SW (wrench size) 13 and washer	240457-002
6		2 or 2	Radiator tee connection set RAUTITAN 16 Length: 250 mm Length: 500 mm Length: 1000 mm Radiator tee connection set RAUTITAN 20 Length: 250 mm Length: 500 mm Length: 1000 mm	 266282-001 240851-001 266292-001 266302-001 240861-001 266312-001

Tab. 1-17

13 Radiator connection from the wall

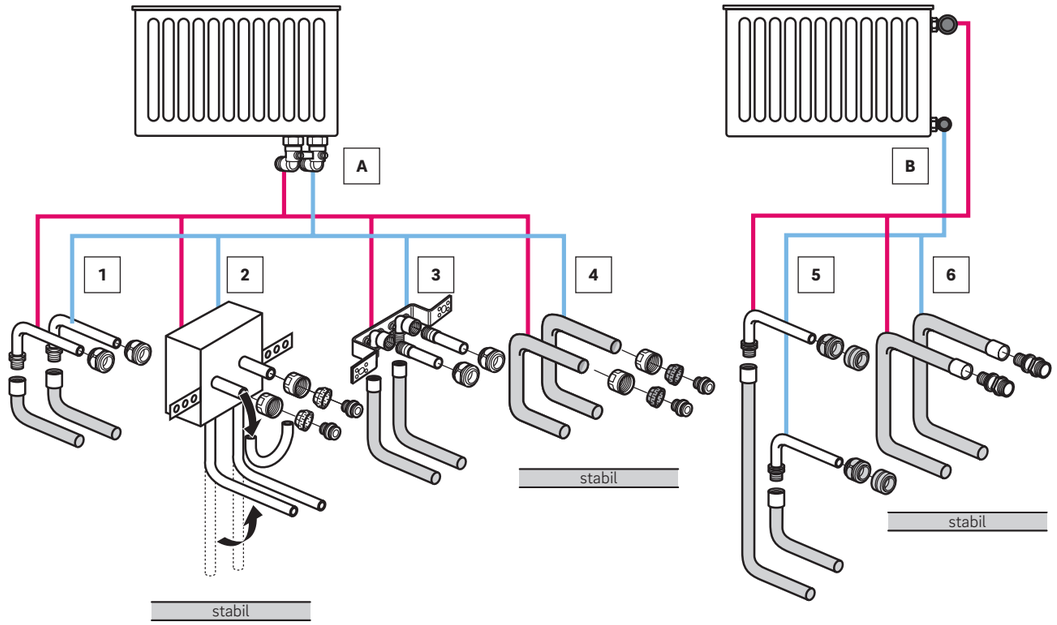


Fig. 13-1 Overview: Radiator connection from the wall

A Inlets underneath - no TRV, etc. - angled valve connection

B Inlets on the side, e.g. TRV, lockshields, etc.

Connection sets to valve-re ulated radiator

1 Radiator elbow connection set RAUTITAN made of stainless steel (see chapter 13.01, page 57)

2 Radiator connection block RAUTITAN stabil (see chapter 13.02, page 58)

3 Radiator bracket set RAUTITAN (see chapter 13.03, page 59)

4 Direct connection with the universal pipe RAUTITAN stabil (see chapter 13.04, page 59)

Connection sets to common valves

5 Radiator elbow connection set RAUTITAN (see chapter 1813.05, page 60)

6 Direct connection with adapter with male thread RAUTITAN MX (see chapter 1813.06, page 60)

- Quick and easy floor cleaning
- Continuous floor covering
- Reduction of sealing joints in wet areas

13.01 Stainless steel radiator elbow connection set RAUTITAN for inlets underneath

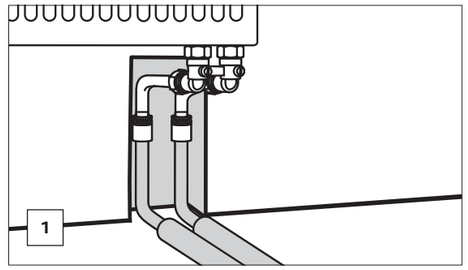
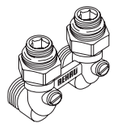
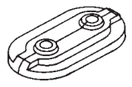


Fig. 13-2

Fig. 13-3

	Article	Amount	Article description	Article no.
1		1	Ball valve block with connection nipple G ½ x G ¾, angled	240737-001
1		2	Screw connection G ¾ - 15	240601-003
1		2 or 2	Radiator elbow connection set RAUTITAN 16/250 Radiator elbow connection set RAUTITAN 20/250	266242-001 266262-001
1		1	Double rosette to cover radiator connecting pipes from the floor or from the wall, two-part, distance between centres: 50 mm Colour: White RAL 9010, size 15	268674-001
1		2 or 2	Compression sleeve 16 RAUTITAN PX Compression sleeve 20 RAUTITAN PX	160001-001 160002-001

Tab. 1-18

13.02 Radiator connection block RAUTITAN stabil for inlets underneath

stabil

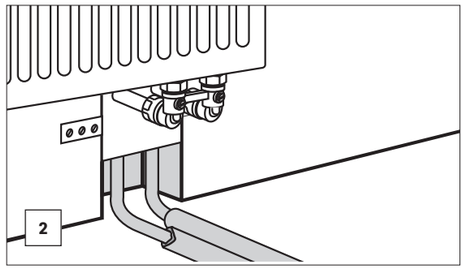


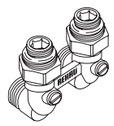
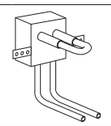
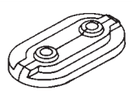
Fig. 13-4

Fig. 13-5

- insulation free of CFC and halogens
- Heat insulation according to German energy saving ordinance (EnEV)
- With fastening strap
- Pressurising and test heating without radiators: Supply and return lines joined by pipe elbows
- Variable connection height
- System-tested screw connections and fittings
- Radiators can be installed after completion of plastering and painting work

The bypass pipe for the radiator connection block RAUTITAN stabil is used only for pressure tests and in the heating test phase. For continuous heating operation, remove the bypass pipe and connect the intended radiator valves.

Cut the bypass pipe outside the bending radius so that the sealing parts of the compression nuts are not in the curved part of the bypass pipe. This results in a maximum effective connecting pipe length of 140 mm starting from leading edge of the insulation box.

	Article	Amount	Article description	Article no.
2		1	Ball valve block with connection nipple G ½ x G ¾, angled	240737-001
2		2	Compression nut RAUTITAN stabil 16.2 x 2.6	266452-003
2		1	Radiator connection block RAUTITAN stabil	110198-001
2		1	Double rosette to cover radiator connecting pipes from the floor or from the wall, two-part, distance between centres: 50 mm Colour: White RAL 9010, sizes 16/20	240777-001
2		2	Compression sleeve 16 RAUTITAN PX (with direct connection to RAUTITAN fittings, e.g. tee pieces)	160001-001

Tab. 1-19

13.03 Radiator bracket set RAUTITAN for inlets underneath

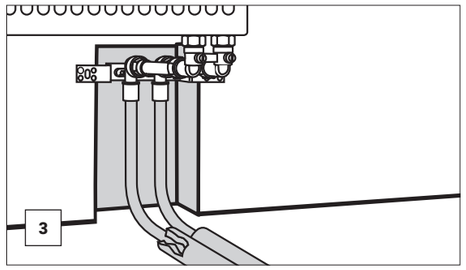


Fig. 13-6

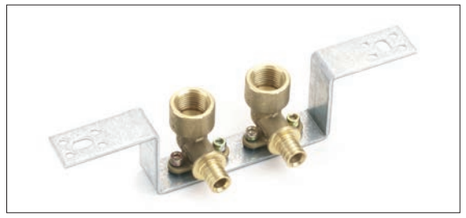


Fig. 13-7

13.04 Direct connection with the universal pipe RAUTITAN stabil for inlets underneath

stabil

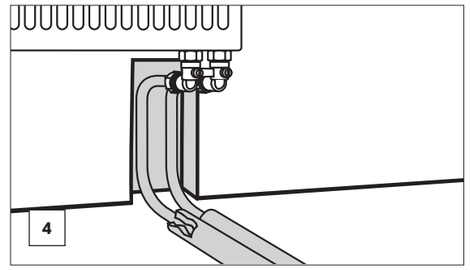
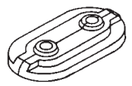
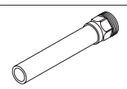
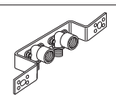


Fig. 13-8

Fig. 13-9

	Article	Amount	Article description	Article no.
3 4		1	Ball valve block with connection nipple G ½ x G ¾, angled	240737-001
3 4		1	Double rosette to cover radiator connecting pipes from the floor or from the wall, two-part, distance between centres: 50 mm Colour: White RAL 9010, size 15 mm	268674-001
3		2	Screw connection G ¾ - 15	240601-003
3		2	Radiator connection pipe R ½ x 15, stainless steel	261313-001
3		1	Radiator bracket set RAUTITAN 16 x 2.2 – Rp ½	240921-401
3		2	Compression sleeve 16 RAUTITAN PX	160001-001
4		2 or 2	Compression nut RAUTITAN stabil 16.2 x 2.6 Compression nut RAUTITAN stabil 20 x 2.9	266452-003 266462-003

Tab. 1-20

13.05 Radiator elbow connection set RAUTITAN for inlets on the side

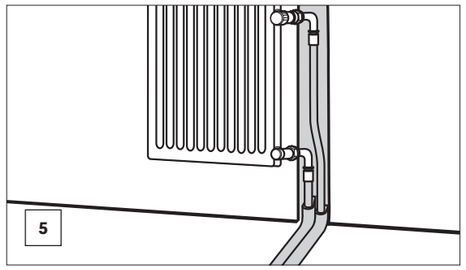


Fig. 13-10

Fig. 13-11

13.06 Direct connection with male iron adaptor RAUTITAN for inlets on the side

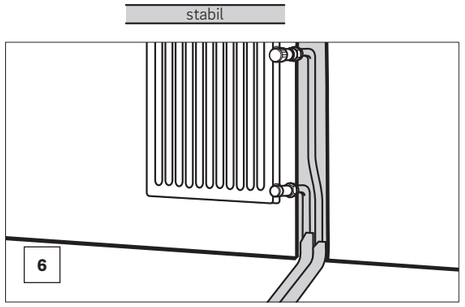


Fig. 13-12

Fig. 13-13

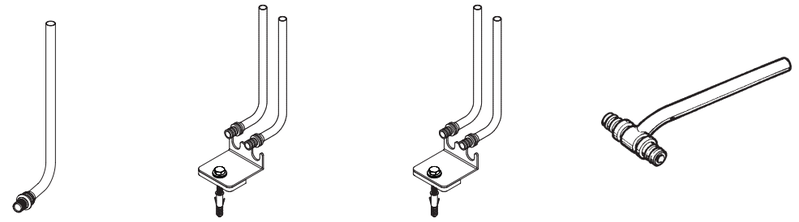
	Article	Amount	Article description	Article no.
5 6		2 or 2	Compression sleeve 16 RAUTITAN PX Compression sleeve 20 RAUTITAN PX	160001-001 160002-001
5		1	Connection nipple set G ½ x G ¾	240711-001
5		2	Screw connection G ¾ - 15	240601-003
5		2 or 2	Radiator elbow connection set RAUTITAN 16/250 Radiator elbow connection set RAUTITAN 20/250	266242-001 266262-001
6		2 or 2	Adapter with male thread RAUTITAN RX+ 16 - R ½ Adapter with male thread RAUTITAN RX+ 20 - R ½	456311-001 456314-001

Tab. 1-21

14 Connections with radiator elbow

14.01 Connection features

Radiator connections with connection sets

		Elbow connection sets		
	Radiator elbow connection sets RAUTITAN	**Radiator elbow connection set RAUTITAN**	**Radiator copper/ brass elbow connection set RAUTITAN**	**Radiator tee connection set RAUTITAN**
Connection from	Wall/Floor	Floor	Floor	Floor
Material	Stainless steel	Stainless steel	Copper/Brass	Stainless steel
Expansion of connection pipe with expander head 15 x 1.0 RO	⚠ Essential	⚠ Essential	⚠ Essential	⚠ Essential
Fastening	Fixing unit recommended	Fixing unit recommended	⚠ Fixing unit essential	On site if required
Pipe size	16 and 20	16 and 20	16	16 and 20
	250, 500, 1000 mm	250 mm	250 mm	250, 500, 1000 mm
Leg length				
	Screw connection G ¾ - 15			
Screw connection				

Tab. 1-22 Information on radiator connections

⚠

Do not use screw connections in flush-mounted installations or in inaccessible places.

14.02 Screw connections

Fig. 14-1 Screw connection G ¾ - 15

- Only for the connection of the radiator connector sets RAUTITAN to the Eurocone contour G ¾ according to EN 16313, e.g.:
  - Radiator elbow connection set RAUTITAN made of stainless steel
  - Radiator tee connection set RAUTITAN made of stainless steel
  - Radiator copper/brass elbow connection set RAUTITAN
- For pipe size 15 x 1.0 mm
  - Stainless steel connection pipes
  - Copper connection pipes

If the screw connection G ¾ - 15 is used, no defined tightening torque is necessary as the screw connection is tightened to the end of the thread.

14.03 Fundamentals

Continuous temperature fluctuations in the heating systems lead to mechanical loads on the radiator connection sets and their screw connections.
If these cycling loads act unrestrained on the radiator connections, it can lead to leaks at the screw connections or damage to the metallic radiator sets.

Binding installation instructions
To guarantee a permanently sealed radiator connection, observe the following binding installation instructions:

- Expand the pipe ends of all connection sets using the expander head 15 x 1.0 QC to prevent mechanical impacts on the sealing function of these screw connections.
- Secure the sets with the fixing unit to the floor to avoid fluctuating loads on the elbow connection sets by thermal expansion/contraction in the radiator connecting pipes.
  - The use of the fixing unit is essential for all connection sets made of copper pipe.
  - For connection sets made of stainless steel, the use of the fixing unit is recommended.
- Screw connections must only be loosened or tightened once the heating system has cooled down.

14.04 Expanding the radiator connection sets RAUTITAN

⚠

For soft-sealing screw connections (screw connection G ¾ -15) to Eurocone G ¾, expand the pipe ends 15 x 1.0 on all RAUTITAN radiator connection sets.

Fig. 14-2 Expander head 15 x 1.0 QC

Steps

1. Cut the connecting pipe square and deburr.
2. Push the screw connection onto the connection set.
3. Push the expander head 15 x 1.0 QC fully into the pipe and expand the pipe end once.

Fig. 14-3 Expand the pipe end once

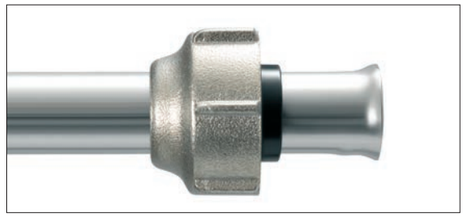


Fig. 14-4 Expanded pipe end

4. Push the connecting pipe fully into the Eurocone and tighten the union nut.

14.05 Securing the elbow connection sets RAUTITAN

Fig. 14-5 Fixing unit

The elbow connection sets are secured to the unfinished floor with the fixing unit.

- Prevents tilting or slipping of the radiator connection sets RAUTITAN
- Prevents inadmissible bending forces, e.g. due to changing temperatures
- Reliable and quick fixing suitable for the building site
  - Polymer base plate to reduce sound transmission
  - Fixing with just one screw
  - Including fastening set

ⓘ

Install the radiator connections (e.g. radiator elbow connection sets RAUTITAN and the fixing unit) insulated to the building (thermal and acoustic insulation).

Note the information in chapter "20 Pipe insulation", page 89.

The use of the fixing unit is also recommended for the radiator elbow connection sets RAUTITAN made of stainless steel to prevent detrimental effects (e. g. tilting when the screed is laid or when the pipes move).

Type of fastening	Connection Set	Use of the fixing unit
Connection from the floor	Radiator elbow connection set RAUTITAN made of stainless steel	Recommended
	Radiator tee connection set RAUTITAN made of stainless steel	Not possible, fasten on site if needed
	Radiator copper/brass elbow connection set RAUTITAN made of copper	⚠ Essential
Connection from the wall	Radiator elbow connection set RAUTITAN made of stainless steel	Recommended

Tab. 1-23 Fixation of radiator elbow connection sets

14.06 Installation procedure for RAUTITAN connection sets – Example

The installation of connection sets RAUTITAN for radiators is described by the example of the radiator elbow connection set RAUTITAN in stainless steel:

1. Transfer the leg length including the insertion depth of the Eurocone connection to the pipe (see Fig. 14-6).
2. Cut the radiator elbow connection sets RAUTITAN square with a tube cutter for stainless steel pipes or a suitable saw and deburr.
3. Push the thermal and acoustic insulation onto the radiator elbow connection sets RAUTITAN (not indicated in the illustrations).
4. Slide the screw connection onto the radiator elbow connection sets RAUTITAN.
5. Expand the pipe ends once with the expander head 15 x 1.0 QC (see Fig. 14-7).
6. Insert both radiator elbow connection sets RAUTITAN fully into the fixing unit (see Fig. 14-8).
7. Push the radiator elbow connection sets RAUTITAN fully into the Eurocone of the ball valve block.
8. Tighten the union nuts by hand.
9. Align the radiator elbow connection sets RAUTITAN parallel.
10. Mark the fixing point of the fixing unit (see Fig. 14-9).
11. Detach the radiator elbow connection sets RAUTITAN from the ball valve block.
12. Drill the hole.
13. Fit the radiator elbow connection sets RAUTITAN to the ball valve block.
14. Tighten the union nuts by hand.
15. Screw the fixing unit to the floor with the appropriate fastening set (see Fig. 14-10).
16. Install the soft-sealing screw connections according to the instructions included in the packaging. Tighten the screw connections G ¾ - 15 all the way up until it goes no further.
17. Create a compression sleeve connection to the heating pipes (see Fig. 14-11).
18. Carry out a leak test.
19. Fully insulate the pipes and connection components.

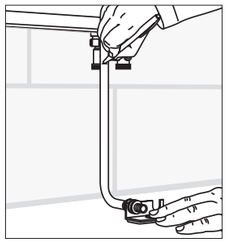


Fig. 14-6 Mark the leg length

Fig. 14-7 Expand the pipe end onc

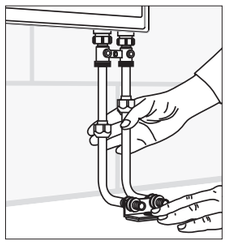


Fig. 14-8 Position the radiator elbow connection set

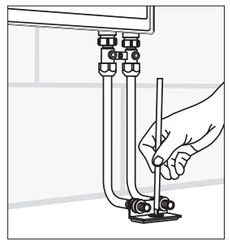


Fig. 14-9 Mark the fixing point

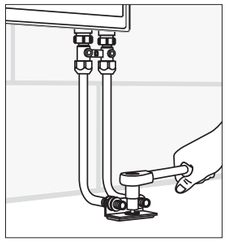


Fig. 14-10 Screw the fixing unit tight

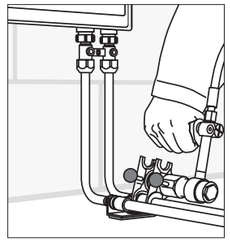


Fig. 14-11 Create compression sleeve connection

15 Connection with compression ring unions

Fig. 15-1 Compression ring union RAUTITAN stabil

Radiators can be directly connected with the universal pipes RAUTITAN stabil and RAUTITAN flex using compression ring unions.

Fig. 15-2 Compression ring union RAUTITAN flex

⚠ Ensure that during assembly and in operation the pipe and the compression ring union are free from inadmissible mechanical stress (i.e. due to a pipe bend directly after the compression nut).

⚠ Connection with compression ring unions should not be installed inside walls or in inaccessible areas.

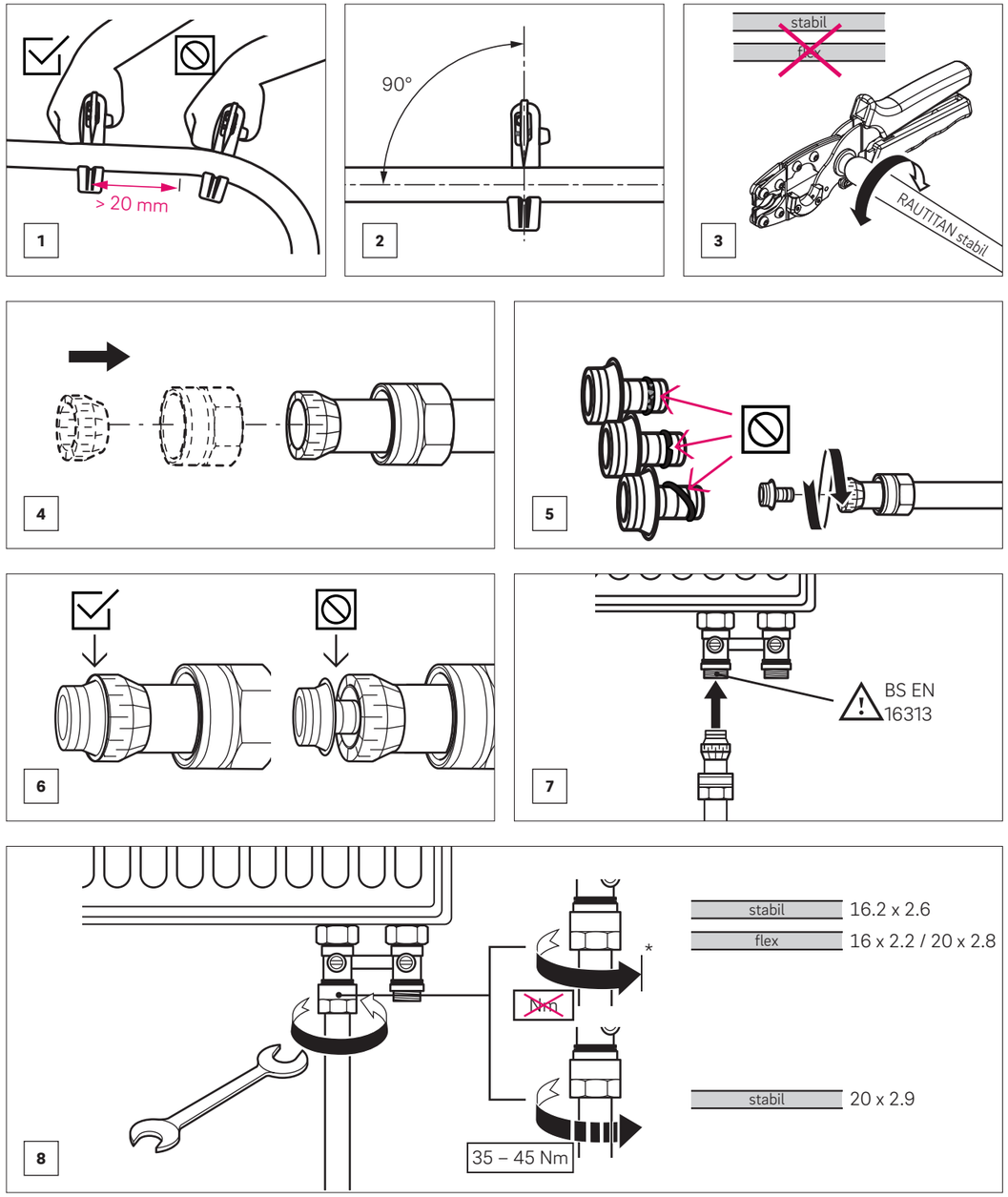
15.01 Characteristics of the connection process

	Marking union nut	Cap colour	Pipe cutters			Pipe calibration	Tightening union nut
Universal pipe RAUTITAN stabil stabil	16.2 x 2.6	Green	 Pipe cutter 16/20 RAUTITAN			⚠ Yes, mandatory 	Up to the stop [1]
	20 x 2.9						Without mechanical stop; tighten at 35 – 45 Nm
Universal pipe RAUTITAN flex flex	16.2 x 2.2	Blue		 Pipe cutter 25	 Pipe cutter 40 stabil	Not required	Up to the stop [1]
	20 x 2.8						Up to the stop [1]

1) Tighten at max. 35 – 45 Nm

Tab. 1-24 Overview connection with compression nut

15.02 Installation procedure for compression ring union RAUTITAN – Example



* up to the stop

16 Connection components

⚠

- Take suitable measures to prevent the effects of cycling loads (e.g. expansion bend, additional fastenings or similar).
- Only loosen or tighten screw connections once the heating system has cooled down.

Eurocone G ¾
The Eurocone G ¾ of heating fittings shall fulfil the requirements and measurements of the standard BS EN 16313.
REHAU recommends:

- Only to use screws, fittings and valves from the same supplier.
- Radiator valve connections with female thread Rp ½ / G ½ to connect the REHAU fittings.

The following screw connections with Eurocone G ¾ are system tested and can be connected to the ball valve block, connection nipple set G ½ x G ¾, heating pipe manifold and heating circuit manifold:

- Compression ring union RAUTITAN stabil
- Compression ring union RAUTITAN flex
- Screw connections

16.01 Ball valve block

Fig. 16-1 Ball valve block - angled Fig. 16-2 Ball valve block - straight

For isolation and connection to radiator inlets underneath and radiator supply pipes

- Straight
- Angled
- With connection nipple G ½ x G ¾
- With Eurocone G ¾

👍

- System-tested screw connection
- Compact shape
- For all screw connections and compression nuts with Eurocone G ¾

16.02 Connection nipple set G ½ x G ¾

Fig. 16-3 Connection nipple set G ½ x G ¾

To connect radiators and valves with female thread Rp ½ and screw connections with Eurocone G ¾

17 Additional system accessories

17.01 Cross-over fitting RAUTITAN

Fig. 17-1 Crossover fitting RAUTITAN with insulating box

The crossover fitting RAUTITAN creates a branch connection from the supply pipes in the floor to the radiator.

By using the crossover fittings RAUTITAN, the screed layer is able to take the insulation directly up to the rectangular insulating box. The crossover fitting RAUTITAN can be fixed with the dowel hooks before and after the cross fitting.

- Reduced installation time
- Pipe crosses without chase work on the rough floor
- Including insulating box
- No additional insulation of the tees
- No crossover of the pipes
- Installation height: 50 mm
- For piping insulation up to an insulation thickness of 13 mm

17.02 Stainless steel radiator manifold steel

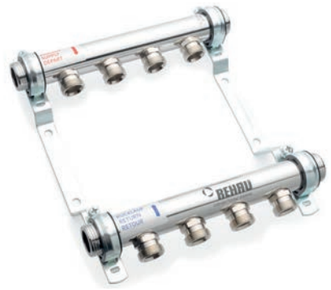


Fig. 17-2 Radiator pipe manifold

The radiator manifold is for distributing and collecting heating water.

For individual designs, different manifold sizes are available for the connection of 2 to 12 radiators. The compression ring unions RAUTITAN required for the connections must be ordered separately.

Scope of delivery

- Radiator manifold, pressure tested, connections possible from either side
- Connection thread G1, flat sealing
- Connection nipple G ¾ according EN 16313 for Eurocone connection
- 2 caps G1
- Bleed valve supplied
- Brackets with acoustic dampeners

- Made of high quality stainless steel
- Flat sealing manifold connections
- Connections possible from either side
- Increased installation comfort due to offset ports
- Pre-assembled on brackets with acoustic dampeners
- Manifold sizes with 2 to 12 outlets

17.03 Double rosette

Fig. 17-3 Double rosette

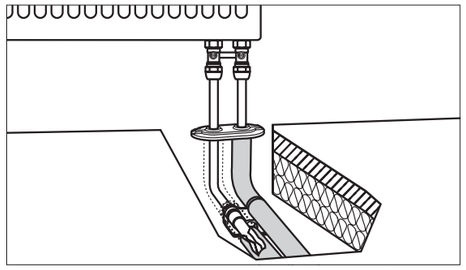


Fig. 17-4 Double rosette on the floor

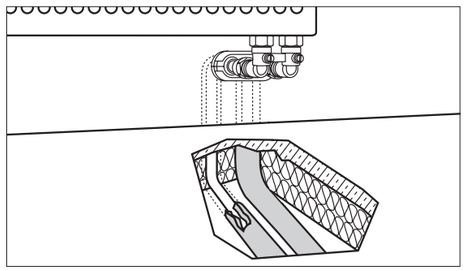


Fig. 17-5 Double rosette on the wall

- To cover radiator connecting pipes in pairs from the wall or the floor
- Two-part
- For pipe size 15
- For the pipe sizes 16 and 20
- Distance between centres: 50 mm
- Colour: White, similar to RAL 9010

17.04 Compression sleeve manifold

Fig. 17-6 Compression sleeve manifold

The compression sleeve manifold can be used as an alternative to the radiator manifold.

- Manifold outlets with compression sleeve technique
- Permanently sealed connection
  - Can be installed flush-mounted or under screed
- Compression sleeve with 2 or 3 outlets
  - Can be extended as needed
  - For pipe sizes 16 or 20
- Manifold pipe connections
  - Male thread R ¾
  - Female thread Rp ¾
- Also suitable for drinking water installation

17.05 Manifold cabinets

Fig. 17-7 Manifold cabinet, flush-mounted version

Fig. 17-8 Manifold cabinet, surface-mounted version

- To receive the radiator manifolds and the compression sleeve manifolds
- Available as flush-mounted version (UP) and surface-mounted version (AP)
- Vertically and horizontally adjustable attachment of the manifold bracket
- In sheet steel painted
- For flush-mounted version only:
  - Wall-mounted housing with reinforcement profile and detachable deflector to guide the heating pipes (manifold outlet)
  - Adjustable height
  - Adjustable depth
  - Frame with adjustable depth, with push-fit door and rotary catch

18 Pressure Test of heating pipe

The successful execution and documentation of a pressure test is a prerequisite for any claims under the REHAU warranty.

§

Deviations to BS EN 14336 concerning the pressure and tightness test have to be agreed with the building owner and if necessary have to be stipulated by contract.

18.01 Guidelines for pressure test

According to BS EN 14336 a pressure test must be conducted on the completed but not yet concealed pipe before commissioning.

The pressure test result (constant, decreasing, increasing) is generally not enough to completely eliminate a leak in the installation.

- The leak-tightness of the system can only be verified by performing a visual examination of the unconcealed piping.
- Micro leaks can only be located by performing a visual examination (water leak or leak detection spray) at high pressure.
- Maximum opening pressure of the safety devices shall be considered.

Subdividing the piping system into smaller test sections increases the testing accuracy.

- Only use leak detection sprays (e.g. foaming agents) with current DVGW/WRAS registration, which were also approved by the respective manufacturer for the PPSU and PVDF materials.

- When using the crossover fitting RAUTITAN the pressure test shall always be performed on both heating flows and returns together and not separately. The radiator connection block can be used to connect flow and returns together. Always test the crossover fitting RAUTITAN with all four ends connected.

Important information on tests with compressed air and inert gas

- Small leaks can only be detected using leak detection sprays at high test pressures or with a supplementary pressure test with water and the appropriate visual inspection.
- Temperature fluctuations can affect the test result (pressure loss or increase).
- Compressed air and inert gas are compressed gases. This means that the piping volume has a lot of influence on the shown pressure result. A high piping volume reduces the ability to detect small leaks base don a pressure drop.

18.02 Flushing heating pipes

After the pressure test and shortly before the commissioning the installation should be flushed out to remove any dirt from the storage and construction phase.

Recommendations and procedure can be found in the standard BS EN 14336 considering that chemical cleaning is not recommended.

18.03 Pressure test certificate: REHAU's RAUTITAN system (heating installation)

The template for a pressure test certificate for a pressure test of a heating installation can be found on the following page.

Pressure test certificate: REHAU's RAUTITAN system (heating installation)

Form

1. System data

Building project: _____

Client: _____

Address/House No.: _____

Post code/Town/City: _____

Maximum operating pressure: _____

Maximum operating temperature: _____

Geodetic altitude: _____

2. Carry out a pressure test

Carry a pressure test to verify the heating installation with the RAUTITAN system is pressure tight:

1. Disconnect any safety devices and meters as necessary and replace with pipes or pipe stoppers.
2. Fill the heating installation with filtered water and bleed.
3. Connect the pressure test unit and pressurise the heating installation:
   The test pressure must be equivalent to the response pressure of the safety valve. Minimum test pressure: 0.1 MPA / 1 bar
4. After 2 hours, restore the test pressure, as a pressure drop due to expansion of the pipes is possible.
5. Retain the test pressure for at least 3 hours in the heating installation and observe.
6. Also examine the entire heating installation for leaks by a visual inspection:
   Water must not escape at any point of the heating installation.
7. If possible, heat the heating installation to the maximum operating temperature after the pressure test, then repeat the visual inspection for leaks.

ⓘ

During the screed laying process, the maximum operating pressure must be applied in the heating installation so that leaks can be identified immediately.

3. Confirmed

The pressure test was conducted correctly. No leaks were found in the test.

Test pressure: _____ Test duration: _____

Client: _____ Signature: _____

Contractor: _____ Signature: _____

Place: _____ Date: _____

Attachments: _____

19 Pressure loss tables

19.01 Overview of the pressure loss tables

19.02 Notes on using the 1 K-table when calculating the pressure loss

In pumped hot water heating systems, the required heat to cover the heat losses must be transported via the piping system to the heating areas. The heat transfer of the water across the heating area is proportional to the resulting temperature difference (spread) between flow and return.

(1) $\Phi \sim \Delta\Theta$
(2) $\Delta\Theta = \Theta_V - \Theta_R$ [K]

The spread is chosen depending on the heating requirements and the system hydraulics by the designer. Here, the following approximate values are used as a basis:

Normal heat requirement Φ [kW]	**Spread ΔΘ** [K]
< 50	10 – 20
> 50	≥ 20
Self-contained central heating	~ 10

Tab. 1-25 Temperature drop depending on the heating requirements

During the transfer of heat to the room, the temperature drop influences the flow rate at constant heat output.

(3) $\Phi = \dot{m} \cdot c \cdot \Delta\Theta$ [W]

Thus, to the piping network calculation, the flow rate is an important value which is taken into account in the 1K tables (independent of the temperature drop).

(4) $\dot{m} = \frac{\Phi}{c \cdot \Delta\Theta}$ [kg/h]

For the pipe sizing, the velocity v and the pressure drops R are to be taken into account. Here, the following approximate values should not be exceeded:

For radiator connecting pipes: v ~ 0.5 m/s
For manifold and rising pipes: v ~ 1.0 – 1.5 m/s

For small systems: R ~ 100 Pa/m
For large systems: R ~ 100 - 200 Pa/m

These approximate values are based on empirical values and may differ in individual cases. For example, with short sections in a distribution pipe, the pressure drops R can be selected higher.

Example for application with the universal pipe RAUTITAN stabil:

Φ = 5815 W (necessary heat load)
$\Delta\Theta$ = 10 K (temperature drop)
c = 1.163 Wh/kg·K (specific thermal capacity of water)

From (4) we get: $\dot{m}$ = 500 kg/h

R value Pa/m	RAUTITAN stabil 16.2 x 2.6	20 x 2.9	25 x 3.7 (stabil)	32 x 4.7 (stabil)	...
50	53.4	112.3	201.2	396.6	...
	0.16	0.20	0.23	0.28	...
55	56.4	118.6	212.4	418.8	...
	0.17	0.21	0.25	0.29	...
60	59.3	124.7	223.3	440.1	...
	0.18	0.22	0.26	0.31	...
65	62.1	130.5	233.7	460.7	...
	0.19	0.23	0.27	0.32	...
70	64.8	136.2	243.8	480.6	...
	0.20	0.24	0.28	0.34	...
75	67.4	141.6	253.6	**500.0**	...
	0.21	0.25	0.29	**0.35**	...
80	69.9	146.9	263.1	518.7	...
	0.22	0.26	0.31	0.37	...
...	...	...	...	...	...
220	124.6	261.9	469.1	924.7	...
	0.38	0.47	0.54	0.65	...
240	131.0	275.3	**493.0**	971.8	...
	0.40	0.49	**0.57**	0.68	...
260	137.1	288.2	**516.0**	1017.3	...
	0.42	0.51	**0.60**	0.72	...
280	143.0	300.6	538.4	1061.3	...
...	...	...	...	...	...

Tab. 1-26 Selection example

From the pressure loss table (spread 1 K) we get:
- Option 1: RAUTITAN stabil 32 x 4.7
- Option 2: RAUTITAN stabil 25 x 3.7

Option 1
At 500 kg/h
Flow speed v = 0.35 m/s
Pressure drop R = 75 Pa/m

Option 2
Here both values are used in the interpolation:
At 500 kg/h
Flow speed v = 0.58 m/s
Pressure drop R = 245 Pa/m

19.03 Pressure loss table: Heating installation (spread 1 K)

Water temperature: 60 °C

R-value Pa/m	RAUTITAN stabil 16.2 x 2.6	20 x 2.9	25 x 3.7 (stabil)	32 x 4.7 (stabil)	40 x 6.0 (stabil)	50 x 4.5	63 x 6.0	RAUTITAN flex 16 x 2.2	20 x 2.8 (flex)	25 x 3.5 (flex)	32 x 4.4	40 x 5.5	$\dot{m}$ v
50	53.4	112.3	201.2	396.6	709.4	1994.0	3584.8	66.4	118.9	213.8	430.8	817.3	kg/h
	0.16	0.20	0.23	0.28	0.33	0.43	0.50	0.17	0.20	0.24	0.29	0.34	m/s
55	56.4	118.6	212.4	418.8	749.1	2103.4	3780.0	70.1	125.6	225.8	454.9	863.1	kg/h
	0.17	0.21	0.25	0.29	0.34	0.45	0.52	0.18	0.21	0.25	0.30	0.36	m/s
60	59.3	124.7	223.3	440.1	787.3	2208.2	3967.2	73.7	132.0	237.3	478.1	907.0	kg/h
	0.18	0.22	0.26	0.31	0.36	0.47	0.55	0.19	0.23	0.26	0.32	0.37	m/s
65	62.1	130.5	233.7	460.7	824.1	2309.2	4147.6	77.2	138.1	248.4	500.5	949.5	kg/h
	0.19	0.23	0.27	0.32	0.38	0.49	0.57	0.20	0.24	0.28	0.33	0.39	m/s
70	64.8	136.2	243.8	480.6	859.7	2406.6	4321.6	80.5	144.1	259.1	522.1	990.6	kg/h
	0.20	0.24	0.28	0.34	0.39	0.51	0.60	0.21	0.25	0.29	0.35	0.41	m/s
75	67.4	141.6	253.6	500.0	894.3	2501.0	4490.2	83.7	149.9	269.6	543.1	1030.4	kg/h
	0.21	0.25	0.29	0.35	0.41	0.54	0.62	0.22	0.26	0.30	0.36	0.43	m/s
80	69.9	146.9	263.1	518.7	927.9	2592.4	4653.6	86.9	155.5	279.7	563.5	1069.1	kg/h
	0.22	0.26	0.31	0.37	0.43	0.55	0.64	0.23	0.27	0.31	0.37	0.44	m/s
90	74.8	157.2	281.5	554.9	992.5	2768.0	4967.0	92.9	166.4	299.2	602.7	1143.5	kg/h
	0.23	0.28	0.33	0.39	0.46	0.59	0.69	0.24	0.28	0.33	0.40	0.47	m/s
100	79.4	166.9	298.9	589.3	1054.1	2934.8	5264.8	98.9	176.7	317.7	640.1	1214.5	kg/h
	0.24	0.30	0.35	0.42	0.48	0.63	0.73	0.26	0.30	0.35	0.42	0.50	m/s
110	83.9	176.3	315.7	622.3	1113.1	3094.2	5549.2	104.2	186.6	335.5	676.0	1282.5	kg/h
	0.26	0.31	0.37	0.44	0.51	0.66	0.77	0.27	0.32	0.37	0.45	0.53	m/s
120	88.1	185.3	331.8	654.0	1169.9	3247.2	5822.0	109.5	196.1	352.6	710.4	1347.9	kg/h
	0.27	0.33	0.39	0.46	0.54	0.69	0.81	0.29	0.34	0.39	0.47	0.56	m/s
130	92.3	193.9	347.3	684.6	1224.6	3394.4	6084.6	114.6	205.3	369.1	743.7	1410.9	kg/h
	0.28	0.35	0.40	0.48	0.56	0.73	0.84	0.30	0.35	0.41	0.49	0.58	m/s
140	96.3	202.3	362.3	714.2	1277.6	3536.4	6337.8	119.6	214.1	385.1	775.9	1472.0	kg/h
	0.30	0.36	0.42	0.50	0.59	0.76	0.88	0.31	0.37	0.43	0.51	0.61	m/s
150	100.1	210.5	376.9	742.9	1328.9	3673.8	6583.0	124.4	222.7	400.6	807.1	1531.2	kg/h
	0.31	0.38	0.44	0.52	0.61	0.79	0.91	0.33	0.38	0.44	0.53	0.63	m/s
160	103.9	218.4	391.0	770.8	1378.9	3807.2	6820.6	129.1	231.1	415.6	837.4	1588.7	kg/h
	0.32	0.39	0.45	0.54	0.63	0.81	0.94	0.34	0.40	0.46	0.55	0.66	m/s
170	107.5	226.1	404.8	798.0	1427.5	3936.6	7051.4	133.6	239.3	430.3	866.9	1644.7	kg/h
	0.33	0.40	0.47	0.56	0.65	0.84	0.98	0.35	0.41	0.48	0.57	0.68	m/s
180	111.1	233.6	418.2	824.5	1474.9	4062.8	7276.2	138.1	247.2	444.6	895.7	1699.3	kg/h
	0.34	0.42	0.49	0.58	0.68	0.87	1.01	0.36	0.42	0.49	0.59	0.70	m/s
190	114.6	240.9	431.4	850.4	1521.1	4185.6	7495.0	142.4	255.0	458.5	923.8	1752.6	kg/h
	0.35	0.43	0.50	0.60	0.70	0.90	1.04	0.37	0.44	0.51	0.61	0.72	m/s
200	118.0	248.1	444.2	875.7	1566.4	4305.6	7708.8	146.6	262.5	472.1	951.3	1804.7	kg/h
	0.36	0.44	0.52	0.62	0.72	0.92	1.07	0.39	0.45	0.52	0.63	0.75	m/s
220	124.6	261.9	469.1	924.7	1654.1	4537.4	8121.6	154.9	277.2	498.6	1004.5	1905.8	kg/h
	0.38	0.47	0.54	0.65	0.76	0.97	1.12	0.41	0.47	0.55	0.67	0.79	m/s
240	131.0	275.3	493.0	971.8	1738.4	4759.6	8517.4	162.7	291.4	524.0	1055.7	2002.9	kg/h
	0.40	0.49	0.57	0.68	0.80	102	1.18	0.43	0.50	0.58	0.70	0.83	m/s
260	137.1	288.2	516.0	1017.3	1819.7	4973.4	8898.2	170.4	305.0	549.0	1105.1	2096.7	kg/h
	0.42	0.51	0.60	0.72	0.83	1.06	1.23	0.45	0.52	0.61	0.73	0.87	m/s
280	143.0	300.6	538.4	1061.3	1898.5	5179.8	9265.4	177.7	318.2	572.2	1152.1	2187.4	kg/h
	0.44	0.54	0.63	0.75	0.87	1.11	1.28	0.47	0.54	0.64	0.76	0.90	m/s
300	148.8	312.7	560.0	1104.0	1974.8	5379.4	9620.6	184.9	331.0	595.2	1199.3	2275.3	kg/h
	0.46	0.56	0.65	0.78	0.91	1.15	1.33	0.49	0.57	0.66	0.79	0.94	m/s
320	154.4	324.5	581.1	1145.5	2049.0	5572.8	9965.0	191.8	343.4	617.6	1244.3	2360.8	kg/h
	0.48	0.58	0.67	0.81	0.94	1.19	1.38	0.50	0.59	0.69	0.82	0.98	m/s
360	165.1	347.0	621.5	1225.2	2191.6	5943.6	10624.6	205.2	367.3	660.6	1331.0	2525.1	kg/h

R-value Pa/m	RAUTITAN stabil (stabil) 16.2 x 2.6	20 x 2.9	25 x 3.7	32 x 4.7	40 x 6.0	50 x 4.5	63 x 6.0	RAUTITAN flex (flex) 16 x 2.2	20 x 2.8	25 x 3.5	32 x 4.4	40 x 5.5	ṁ v
	0.51	0.62	0.72	0.86	1.01	1.27	1.47	0.54	0.63	0.73	0.88	1.04	m/s
400	175.4	368.6	660.1	1301.2	2327.6	6295.6	11250.6	217.9	390.1	701.6	1413.6	2681.8	kg/h
	0.54	0.66	0.77	0.92	1.07	1.35	1.56	0.57	0.67	0.78	0.94	1.11	m/s
450	187.6	394.3	706.0	1391.8	2489.7	6713.2	11993.0	233.1	417.3	750.4	1512.0	2868.6	kg/h
	0.58	0.70	0.82	0.98	1.14	1.44	1.66	0.61	0.71	0.83	1.00	1.19	m/s
500	199.2	418.7	749.8	1478.2	2644.2	7109.6	12697.6	247.6	443.2	797.0	1605.8	3046.6	kg/h
	0.61	0.75	0.87	1.04	1.21	1.52	1.76	0.65	0.76	0.88	1.06	1.26	m/s
550	210.4	442.2	791.8	1560.9	2792.2	7487.6	13369.6	261.4	468.0	841.6	1695.7	3217.1	kg/h
	0.65	0.79	0.92	1.10	1.28	1.60	1.85	0.69	0.80	0.93	1.12	1.33	m/s
600	221.1	464.7	832.2	1640.5	2934.5	7487.6	14013.2	274.7	491.8	884.5	1782.1	3381.1	kg/h
	0.68	0.83	0.97	1.16	1.35	1.60	1.94	0.72	0.84	0.98	1.18	1.40	m/s
700	241.4	507.5	908.8	1791.6	3204.8	8534.2	15228.6	300.0	537.1	966.0	1946.2	3692.4	kg/h
	0.74	0.91	1.06	1.26	1.47	1.83	2.11	0.79	0.92	1.07	1.29	1.53	m/s
800	260.6	547.7	980.9	1933.6	3458.9	9173.6	16364.0	323.8	579.7	1042.6	2100.5	3985.2	kg/h
	0.80	0.98	1.14	1.36	1.59	1.96	2.26	0.85	0.99	1.16	1.39	1.65	m/s
1000	296.0	622.2	1114.3	2196.6	3929.3	10347.8	18447.8	367.9	658.6	1184.4	2386.2	4527.2	kg/h
	0.91	1.11	1.29	1.55	1.80	2.21	2.55	0.97	1.13	1.31	1.58	1.87	m/s

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m^3

19.04 Pressure loss table: Heating installation RAUTITAN stabil 16.2 x 2.6 (spread 10, 15 and 20 K) (stabil)

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
Q̇	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
400	34.4	0.10	22.1	22.9	0.07	11.2	17.2	0.05	6.9
500	43.0	0.13	32.3	28.7	0.09	16.3	21.5	0.06	10.1
600	51.6	0.15	44.1	34.4	0.10	22.1	25.8	0.08	13.6
700	60.2	0.18	57.5	40.1	0.12	28.8	30.1	0.09	17.7
800	68.8	0.20	72.3	45.9	0.14	36.1	34.4	0.10	22.1
900	77.4	0.23	88.6	51.6	0.15	44.1	38.7	0.12	27.0
1000	86.0	0.26	106.4	57.3	0.17	52.9	43.0	0.13	32.3
1100	94.6	0.28	125.5	63.1	0.19	62.3	47.3	0.14	38.0
1200	103.2	0.31	146.0	68.8	0.20	72.3	51.6	0.15	44.1
1300	111.8	0.33	167.9	74.6	0.22	83.0	55.9	0.17	50.6
1400	120.4	0.36	191.1	80.3	0.24	94.4	60.2	0.18	57.5
1500	129.0	0.38	215.6	86.0	0.26	106.4	64.5	0.19	64.7
1600	137.6	0.41	241.4	91.8	0.27	119.0	68.8	0.20	72.3
1700	146.2	0.43	268.5	97.5	0.29	132.2	73.1	0.22	80.3
1800	154.8	0.46	296.9	103.2	0.31	146.0	77.4	0.23	88.6
1900	163.4	0.49	326.6	109.0	0.32	160.4	81.7	0.24	97.3
2000	172.0	0.51	357.5	114.7	0.34	175.5	86.0	0.26	106.4
2200	189.2	0.56	423.1	126.1	0.38	207.3	94.6	0.28	125.5
2400	206.5	0.61	493.7	137.6	0.41	241.4	103.2	0.31	146.0
2600	223.7	0.66	569.1	149.1	0.44	277.9	111.8	0.33	167.9
2800	240.9	0.72	649.3	160.6	0.48	316.6	120.4	0.36	191.1
3000	258.1	0.77	734.3	172.0	0.51	357.5	129.0	0.38	215.6
3200	275.3	0.82	824.0	183.5	0.55	400.7	137.6	0.41	241.4
3400	292.5	0.87	918.4	195.0	0.58	446.1	146.2	0.43	268.5
3600	309.7	0.92	1017.5	206.5	0.61	493.7	154.8	0.46	296.9
3800	326.9	0.97	1121.2	217.9	0.65	543.4	163.4	0.49	326.6
4000	–	–	–	229.4	0.68	595.3	172.0	0.51	357.5
4200	–	–	–	240.9	0.72	649.3	180.6	0.54	389.7
4400	–	–	–	252.3	0.75	705.4	189.2	0.56	423.1
4500	–	–	–	258.1	0.77	734.3	193.5	0.58	440.3
4700	–	–	–	269.5	0.80	793.6	202.2	0.60	475.6
4900	–	–	–	281.0	0.84	855.0	210.8	0.63	512.1
5100	–	–	–	292.5	0.87	918.4	219.4	0.65	549.8
5300	–	–	–	303.9	0.90	984.0	228.0	0.68	588.7
5500	–	–	–	315.4	0.94	1051.6	236.6	0.70	628.8
5700	–	–	–	326.9	0.97	1121.2	245.2	0.73	670.1
5900	–	–	–	338.4	1.01	1192.9	253.8	0.75	712.6
6100	–	–	–	–	–	–	262.4	0.78	756.3
6300	–	–	–	–	–	–	271.0	0.81	801.1
6500	–	–	–	–	–	–	279.6	0.83	847.2
6700	–	–	–	–	–	–	288.2	0.86	894.4
6900	–	–	–	–	–	–	296.8	0.88	942.8
7100	–	–	–	–	–	–	305.4	0.91	992.3
7300	–	–	–	–	–	–	314.0	0.93	1043.0
7500	–	–	–	–	–	–	322.6	0.96	1094.9
7700	–	–	–	–	–	–	331.2	0.98	1147.9
7900	–	–	–	–	–	–	339.8	1.01	1202.0

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m^3

19.05 Pressure loss table: Heating installation RAUTITAN stabil 20 x 2.9 (spread 10, 15 and 20 K)

stabil

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
$\dot{Q}$	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
600	51.6	0.09	13.2	34.4	0.06	6.7	25.8	0.05	4.1
700	60.2	0.11	17.2	40.1	0.07	8.7	30.1	0.05	5.3
800	68.8	0.12	21.6	45.9	0.08	10.8	34.4	0.06	6.7
900	77.4	0.14	26.4	51.6	0.09	13.2	38.7	0.07	8.1
1000	86.0	0.15	31.7	57.3	0.10	15.8	43.0	0.08	9.7
1200	103.2	0.18	43.4	68.8	0.12	21.6	51.6	0.09	13.2
1400	120.4	0.21	56.6	80.3	0.14	28.1	60.2	0.11	17.2
1600	137.6	0.25	71.4	91.8	0.16	35.4	68.8	0.12	21.6
1800	154.8	0.28	87.7	103.2	0.18	43.4	77.4	0.14	26.4
2000	172.0	0.31	105.4	114.7	0.20	52.0	86.0	0.15	31.7
2200	189.2	0.34	124.5	126.2	0.23	61.4	94.6	0.17	37.3
2400	206.5	0.37	145.1	137.6	0.25	71.4	103.2	0.18	43.4
2600	223.7	0.40	167.0	149.1	0.27	82.1	111.8	0.20	49.8
2800	240.9	0.43	190.3	160.6	0.29	93.4	120.4	0.21	56.6
3000	258.1	0.46	214.9	172.0	0.31	105.4	129.0	0.23	63.8
3200	275.3	0.49	240.9	183.5	0.33	118.0	137.6	0.25	71.4
3400	292.5	0.52	268.2	195.0	0.35	131.2	146.2	0.26	79.4
3600	309.7	0.55	296.8	206.5	0.37	145.1	154.8	0.28	87.7
3800	326.9	0.58	326.7	217.9	0.39	159.5	163.4	0.29	96.4
4000	344.1	0.61	358.0	229.4	0.41	174.6	172.0	0.31	105.4
4200	361.3	0.64	390.4	240.9	0.43	190.3	180.6	0.32	114.8
4400	378.5	0.68	424.2	252.3	0.45	206.6	189.2	0.34	124.5
4600	395.7	0.71	459.2	263.8	0.47	223.5	197.8	0.35	134.6
4800	412.9	0.74	495.5	275.3	0.49	240.9	206.5	0.37	145.1
5000	430.1	0.77	533.1	286.7	0.51	259.0	215.1	0.38	155.9
5200	447.3	0.80	571.8	298.2	0.53	277.6	223.7	0.40	167.0
5400	464.5	0.83	611.9	309.7	0.55	296.8	232.3	0.41	178.5
5600	481.7	0.86	653.1	321.1	0.57	316.6	240.9	0.43	190.3
5800	498.9	0.89	695.6	332.6	0.59	337.0	249.5	0.45	202.5
6000	516.1	0.92	739.3	344.1	0.61	358.0	258.1	0.46	214.9
6200	533.3	0.95	784.3	355.6	0.63	379.5	266.7	0.48	227.8
6400	550.5	0.98	830.4	367.0	0.65	401.6	275.3	0.49	240.9
6600	567.7	1.01	877.8	378.5	0.68	424.2	283.9	0.51	254.4
7000	–	–	–	401.4	0.72	471.2	301.1	0.54	282.4
7400	–	–	–	424.4	0.76	520.4	318.3	0.57	311.6
7800	–	–	–	447.3	0.80	571.8	335.5	0.60	342.2
8200	–	–	–	470.3	0.84	625.5	352.7	0.63	374.0
8600	–	–	–	493.2	0.88	681.3	369.9	0.66	407.2
9000	–	–	–	516.1	0.92	739.3	387.1	0.69	441.6
9400	–	–	–	539.1	0.96	799.5	404.3	0.72	477.2
9800	–	–	–	562.0	1.00	861.9	421.5	0.75	514.1
10000	–	–	–	–	–	–	430.1	0.77	533.1
10200	–	–	–	–	–	–	438.7	0.78	552.3
10400	–	–	–	–	–	–	447.3	0.80	571.8
10600	–	–	–	–	–	–	455.9	0.81	591.7
10800	–	–	–	–	–	–	464.5	0.83	611.9
11000	–	–	–	–	–	–	473.1	0.84	632.3
11500	–	–	–	–	–	–	494.6	0.88	684.9

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
$\dot{Q}$	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
12000	–	–	–	–	–	–	516.1	0.92	739.3
12500	–	–	–	–	–	–	537.6	0.96	795.7
13000	–	–	–	–	–	–	559.1	1.00	854.0

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m^3

19.06 Pressure loss table: Heating installation RAUTITAN stabil 25 x 3.7 (spread 10, 15 and 20 K) stabil

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
Q̇	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
1000	86.0	0.10	11.5	57.3	0.07	5.8	43.0	0.05	3.6
1200	103.2	0.12	15.7	68.8	0.08	7.9	51.6	0.06	4.8
1400	120.4	0.14	20.5	80.3	0.09	10.2	60.2	0.07	6.3
1600	137.6	0.16	25.8	91.8	0.11	12.8	68.8	0.08	7.9
2000	172.0	0.20	37.9	114.7	0.13	18.8	86.0	0.10	11.5
2400	206.5	0.24	52.1	137.6	0.16	25.8	103.2	0.12	15.7
2800	240.9	0.28	68.2	160.6	0.19	33.6	120.4	0.14	20.5
3200	275.3	0.32	86.2	183.5	0.21	42.4	137.6	0.16	25.8
3600	309.7	0.36	106.0	206.5	0.24	52.1	154.8	0.18	31.6
4000	344.1	0.40	127.7	229.4	0.27	62.6	172.0	0.20	37.9
4400	378.5	0.44	151.1	252.3	0.29	74.0	189.2	0.22	44.8
4800	412.9	0.48	176.3	275.3	0.32	86.2	206.5	0.24	52.1
5200	447.3	0.52	203.2	298.2	0.35	99.2	223.7	0.26	59.9
5600	481.7	0.56	231.8	321.1	0.37	113.0	240.9	0.28	68.2
6000	516.1	0.60	262.2	344.1	0.40	127.7	258.1	0.30	77.0
6400	550.5	0.64	294.1	367.0	0.43	143.1	275.3	0.32	86.2
6800	584.9	0.68	327.8	390.0	0.45	159.3	292.5	0.34	95.9
7000	602.2	0.70	345.3	401.4	0.47	167.7	301.1	0.35	100.9
7400	636.6	0.74	381.4	424.4	0.49	185.1	318.3	0.37	111.3
7800	671.0	0.78	419.2	447.3	0.52	203.2	335.5	0.39	122.1
8200	705.4	0.82	458.5	470.3	0.55	222.1	352.7	0.41	133.4
8600	739.8	0.86	499.5	493.2	0.57	241.8	369.9	0.43	145.1
9000	774.2	0.90	542.1	516.1	0.60	262.2	387.1	0.45	157.2
9400	808.6	0.94	586.3	539.1	0.63	283.3	404.3	0.47	169.8
9800	843.0	0.98	632.1	562.0	0.65	305.2	421.5	0.49	182.9
10200	877.4	1.02	679.5	584.9	0.68	327.8	438.7	0.51	196.3
10600	–	–	–	607.9	0.71	351.2	455.9	0.53	210.2
11000	–	–	–	630.8	0.73	375.3	473.1	0.55	224.5
11500	–	–	–	659.5	0.77	406.4	494.6	0.57	243.0
12000	–	–	–	688.2	0.80	438.6	516.1	0.60	262.2
12500	–	–	–	716.8	0.83	472.0	537.6	0.62	282.0
13000	–	–	–	745.5	0.87	506.5	559.1	0.65	302.4
13500	–	–	–	774.2	0.90	542.1	580.6	0.67	323.5
14000	–	–	–	802.9	0.93	578.9	602.2	0.70	345.3
14500	–	–	–	831.5	0.97	616.7	623.7	0.72	367.6
15000	–	–	–	860.2	1.00	655.6	645.2	0.75	390.7
15500	–	–	–	–	–	–	666.7	0.77	414.3
16000	–	–	–	–	–	–	688.2	0.80	438.6
16500	–	–	–	–	–	–	709.7	0.82	463.6
17000	–	–	–	–	–	–	731.2	0.85	489.1
17500	–	–	–	–	–	–	752.7	0.87	515.3
18000	–	–	–	–	–	–	774.2	0.90	542.1
18500	–	–	–	–	–	–	795.7	0.92	569.6
19000	–	–	–	–	–	–	817.2	0.95	597.6
19500	–	–	–	–	–	–	838.7	0.97	626.3
20000	–	–	–	–	–	–	860.2	1.00	655.6

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m^3

19.07 Pressure loss table: Heating installation RAUTITAN stabil 32 x 4.7 (spread 10, 15 and 20 K) stabil

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
Q̇	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
1800	154.8	0.11	9.7	103.2	0.07	4.8	77.4	0.05	3.0
2000	172.0	0.12	11.6	114.7	0.08	5.8	86.0	0.06	3.5
2200	189.2	0.13	13.7	126.2	0.09	6.8	94.6	0.07	4.2
2400	206.5	0.15	15.9	137.6	0.10	7.9	103.2	0.07	4.8
2600	223.7	0.16	18.2	149.1	0.11	9.1	111.8	0.08	5.5
2800	240.9	0.17	20.7	160.6	0.11	10.3	120.4	0.08	6.3
3000	258.1	0.18	23.4	172.0	0.12	11.6	129.0	0.09	7.1
3400	292.5	0.21	29.1	195.0	0.14	14.4	146.2	0.10	8.8
3800	326.9	0.23	35.3	217.9	0.15	17.4	163.4	0.12	10.6
4000	344.1	0.24	38.6	229.4	0.16	19.1	172.0	0.12	11.6
4500	387.1	0.27	47.5	258.1	0.18	23.4	193.5	0.14	14.2
5000	430.1	0.30	57.2	286.7	0.20	28.1	215.1	0.15	17.0
5500	473.1	0.33	67.7	315.4	0.22	33.2	236.6	0.17	20.1
6000	516.1	0.36	78.9	344.1	0.24	38.6	258.1	0.18	23.4
6500	559.1	0.39	90.9	372.8	0.26	44.5	279.6	0.20	26.9
7000	602.2	0.42	103.7	401.4	0.28	50.7	301.1	0.21	30.6
7500	645.2	0.45	117.2	430.1	0.30	57.2	322.6	0.23	34.5
8000	688.2	0.48	131.4	458.8	0.32	64.1	344.1	0.24	38.6
8500	731.2	0.51	146.4	487.5	0.34	71.3	365.6	0.26	43.0
9000	774.2	0.55	162.1	516.1	0.36	78.9	387.1	0.27	47.5
9500	817.2	0.58	178.5	544.8	0.38	86.8	408.6	0.29	52.3
10000	860.2	0.61	195.7	573.5	0.40	95.1	430.1	0.30	57.2
10500	903.2	0.64	213.5	602.2	0.42	103.7	451.6	0.32	62.3
11000	946.2	0.67	232.1	630.8	0.44	112.6	473.1	0.33	67.7
11500	989.2	0.70	251.3	659.5	0.46	121.8	494.6	0.35	73.2
12000	1032.3	0.73	271.3	688.2	0.48	131.4	516.1	0.36	78.9
12500	1075.3	0.76	291.9	716.8	0.50	141.3	537.6	0.38	84.8
13000	1118.3	0.79	313.3	745.5	0.53	151.5	599.1	0.39	90.9
13500	1161.3	0.82	335.3	774.2	0.55	162.1	580.6	0.41	97.2
14000	1204.3	0.85	358.0	802.9	0.57	173.0	602.2	0.42	103.7
14500	1247.3	0.88	381.4	831.5	0.59	184.1	623.7	0.44	110.3
15000	1290.3	0.91	405.5	860.2	0.61	195.7	645.2	0.45	117.2
15500	1333.3	0.94	430.2	888.9	0.63	207.5	666.7	0.47	124.2
16000	1376.3	0.97	455.6	917.6	0.65	219.6	688.2	0.48	131.4
16500	1419.4	1.00	481.7	946.2	0.67	232.1	709.7	0.50	138.8
17000	–	–	–	974.9	0.69	244.8	731.2	0.51	146.4
17500	–	–	–	1003.6	0.71	257.9	752.7	0.53	154.1
18000	–	–	–	1032.3	0.73	271.3	774.2	0.55	162.1
18500	–	–	–	1060.9	0.75	285.0	795.7	0.56	170.2
19000	–	–	–	1089.6	0.77	299.0	817.2	0.58	178.5
19500	–	–	–	1118.3	0.79	313.3	838.7	0.59	187.0
20000	–	–	–	1147.0	0.81	327.9	860.2	0.61	195.7
20500	–	–	–	1175.6	0.83	342.8	881.7	0.62	204.5
21000	–	–	–	1204.3	0.85	358.0	903.2	0.64	213.5
21500	–	–	–	1233.0	0.87	373.5	924.7	0.65	222.7
22500	–	–	–	1290.3	0.91	405.5	967.7	0.68	241.6
23500	–	–	–	1347.7	0.95	438.6	1010.8	0.71	261.2
24500	–	–	–	1405.0	0.99	473.0	1053.8	0.74	281.5

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
$\dot{Q}$	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
25500	–	–	–	1462.4	1.03	508.5	1096.8	0.77	302.5
26500	–	–	–	–	–	–	1139.8	0.80	324.2
27500	–	–	–	–	–	–	1182.8	0.83	346.6
28500	–	–	–	–	–	–	1225.8	0.86	369.6
29500	–	–	–	–	–	–	1268.8	0.89	393.4
30500	–	–	–	–	–	–	1311.8	0.92	417.8
31500	–	–	–	–	–	–	1354.8	0.95	442.9
32500	–	–	–	–	–	–	1397.8	0.98	468.6
33500	–	–	–	–	–	–	1440.9	1.01	495.0

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m^3

19.08 Pressure loss table: Heating installation RAUTITAN stabil 40 x 6.0 (spread 10, 15 and 20 K)

stabil

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
$\dot{Q}$	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
2800	240.9	0.11	7.5	160.6	0.07	3.7	120.4	0.06	2.3
3000	258.1	0.12	8.5	172.0	0.08	4.2	129.0	0.06	2.6
3200	275.3	0.13	9.5	183.5	0.08	4.7	137.6	0.06	2.9
3400	292.5	0.13	10.5	195.0	0.09	5.2	146.2	0.07	3.2
3600	309.7	0.14	11.6	206.5	0.09	5.8	154.8	0.07	3.5
3800	326.9	0.15	12.7	217.9	0.10	6.3	163.4	0.07	3.9
4000	344.1	0.16	13.9	229.4	0.11	6.9	172.0	0.08	4.2
4500	387.1	0.18	17.1	258.1	0.12	8.5	193.5	0.09	5.1
5000	430.1	0.20	20.6	286.7	0.13	10.2	215.1	0.10	6.2
5500	473.1	0.22	24.3	315.4	0.14	12.0	236.6	0.11	7.3
6000	516.1	0.24	28.3	344.1	0.16	13.9	258.1	0.12	8.5
6500	559.1	0.26	32.6	372.8	0.17	16.0	279.6	0.13	9.7
7000	602.2	0.28	37.2	401.4	0.18	18.2	301.1	0.14	11.0
7500	645.2	0.30	42.0	430.1	0.20	20.6	322.6	0.15	12.5
8000	688.2	0.32	47.0	458.8	0.21	23.0	344.1	0.16	13.9
8500	731.2	0.34	52.3	487.5	0.22	25.6	365.6	0.17	15.5
9000	774.2	0.36	57.9	516.1	0.24	28.3	387.1	0.18	17.1
9500	817.2	0.37	63.8	544.8	0.25	31.1	408.6	0.19	18.8
10000	860.2	0.39	69.8	573.5	0.26	34.1	430.1	0.20	20.6
10500	903.2	0.41	76.1	602.2	0.28	37.2	451.6	0.21	22.4
11000	946.2	0.43	82.7	630.8	0.29	40.3	473.1	0.22	24.3
11500	989.2	0.45	89.5	659.5	0.30	43.6	494.6	0.23	26.3
12000	1032.3	0.47	96.6	688.2	0.32	47.0	516.1	0.24	28.3
13000	1118.3	0.51	111.4	745.5	0.34	54.2	559.1	0.26	32.6
14000	1204.3	0.55	127.2	802.9	0.37	61.8	602.2	0.28	37.2
15000	1290.3	0.59	143.9	860.2	0.39	69.8	645.2	0.30	42.0
16000	1376.3	0.63	161.6	917.6	0.42	78.3	688.2	0.32	47.0
17000	1462.4	0.67	180.2	974.9	0.45	87.2	731.2	0.34	52.3
18000	1548.4	0.71	199.7	1032.3	0.47	96.6	774.2	0.36	57.9
19000	1634.4	0.75	220.6	1089.6	0.50	106.4	817.2	0.37	63.8
20000	1720.4	0.79	241.4	1147.0	0.53	116.6	860.2	0.39	69.8
21000	1806.5	0.83	263.6	1204.3	0.55	127.2	903.2	0.41	76.1
22000	1892.5	0.87	286.7	1261.6	0.58	138.2	946.2	0.43	82.7
23000	1978.5	0.91	310.7	1319.0	0.61	149.7	989.2	0.45	89.5
24000	2064.5	0.95	335.6	1376.3	0.63	161.6	1032.3	0.47	96.6
25000	2150.5	0.99	361.4	1433.7	0.66	173.9	1075.3	0.49	103.9
26000	–	–	–	1491.0	0.68	186.6	1118.3	0.51	111.4
27000	–	–	–	1548.4	0.71	199.7	1163.3	0.53	119.2
28000	–	–	–	1605.7	0.74	213.2	1204.3	0.55	127.2
29000	–	–	–	1663.1	0.76	227.1	1247.3	0.57	135.4
30000	–	–	–	1720.4	0.79	241.4	1290.3	0.59	143.9
31000	–	–	–	1777.8	0.82	256.1	1333.3	0.61	152.6
32000	–	–	–	1835.1	0.84	271.2	1376.3	0.63	161.6
33000	–	–	–	1892.5	0.87	286.7	1419.4	0.65	170.8
34000	–	–	–	1949.8	0.89	302.6	1462.4	0.67	180.2
35000	–	–	–	2007.2	0.92	318.9	1505.4	0.69	189.8
36000	–	–	–	2064.5	0.95	335.6	1548.4	0.71	199.7
37000	–	–	–	2121.9	0.97	352.7	1591.4	0.73	209.8

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
$\dot{Q}$	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
38000	–	–	–	–	–	–	1633.7	0.75	220.1
40000	–	–	–	–	–	–	1719.7	0.79	241.4
42000	–	–	–	–	–	–	1805.7	0.83	263.6
44000	–	–	–	–	–	–	1891.7	0.87	286.7
46000	–	–	–	–	–	–	1977.6	0.91	310.7
48000	–	–	–	–	–	–	2063.6	0.95	335.6
50000	–	–	–	–	–	–	2149.6	0.99	361.4

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m^3

19.09 Pressure loss table: Heating installation RAUTITAN stabil 50 x 4.5 (spread 10, 15 and 20 K)

stabil

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
$\dot{Q}$	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
4500	387.10	0.08	2.8	258.06	0.06	1.4	193.55	0.04	0.9
5000	430.11	0.09	3.4	286.74	0.06	1.7	215.05	0.05	1.0
5500	473.12	0.10	4.0	315.41	0.07	2.0	236.56	0.05	1.2
6000	516.13	0.11	4.6	344.09	0.07	2.3	258.06	0.06	1.4
6500	559.14	0.12	5.3	372.76	0.08	2.6	279.57	0.06	1.6
7000	602.15	0.13	6.0	401.43	0.09	3.0	301.08	0.06	1.8
7500	645.16	0.14	6.8	430.11	0.09	3.4	322.58	0.07	2.0
8000	688.17	0.15	7.6	458.78	0.10	3.8	344.09	0.07	2.3
8500	731.18	0.16	8.5	487.46	0.10	4.2	365.59	0.08	2.5
9000	774.19	0.17	9.4	516.13	0.11	4.6	387.10	0.08	2.8
9500	817.20	0.17	10.3	544.80	0.12	5.1	408.60	0.09	3.1
10000	860.22	0.18	11.3	573.48	0.12	5.5	430.11	0.09	3.4
11000	946.24	0.20	13.3	630.82	0.13	6.5	473.12	0.10	4.0
12000	1032.26	0.22	15.5	688.17	0.15	7.6	516.13	0.11	4.6
13000	1118.28	0.24	17.9	745.52	0.16	8.8	559.14	0.12	5.3
14000	1204.30	0.26	20.4	802.87	0.17	10.0	602.15	0.13	6.0
16000	1376.34	0.29	25.8	917.56	0.20	12.6	688.17	0.15	7.6
18000	1548.39	0.33	31.8	1032.26	0.22	15.5	774.19	0.17	9.4
20000	1720.43	0.37	38.4	1146.95	0.25	18.7	860.22	0.18	11.3
22000	1892.47	0.40	45.5	1261.65	0.27	22.1	946.24	0.20	13.3
24000	2064.52	0.44	53.2	1376.34	0.29	25.8	1032.26	0.22	15.5
26000	2236.56	0.48	61.4	1491.04	0.32	29.8	1118.28	0.24	17.9
28000	2408.60	0.52	70.1	1605.73	0.34	34.0	1204.30	0.26	20.4
30000	2580.65	0.55	79.3	1720.43	0.37	38.4	1290.32	0.28	23.0
32000	2752.69	0.59	89.1	1835.13	0.39	43.1	1376.34	0.29	25.8
34000	2924.73	0.63	99.4	1949.82	0.42	48.0	1462.37	0.31	28.8
36000	3096.77	0.66	110.2	2064.52	0.44	53.2	1548.39	0.33	31.8
38000	3268.82	0.70	121.5	2179.21	0.47	58.6	1634.41	0.35	35.1
40000	3440.86	0.74	133.2	2293.91	0.49	64.2	1720.43	0.37	38.4
42000	3612.90	0.77	145.5	2408.60	0.52	70.1	1806.45	0.39	41.9
44000	3784.95	0.81	158.3	2523.30	0.54	76.2	1892.47	0.40	45.5
46000	3956.99	0.85	171.6	2637.99	0.56	82.5	1978.49	0.42	49.3
48000	4129.03	0.88	185.4	2752.69	0.59	89.1	2064.52	0.44	53.2
50000	4301.08	0.92	199.6	2867.38	0.61	95.9	2150.54	0.46	57.2
52000	4473.12	0.96	214.4	2982.08	0.64	102.9	2236.56	0.48	61.4
54000	4645.16	0.99	229.6	3096.77	0.66	110.2	2322.58	0.50	65.7
56000	4817.20	1.03	245.3	3211.47	0.69	117.6	2408.60	0.52	70.1
58000	–	–	–	3326.16	0.71	125.3	2494.62	0.53	74.7
60000	–	–	–	3440.86	0.74	133.2	2580.65	0.55	79.3
62000	–	–	–	3555.56	0.76	141.4	2666.67	0.57	84.2
64000	–	–	–	3670.25	0.79	149.7	2752.69	0.59	89.1
66000	–	–	–	3784.95	0.81	158.3	2838.71	0.61	94.2
68000	–	–	–	3899.64	0.83	167.1	2924.73	0.63	99.4
70000	–	–	–	4014.34	0.86	176.1	3010.75	0.64	104.7
71000	–	–	–	4071.68	0.87	180.7	3053.76	0.65	107.4
72000	–	–	–	4129.03	0.88	185.4	3096.77	0.66	110.2
73000	–	–	–	4186.38	0.90	190.1	3139.78	0.67	112.9
74000	–	–	–	4243.73	0.91	194.8	3182.80	0.68	115.7

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
$\dot{Q}$	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
75000	–	–	–	4301.08	0.92	199.6	3225.81	0.69	118.6
76000	–	–	–	4358.42	0.93	204.5	3268.82	0.70	121.5
77000	–	–	–	4415.77	0.94	209.4	3311.83	0.71	124.4
78000	–	–	–	4473.12	0.96	214.4	3354.84	0.72	127.3
79000	–	–	–	4530.47	0.97	219.4	3397.85	0.73	130.2
80000	–	–	–	4587.81	0.98	224.5	3440.86	0.74	133.2
81000	–	–	–	4645.16	0.99	229.6	3483.87	0.75	136.3
82000	–	–	–	4702.51	1.01	234.8	3526.88	0.75	139.3
83000	–	–	–	–	–	–	3569.89	0.76	142.4
84000	–	–	–	–	–	–	3612.90	0.77	145.5
86000	–	–	–	–	–	–	3698.92	0.79	151.9
88000	–	–	–	–	–	–	3784.95	0.81	158.3
90000	–	–	–	–	–	–	3870.97	0.83	164.9
92000	–	–	–	–	–	–	3956.99	0.85	171.6
94000	–	–	–	–	–	–	4043.01	0.87	178.4
96000	–	–	–	–	–	–	4129.03	0.88	185.4
98000	–	–	–	–	–	–	4215.05	0.90	192.4
100000	–	–	–	–	–	–	4301.08	0.92	199.6
102000	–	–	–	–	–	–	4387.10	0.94	206.9
104000	–	–	–	–	–	–	4473.12	0.96	214.4
106000	–	–	–	–	–	–	4559.14	0.98	221.9
108000	–	–	–	–	–	–	4645.16	0.99	229.6

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m^3

19.10 Pressure loss table: Heating installation RAUTITAN stabil 63 x 6.0 (spread 10, 15 and 20 K)

stabil

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
$\dot{Q}$	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
4500	387.10	0.05	1.0	258.06	0.04	0.5	193.55	0.03	0.3
5000	430.11	0.06	1.2	286.74	0.04	0.6	215.05	0.03	0.4
5500	473.12	0.07	1.4	315.41	0.04	0.7	236.56	0.03	0.4
6000	516.13	0.07	1.6	344.09	0.05	0.8	258.06	0.04	0.5
6500	559.14	0.08	1.9	372.76	0.05	0.9	279.57	0.04	0.6
7000	602.15	0.08	2.1	401.43	0.06	1.1	301.08	0.04	0.6
7500	645.16	0.09	2.4	430.11	0.06	1.2	322.58	0.04	0.7
8000	688.17	0.10	2.7	458.78	0.06	1.3	344.09	0.05	0.8
8500	731.18	0.10	3.0	487.46	0.07	1.5	365.59	0.05	0.9
9000	774.19	0.11	3.3	516.13	0.07	1.6	387.10	0.05	1.0
9500	817.20	0.11	3.6	544.80	0.08	1.8	408.60	0.06	1.1
10000	860.22	0.12	4.0	573.48	0.08	2.0	430.11	0.06	1.2
11000	946.24	0.13	4.7	630.82	0.09	2.3	473.12	0.07	1.4
12000	1032.26	0.14	5.5	688.17	0.10	2.7	516.13	0.07	1.6
13000	1118.28	0.15	6.3	745.52	0.10	3.1	559.14	0.08	1.9
14000	1204.30	0.17	7.2	802.87	0.11	3.5	602.15	0.08	2.1
16000	1376.34	0.19	9.1	917.56	0.13	4.5	688.17	0.10	2.7
18000	1548.39	0.21	11.2	1032.26	0.14	5.5	774.19	0.11	3.3
20000	1720.43	0.24	13.5	1146.95	0.16	6.6	860.22	0.12	4.0
22000	1892.47	0.26	16.0	1261.65	0.17	7.8	946.24	0.13	4.7
24000	2064.52	0.29	18.7	1376.34	0.19	9.1	1032.26	0.14	5.5
26000	2236.56	0.31	21.5	1491.04	0.21	10.5	1118.28	0.15	6.3
28000	2408.60	0.33	24.5	1605.73	0.22	11.9	1204.30	0.17	7.2
30000	2580.65	0.36	27.8	1720.43	0.24	13.5	1290.32	0.18	8.1
32000	2752.69	0.38	31.1	1835.13	0.25	15.1	1376.34	0.19	9.1
34000	2924.73	0.40	34.7	1949.82	0.27	16.9	1462.37	0.20	10.1
36000	3096.77	0.43	38.5	2064.52	0.29	18.7	1548.39	0.21	11.2
38000	3268.82	0.45	42.4	2179.21	0.30	20.5	1634.41	0.23	12.3
40000	3440.86	0.48	46.5	2293.91	0.32	22.5	1720.43	0.24	13.5
42000	3612.90	0.50	50.7	2408.60	0.33	24.5	1806.45	0.25	14.7
44000	3784.95	0.52	55.1	2523.30	0.35	26.7	1892.47	0.26	16.0
46000	3956.99	0.55	59.7	2637.99	0.36	28.9	1978.49	0.27	17.3
48000	4129.03	0.57	64.5	2752.69	0.38	31.1	2064.52	0.29	18.7
50000	4301.08	0.59	69.4	2867.38	0.40	33.5	2150.54	0.30	20.1
52000	4473.12	0.62	74.5	2982.08	0.41	35.9	2236.56	0.31	21.5
54000	4645.16	0.64	79.7	3096.77	0.43	38.5	2322.58	0.32	23.0
56000	4817.20	0.67	85.2	3211.47	0.44	41.0	2408.60	0.33	24.5
58000	4989.25	0.69	90.7	3326.16	0.46	43.7	2494.62	0.35	26.1
60000	5161.29	0.71	96.5	3440.86	0.48	46.5	2580.65	0.36	27.8
62000	5333.33	0.74	102.4	3555.56	0.49	49.3	2666.67	0.37	29.4
64000	5505.38	0.76	108.4	3670.25	0.51	52.2	2752.69	0.38	31.1
66000	5677.42	0.79	114.6	3784.95	0.52	55.1	2838.71	0.39	32.9
68000	5849.46	0.81	121.0	3899.64	0.54	58.2	2924.73	0.40	34.7
70000	6021.51	0.83	127.6	4014.34	0.56	61.3	3010.75	0.42	36.6
71000	6107.53	0.84	130.9	4071.68	0.56	62.9	3053.76	0.42	37.5
72000	6193.55	0.86	134.3	4129.03	0.57	64.5	3096.77	0.43	38.5
73000	6279.57	0.87	137.7	4186.38	0.58	66.1	3139.78	0.43	39.4
74000	6365.59	0.88	141.1	4243.73	0.59	67.7	3182.80	0.44	40.4

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
	Flow rate	Velocity	Pressure loss	Flow rate	Velocity	Pressure loss	Flow rate	Velocity	Pressure loss
$\dot{Q}$	$\dot{m}$	v	R	$\dot{m}$	v	R	$\dot{m}$	v	R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
75000	6451.61	0.89	144.6	4301.08	0.59	69.4	3225.81	0.45	41.4
76000	6537.63	0.90	148.1	4358.42	0.60	71.1	3268.82	0.45	42.4
77000	6623.66	0.92	151.7	4415.77	0.61	72.8	3311.83	0.46	43.4
78000	6709.68	0.93	155.3	4473.12	0.62	74.5	3354.84	0.46	44.4
79000	6795.70	0.94	158.9	4530.47	0.63	76.2	3397.85	0.47	45.4
80000	6881.72	0.95	162.6	4587.81	0.63	78.0	3440.86	0.48	46.5
81000	6967.74	0.96	166.3	4645.16	0.64	79.7	3483.87	0.48	47.5
82000	7053.76	0.98	170.1	4702.51	0.65	81.5	3526.88	0.49	48.6
83000	7139.78	0.99	173.9	4759.86	0.66	83.3	3569.89	0.49	49.6
84000	7225.81	1.00	177.7	4817.20	0.67	85.2	3612.90	0.50	50.7
86000	–	–	–	4931.90	0.68	88.9	3698.92	0.51	52.9
88000	–	–	–	5046.59	0.70	92.6	3784.95	0.52	55.1
90000	–	–	–	5161.29	0.71	96.5	3870.97	0.54	57.4
92000	–	–	–	5275.99	0.73	100.4	3956.99	0.55	59.7
94000	–	–	–	5390.68	0.75	104.4	4043.01	0.56	62.1
96000	–	–	–	5505.38	0.76	108.4	4129.03	0.57	64.5
98000	–	–	–	5620.07	0.78	112.6	4215.05	0.58	66.9
100000	–	–	–	5734.77	0.79	116.8	4301.08	0.59	69.4
101000	–	–	–	5792.11	0.80	118.9	4344.09	0.60	70.7
102000	–	–	–	5849.46	0.81	121.0	4387.10	0.61	71.9
104000	–	–	–	5964.16	0.82	125.4	4473.12	0.62	74.5
106000	–	–	–	6078.85	0.84	129.8	4559.14	0.63	77.1
108000	–	–	–	6193.55	0.86	134.3	4645.16	0.64	79.7
110000	–	–	–	6308.24	0.87	138.8	4731.18	0.65	82.4
112000	–	–	–	6422.94	0.89	143.4	4817.20	0.67	85.2
114000	–	–	–	6537.63	0.90	148.1	4903.23	0.68	87.9
116000	–	–	–	6652.33	0.92	152.9	4989.25	0.69	90.7
118000	–	–	–	6767.03	0.94	157.7	5075.27	0.70	93.6
120000	–	–	–	6881.72	0.95	162.6	5161.29	0.71	96.5
122000	–	–	–	6996.42	0.97	167.6	5247.31	0.73	99.4
124000	–	–	–	7111.11	0.98	172.6	5333.33	0.74	102.4
126000	–	–	–	7225.81	1.00	177.7	5419.35	0.75	105.4
127000	–	–	–	–	–	–	5462.37	0.76	106.9
128000	–	–	–	–	–	–	5505.38	0.76	108.4
129000	–	–	–	–	–	–	5548.39	0.77	110.0
130000	–	–	–	–	–	–	5591.40	0.77	111.5
135000	–	–	–	–	–	–	5806.45	0.80	119.4
140000	–	–	–	–	–	–	6021.51	0.83	127.6
150000	–	–	–	–	–	–	6451.61	0.89	144.6
155000	–	–	–	–	–	–	6666.67	0.92	153.5
160000	–	–	–	–	–	–	6881.72	0.95	162.6
165000	–	–	–	–	–	–	7096.77	0.98	172.0
168000	–	–	–	–	–	–	7225.81	1.00	177.7

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m³

19.11 Pressure loss table: Heating installation RAUTITAN flex 12 x 1.7 (spread 10, 15 and 20 K) flex

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 20 K			Spread 30 K		
	Flow rate	Velocity	Pressure loss	Flow rate	Velocity	Pressure loss	Flow rate	Velocity	Pressure loss
$\dot{Q}$	$\dot{m}$	v	R	$\dot{m}$	v	R	$\dot{m}$	v	R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
100	8.6	0.042	7.0	4.3	0.021	2.3	2.9	0.014	1.2
200	17.2	0.084	21.9	8.6	0.042	7.0	5.7	0.028	3.6
300	25.8	0.126	43.3	12.9	0.063	13.6	8.6	0.042	7.0
400	34.4	0.167	70.6	17.2	0.084	21.9	11.5	0.056	11.2
500	43.0	0.209	103.4	21.5	0.105	31.9	14.3	0.070	16.2
600	51.6	0.251	141.6	25.8	0.126	43.3	17.2	0.084	21.9
700	60.2	0.293	184.8	30.1	0.146	56.3	20.1	0.098	28.4
800	68.8	0.335	233.0	34.4	0.167	70.6	22.9	0.112	35.5
900	77.4	0.377	286.0	38.7	0.188	86.4	25.8	0.126	43.3
1000	86.0	0.418	343.8	43.0	0.209	103.4	28.7	0.139	51.8
1100	94.6	0.460	406.2	47.3	0.230	121.9	31.5	0.153	60.9
1200	103.2	0.502	473.3	51.6	0.251	141.6	34.4	0.167	70.6
1300	111.8	0.544	544.9	55.9	0.272	162.5	37.3	0.181	81.0
1400	120.4	0.586	620.9	60.2	0.293	184.8	40.1	0.195	91.9
1500	129.0	0.628	701.5	64.5	0.314	208.3	43.0	0.209	103.4
1600	137.6	0.669	786.4	68.8	0.335	233.0	45.9	0.223	115.6
1700	146.2	0.711	875.7	73.1	0.356	258.9	48.7	0.237	128.3
1800	154.8	0.753	969.3	77.4	0.377	286.0	51.6	0.251	141.5
1900	163.4	0.795	1067.2	81.7	0.397	314.3	54.5	0.265	155.4
2000	172.0	0.837	1169.4	86.0	0.418	343.8	57.3	0.279	169.8
2100	180.6	0.879	1275.8	90.3	0.439	374.4	60.2	0.293	184.8
2200	189.2	0.920	1386.5	94.6	0.460	406.2	63.1	0.307	200.3
2300	197.8	0.962	1501.3	98.9	0.481	439.2	65.9	0.321	216.3
2400	206.5	1.004	1620.3	103.2	0.502	473.3	68.8	0.335	232.9
2500	-	-	-	107.5	0.523	508.5	71.7	0.349	250.1
2600	-	-	-	111.8	0.544	544.9	74.6	0.363	267.8
2700	-	-	-	116.1	0.565	582.3	77.4	0.377	286.0
2800	-	-	-	120.4	0.586	620.9	80.3	0.390	304.7
2900	-	-	-	124.7	0.607	660.7	83.2	0.404	324.0
3000	-	-	-	129.0	0.628	701.5	86.0	0.418	343.7
3100	-	-	-	133.3	0.648	743.4	88.9	0.432	364.0
3200	-	-	-	137.6	0.669	786.4	91.8	0.446	384.9
3300	-	-	-	141.9	0.690	830.5	94.6	0.460	406.2
3400	-	-	-	146.2	0.711	875.7	97.5	0.474	428.0
3500	-	-	-	150.5	0.732	922.0	100.4	0.488	450.4
3600	-	-	-	154.8	0.753	969.3	103.2	0.502	473.3
3700	-	-	-	159.1	0.774	1017.7	106.1	0.516	496.6
3800	-	-	-	163.4	0.795	1067.2	109.0	0.530	520.5
3900	-	-	-	167.7	0.816	1117.8	111.8	0.544	544.8
4000	-	-	-	172.0	0.837	1169.4	114.7	0.558	569.7
4100	-	-	-	176.3	0.858	1222.1	117.6	0.572	595.1
4200	-	-	-	180.6	0.879	1275.8	120.4	0.586	620.9
4300	-	-	-	184.9	0.900	1330.6	123.3	0.600	647.3
4400	-	-	-	189.2	0.920	1386.5	126.2	0.614	674.1
4500	-	-	-	193.5	0.941	1443.4	129.0	0.628	701.5
4600	-	-	-	197.8	0.962	1501.3	131.9	0.642	729.3
4700	-	-	-	202.2	0.983	1560.3	134.8	0.655	757.6
4800	-	-	-	-	-	-	137.6	0.669	786.4
4900	-	-	-	-	-	-	140.5	0.683	815.7
5000	-	-	-	-	-	-	143.4	0.697	845.4
5100	-	-	-	-	-	-	146.2	0.711	875.7
5200	-	-	-	-	-	-	149.1	0.725	906.4
5300	-	-	-	-	-	-	152.0	0.739	937.6
5400	-	-	-	-	-	-	154.8	0.753	969.3
5500	-	-	-	-	-	-	157.7	0.767	1001.4
5600	-	-	-	-	-	-	160.6	0.781	1034.1
5700	-	-	-	-	-	-	163.4	0.795	1067.2
5800	-	-	-	-	-	-	166.3	0.809	1100.8
5900	-	-	-	-	-	-	169.2	0.823	1134.8
6000	-	-	-	-	-	-	172.0	0.837	1169.4
6100	-	-	-	-	-	-	174.9	0.851	1204.4
6200	-	-	-	-	-	-	177.8	0.865	1239.9
6300	-	-	-	-	-	-	180.6	0.879	1275.8
6400	-	-	-	-	-	-	183.5	0.893	1312.2
6500	-	-	-	-	-	-	186.4	0.907	1349.1
6600	-	-	-	-	-	-	189.2	0.920	1386.4
6700	-	-	-	-	-	-	192.1	0.934	1424.3
6800	-	-	-	-	-	-	195.0	0.948	1462.5
6900	-	-	-	-	-	-	197.8	0.962	1501.3
7000	-	-	-	-	-	-	200.7	0.976	1540.5
7100	-	-	-	-	-	-	203.6	0.990	1580.2

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m³

19.12 Pressure loss table: Heating installation RAUTITAN flex 16 x 2.2 (spread 10, 15 and 20 K) flex

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
Q̇	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
400	34.4	0.09	16.8	22.9	0.06	8.5	17.2	0.05	5.3
500	43.0	0.11	24.5	28.7	0.08	12.3	21.5	0.06	7.6
600	51.6	0.14	33.4	34.4	0.09	16.8	25.8	0.07	10.3
700	60.2	0.16	43.4	40.1	0.11	21.8	30.1	0.08	13.4
800	68.8	0.18	54.6	45.9	0.12	27.3	34.4	0.09	16.8
900	77.4	0.20	66.9	51.6	0.14	33.4	38.7	0.10	20.5
1000	86.0	0.23	80.2	57.3	0.15	39.9	43.0	0.11	24.5
1100	94.6	0.25	94.6	63.1	0.17	47.0	47.3	0.12	28.8
1200	103.2	0.27	110.1	68.8	0.18	54.6	51.6	0.14	33.4
1300	111.8	0.29	126.5	74.5	0.20	62.7	55.9	0.15	38.2
1400	120.4	0.32	143.9	80.3	0.21	71.2	60.2	0.16	43.4
1500	129.0	0.34	162.4	86.0	0.23	80.2	64.5	0.17	48.9
1600	137.6	0.36	181.8	91.7	0.24	89.7	68.8	0.18	54.6
1800	154.8	0.41	223.5	103.2	0.27	110.1	77.4	0.20	66.9
2000	172.0	0.45	268.9	114.7	0.30	132.9	86.0	0.23	80.2
2200	189.2	0.50	318.1	126.1	0.33	156.1	94.6	0.25	94.6
2400	206.4	0.54	371.0	137.6	0.36	181.8	103.2	0.27	110.1
2600	223.6	0.59	427.5	149.1	0.39	209.1	111.8	0.29	126.5
2800	240.8	0.63	487.6	160.5	0.42	238.2	120.4	0.32	143.9
3000	258.0	0.68	551.2	172.0	0.45	268.9	129.0	0.34	162.4
3200	275.2	0.72	618.4	183.5	0.48	301.3	137.6	0.36	181.8
3400	292.4	0.77	689.1	194.9	0.51	335.4	146.2	0.38	202.1
3700	318.2	0.48	801.5	212.1	0.56	389.4	159.1	0.42	234.5
4100	352.6	0.93	963.5	235.1	0.62	467.2	176.3	0.46	280.9
4300	369.8	0.97	1049.5	246.5	0.65	508.4	184.9	0.49	305.5
4500	–	–	–	258.0	0.68	551.2	193.5	0.51	331.0
4700	–	–	–	269.5	0.71	595.6	202.1	0.53	357.4
4900	–	–	–	280.9	0.74	641.6	210.7	0.55	384.8
5100	–	–	–	292.4	0.77	689.1	219.3	0.58	413.1
5300	–	–	–	303.9	0.80	738.1	227.9	0.60	442.2
5500	–	–	–	315.3	0.83	788.6	236.5	0.62	472.2
5700	–	–	–	326.8	0.86	840.7	245.1	0.64	503.2
5900	–	–	–	338.3	0.89	894.3	253.7	0.67	535.0
6100	–	–	–	349.7	0.92	949.4	262.3	0.69	567.7
6300	–	–	–	361.2	0.95	1006.1	270.9	0.71	601.3
6500	–	–	–	372.7	0.98	1064.2	279.5	0.73	635.7
6700	–	–	–	–	–	–	288.1	0.76	671.1
6900	–	–	–	–	–	–	296.7	0.78	707.3
7100	–	–	–	–	–	–	305.3	0.80	744.3
7300	–	–	–	–	–	–	313.9	0.83	782.2
7500	–	–	–	–	–	–	322.5	0.85	821.0
7700	–	–	–	–	–	–	331.1	0.87	860.6
7900	–	–	–	–	–	–	339.7	0.89	901.1
8100	–	–	–	–	–	–	348.3	0.92	942.5
8300	–	–	–	–	–	–	356.9	0.94	984.7
8500	–	–	–	–	–	–	365.5	0.96	1027.7
8800	–	–	–	–	–	–	378.4	0.99	1093.8

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m³

19.13 Pressure loss table: Heating installation RAUTITAN flex 20 x 2.8 (spread 10, 15 and 20 K) flex

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
Q̇	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
600	51.6	0.09	12.0	34.4	0.06	6.1	25.8	0.04	3.8
700	60.2	0.10	15.6	40.1	0.07	7.9	30.1	0.05	4.9
800	68.8	0.12	19.6	45.9	0.08	9.9	34.4	0.06	6.1
900	77.4	0.13	24.0	51.6	0.09	12.0	38.7	0.07	7.4
1000	86.0	0.15	28.8	57.3	0.10	14.4	43.0	0.07	8.8
1100	94.6	0.16	33.9	63.1	0.11	16.9	47.3	0.08	10.4
1200	103.2	0.18	39.4	68.8	0.12	19.6	51.6	0.09	12.0
1300	111.8	0.19	45.3	74.5	0.13	22.5	55.9	0.10	13.8
1400	120.4	0.21	51.4	80.3	0.14	25.6	60.2	0.10	15.6
1600	137.6	0.23	64.9	91.7	0.16	32.2	68.8	0.12	19.6
1800	154.8	0.26	79.6	103.2	0.18	39.4	77.4	0.13	24.0
2000	172.0	0.29	95.7	114.7	0.20	47.3	86.0	0.15	28.8
2200	189.2	0.32	113.0	126.1	0.22	55.8	94.6	0.16	33.9
2400	206.4	0.35	131.7	137.6	0.23	64.9	103.2	0.18	39.4
2600	223.6	0.38	151.6	149.1	0.25	74.5	111.8	0.19	45.3
2800	240.8	0.41	172.7	160.5	0.27	84.8	120.4	0.21	51.4
3000	258.0	0.44	195.0	172.0	0.29	95.7	129.0	0.22	58.0
3200	275.2	0.47	218.6	183.5	0.31	107.1	137.6	0.23	64.9
3400	292.4	0.50	243.3	194.9	0.33	119.1	146.2	0.25	72.1
3600	309.6	0.53	269.2	206.4	0.35	131.7	154.8	0.26	79.6
3800	326.8	0.56	296.3	217.9	0.37	144.8	163.4	0.28	87.5
4000	344.0	0.59	324.6	229.3	0.39	158.5	172.0	0.29	95.7
4200	361.2	0.62	354.0	240.8	0.41	172.7	180.6	0.31	104.2
4400	378.4	0.65	384.6	252.3	0.43	187.4	189.2	0.32	113.0
4600	395.6	0.67	416.4	263.7	0.45	202.7	197.8	0.34	122.2
4800	412.8	0.70	449.2	275.2	0.47	218.6	206.4	0.35	131.7
5000	430.0	0.73	483.2	286.7	0.49	234.9	215.0	0.37	141.5
5200	447.2	0.76	518.3	298.1	0.51	251.8	223.6	0.38	151.6
5600	481.6	0.82	591.9	321.1	0.55	287.2	240.8	0.41	172.7
6000	516.0	0.88	670.0	344.0	0.59	324.6	258.0	0.44	195.0
6400	550.4	0.94	752.4	366.9	0.63	364.1	275.2	0.47	218.6
6800	584.8	1.00	839.2	389.9	0.66	405.6	292.4	0.50	243.3
7200	–	–	–	412.8	0.70	449.2	309.6	0.53	269.2
7600	–	–	–	435.7	0.74	494.8	326.8	0.56	296.3
8000	–	–	–	458.7	0.78	542.4	344.0	0.59	324.6
8400	–	–	–	481.6	0.82	591.9	361.2	0.62	354.0
8800	–	–	–	504.5	0.86	643.5	378.4	0.65	384.6
9200	–	–	–	527.5	0.90	697.0	395.6	0.67	416.4
9600	–	–	–	550.4	0.94	752.4	412.8	0.70	449.2
10000	–	–	–	573.3	0.98	809.8	430.0	0.73	483.2
10500	–	–	–	–	–	–	451.5	0.77	527.3
11000	–	–	–	–	–	–	473.0	0.81	573.1
11500	–	–	–	–	–	–	494.5	0.84	620.7
12000	–	–	–	–	–	–	516.0	0.88	670.0
12500	–	–	–	–	–	–	537.5	0.92	721.0
13000	–	–	–	–	–	–	559.0	0.95	773.7
13500	–	–	–	–	–	–	580.5	0.99	828.1

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m³

19.14 Pressure loss table: Heating installation RAUTITAN flex 25 x 3.5 (spread 10, 15 and 20 K) flex

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
Q̇	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
1000	86.0	0.09	10.0	57.3	0.06	5.0	43.0	0.05	3.1
1200	103.2	0.11	13.7	68.8	0.08	6.9	51.6	0.06	4.2
1400	120.4	0.13	17.9	80.3	0.09	8.9	60.2	0.07	5.5
1600	137.6	0.15	22.5	91.7	0.10	11.2	68.8	0.08	6.9
1800	154.8	0.17	27.6	103.2	0.11	13.7	77.4	0.08	8.4
2000	172.0	0.19	33.1	114.7	0.13	16.4	86.0	0.09	10.0
2400	206.4	0.23	45.4	137.6	0.15	22.5	103.2	0.11	13.7
2800	240.8	0.26	59.5	160.5	0.18	29.4	120.4	0.13	17.9
3200	275.2	0.30	75.1	183.5	0.20	37.0	137.6	0.15	22.5
3600	309.6	0.34	92.4	206.4	0.23	45.4	154.8	0.17	27.6
4000	344.0	0.38	111.2	229.3	0.25	54.6	172.0	0.19	33.1
4400	378.4	0.41	131.6	252.3	0.28	64.5	189.2	0.21	39.0
4800	412.8	0.45	153.5	275.2	0.30	75.1	206.4	0.23	45.4
5200	447.2	0.49	176.9	298.1	0.33	86.5	223.6	0.24	52.2
5600	481.6	0.53	201.8	321.1	0.35	98.5	240.8	0.26	59.5
6000	516.0	0.56	228.2	344.0	0.38	111.2	258.0	0.28	67.1
6400	550.4	0.60	256.0	366.9	0.40	124.7	275.2	0.30	75.1
6800	584.8	0.64	285.3	389.9	0.43	138.8	292.4	0.32	83.6
7200	619.2	0.68	316.0	412.8	0.45	153.5	309.6	0.34	92.4
7600	653.6	0.71	348.1	435.7	0.48	169.0	326.8	0.36	101.6
8000	688.0	0.75	381.6	458.7	0.50	185.1	344.0	0.38	111.2
8500	731.0	0.80	425.4	487.3	0.53	206.1	365.5	0.40	128.8
9000	774.0	0.84	471.5	516.0	0.56	228.2	387.0	0.42	137.0
9500	817.0	0.89	519.7	544.7	0.59	251.3	408.5	0.45	150.7
10000	860.0	0.94	570.0	573.3	0.63	275.4	430.0	0.47	165.1
10500	903.0	0.99	622.5	602.0	0.66	300.4	451.5	0.49	180.0
11000	–	–	–	630.7	0.69	326.5	473.0	0.52	195.5
11500	–	–	–	659.3	0.72	353.6	494.5	0.54	211.6
12000	–	–	–	688.0	0.75	381.6	516.0	0.56	228.2
12500	–	–	–	716.7	0.78	410.6	537.5	0.59	245.4
13000	–	–	–	745.3	0.81	440.6	559.0	0.61	263.2
13500	–	–	–	774.0	0.84	471.5	580.5	0.63	281.5
14000	–	–	–	802.7	0.88	503.4	602.0	0.66	300.4
14500	–	–	–	831.3	0.91	536.2	623.5	0.68	319.9
15000	–	–	–	860.0	0.94	570.0	645.0	0.70	339.9
15500	–	–	–	888.7	0.97	604.8	666.5	0.73	360.5
16000	–	–	–	917.3	1.00	640.5	688.0	0.75	381.6
16500	–	–	–	–	–	–	709.5	0.77	403.2
17000	–	–	–	–	–	–	731.0	0.80	425.4
17500	–	–	–	–	–	–	752.5	0.82	448.2
18000	–	–	–	–	–	–	774.0	0.84	471.5
18500	–	–	–	–	–	–	795.5	0.87	495.3
19000	–	–	–	–	–	–	817.0	0.89	519.7
19500	–	–	–	–	–	–	838.5	0.92	544.6
20000	–	–	–	–	–	–	860.0	0.94	570.0
20500	–	–	–	–	–	–	881.5	0.96	596.0
21000	–	–	–	–	–	–	903.0	0.99	622.5

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m³

19.15 Pressure loss table: Heating installation RAUTITAN flex 32 x 4.4 (spread 10, 15 and 20 K) flex

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
Q̇	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R	Flow rate ṁ	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
1800	154.8	0.10	8.3	103.2	0.07	4.1	77.4	0.05	2.5
2000	172.0	0.11	9.9	114.7	0.08	5.0	86.0	0.06	3.0
2200	189.2	0.12	11.7	126.1	0.08	5.8	94.6	0.06	3.6
2400	206.4	0.14	13.6	137.6	0.09	6.8	103.2	0.07	4.1
2600	223.6	0.15	15.6	149.1	0.10	7.8	111.8	0.07	4.7
2800	240.8	0.16	17.8	160.5	0.11	8.8	120.4	0.08	5.4
3000	258.0	0.17	20.0	172.0	0.11	9.9	129.0	0.08	6.1
3400	292.4	0.19	24.9	194.9	0.13	12.3	146.2	0.10	7.5
3800	326.8	0.21	30.3	217.9	0.14	14.9	163.4	0.11	9.1
4200	361.2	0.24	36.1	240.8	0.16	17.8	180.6	0.12	10.8
4600	395.6	0.26	42.3	263.7	0.17	20.8	197.8	0.13	12.6
5000	430.0	0.28	49.0	286.7	0.19	24.1	215.0	0.14	14.6
5500	473.0	0.31	57.9	315.3	0.21	28.4	236.5	0.16	17.2
6000	516.0	0.34	67.5	344.0	0.23	33.1	258.0	0.17	20.0
6500	559.0	0.37	77.8	372.7	0.24	38.1	279.5	0.18	23.0
7000	602.0	0.40	88.7	401.3	0.26	43.4	301.0	0.20	26.2
7500	645.0	0.42	100.2	430.0	0.28	49.0	322.5	0.21	29.6
8000	688.0	0.45	112.4	458.7	0.30	54.9	344.0	0.23	33.1
8500	731.0	0.48	125.2	487.3	0.32	61.0	365.5	0.24	36.8
9000	774.0	0.51	138.6	516.0	0.34	67.5	387.0	0.25	40.7
9500	817.0	0.54	152.6	544.7	0.36	74.3	408.5	0.27	44.7
10000	860.0	0.57	167.2	573.3	0.38	81.3	430.0	0.28	49.0
11000	946.0	0.62	198.3	630.7	0.41	96.3	473.0	0.31	57.9
12000	1032.0	0.68	231.8	688.0	0.45	112.4	516.0	0.34	67.5
13000	1118.0	0.73	267.6	745.3	0.49	129.6	559.0	0.37	77.8
14000	1204.0	0.79	305.8	802.7	0.53	147.9	602.0	0.40	88.7
15000	1290.0	0.85	346.3	860.0	0.57	167.2	645.0	0.42	100.2
16000	1376.0	0.90	389.0	917.3	0.60	187.7	688.0	0.45	112.4
17000	1462.0	0.96	434.1	974.7	0.64	209.2	731.0	0.48	125.2
18000	–	–	–	1032.0	0.68	231.8	774.0	0.51	138.6
19000	–	–	–	1089.3	0.72	255.4	817.0	0.54	152.6
20000	–	–	–	1146.7	0.75	280.1	860.0	0.57	167.2
21000	–	–	–	1204.0	0.79	305.8	903.0	0.59	182.5
22000	–	–	–	1261.3	0.83	332.5	946.0	0.62	198.3
23000	–	–	–	1318.7	0.87	360.3	989.0	0.65	214.8
24000	–	–	–	1376.0	0.90	389.0	1032.0	0.68	231.8
25000	–	–	–	1433.3	0.94	418.8	1075.0	0.71	249.4
26000	–	–	–	1490.7	0.98	449.6	1118.0	0.73	267.6
27000	–	–	–	–	–	–	1161.0	0.76	286.4
28000	–	–	–	–	–	–	1204.0	0.79	305.8
29000	–	–	–	–	–	–	1247.0	0.82	325.7
30000	–	–	–	–	–	–	1290.0	0.85	346.3
31000	–	–	–	–	–	–	1333.0	0.88	367.4
32000	–	–	–	–	–	–	1376.0	0.90	389.0
33000	–	–	–	–	–	–	1419.0	0.93	411.3
34000	–	–	–	–	–	–	1462.0	0.96	434.1
35000	–	–	–	–	–	–	1505.0	0.99	457.5

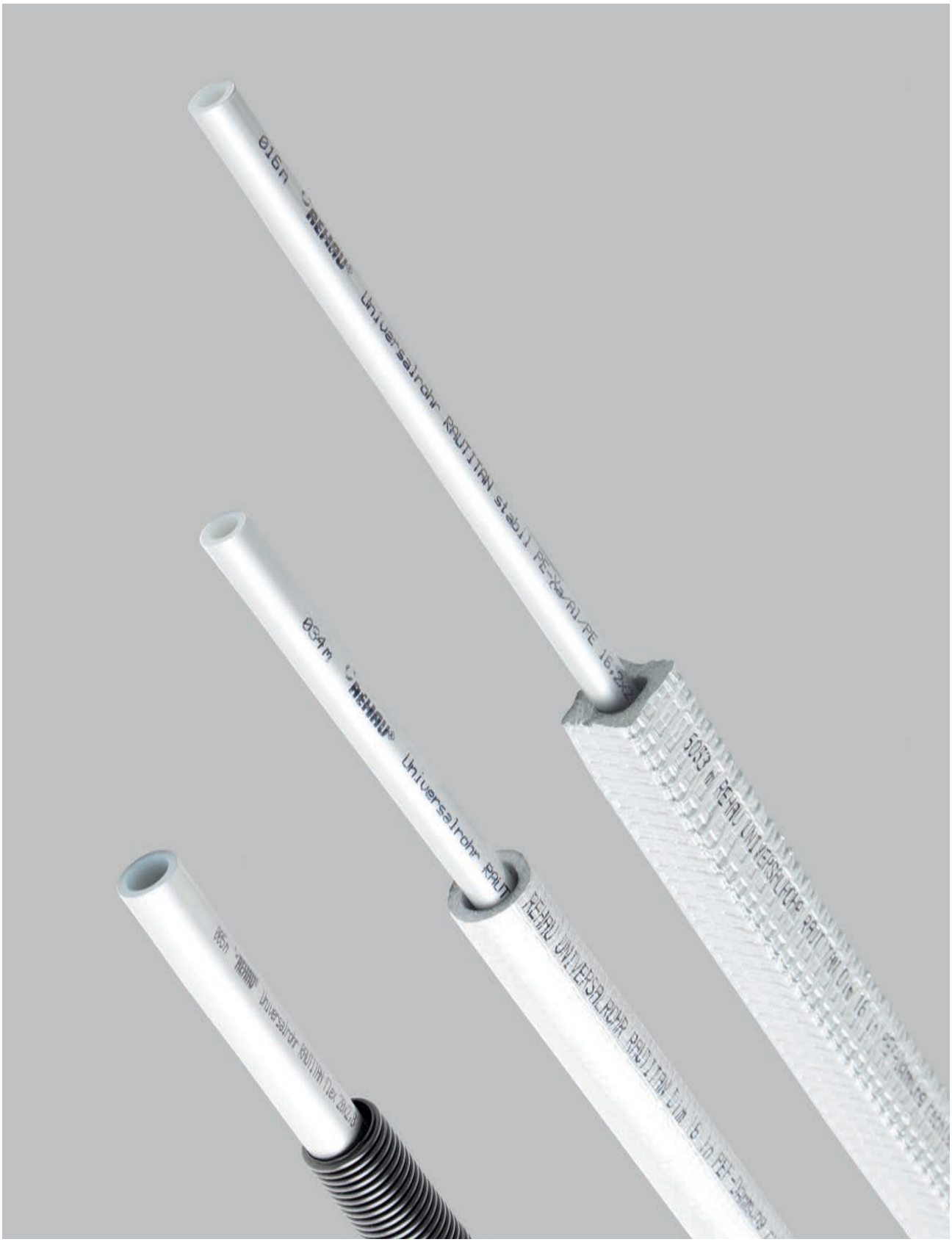
Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m³

19.16 Pressure loss table: Heating installation RAUTITAN flex 40 x 5.5 (spread 10, 15 and 20 K) flex

Water temperature: 60 °C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
$\dot{Q}$	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R	Flow rate $\dot{m}$	Velocity v	Pressure loss R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
2800	240.8	0.10	6.2	160.5	0.07	3.1	120.4	0.05	1.9
3000	258.0	0.11	7.0	172.0	0.07	3.5	129.0	0.05	2.1
3200	275.2	0.12	7.8	183.5	0.08	3.9	137.6	0.06	2.4
3400	292.4	0.12	8.6	194.9	0.08	4.3	146.2	0.06	2.6
3600	309.6	0.13	9.5	206.4	0.09	4.7	154.8	0.07	2.9
3800	326.8	0.14	10.5	217.9	0.09	5.2	163.4	0.07	3.2
4000	344.0	0.14	11.5	229.3	0.10	5.7	172.0	0.07	3.5
4500	387.0	0.16	14.1	258.0	0.11	7.0	193.5	0.08	4.2
5000	430.0	0.18	16.9	286.7	0.12	8.3	215.0	0.09	5.1
5500	473.0	0.20	20.0	315.3	0.13	9.8	236.5	0.10	6.0
6000	516.0	0.22	23.3	344.0	0.14	11.5	258.0	0.11	7.0
6500	559.0	0.24	26.8	372.7	0.16	13.2	279.5	0.12	8.0
7000	602.0	0.25	30.5	401.3	0.17	15.0	301.0	0.13	9.1
7500	645.0	0.27	34.4	430.0	0.18	16.9	322.5	0.14	10.2
8000	688.0	0.29	38.6	458.7	0.19	18.9	344.0	0.14	11.5
8500	731.0	0.31	42.9	487.3	0.20	21.0	365.5	0.15	12.7
9000	774.0	0.33	47.5	516.0	0.22	23.3	387.0	0.16	14.1
9500	817.0	0.34	52.3	544.7	0.23	25.6	408.5	0.17	15.4
10000	860.0	0.36	57.2	573.3	0.24	28.0	430.0	0.18	16.9
10500	903.0	0.38	62.4	602.0	0.25	30.5	451.5	0.19	18.4
11000	946.0	0.40	67.8	630.7	0.27	33.1	473.0	0.20	20.0
11500	989.0	0.42	73.4	659.3	0.28	35.8	494.5	0.21	21.6
12000	1032.0	0.43	79.1	688.0	0.29	38.6	516.0	0.22	23.3
13000	1118.0	0.47	91.3	745.3	0.31	44.4	559.0	0.24	26.8
14000	1204.0	0.51	104.2	802.7	0.34	50.7	602.0	0.25	30.5
15000	1290.0	0.54	117.9	860.0	0.36	57.2	645.0	0.27	34.4
17000	1462.0	0.61	147.5	974.7	0.41	71.5	731.0	0.31	42.9
19000	1634.0	0.69	180.1	1089.3	0.46	87.1	817.0	0.34	52.3
21000	1806.0	0.76	215.7	1204.0	0.51	104.2	903.0	0.38	62.4
23000	1978.0	0.83	254.1	1318.7	0.55	122.6	989.0	0.42	73.4
25000	2150.0	0.90	295.5	1433.3	0.60	142.3	1075.0	0.45	85.1
27000	2322.0	0.98	339.7	1548.0	0.65	163.4	1161.0	0.49	97.6
28000	–	–	–	1605.3	0.68	174.5	1204.0	0.51	104.2
30000	–	–	–	1720.0	0.72	197.5	1290.0	0.54	117.9
32000	–	–	–	1834.7	0.77	221.9	1376.0	0.58	132.3
34000	–	–	–	1949.3	0.82	247.5	1462.0	0.61	147.5
36000	–	–	–	2064.0	0.87	274.5	1548.0	0.65	163.4
38000	–	–	–	2178.7	0.92	302.7	1634.0	0.69	180.1
40000	–	–	–	2293.3	0.96	332.2	1720.0	0.72	197.5
42000	–	–	–	–	–	–	1806.0	0.76	215.7
44000	–	–	–	–	–	–	1892.0	0.80	234.5
46000	–	–	–	–	–	–	1978.0	0.893	254.1
48000	–	–	–	–	–	–	2064.0	0.87	274.5
50000	–	–	–	–	–	–	2150.0	0.90	295.5
52000	–	–	–	–	–	–	2236.0	0.94	317.3
55000	–	–	–	–	–	–	2365.0	0.99	351.2

Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m^3



Insulation and noise protection

Contents

20 Pipe insulation

The specifications in this chapter only apply to
stabil — Universal pipe RAUTITAN stabil
flex — Universal pipe RAUTITAN flex

20.01 General purpose of pipe insulations

Pipe insulation can be thermal insulation or any other kind of pipe sleeving:
- Protection of cold water pipes against heat
- Protection against condensation
- Reduction of heat loss
- Restriction of heat emission from hot piping
- Reduction of sound transmission (separation of the piping from the building)
- Protection of piping against UV radiation
- To a small degree compensation of thermal movement within the insulation sleeve
- Mechanical protection against damage
- Corrosion protection of the piping

Consult the client and the contractors of other trades on the intended type and thickness of the insulation before beginning work.

Always insulate/sleeve pipes and connection components, even though thermal insulation may not be mandatory.

20.02 Pipe insulation

REHAU pipes are factory pre-insulated in various types:
- For pipe sizes 16, 20 and 25
- In various thicknesses according to BS EN 806, DIN 1988 and EnEV
- With insulation in closed-cell PE foam with co-extruded PE film moisture barrier
  - In round shape
  - In eccentric shape
- Sleeved with protective PE piping at the factory
- Selected variants in 13mm thickness with fire class BL-s2-d0 to BS EN 13501-1

Insulation thicknesses which are not within the REHAU product range, can be sourced on site from other suppliers.

20.03 Fitting insulation

As a supplement to the on-site insulation of fittings, REHAU provides the following easily-installed insulating boxes:
- Insulating box for elbows Rp ½
- Cross fitting RAUTITAN with insulating box

20.04 Benefits of using factory-manufactured pre-insulated pipes

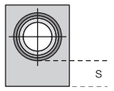
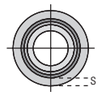
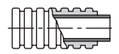
Fig. 20-1 Round pre-insulated pipe RAUTITAN (also available rectangular pre-insulated)

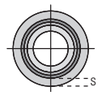
- Fewer points (insulation joints) which must be lagged later
- Efficient and fast pipe installation
- For insulation with eccentric shapes, no additional laying of a compensating layer necessary as specified in DIN 18560-2 (test certificate for impact sound improvement)
- Lower storage and transport costs

20.05 Standard and guidelines

When insulating pipes, observe the following statutory regulations and standards:
- Drinking water pipes
  - BS EN 806
  - BS 5442 (cold and hot)
  - German energy saving ordinance (EnEV) (hot drinking water)
  - Country-specific standards and guidelines
- Heating pipes
  - BS 5442
  - Country specific standards and guidelines

20.06 Pre-insulated pipes - Applications

Area of application	Heating systems on raw floor	Drinking water and heating installation	
Type	 Eccentric rectangular shape	 Round shape	 Protective pipe
Pipe sizes	16 / 20	16 / 20 / 25	16 / 20
Thermal conductivity (at 40 °C)	λ = 0.040 W/(m · K)	λ = 0.040 W/(m · K)	–
Material	PE foam insulation ▪ Closed-cell extruded ▪ With co-extruded, PE film moisture barrier	PE foam insulation ▪ Closed-cell extruded ▪ With co-extruded, PE film moisture barrier	▪ Executed to DIN 49019 ▪ Polyethylene material ▪ Formulated for heat resistance up to +105 °C
Properties/Benefits	▪ Reduced heat loss ▪ High stability on the raw floor ▪ Greater acceptance from succeeding contractors (e.g. screed layers) due to the shape ▪ No additional laying of a compensating layer necessary (test certificate for impact sound improvement) ▪ Better application of impact sound insulation ▪ Low height above the floor	▪ Reduced condensation, limitation of heat gains and losses ▪ Reduced heat loss ▪ Can be laid as required on rough floors, in shafts and wall chases	▪ Reduced against condensation ▪ At expansion joint crossings ▪ As protection at the pipe entries to manifolds

Drinking water and heating installation
 Round shape
16 / 20 / 25
λ = 0.040 W/(m · K)
13mm PE foam insulation ▪ Closed-cell extruded ▪ Fire classification BL-s2-d0 to EN 13501-1 ▪ With co-extruded, PE film moisture barrier
▪ Protection against the formation of condensation , heating and cooling of piping Restriction of heat loss ▪ Can be laid as required on rough floors, in shafts, stud walls and wall chases

21 Noise protection

The specifications in this chapter only apply to
stabil Universal pipe RAUTITAN stabil
flex Universal pipe RAUTITAN flex

21.01 Preventative measures to reduce the transmission of sound

Floor plans
- Planning locations of rooms requiring insulation adjacent to bathrooms and WCs should be avoided
- Acoustically advantageous arrangement of bathroom appliances, fittings and piping

Planning and design of the piping systems
- Using the universal system RAUTITAN for drinking water and heating (acoustic insulation properties)
- Reduction of the pipe pressure
- Consideration of the flow velocities
- Selection of pipe and fitting fixings
- Use of low-noise fittings

Installation of the piping systems
- Avoidance of structure-borne noise bridges
- Avoidance of direct contact of connection components and pipes with the building
- All pipes insulated
- Use of soft and elastic insulating materials (e.g. factory pre-insulated pipes with closed-cell foamed PE insulation)
- Use of pipe clamps with acoustic dampeners
- Use of insulating boxes

21.02 Benefits of using the universal system RAUTITAN for drinking water and heating

Fig. 21-1 Insulation box elbow RAUTITAN

Fig. 21-2 Insulation box Rp½ flow-through elbow

- Acoustic insulation properties of the RAU-PE-Xa pipe material
- Acoustic insulation of the REHAU elbow Rp ½ with REHAU insulating box Rp ½ long/short
- Sound insulation of the tees with the insulating box
- Pre-insulated pipes

21.03 Noise insulating properties of the piping

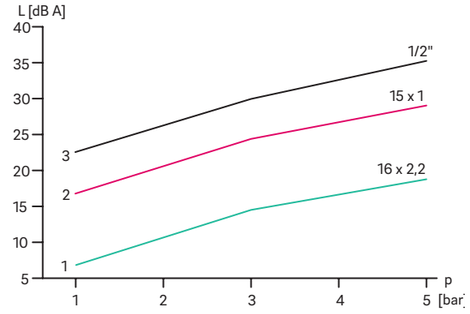


Fig. 21-3 Result of Fraunhofer Institute test report: Comparison of pipe materials

L Sound level
p Flow pressure
1 Plastic pipe made of RAU-PE-Xa
2 Copper pipes
3 Galvanized steel pipes DN 15

Noises are propagated partly in the pipe walls and partly in the water column. The piping transmits vibration to the wall and ceiling. In comparison with metal pipes, pipes made of RAU-PE-Xa (former designation RAU-VPE) transmit only little of the structure-borne noise.
The Fraunhofer Institute for Structural Physics examined the noise transmission properties of pipes made of RAU-PE-Xa (RAU-VPE), copper and galvanised steel. The noise levels of pipes in the three most common sizes were measured under the same conditions of flow pressure and flow rate and were compared with each other. The results of this overall noise examination are graphically represented (see Fig. 21-3).
The results of the overall noise examination demonstrate a clearly lower development of noise with the pipes made of RAU-PE-Xa in comparison with metal pipe installations. They were therefore classified as the most favourable to achieve low-noise installations.

With metal/plastic composite pipes (e.g. univeral pipe RAUTITAN stabil), the lower noise levels of the plastic pipes (RAU-PE-Xa) are not achieved due to the material combination. However, they are below the values of purely metallic piping systems.

System guidelines, planning and assembly

Contents

22 Important instructions for connecting the pipes RAUTITAN stabil, the compression sleeves RAUTITAN PX stabil and fittings RAUTITAN RX+ stabil in the sizes 50 and 63

22.01 Universal Plumbing system for potable water and heating installations

Fig. 22-1 Permitted combination

Different system dimensions
Pipes RAUTITAN flex, Fittings RAUTITAN LX/RX/RX+ und the compression sleeves LX/MX in sizes 50 x 5.9 und 60 x 8.6 are not compatible with the pipes RAUTITAN stabil 50 x 4.5 und 60 x 6.0 , the fitting RAUITAN RX+ stabil and the compression sleeves RAUTITAN PX stabil.

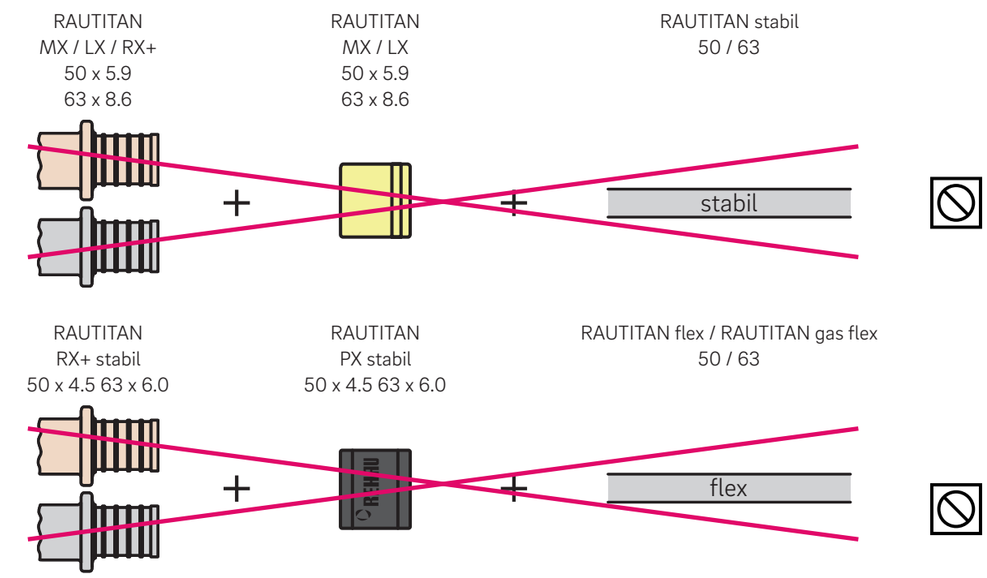


Fig. 22-2 Prohibited combination

22.02 RAUTOOL

New	For RAUTITAN stabil Ø 50 x 4.5 / 63 x 6.0	For RAUTITAN flex Ø 50 / 63	For RAUTITAN stabil Ø 50 x 4.5 / 63 x 6.0
Mat.-Nr. 13258201001 13258211001		Mat.-Nr. 13174361001 13174371001	
Mat.-Nr. 10011281001 10011331001		Mat.-Nr. 11376241001 11376341001	

Tab. 1-1 RAUTOOL for the pipes RAUTITAN stabil, the compression sleeves RAUTITAN PX stabil and fittings RAUTITAN RX+ stabil in sizes 50 and 63

Different system dimensions

The working tool G, both expansion heads and compression jaws are not compatible with the pipes RAUTITAN stabil 50 x 4.5 and 60 x 6.0, the fittings RAUTITAN RX+ stabil and compression sleeves RAUTITAN PX stabil.

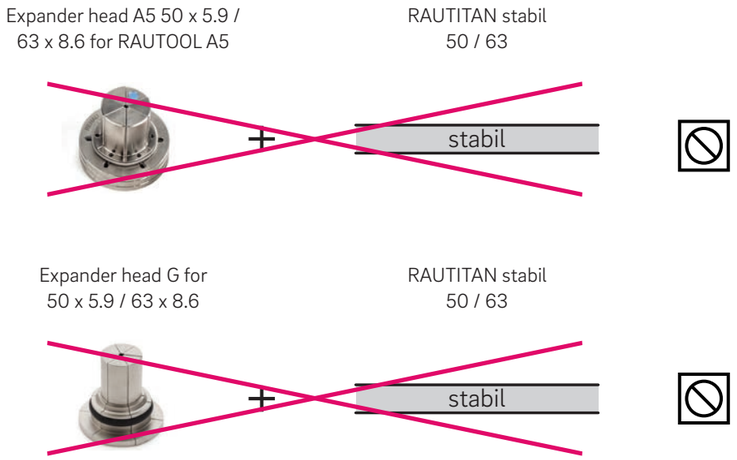


Fig. 22-3 Prohibited expansion tools

23 Transport and storage

Universal pipes RAUTITAN stabil and RAUTITAN flex delivered with protective end caps for a transport and a storage under optimal hygienic conditions.

Handling the pipes and system components

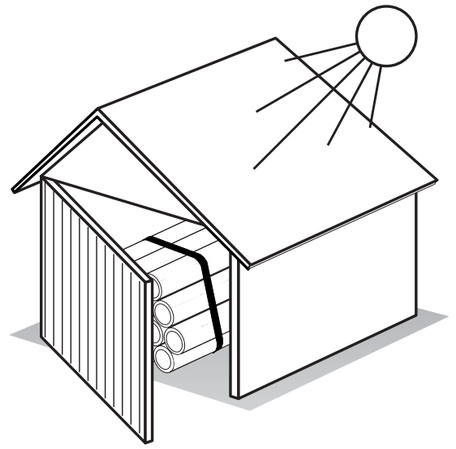


Fig. 23-1 Protect pipes against sunlight

Protect pipes and components from UV radiation when storing and transporting.

Avoid damaging the pipes and system components:

- Load and unload with due care.
- Transport in a way suitable for the material.
- Do not drag over floors or concrete surfaces.
- Store on a flat surface with no sharp edges.
- Protect against mechanical damage.
- Protect against dirt, drilling dust, mortar, grease, oil, paint, solvents, chemicals, humidity, etc.
- Protect against sunlight, e.g. with a tarpaulin or similar.
- During construction protect from prolonged exposure to sunlight.
- Only unpack shortly before laying.
- Note the hygienic requirements (e.g. sealing of pipe ends, protection of the fittings, compliance with VDI 6023).
- Hygiene-conscious planning, execution, operation and installation of drinking water systems.

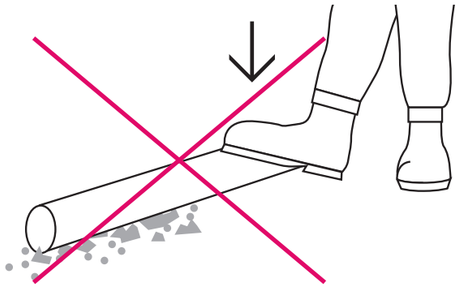


Fig. 23-2 Do not store pipes on sharp-edged surfaces

24 Pipes

24.01 PE-X materials

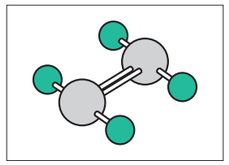


Fig. 24-1 Ethylene

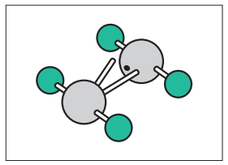


Fig. 24-2 Ethylene, detaching double bond

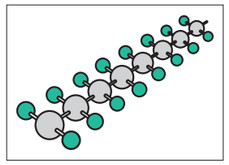


Fig. 24-3 Polyethylene (PE)

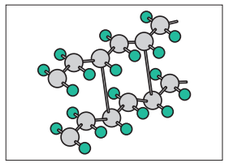


Fig. 24-4 Crosslinked polyethylene (PE-X)

- Corrosion resistance of the pipes: No pitting
- No tendency to deposits
- Polymer pipe material reduces sound transmission along the pipe
- Good resistance to abrasion
- Toxicologically and physiologically harmless
- All RAUTITAN pipes with WRAS registration comply with the water regulations

Peroxide-crosslinked polyethylene
Peroxide-crosslinked polyethylene is designated PE-Xa. This method of crosslinking is conducted at high temperatures and pressure with the aid of peroxides. Here, the individual molecules of the polyethylene combine to form a three-dimensional network. This high-pressure crosslinking is characterised by crosslinking in the melt away from the crystallite melting point. Crosslinking occurs during the moulding of the pipe in the tool. This method of crosslinking ensures an even and very high degree of crosslinking over the entire cross-section of even thick-walled pipes.

Radiation crosslinked polyethylene
Radiation crosslinked polyethylene is designated PE-Xc. Crosslinking is conducted after the production of the pipes under the effects of high-energy radiation.

Inliner universal pipe RAUTITAN stabil
The interior pipe in the universal pipe RAUTITAN stabil, which comes into contact with the flowing medium, is known as inliner. This inliner is made of cross-linked polyethylene (PE-X).

24.02 Material – Pipe (overview)

Composition / Material	Pipe
▪ Self-supporting PE-X inliner (sizes 16 to 40), pressure-resistant and crosslinked ▪ Aluminium layer ▪ Polyethylene outer layer	Universal pipe RAUTITAN stabil stabil
▪ RAU-PE-Xa ▪ Adhesive agent ▪ Oxygen diffusion barrier	Universal pipe RAUTITAN flex flex

Tab. 1-2 Pipe composition/material (composition from inside to outside)

24.03 Areas of application: Pipes for plumbing applications

	Universal pipe RAUTITAN stabil stabil	Universal pipe RAUTITAN flex flex	Heating pipes RAUTHERM	Industrial pipes
Drinking water	++	++	–	–
Heating	++	++	–	–
Radiator connection from the skirting	++	–	–	–
Underfloor heating/cooling	+	+	++	–
Gas	–	–	–	–

++ Use permitted + Use permitted with limitation – Use not permitted

24.04 Areas of application: Pipes in underfloor heating/cooling

Installation system		Universal pipe RAUTITAN stabil	Universal pipe RAUTITAN flex
Stapler tracker system		16.2 x 2.6 mm / 20.0 x 2.9 mm	16 x 2.2 mm / 20 x 2.8 mm
RAUFIX rail	for 12/14	–	–
	for 16/17/20	16.2 x 2.6 mm	16 x 2.2 mm 20 x 2.8 mm
Pipe to mesh		16.2 x 2.6 mm / 20.0 x 2.8 mm	16 x 2.2 mm / 20 x 2.8 mm
Dry floor system		16.2 x 2.6 mm	16 x 2.2 mm
Chilled ceiling		–	–
Acoustic chilled ceiling		–	–
Wall heating/cooling in drywall/in wetwall		–	–
Ceiling in wetwall construction		–	–

24.05 Areas of application: Industrial applications

	Pipes RAUTITAN	Industrial pipe RAUPEX	Industrial pipe RAUTHERM-FW	Pre-insulated iindustrial pipe RAUFRIGO
Compressed air	–	++	–	–
Vacuum	–	++	–	–
Inert Gas	–	++	–	–
Cooling water	–	++	–	+
Water for industrial use	–	++	–	–
Industrial heating	–	–	++	–
Refrigerant medium transport	–	+	–	++

++ Use permitted + Use permitted with limitation – Use not permitted

24.06 Universal pipe RAUTITAN stabil

Fig. 24-5 Universal pipe RAUTITAN stabil

- Metal/plastic composite pipe with the following structure:
  - Self-supporting inliner in dimensions 16-40 (pressure-resistant inner tube) made of crosslinked polyethylene (PE-X)
  - Oxygen-diffusion tight aluminium layer
  - Polyethylene outer layer
- Areas of application
  - Drinking water installation
  - Heating installation

RAUTITAN pipe delivered with protective end caps for a transport and a storage under optimal hygienic conditions.

Approvals for Germany and quality certificates
- DVGW registration for universal pipe RAUTITAN stabil and compression sleeve jointing technique from REHAU with RAUTITAN connection components
- System approvals for sizes 16–63: DVGW DW-8501AU2346 and DVGW DW-8803CT053
- The universal pipe RAUTITAN stabil complies with DIN EN ISO 21003 - application classes 1-5 / 1 MPa (10 bar).

Approvals for United Kingdom
WRAS or KIWA UK Reg4 approval.

Pipe size

d [mm]	**s** [mm]	**DN** [1] [mm]	**Aluminium thickness** [mm]	**Content** [l/m]
16.2	2.6	12	0.2	0.095
20	2.9	15	0.3	0.158
25	3.7	20	0.4	0.243
32	4.7	25	0.4	0.401
40	6.0	32	0.5	0.616
50	4.5	40	0.6	1.320
63	6.0	50	0.8	2.043

1) This information is intended to aid in the selection of other system components and as a first orientation during the initial system sizing. The exact pipe inner diameter ist d – 2 x s and has to be used during the installation design.

Tab. 1-3 Pipe size, universal pipe RAUTITAN stabil

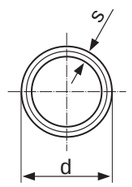


Fig. 24-6 Diameter/Wall thickness

24.07 Universal pipe RAUTITAN flex

Fig. 24-7 Universal pipe RAUTITAN flex

- Pipe made from RAU-PE-Xa
  - Peroxide-crosslinked polyethylene (PE-Xa)
  - With oxygen diffusion barrier
  - Oxygen-tight according to DIN 4726
- Areas of application
  - Drinking water installation
  - Heating installation

RAUTITAN pipe delivered with pre-assembled stoppers for a transport and a storage under optimal hygienic conditions.

Approvals for Germany and quality certificates
- DVGW registration for universal pipe RAUTITAN flex and compression sleeve jointing technique from REHAU with RAUTITAN connection components
- System approval: DVGW DW-8501AU2200
- The universal pipe RAUTITAN flex complies with DIN EN ISO 15875
- DIN CERTCO registration confirms the suitability of the pipes for use in the heating installation to DIN 4726/DIN EN ISO 15875 - application class 1–4 / 1 MPa (10 bar) and 5 / 0.8 MPa (8 bar) and the necessary tightness against oxygen diffusion

Approvals for United Kingdom
WRAS or KIWA UK Reg4 approval.

Pipe size

d [mm]	**s** [mm]	**DN** [1] [mm]	**Content** [l/m]
12	1.7	8	0.058
16	2.2	12	0.106
20	2.8	15	0.163
25	3.5	20	0.254
32	4.4	25	0.423
40	5.5	32	0.661

1) This information is intended to aid in the selection of other system components and as a first orientation during the initial system sizing. The exact pipe inner diameter ist d – 2 x s and has to be used during the installation design.

Tab. 1-4 Pipe size, universal pipe RAUTITAN flex

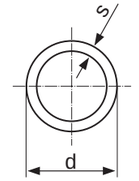


Fig. 24-8 Diameter/Wall thickness

24.08 Technical data of pipes

Technical data	Unit	Pipe Universal pipe RAUTITAN stabil stabil	Universal pipe RAUTITAN flex flex
Material	–	PE-X/Al/PE	PE-Xa EVAL-coated
Colour (surface)	–	Silver	Silver
Notch impact strength at 20 °C	–	No fracture	No fracture
Notch impact strength at –20 °C	–	No fracture	No fracture
Average coefficient of expansion	[mm/(m·K)]	0.026	0.15
when laying with pipe support channel			
Size 16–40 Size 50 and 63		– –	0.04 0.1
Thermal conductivity	[W/(m·K)]	0.43	0.35
Pipe roughness	[mm]	0.007	0.007
Oxygen diffusion (to DIN 4726)	–	Oxygen-tight	Oxygen-tight
Material constant C	–	33	12
Building material class acc. DIN 4102-1 Construction product class acc. DIN EN 13501-1	–	B2 E	B2 E
Maximum/Minimum laying temperature	[°C]	+50/–10	+50/–10
Minimum bending radius without tools d = Pipe diameter	–	5 x d	8 x d
Minimum bending radius with spiral spring/tool d = Pipe diameter	–	3 x d	–
Minimum bending radius with pipe bend brackets d = Pipe diameter	–	–	3–4 x d Plumbing 5 x d Plumbing/Heating
Available sizes	[mm]	16–63	12–40

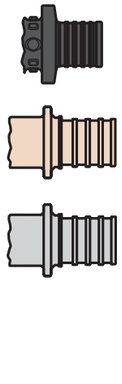
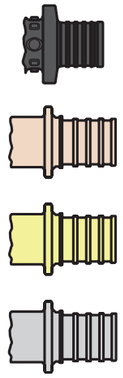
Tab. 1-5 Technical data of pipes / approximate values

In rare cases it is possible for small blisters to form on the surface of the universal RAUTITAN stabil pipe. The blisters do in no way impact the pipe quality or its fitness for purpose and are harmless.

25 Fittings and compression sleeves

25.01 Differentiating the fittings and compression sleeves

Areas of application of the fittings and compression sleeves

Drinking water installation stabil / flex		Heating installation stabil / flex	
Fitting	Compression sleeve	Fitting	Compression sleeve
			

Tab. 1-6 Areas of application of the fittings and compression sleeves

Fig. 25-5 RAUTITAN LX (standard brass), RAUTITAN RX+ (gunmetal) and RAUTITAN SX (stainless steel) fittings

25.02 Fittings and compression sleeves of the RAUTITAN system

- Application in plumbing and heating installation
- Permanently sealing compression sleeve jointing technique according to BS EN 806, DIN 1988 and DVGW-worksheet W 534
- Approved for flush-mounted installation in accordance with DIN 18380 (VOB)
- Without o-ring (pipe material seals itself)
- Easy visual check
- Can be immediately pressurised
- RAUTITAN RX+ fittings, through wich drinking water flows, are made of lead free gunmetal according to DIN SPEC 2701
- DVGW registration (all sizes)
  - For the RAUTITAN pipes in the drinking water installation
  - For the REHAU compression sleeve jointing technique
- Manufacture of the compression sleeve joint with RAUTOOL
  - Especially coordinated with the RAUTITAN and RAUTHERM S systems
  - Development and service directly from REHAU

Fig. 25-1 Fittings RAUTITAN PX made from PPSU

Fig. 25-2 RAUTITAN compression sleeves

- Only use the fittings and compression sleeves RAUTITAN PX, RAUTITAN RX+ or RAUTITAN SX in the drinking water and heating installation.
- Only push RAUTITAN PX compression sleeves onto RAUTITAN PX fittings.
- Do not mix the RAUTITAN connection components with the connection components of the heating pipe RAUTHERM S (underfloor heating/cooling) (e.g. stainless steel RAUTITAN SX system adapters or radiator elbow connection sets RAUTITAN). Do not combine fittings and compressions sleeves from different ranges with each other.
- Do not use fittings for the heating installation (as labeled on the packaging) in drinking water installations.
- Please note the measurements of the fittings and compression sleeves.

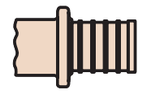
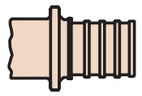
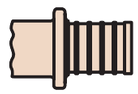
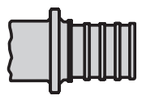
For detailed information about the compatibility of the fittings and compression sleeves with existing pipes, please contact your REHAU sales office.

Size designation of the fittings and compression sleeves for the RAUTITAN system

- 12 x 1.7
- 16 x 2.2
- 20 x 2.8
- 25 x 3.5
- 32 x 4.4
- 40 x 5.5
- 50 x 4.5
- 63 x 6.0

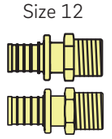
25.02.01 Fittings

Fittings for drinking water and heating

	Size 16–40	Size 50–63
Threadless fittings	 RAUTITAN PX	 RAUTITAN RX+ stabil
Material	PPSU	Gunmetal
	Size 16–40	Size 50–63
Fittings for screwing, soldering, clamping	 RAUTITAN RX+	 RAUTITAN RX+ stabil
Material	Gunmetal	
	Size 16–40	
	 RAUTITAN SX	
Material	Stainless steel	

Tab. 1-7 Fittings for plumbing and heating installations

Fittings for RAUTITAN flex - Heating only

	Size 12
Threaded, threadless fittings	 RAUTTIAN LX Standard brass

Fitting	Material
RAUTITAN PX RAUTITAN PX stabil	Polyphenyl sulphone Material marking: PPSU
RAUTITAN RX+ RAUTITAN RX+ stabil	Lead free gunmetal according to DIN SPEC 2701 (material designation CuSn4Zn2PS) Material marking: Rg+
RAUTITAN SX	Stainless steel (material designations 1.4404/1.4408) The fittings are manufactured according to DIN EN 10088, part 3
RAUTITAN LX	Standard brass (CW 617N) according to DIN EN 1254-3

Differences of the fittings for the heating installation

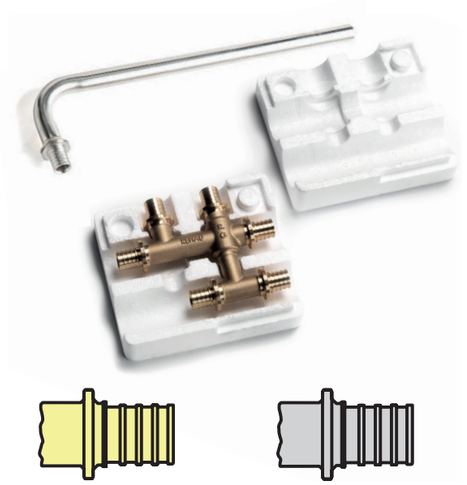


Fig. 25-3 Fittings for the heating installation only

- Only use fittings of the RAUTITAN system in the heating installation with RAUTITAN (e.g. radiator elbow connection sets, radiator tee connection sets, cross fittings) if they are are labeled as heating fittings on the packaging.

25.02.02 Compression sleeves

Compression sleeves for the RAUTITAN universal system for drinking water and heating

Fig. 25-4 RAUTITAN PX compression sleeve

	RAUTITAN PX RAUTITAN PX stabil
	
Size	16 x 2.2 mm 20 x 2.8 mm 25 x 3.5 mm 32 x 4.4 mm 40 x 5.5 mm 50 x 4.5 mm 63 x 6.0 mm
Material	PVDF (Polyvinylidene fluoride)
Characteristic features	▪ Can be pushed onto the fitting from both sides ▪ Black

Tab. 1-8 RAUTITAN compression sleeves

- Can be used for all pipe types of the RAUTITAN universal system for drinking water and heating
- Permanently sealing compression sleeve jointing technique
  - According to BS EN 806, DIN 1988 and DVGW worksheet W 534
  - Approved for flush-mounted installation according to DIN 18380 (VOB)

Compression sleeves for RAUTITAN flex - Heating only

	
Size	12 x 1.7 mm
Material	RAUTTIAN LX Standard brass
Features	Sleeve with orientation, must be pushed on the right way around

25.03 Transition to other pipe materials

Fig. 25-6 RAUTITAN RX+ (lead free gunmetal) fitting

Fig. 25-7 RAUTITAN SX (stainless steel) fitting

⚠

- Only make joints after the soldering process.
- Let the solder cool down fully.
- A direct connection thread between the fitting RAUTITAN SX made of stainless steel and fittings made of galvanised steel is according to BS EN 806-4 not allowed.
  We recommend for that the use of a non ferrous metal transition fitting (e.g. gunmetal).
- To extend the thread fittings RAUTITAN we recommend the use of thread pieces made of gunmetal.

E.g. if repairs or piping network extensions make a system change to the RAUTITAN system or to the REHAU systems for underfloor heating/cooling necessary, a threaded joint must always be used to preserve the guarantee and as a clear interface between the different systems.
An exception to this rule is the use of the soldering/pressing adapter RAUTITAN RX+ and the RAUTITAN SX stainless steel system pressing adapter.

For transitions from the RAUTITAN system to soldering or metal compression systems (radial crimp systems), use the soldering/pressing adapter RAUTITAN RX+ or RAUTITAN SX.
When using with metal compression systems, ensure that the surfaces of the soldering/compression end are free of grooves and deformations.
Observe the instructions of the metal compression system manufacturers.

Fig. 25-8 Adapter with male thread and soldering/pressing adapter

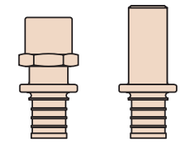


Fig. 25-9 RAUTITAN fittings for transitions to other materials

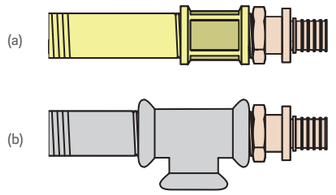


Fig. 25-10 Adapter with RAUTITAN male thread screwed into:
(a) Brass fittings
(b) Systems with galvanised pipes and fittings

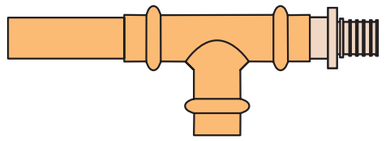


Fig. 25-11 Soldering/Pressing adapter RAUTITAN RX+ with copper pressing system

Use suitable solder and flux for soft-soldering and hard-soldering.

§

Use soft-soldering methods only in the drinking water installation.

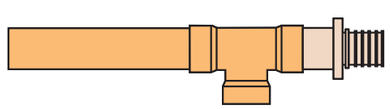


Fig. 25-12 Soldering/Pressing adapter RAUTITAN RX+ soldered into a copper piping system

Transition to stainless steel systems

Fig. 25-13 System adapter with stainless steel RAUTITAN SX male thread and stainless steel RAUTITAN SX system pressing adapter

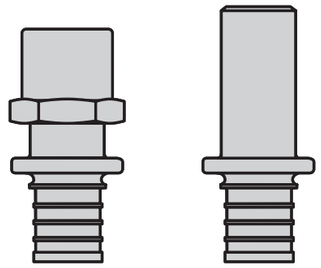


Fig. 25-14 System adapter with stainless steel RAUTITAN SX male thread and stainless steel RAUTITAN SX

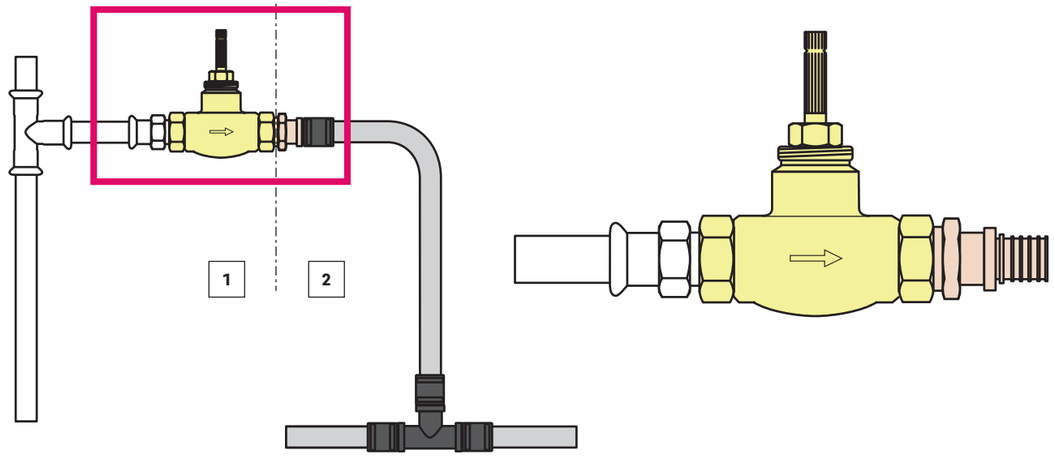


Fig. 25-15 Installation situation of a system adapter to a flush mounted valve (example)

1 Stainless steel system with flush-mounted valve
2 RAUTITAN system with RAUTITAN RX+ thread adapters

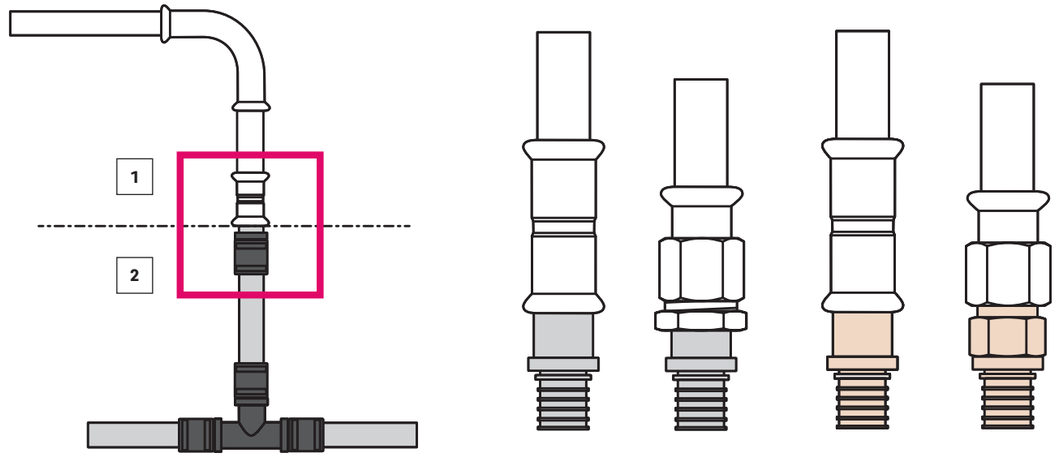


Fig. 25-16 Direct transition from stainless steel systems to the RAUTITAN system up to size 32 or with threads up to R1/Rp1

1 Stainless steel system
2 RAUTITAN system with RAUTITAN SX adapters (stainless steel) and RAUTITAN RX+ (gunmetal)

System adapter made of stainless steel

- To connect installation systems made of stainless steel, the use of the system pressing adapters RAUTITAN SX and system adapters with male threads RAUTITAN SX, both in stainless steel is recommended.
- The system pressing adaparters are available for metal compression system made of stainless steel with radial compression joints according to DVGW worksheet W 534.
- Do not mix up the RAUTITAN SX fittings with the fittings with silver surfaces, which are used to connect the heating pipe RAUTHERM S (underfloor heating/cooling).
- Please note the dimensions of the fittings.

Threaded fittings made of stainless steel

- Do not use sealing tape or sealants (e.g. Teflon) which release chloride ions soluble in water.
- Use sealants which do not release chloride ions soluble in water (e.g. hemp).
- To avoid a crevice corrosion of the fittings RAUTITAN SX we recommend the use of hemp as thread sealant.

If the RAUTITAN system is connected to other systems made of stainless steel by interconnecting fittings (e.g. flush-mounted valves or water meters), it is unnecessary to use the RAUTITAN SX adapters.

The material combination of copper alloy with stainless steel has been acknowledged in technical rules for a long time. However, the direct transition point to other systems is not explicitly regulated by the manufacturer's warranty guidelines of stainless steel system suppliers.

REHAU recommends the system pressing adapters RAUTITAN SX and RAUTITAN SX system adapters with male threads (both in stainless steel) for direct system connections to stainless steel installation systems.

The same fitting directions apply for the RAUTITAN SX system pressing adapters as for the RAUTITAN RX+ soldering/pressing adapters.

25.04 Connection to valves

Fig. 25-17 Adapter with RAUTITAN union nut

Equipment and fittings can be easily connected by using adapters with union nuts.

The pipe and the thread nominal diameter has to be considered to choose an appropiate connector.
For example:
Connector 20 - G¾ is appropriate for a valve DN 15 with an male thread G¾.

25.05 Installation guidance

Installation temperature
- Do not install below the minimum laying temperature of –10 °C.
- Do not install above the maximum laying temperature of +50 °C.

- Do not use dirty or damaged system components, pipes, fittings, compression sleeves or seals.
- Make sure that the connection components are free of inadmissible stress during assembly and in operation. Make sure that the piping has sufficient scope of movement (e.g. from deflection legs).
- Do not clamp fitting too tightly into the vice.
- Using pipe wrenches can cause damage to the fittings and compression sleeves.

Aligning the fittings

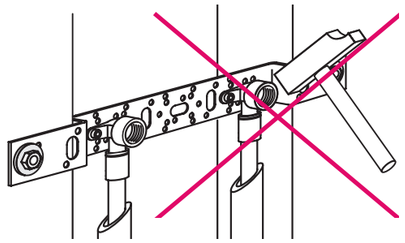


Fig. 25-18 Do not align using a hammer

- Do not subject fittings and compression sleeves to plastic deformation, e.g. by hammer blows.
- Only align fittings with appropriate tools, e.g. pipe nipples or spanners.

Threaded fittings
The threads of fittings with thread adapters are manufactured as follows:
- Thread according to ISO 7-1 and BS EN 10226-1:
  - Rp = cylindrical female thread
  - R = conical male thread
- Thread according to ISO 228:
  - G = cylindrical thread, non-sealing in the thread

- Only use threads according to ISO 7-1, DIN EN 10226-1 and ISO 228 standards.
  Other thread types are not permitted.
- Check if thread types ISO 7-1 and BS EN 10226-1 are capable of being combined with the thread typ ISO 228 before screwing them together, e.g. tolerances, free movement.
  Other thread types are not permitted.
- Only use an appropriate G male connector with flat sealing thread fittings with G female thread.
- If using long threads, ensure the maximum possible screwing depth and sufficient thread depth in opposing parts with inside threads.
- Only use sealants approved for water installation (e.g. WRAS-certified sealants).
- Do not apply excessive hemp to threaded joints. The thread tips must be visible.
- Use spanners in the right size.
- Avoid overtightening threaded joints.
- Do not extend the leverage of system tools, e.g. with pipes.
- Screw the threaded joints together so that the thread end remains visible.
- When flat-sealed joints (or similar) are opened, check that the sealing surface is undamaged before reconnecting and insert a new seal if necessary.

Protection against corrosion and damage

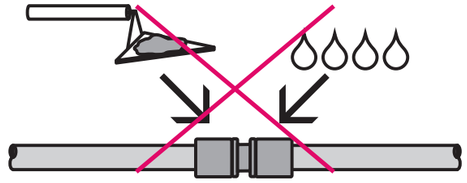


Fig. 25-19 Avoid the risk of corrosion

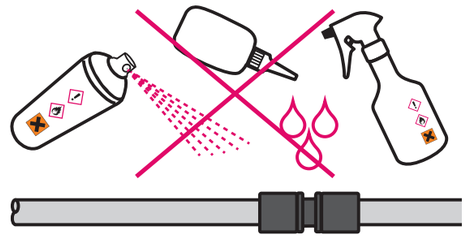


Fig. 25-20 RAUTITAN PX: Avoid contact with lacquer, liquid thread sealant and tapping oil

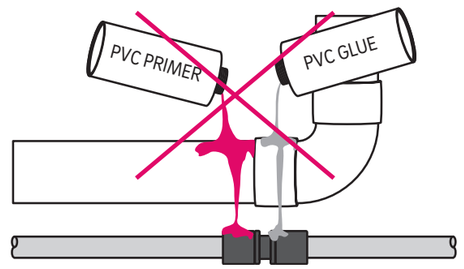


Fig. 25-21 RAUTITAN PX: Avoid contact with glue (e.g. PVC glue)

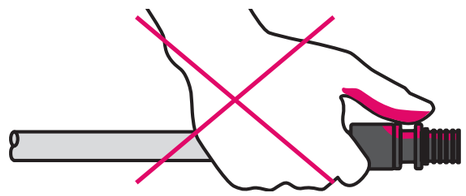


Fig. 25-22 RAUTITAN PX: Avoid unintentional contact with aggressive substances

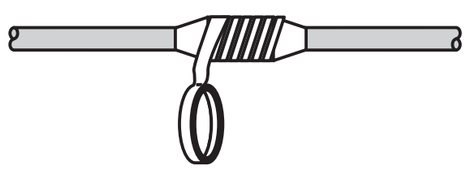


Fig. 25-23 Protect connection components against corrosion and damages

Water additives
The piping can be damaged when using inhibitors, antifreeze agents or other heating water additives. Approval must be obtained from the respective manufacturers and from our Applications Department.
In this case, please consult your REHAU sales office.

- Use suitable sleeving to protect fittings and compression sleeves against contact with brickwork or with screed, cement, plaster, bonding agents, aggressive media and other materials and substances which can cause corrosion.
- Protect fittings, pipes and compression sleeves against moisture.
- Ensure that the employed sealants, cleaning agents, building foams, insulation, protective tape, adhesive tape or thread sealant etc. do not contain any components which cause stress cracking or corrosion, e.g. ammonia, ammonia-bearing, aromatic and oxygenated solvents (e.g. ketone and ether), chlorinated hydrocarbons or chloride ions which can leach.
- Protect fittings, pipes and compression sleeves against dirt, drilling dust, primer and glue, mortar, grease, oil, paint, lacquers, adhesive/protective primers, solvents, etc.
- In aggressive environments (e.g. farming, encased in concrete, sea water atmosphere, cleaning agents), protect piping and fittings against corrosion adequately and in such a way that they are sealed against diffusion (e.g. to aggressive gases, fermentation gases, chloride mediums).
- Protect systems against contact with chemicals and damage (e.g. during the construction phase, when close to vehicles, machines or farming, and from damage caused by animal bites).

⚠

RAUTITAN PX

- Only use leak detection agents (e.g. foaming agents) with current DVGW registration, which were also approved by the respective manufacturer for the PPSU and PVDF materials.
- Only use sealants, thread sealants, cleaning agents, insulation, protective tape, adhesive tape and flux, which were approved by the respective manufacturer for the materials PPSU and PVDF.
- Avoid the contact with building foams using a suitable product (e.g. protective tape RAUTITAN).
- When using the connection components, check the compatibility of materials for the corresponding area of application.
- Contact with aromatic and oxygenated solvents (e.g. ketone and ether) as well as halogenated hydrocarbons (e.g. chlorinated hydrocarbons) is not permitted.
- Contact with water-based acrylic paints and adhesive/protective primers is not permitted.

RAUTITAN SX

- Do not use sealing tape or sealants (e.g. Teflon) which release chloride ions soluble in water.
- Use sealants which do not release chloride ions soluble in water (e.g. hemp).
- To avoid a crevice corrosion of the fittings RAUTITAN SX we recommend the use of hemp as thread sealant.

26 System tools RAUTOOL

- Before using tools, fully read and observe the information in the operating instructions.
- If these operating instructions are no longer present with the tool or are no longer available, order a copy or download them in internet.
- Do not use damaged tools or tools limited in their function; send these for repair to your REHAU sales office.
- Only make compression sleeve joints with RAUTOOL tools.
  If foreign tools are to be used when making the joint, these must be approved by the corresponding manufacturer for use with the RAUTITAN system and especially for use with the new RAUTITAN PX fittings and compression sleeves.

Operating instructions can be downloaded online from www.rehau.com

26.01 Compression sleeve tools RAUTOOL (part of the product program)

- Plumbings installation with RAUTITAN
- Radiant heating and cooling with RAUTHERM
- Industrial applications with RAUPEX
- Local and district heating supply with RAUTHERMEX and RAUVITHERM

The hydraulic tools RAUTOOL A-light2/A-light, E3/E2 and H2/H1 are compatible with each other and can be equipped with the same compression jaw sets.

RAUTOOL A-light2 Kombi

- Combined battery hydraulic tool and expander with Li-Ion battery
- Sizes 16 to 40 mm
- Patented Quick-change system for rapid change of expander heads

RAUTOOL Xpand QC

- Battery hydraulic expansion tool with Li-Ion battery
- Sizes 16 – 40 mm
- Patented Quick-change system for rapid change of expander heads

RAUTOOL A-light2

- Battery hydraulic tool
- Sizes 16 – 40 mm

RAUTOOL A5

- Compact battery hydraulic tool with Li-Ion battery
- Sizes 40 – 75 mm
- With the patented system for changing jaws and expander bit fast

RAUTOOL M1

- Manual tool
- Sizes 16 – 40 mm

Only use the compression jaws M1 with the RAUTOOL M1.

RAUTOOL K 12 x 1.7

- Pipe expansion and joint compression in one tool
- Size 12
- Only suitable for RAUTITAN flex 12 x 1.7mm with RAUTITAN LX brass sleeve

26.02 Pipe cutters

⚠

- Check the blade of the pipe cutter regularly for damage and replace the blade or the cutter as necessary. Damaged or blunt blades can cause burrs or notches on the pipe, which can tear when the pipe is expanded.
- Cut off improperly cut pipe ends.
- If cracks occur in the expanded zone, cut off the damaged pipe end and repeat the expanding procedure.

When cutting the pipes, observe the following:
- Use the correct pipe cutter for the corresponding pipe type only.
- Cut the pipe square and without burrs.
- Pipe cutters must be free of damages.

Spare blades for the pipe cutters can be re-ordered (except the pipe cutter 25).

Pipe size		16/20	25 to 40	40 to 63
Universal pipe RAUTITAN stabil	stabil	 Pipe cutter 16/20 RAUTITAN	 Pipe cutter 40 stabil	 Wheel cutter

Pipe size		to 20	to 25	to 40	40 to 63
Universal pipe RAUTITAN flex	flex	 Pipe cutter 16/20 RAUTITAN	 Pipe cutter 25	 Pipe cutter 40 stabil	 Pipe Cutter 63

Tab. 26-1 Selection of pipe cutters

ⓘ

RAUTITAN stabil in sizes 50 and 63 can be cut with the pipe cutter 63. However, since the use of the pipe cutter is difficult and requires some effort, REHAU recommends the use of a wheel cutter.

Using the pipe cutter 63 to cut RAUTITAN stabil 50 and 63 can cause an oval deformation of the pipe cross-section and thus complicates or prevents further work steps.

26.03 Pipe cutter 16/20 RAUTITAN

Fig. 26-1 Cutting a universal pipe RAUTITAN stabil with the pipe cutter 16/20 RAUTITAN

For right-angled cutting of the universal pipe RAUTITAN stabil without burrs in sizes 16 and 20.

⚠

Only use pipe cutter 16/20 RAUTITAN when cutting universal pipe RAUTITAN stabil in sizes 16 and 20.

⚠

When using the compression ring union, calibrate the universal pipe RAUTITAN stabil (pipe sizes 16 and 20) with the calibrating mandrel moulded onto the side of the pipe cutter 16/20 RAUTITAN.

ⓘ

PE-X pipes can also be cut with the pipe cutter 16/20 RAUTITAN.

Fig. 26-2 Calibrating mandrel

26.04 Pipe cutter 25

To be used exclusively for burr-free cutting of PE-X pipes up to size 25 (see „Tab. 26-1 Selection of pipe cutters“)

26.05 Pipe cutter 40 stabil

To be used exclusively for burr-free cutting of PE-X-pipes up to size 40 and for RAUTITAN stabil/ RAUTITAN gas stabil in size 25 to size 40 (see „Tab. 26-1 Selection of pipe cutters“).

26.06 Wheel cutter

For burr-free cutting of RAUTITAN stabil pipes 50 and 63.

26.07 Pipe cutter 63

For burr-free cutting of RAUTITAN pipes in sizes 40–63 (see „Tab. 26-1 Selection of pipe cutters“)

⚠

Use a pipe cutter 63 with a very scharp and in mint condition blade to cut RAUTITAN stabil 50 and 63.

27 Expanding tools

27.01 Expander heads and expander bits for pipes

	Expander heads		Expander bits	Expander head for RAUTOOL A5
Pipe size	**16/20/25/32**		**40**	**50/63**
Universalrohr RAUTITAN stabil stabil	 Expander head QC	 Expander head QC 1		
Rohrabmessungen	**16/20/25/32**		**40**	
Universalrohr RAUTITAN flex flex	 Expander head QC	 Expander head QC 1		

Tab. 27-1 Selection of expanding tools

Expander head for radiator connection sets RAUTITAN

Fig. 27-1 Expander head 15 x 1.0 QC

Stainless steel pipes or copper pipes 15 x 1.0 of the radiator connection sets RAUTITAN.
Using the expander head 15 x 1.0 QC is described in chapter "14 Connections with radiator elbow", page 89.

Difference between expander heads

- Expander head for universal pipe RAUTITAN stabil
  - Green colour code
  - Black retaining nuts in sizes 16–32
  - Expansion segments bevelled
- Expansion head for the universal pipe RAUTITAN stabil in sizes 50 and 63
  - Green colour code
  - Silver retaining nuts
  - 8 expansion segments bevelled
- Expander head for universal pipe RAUTITAN flex, RAUTITAN gas flex
  - Blue colour code
  - Silver retaining nut in sizes 16–32
  - Expansion segments without bevelling
- Expander head 15 x 1.0 for radiator connection sets RAUTITAN
  - No colour code
  - For expanding connection sets made from stainless steel or copper

Expander head QC

- Expander head with patented Quick Change bayonet lock

- Expander head for universal pipe RAUTITAN stabil
  - Green colour band
  - Black retaining nut for sizes 16–32
  - 6 expansion segments with chamfer

- Expander head for universal pipe RAUTITAN stabil in sizes 50 and 63
  - Green colour coding
  - Silver retaining nut
  - 8 expansion segments with chamfer

- Expander head for universal pipe RAUTITAN flex
  - Blue colour band
  - Silver retaining nut for sizes 16–32
  - 6 expansion square segments without chamfer

- Expander head 15 x 1,0 fur radiator connection sets RAUTITAN
  - No colour band / coding

For expanding stainless steel and copper connection sets

Expander head QC 1

- Expander head with patented Quick Change bayonet lock and 4 interlocking expansion segments
- Single step expansion (simplified jointing process)
- Black expansion segments

Not compatible with brass compression sleeves

- Expander head for universal pipe RAUTITAN stabil
  - Green colour band
  - Black retaining nut

- Expander head for universal pipe RAUTITAN flex
  - Blue colour band
  - Silver retaining nut

Universal expander bit

Fig. 27-2 Universal expander bit

The unviersal expander bit QC can be used in combination with the suitable expander heads and hydraulic tool to expand RAUTITAN pipes 25 and 32.

27.02 Expander bits

When combined with the RAUTOOL tools A-light2, the following expander bits can be used:
- Universal expander bit 25/32 QC
- Expander bit 40 x 6.0 stabil
- Expander bit 40 x 5.5

Only expand universal pipe RAUTITAN stabil in size 40 with the expander bit 40 x 6.0.
- Expansion only possible with RAUTOOL A-light2.
- Expansion not possible with RAUTOOL G2/G1, H/G1 and M1.

27.03 Safety advice on the expander heads

⚠
- Do not use any defective segments or expander heads (e.g. bent, broken off, fractured).
- Ensure that expansion is even over the entire circumference of the pipe.
- Discard unevenly expanded pipe ends.
- Check the expander head for damage, if necessary carry out test expansion to test even expansion (e.g. no grooves, no local overstretching of the pipe material).
- Replace defective expander head.
- Do not apply grease or similar materials to the expansion segments.
- Apply grease to the cone of the expander.
- Do not use dirty or damaged expander heads, pipes or connection components.
- If cracks are forming inside the expansion area or the area has not expanded properly, trim of the affected area, check th e blade of the pipe cutter for any damage and repeat the expansion process.
- Take care to use the correct expander head for each pipe type and size.
- If cracks occur at the expanded zone or if the pipe ends were not expanded properly, cut off the damaged pipe end and repeat the expanding procedure.
- Observe the allocation of the expander heads to the respective pipe types and sizes.

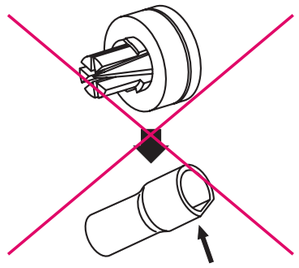


Fig. 27-3 Damage to the piping material by defective expander head

ⓘ
- Accessories (brush, lubricating grease, etc.) are included in the tool case.
- The universal pipe RAUTITAN flex is equipped with an oxygen diffusion barrier. The oxygen diffusion barrier is not always as flexible as the crosslinked polyethylene base pipe. It could thus happen that the diffusion barrier tears slightly when the pipe is expanded at low temperatures. These tears do not have an effect on the pipe's performance and have no effect on the reliability of the compression sleeve joint. As the tears are located at the compression sleeve joint and are enclosed at both sides with the fitting or compression sleeve and they have no notable effect on the oxygen-tightness as specified in DIN 4726.

28 Making the compression sleeve joint

28.01 Important advices

ⓘ

The detailed instructions for operating and handling the tools are provided in the corresponding tool manuals.

The following pages give only an example of the REHAU EVERLOC jointing process for pipe sizes 16-32mm using a RAUTOOL A-light and for sizes 50-63 using the RAUTOOL A5.

⚠
- Only make compression sleeve joints with RAUTOOL tools.
  If foreign tools are to be used for making the joint, these must be approved by the corresponding manufacturer for use with the RAUTITAN system and especially for use with the new RAUTITAN PX fittings and compression sleeves.
- Only make the joint with the appropriate system tools.
- Please consult the Technical Information and corresponding operating instructions and instruction leaflets for information on handling the tools and making joints.
- Do not use dirty or damaged connection components or tools.
- The battery and mains operated tools like A-light 2, A3, E3, G2 are not suitable for permanent operation. After approx. 50 consecutive clamping operations, a break of at least 15 min. is required to allow the tool to cool down.

Installation temperature
- Do not install below the minimum laying temperature of –10 °C.
- Do not install above the maximum laying temperature of +50 °C.

ⓘ

Close to the minimum laying temperature (–10 °C) we recommend using the hydraulic-assisted system tools RAUTOOL to make the installation more comfortable.

Operating instructions can be downloaded online from **www.rehau.com**.

ⓘ

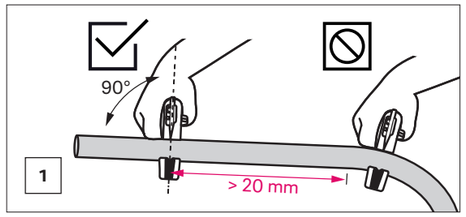
The minimum distance between fittings on RAUTITAN stabil and flex is 3 x L (L = length of compression sleeve).

This only applies to all fitting and material types used with a compression sleeve in all RAUTITAN plumbing and heating applications.

28.02 Making the compression sleeve joint sizes 16 to 40

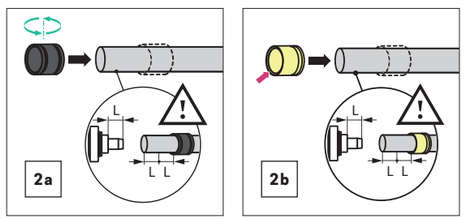
Cutting the pipe

The universal pipe RAUTITAN stabil 40 x 6.0 has a shorter expansion length than the other RAUTITAN pipes in size 40.
When correctly expanded and pushed fully on, the expanded pipe section ends approx. 6 mm before the collar of the fitting.
Here, each Z-measurement extends by 4 mm. The entire pipe length, which is to be cut off, thus reduces by approx. 8 mm.



Use pipes free from any contamination (e.g. lubricant, adhesive or adhesive tape).

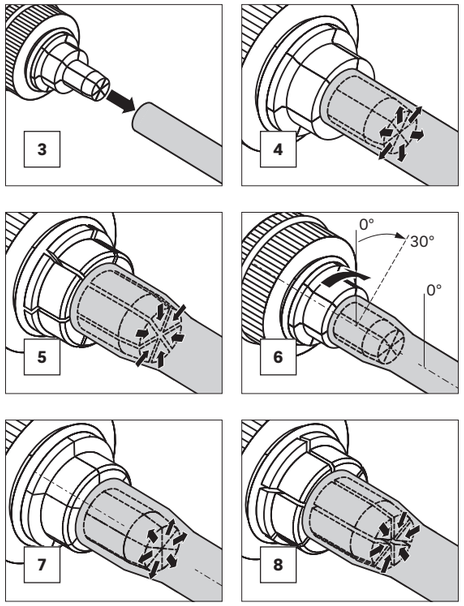
Pushing the compression sleeve over the pipe



Expanding the pipe

- Follow the safety advice for the expander heads (see page 130).
- Check the expander heads for freedom of movement and dirt and clean, if necessary.
- Screw the expander heads fully onto the expansion tool (must not become detached when twisted in pipe).
- Expand the pipe when cold.
- If cracks occur at the expanded zone or if the pipe ends were not expanded properly, cut off the damaged pipe end and repeat the expanding procedure.

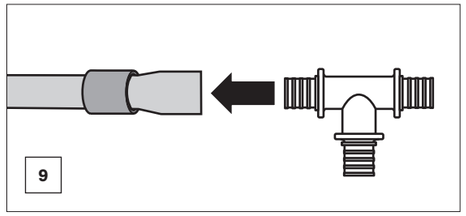
- The pipe to be expanded must have an even temperature. Avoid local heating (e.g. by inspection lamps, etc.).
- Expand the pipe when cold and stress-free.
- Always push the segments of the expander head fully into the pipe.
- Avoid skewing the expander head.



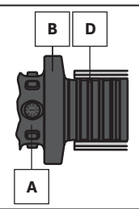
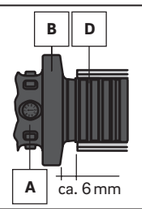
- When using the QC1 expander head, pipes must only be expanded once.

Inserting the fitting into the expanded pipe

- When the pipe has been correctly expanded, the fitting can be pushed into the expanded pipe without difficulty.
- After a short time, the fitting is held firmly in the pipe, as the pipe contracts (memory effect).
- Handle joints which are not clamped when inserting them into the tool and during clamping so that they cannot fall apart.
- All sealing ribs must be covered by the pipe, as shown in Tab. 28-1 and Tab. 28-2. A gap of up less than approximately 1mm to the fitting shoulder can occur based on manufacturing tolerances. An exception is when pushing the universal pipe RAUTITAN stabil onto the RAUTITAN PX fittings, size 40. Here, the last sealing rib may not be fully covered.

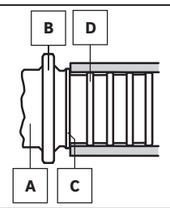
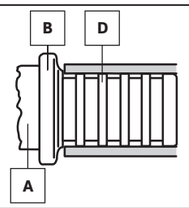


Correct position of the pipe on the RAUTITAN PX fitting

16–32	40
	

Tab. 28-1 Correct position of the pipe on RAUTITAN PX fitting

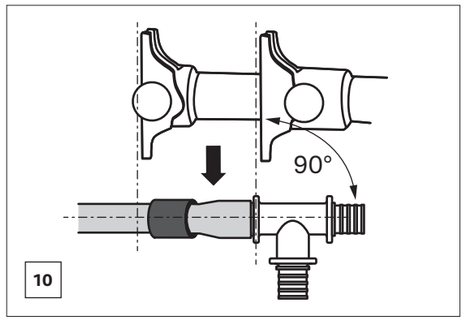
Correct position of the pipe on metal fittings

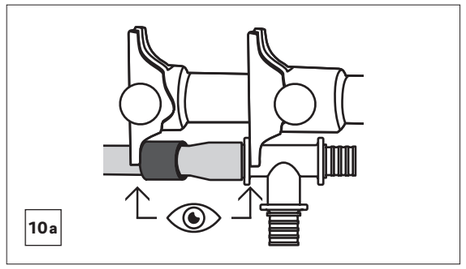
16-32	40
	

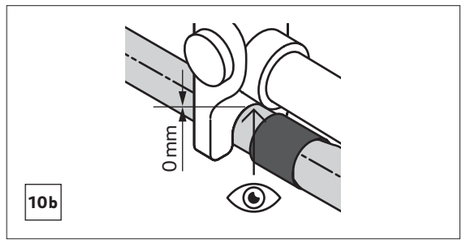
Tab. 28-2 Correct position of the pipe on the fitting

A Fitting body
B Fitting shoulder
C Pre-stop
D Sealing rib

Inserting the joint into the clamping tool



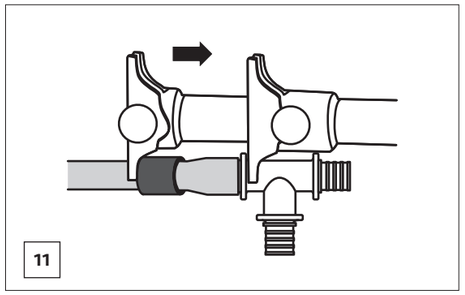


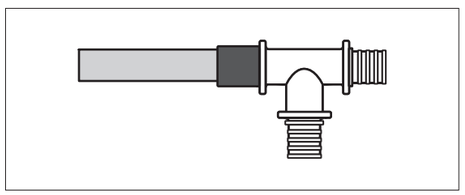


Pushing the compression sleeve up to the fitting shoulder

- Operate the pressure switch on the tool until the tool automatically ends the pressing process.
- Carry out a visual check of the joint for damages and incomplete movement of the compression sleeve.

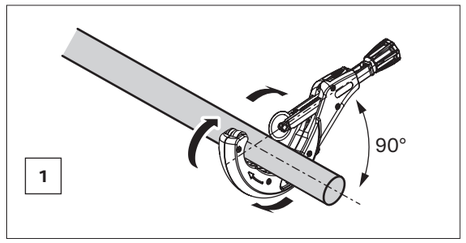
- Bulging of the metal compression sleeve does not impair the quality of the joint.
- During the compression process an additional accumulation of the pipe material can occur. In this case, stop pushing on the brass compression sleeve shortly before the bulge (approx. 2 mm distance to the fitting shoulder).





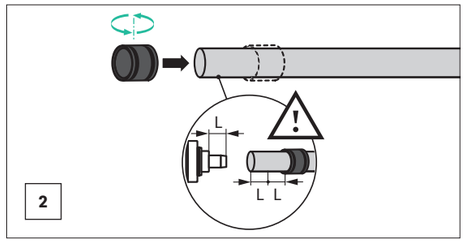
28.03 Making the compression sleeve connection with RAUTITAN 50 and 63

Cutting the pipe



Use pipes free from any contamination (e.g. lubricant, adhesive or adhesive tape).

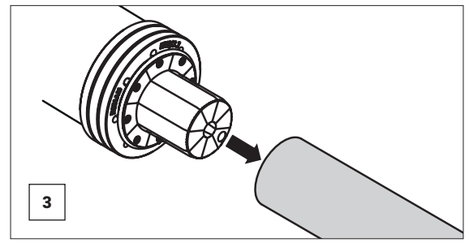
Pushing the compression sleeve over the pipe

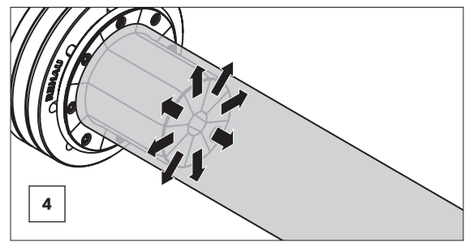


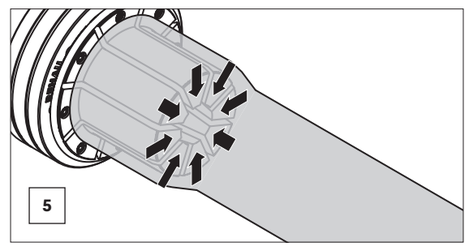
Expanding the pipe with the expander once

- Follow the safety advice for the expander heads (see page 130).
- Check the expander heads for freedom of movement and dirt and clean, if necessary.
- Screw the expander heads fully onto the expansion tool (must not become detached when twisted in pipe).
- Expand the pipe when cold.
- If cracks occur at the expanded zone or if the pipe ends were not expanded properly, cut off the damaged pipe end and repeat the expanding procedure.

- The pipe to be expanded must have an even temperature. Avoid local heating (e.g. by inspection lamps, etc.).
- Expand the pipe when cold and stress-free.
- Always push the segments of the expander head fully into the pipe.
- Avoid skewing the expander head.

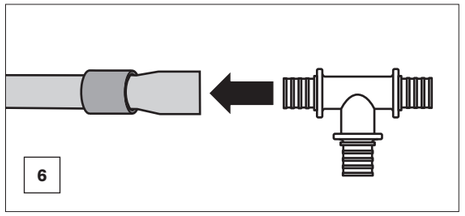




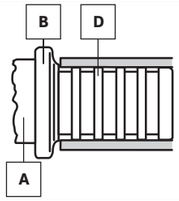


Inserting the fitting into the expanded pipe

- When the pipe has been correctly expanded, the fitting can be pushed into the expanded pipe without difficulty.
- Handle joints which are not clamped when inserting them into the tool and during clamping so that they cannot fall apart.
- All sealing ribs must be covered by the pipe, as shown in Tab. 28-144-3.



Correct position of the pipe on metal fittings

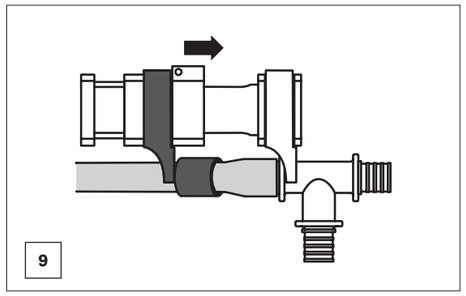
Size	50–63
Universal pipe RAUTITAN stabil stabil	

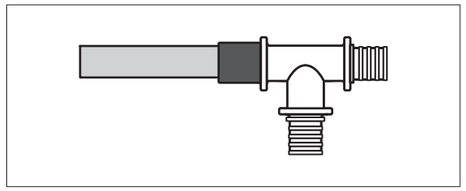
Tab. 28-3 Correct position of the pipe on the fitting

A Fitting body B Fitting shoulder D Sealing rib

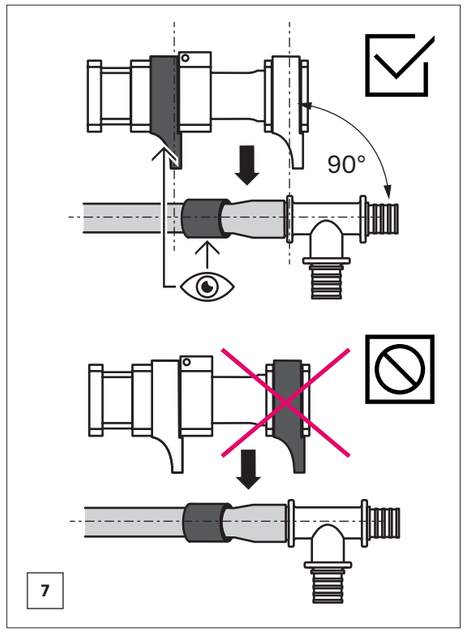
Pushing the compression sleve up to the fitting shoulder

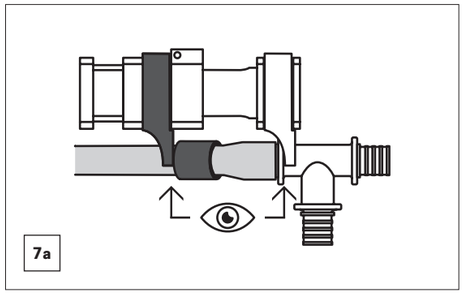
- Operate the pressure switch on the tool until the tool automatically ends the pressing process.
- Carry out a visual check of the joint for damage and incomplete movement of the compression sleeve.

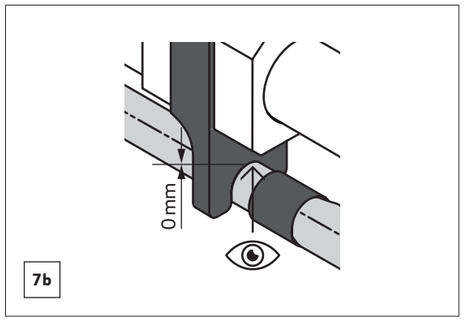




Inserting the joint into the clamping tool







29 Separating a compression sleeve joint

REHAU will not accept liability if these instructions are not followed (e.g. when heating up the compression sleeve joint when attached).

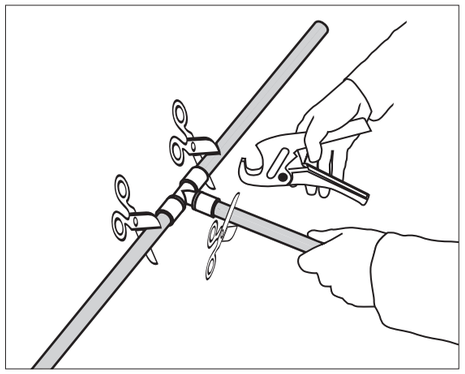


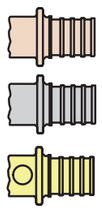
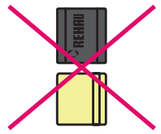
Fig. 29-1 Cutting out the joint

29.01 Cutting out the joint

Cut the joint to be separated completely out of the existing piping using the pipe cutters. Maintain a safe distance between the holding hand and the pipe cutters.

29.02 Re-use of separated joint components

Usability of the parts of a separated compression sleeve joint

Reusable	Not reusable Dispose of together with all cut-out pipe parts	
RAUTITAN system	Compression sleeves	Fittings RAUTITAN PX
		

Tab. 29-1 Re-use of separated compression sleeve joints

Removed fittings from water installations

- Mark any used polymer RAUTITAN PX fittings and polymer RAUTITAN sleeves as "do not use" or destroy fully and dispose of straight away.
- Only reuse removed metal fittings if in perfect condition and within the same installation type from which they were removed.
- Mark any used compression sleeves as "do not use" or destroy fully and dispose of straight away.

29.03 Separating the joint removed from drinking water and heating installations

29.03.01 Heating the joint to be separated

Heating up the RAUTITAN PX compression sleeves to over 200 °C or direct flame exposure can lead to a build-up of toxic gases.

- Do not heat RAUTITAN PX compression sleeves to over 200 °C.
- It is not permitted to burn or apply a flame to the RAUTITAN PX compression sleeves.

1. Heat up the cut-out metal fitting with a hot air gun. Observe the safety advice in the operating instructions of the hot air gun.
2. On reaching a temperature of approx. 135 °C remove the compression sleeve from the fitting body (e.g. with pliers).

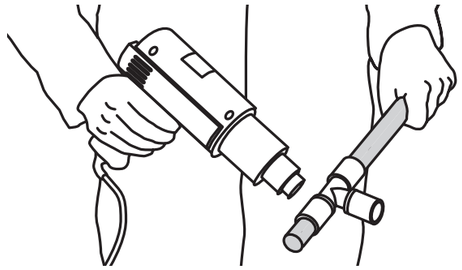


Fig. 29-2 Heating up the joint which is to be separated

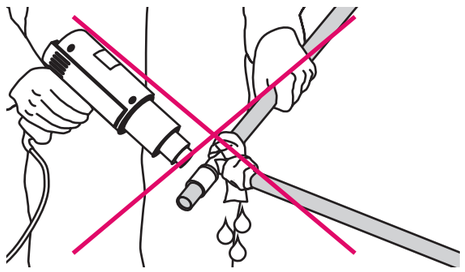


Fig. 29-3 Not permitted

When the joint to be separated is heated, all joints of the heated fitting are no longer sealed.

Always separate the fitting to be heated completely from the piping!

29.03.02 Pulling off the compression sleeves

1. Remove pipe from fitting body.
2. Clean dirt from fitting.
   - When in perfect condition and cooled, the fitting can be reused.
   - Do not reuse detached compression sleeves and pipe sections.
3. Dispose of the compression sleeves with the detached pipe sections.

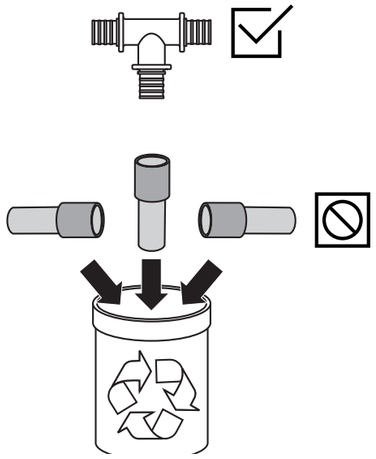


Fig. 29-4 Dispose of the compression sleeves with the detached pipe sections

Detaching Fittings 50 and 63

Due to the large pipe wall thickness fittings in sizes 50 and 63 can only be removed with some effort.
The risk of deforming or damaging them during this process is therefore high.

Check detached fittings closely for damage before re-using them.

30 Bending the pipes

30.01 Bending the universal pipe RAUTITAN stabil

stabil

Fig. 30-1 Bent universal pipes RAUTITAN stabil

The universal pipe RAUTITAN stabil can be bent either by hand or by using a bending tool..

Minimum bending radius

- When bending without tools, the minimum bending radius is five times the outside pipe diameter.
- When bending with a bending spring, the minimum bending radius is three times the outside pipe diameter.
- The minimum bending radius is in relation to the centre of the pipe.
- Make sure to comply with the specified minimum bending radii.
- After bending, ensure that there are no depressions, kinks or bulges and that the outer PE layer and aluminium layer are undamaged.

At installation temperatures below 0°C, pipes must be slightly over bent. Only ever cold bend RAUTITAN stabil pipes.

Pipe	stabil		stabil	
	with bending tool (90°) 3 x d		bent by hand (90°) 5 x d	
Pipe sizes	Bending radius R [mm]	Arc B [mm]	Bending radius R [mm]	Arc B [mm]
16	48.6	76	81	127
20	60	94	100	157
25	75	118	125	196
32	96	151	160	251
40	120	188	-	-
50	150	236	-	-
63	189	297	-	-

Tab. 30-1 Minimum bending radii of universal pipe RAUTITAN stabil

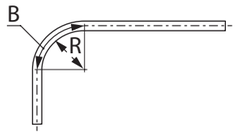


Fig. 30-2 Bending radius and arc

R Bending radius
B Arc

Approved bending tools for universal pipe RAUTITAN stabil

stabil

Pipe size [mm]	Source Manufacturer	Model description	Material	Article number
16/20	See price list REHAU sales office	Internal spiral spring 16 stabil Internal spiral spring 20 stabil		247484-001 247494-001
16/20/25	Roller, D-71332 Waiblingen	Roller Polo	153022	
16/20/25	CML Deutschland, D-73655 Plüderhausen	Ercolina Junior	0130G	
16/20/25	REMS, D-71332 Waiblingen	REMS Swing	153022	
16/20/25/32	Tinsel, D-73614 Schorndorf	OB 85	–	
16/20/25/32/40	CML Deutschland, D-73655 Plüderhausen	Ercolina Jolly	0101	
40	REMS, D-71332 Waiblingen	Curvo	580025	
40	Tinsel, D-73614 Schorndorf	UNI 42	–	
40/50/63	Rothenberger, D-69779 Kelkheim	Robull MSR	5.7900	
40/50/63	REMS, D-71332 Waiblingen	Phyton V	59022 R	

Tab. 30-2 Approved bending tools for the universal pipe RAUTITAN stabil (as of: 2020)

30.02 Bending the universal pipe RAUTITAN flex

flex

Fig. 30-3 Pipe bend, plumbing (3–4 x d) - 90° or 45° for size 16–32

Fig. 30-4 Pipe bend former, plumbing/heating (5 x d) - 90° or 45° for size 16– 25

Fig. 30-5 Pipe bend former, plumbing (4 x d) - 90° and pipe bend former, plumbing/heating (5 x d) - 90° each in size 32

Hot bending of universal pipes RAUTITAN flex can damage the oxygen diffusion barrier.

Only bend universal pipes RAUTITAN flex when cold.

Elbows are not always required for sizes between 16 and 32. With pipe bend formers, 90° and 45° elbows can be cold-bent quickly and easily.
For pipe sizes 40 to 63, we recommend using fittings.

Minimum bending radius
When bending by hand, the minimum bending radius is eight times the outside pipe diameter.

When laying with pipe bend former, the minimum bending radius in plumbing installations is three times and for heating installations five times the outside pipe diameter.

The minimum bending radius is in relation to the centre of the pipe.

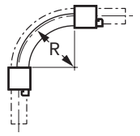


Fig. 30-6 Pipe bend former, plumbing 90 degrees, for size 16– 32 and pipe bend former plumbing/ heating 5 x d 90 degree for size 32

R Bending radius

Pipe	Drinking water installation with pipe bend former plumbing 90°, approx. 3–4 x d		Drinking water and heating installation with pipe bend former plumbing/heating 90°, 5 x d		Bend by hand (90°) 8 x d	
	flex		flex		flex	
Pipe sizes	**Bending radius R** [mm]	**Arc B** [mm]	**Bending radius R** [mm]	**Arc B** [mm]	**Bending radius R** [mm]	**Arc B** [mm]
12	-	-	-	-	96	151
16	48	75	80	126	128	201
20	60	94	100	157	160	251
25	75	118	125	196	200	314
32	112	176	160	251	256	402

Tab. 30-3 Minimum bending radii for RAU-PE-Xa pipes

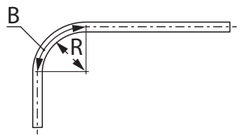


Fig. 30-7 Bending radius and arc

R Bending radius
B Arc

31 Pipe support channel

31.01 Benefits of using the pipe support channel in combination with RAUTITAN flex

- Reduces thermal changes in length
- Clip effect increases the axial retaining force
- Stabilises pipes against sagging and sideways bending
- Increases rigidity
- Increases the pipe clamp interval to 2 m regardless of the pipe size
- Visually attractive installations in exposed areas with RAU-PE-Xa pipes
- Simple assembly
- Self-supporting
  - Is clipped onto the pipe
  - No additional fastenings (e.g. cable ties, insulating tape) required
- Offcuts of pipe support channels can be used

31.02 Functionality

The pipe support channel encloses the pipe by about 60 % and is shaped to closely encase the pipe without additional fastenings. This strong clamping effect prevents the pipe from bending and reduces thermal changes in length.

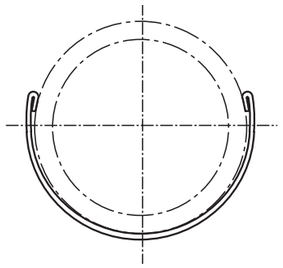


Fig. 31-1 Cross-section of pipe support channel

31.03 Assembly of the pipe support channel

Do not fit pipe support channels or pipe fasteners close to deflection legs so free pipe movement is not restrained.

Pipe cover

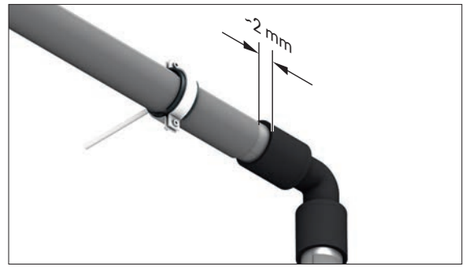


Fig. 31-2 Let the pipe support channel end approx. 2 mm before the compression sleeve

The pipe support channel must be fitted over the entire length of the piping up to 2 mm before the compression sleeve, as only this ensures reduction of the thermal change in length.

Pipe clamp intervals

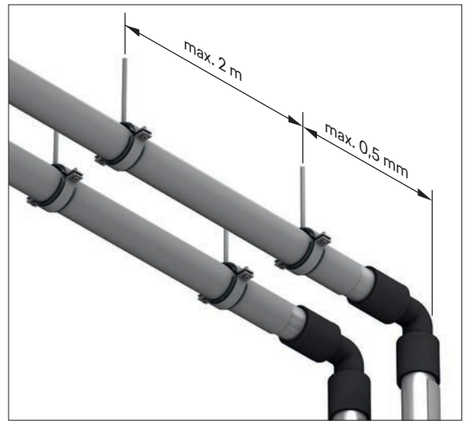


Fig. 31-3 Maximum pipe clamp intervals

The maximum pipe clamp interval when using the pipe support channel is 2 m for all sizes. The distance from any pipe bracket to the pipe end or directional changes must not exceed 0.5m. This allows any pipe brackets to be spaced uniformly and efficiently across multiple pipe runs attached to walls or suspended form ceilings.

Fitting cover

When using RAUTITAN PX compression sleeves, clipping over the fittings is not possible.

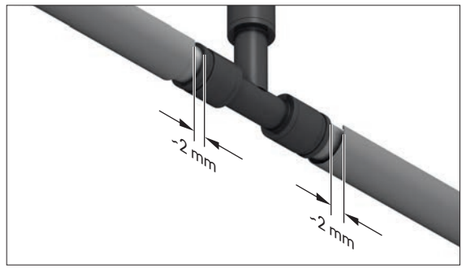


Fig. 31-4 Do not clip over RAUTITAN PX compression sleeves

Installation of the pipe support channels
Reduced retaining force of the pipe support channel can cause greater thermal linear expansion of the pipe.

Do not compromise the retaining force of the pipe support channels by storing or assembling them improperly.

1. Cut off the pipe support channel with a metal saw (see Fig. 31-5). Maintain a safe distance between the holding hand and the cutting tool. Saw pipe support channels from the rounded rear side so that they are not bent open at their folded ends.

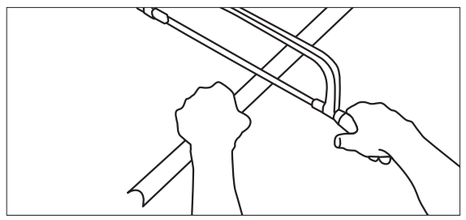


Fig. 31-5 Cutting off

2. If the pipe support channel has been bent inwards or outwards when it was cut to length, bend the pipe support channel back to its original shape.

3. Deburr the ends of the pipe support channel.

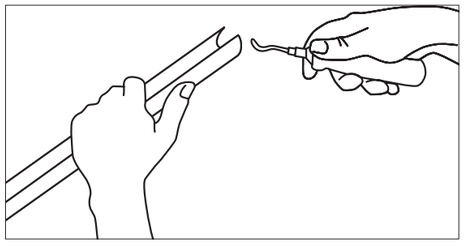


Fig. 31-6 Deburring

4. Clip the pipe support channel onto the pipe (by hand or using a pump or pipe wrench with plastic jaws). Do not overlap the pipe support channels when laying.

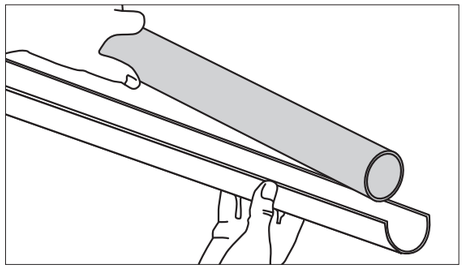


Fig. 31-7 Clipping in

5. Clip offcuts over the joints of the pipe support channels.

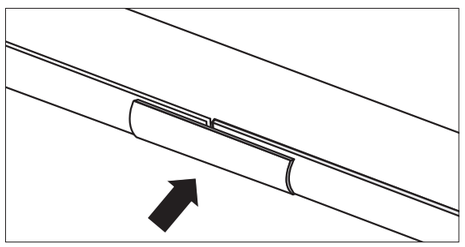


Fig. 31-8 Clipping over

Even short offcuts of the pipe support channel can be used for clipping over joints allowing for almost waste free installation.

32 Pipe fixing

- Observe the information from the pipe bracket manufacturer.
- The guide values for planning and installation of the pipe brackets (see Tab. 32-1, page 146) must always be adjusted as necessary based on the building specifics and the specification of the pipe bracket manufacturer.
- For installation of pipes made of RAU-PE-Xa without pipe support channel, sagging of the piping is to be expected.
- Fixed points can be used to direct thermal changes in length in a desired direction.
- Longer lengths of piping can be subdivided into individual sections with fixed points.
- Fixed points can be created at tees, elbows or couplers by placing pipe brackets next to the compression sleeves on either side of the fitting.

32.01 Pipe brackets

Use only pipe clamps with the following properties:
- Suitable for plastic pipes
- Acoustically insulating pipe clamp inserts
- Matching size (for a uniform pipe glide once installed and to prevent the pipe inserts from being ripped out)
- Free of burrs

32.02 Fixed point installation

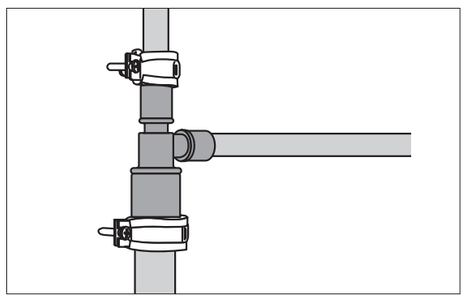


Fig. 32-1 Fixed point made with pipe brackets

Do not install pipe brackets on the compression sleeves.

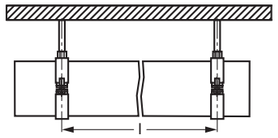
32.03 Spacing of brackets

Select the spacing from the guide values (see Tab. 32-1, page 146) for installation with or without pipe support channels.

For vertical clipping intervals can be larger. We recommend at least 2 pipe brackets in each floor..

32.04 Installation in visible areas

When installing pipes in visible areas or in long runs without changes in direction, the use of the pipe support channel is recommended for the RAU-PE-Xa pipes.
- For installation without the pipe support channel, place the fixed points at intervals of 6 m.
- Ensure sufficient space for the piping to expand and a safe pipe fixation.

Pipe type	Pipe size [mm]	l = Maximum pipe fixing distance without pipe support channel [m]	l = Maximum pipe fixing distance with pipe support channel [m]
			
Universal pipe RAUTITAN stabil stabil	16	1	–
	20	1.25	–
	25	1.5	–
	32	1.75	–
	40	2	–
	50	1.8	–
	63	2	–
Universal pipe RAUTITAN flex flex	12	1	–
	16	1	2
	20	1	2
	25	1.2	2
	32	1.4	2
	40	1.5	2
	50	1.5	2
	63	1.5	2

Tab. 32-1 Approximate values for pipe clipping intervals

33 Thermal length changes

33.01 Guidelines

Due to physical laws, all piping materials expand when heated and contract when cooled. This effect, which occurs regardless of the piping material, must be taken into account in the installation of drinking water, and heating pipes. This also applies to the piping of the RAUTITAN system.
The thermal change in length occurs mainly due to the different installation, ambient and operating temperatures. During installation, appropriate pipe routing with provisions for movement (e.g. at changes in direction) and corresponding space for expansion of the piping must always be taken into account. Additional deflection legs, e.g. U expansion bends or lyre loops, are usually only necessary for larger changes in length.

RAUTITAN flex, used with support channel and RAUTITAN stabil have a small thermal length change (see Tab. 33-1.

33.02 Calculation of thermal expansion

The thermal change in length is calculated with the following equation:
$\Delta L = \alpha \cdot L \cdot \Delta T$
ΔL = Length change in mm
α = Coefficient of linear expansion in $\frac{mm}{m \cdot K}$
L = Length of the piping in m
ΔT = Temperature difference in K
The coefficient of linear expansion must be chosen according to the pipe type in question and any additionally installed pipe support channel.

Determining the pipe length L
The pipe length L used in the calculation is taken from the actually installed pipe length. This can be subdivided by installing fixed points or additional deflection legs.

Determining the temperature difference ΔT
In determining the temperature difference ΔT, the ambient temperature at time of install as well as the minimum and maximum temperatures of the pipe wall during operation (e.g. thermal disinfection) and when the system is out of service must be.

Pipe type	Pipe size	Coefficient of linear expansion $\alpha \left[\frac{mm}{m \cdot K}\right]$	Material constant C
Equation		$\Delta L = \alpha \cdot L \cdot \Delta T$	$L_{BS} = C \cdot \sqrt{d_a \cdot \Delta L}$
Universalrohr RAUTITAN stabil stabil	16–63	0,026	33
Universalrohr RAUTITAN flex flex	12–40 ohne Cliphalbschale	0,15	12
	16–40 mit Cliphalbschale	0,04	–

Tab. 33-1 Coefficients of linear expansion (approximate values) and material constants for deflection leg calculation (approximate values)

34 Deflection legs

Thermal changes in length can be accommodated by deflection legs. RAU-PE-Xa pipes are particularly suitable for this due to their flexible material.
A deflection leg is the freely moveable pipe length, which can take up the required length change. The length of the deflection leg is influenced mainly by the material (material constant C).
Deflection legs result mostly from changes in direction of the piping.
For long lengths of piping, additional deflection legs must be installed in the piping to compensate the thermal change in length.

Do not fit pipe support channels or pipe fastenings close to deflection legs so free pipe movement is not restrained.

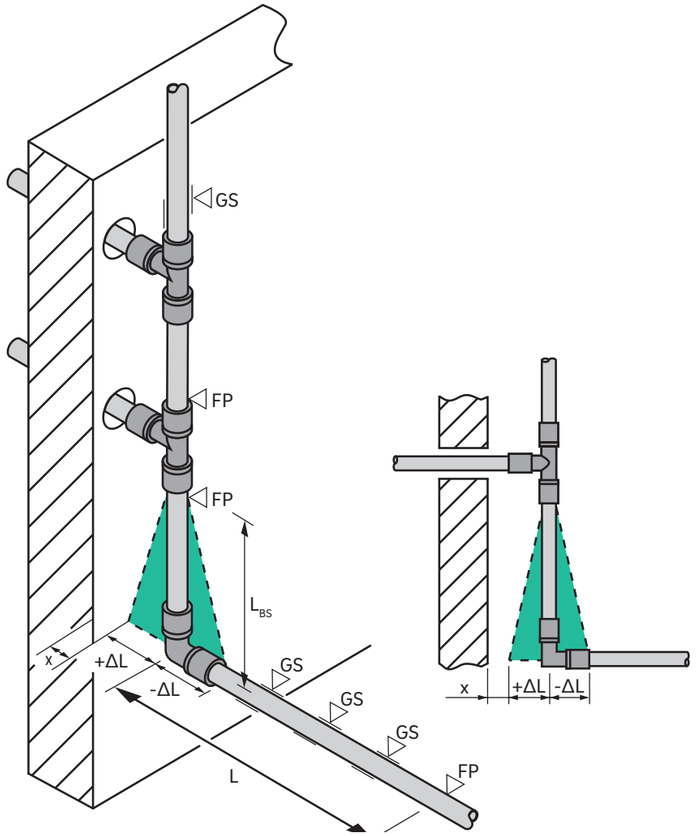


Fig. 34-1 Deflection legs

L_{BS} Length of the deflection leg
ΔL Thermal changes in length
L Pipe length
x Minimum distance of the pipe from the wall
FP Fixed point clamp
GS Guide clamp

34.01 Calculation of deflection leg length

The minimum length of deflection legs (BS) is calculated by the following formula:

$$L_{BS} = C \cdot \sqrt{d_a \cdot \Delta L}$$

L_{BS} = Length of the deflection leg in mm
C = Material constant of the piping material
d_a = Outside pipe diameter in mm
ΔL = Length change in mm

Approximate values for the material constant C see Tab. 33-1, page 147.

Do not fit pipe support channels or pipe brackets close to deflection legs so free pipe movement is not restrained.

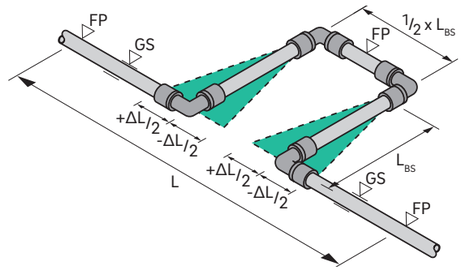


Fig. 34-2 U expansion bends

L_{BS} Length of the deflection leg
ΔL Thermal change in length
L Pipe length
FP Fixed point clamp
GS Guide clamp

34.02 Calculation examples

The piping length L, for which the thermal change in length is to be accommodated with a deflection leg, is 7 m.
The temperature difference between the minimum and maximum value (installation temperature and subsequent operating temperature) is 50 K.
The pipe in question has an outside diameter of 25 mm.
What length of deflection leg is required based on the selected pipe type?

Calculation of the deflection leg length with the universal pipe RAUTITAN stabil

stabil

$$\Delta L = a \cdot L \cdot \Delta T$$

$$\Delta L = 0.026 \frac{mm}{m \cdot K} \cdot 7\ m \cdot 50\ K$$

$$\Delta L = 9.1\ mm$$

$$L_{BS} = C \cdot \sqrt{d_a \cdot \Delta L}$$

$$L_{BS} = 33 \cdot \sqrt{25\ mm \cdot 9.1\ mm}$$

$$L_{BS} = 498\ mm$$

Calculation of the deflection leg length with RAU-PE-Xa pipes with pipe support channel

flex

$$\Delta L = a \cdot L \cdot \Delta T$$

$$\Delta L = 0.04 \frac{mm}{m \cdot K} \cdot 7\ m \cdot 50\ K$$

$$\Delta L = 14\ mm$$

$$L_{BS} = C \cdot \sqrt{d_a \cdot \Delta L}$$

$$L_{BS} = 12 \cdot \sqrt{25\ mm \cdot 14\ mm}$$

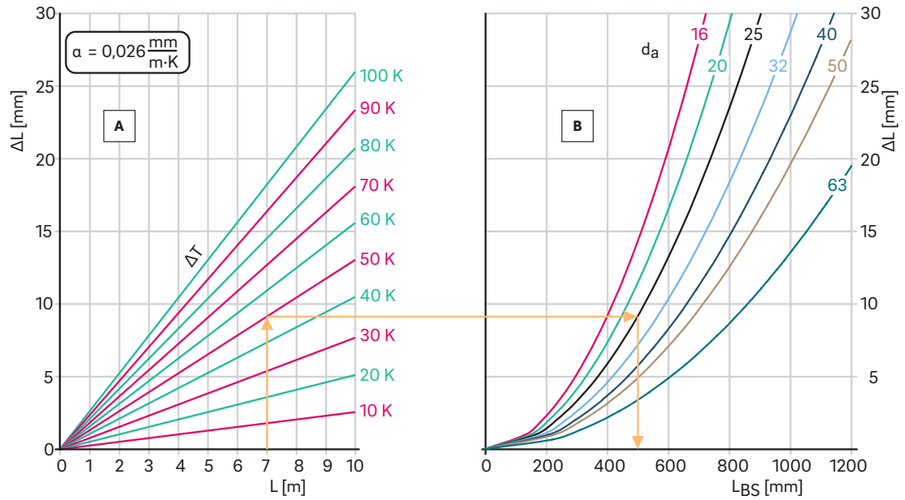
$$L_{BS} = 224\ mm$$

Assessment of the results
The universal pipe RAUTITAN stabil has a lower thermal expansion than a RAU-PE-Xa pipe due to its aluminium layer. However, the required deflection leg length for the RAU-PE-Xa is smaller due to the more flexible pipe material.
For metallic pipe materials, a substantially larger deflection leg is required with the same operating parameters during installation, due to the significantly higher material constant (C), than for the pipes of the RAUTITAN system.

34.03 Calculation diagrams to determine deflection legs

Universal pipe RAUTITAN stabil sizes 16–63

stabil

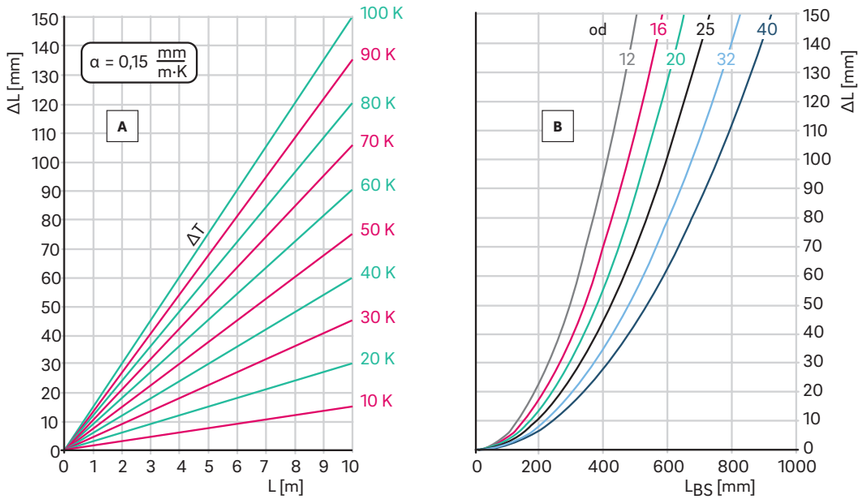


A Thermal change in length
B Deflection leg determination
ΔL Change in length
L Pipe length

L_{BS} Deflection leg length
ΔL Temperature difference
d_a Outer pipe diameter

Pipes made from RAU-PE-Xa, sizes 12–40 without pipe support channel

flex

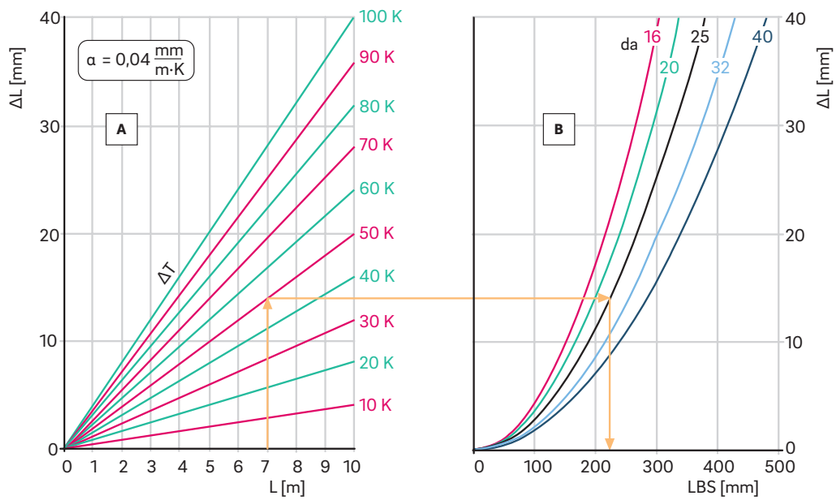


A Thermal change in length
B Deflection leg determination
ΔL Change in length
L Pipe length

L_{BS} Deflection leg length
ΔL Temperature difference
d_a Outer pipe diameter

Pipes made from RAU-PE-Xa, sizes 16–40 with pipe support channel

flex



A Thermal change in length
B Deflection leg determination
ΔL Change in length
L Pipe length

L_{BS} Deflection leg length
ΔL Temperature difference
d_a Outer pipe diameter

35 Installation guidelines

35.01 Pipe installtion subject to freezing

Piping has to be installed without risk of freezing.. In areas with risk of freezing, e.g. in rooms with no heated at all, a frost protection using pipe insulation is generally not enough.

- In these areas the piping has to be equipped with auxiliary heating or must be emptied during the cold period.
- Suitable devices for emptying the system must be already considered in the planning phase.

35.02 Laying on the raw floor

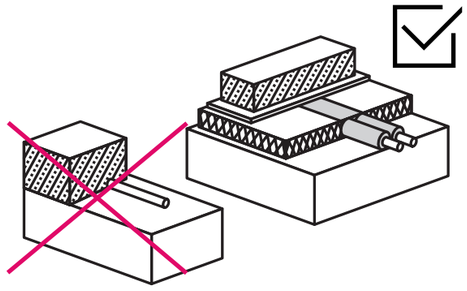


Fig. 35-1 Laying with a compensating layer

- Details on pipe protection and insulation can be found in the respective chapters.
- Always lay RAUTITAN pipes with insulation in drinking water and heating installation.
- Take note of the by the pipe insulation increased construction height in the planning phase.
- Fix the pipes on the floor (take note of the specifications in BS 8204 and DIN 18 560, Floor screeds in building construction).
- Install pipes in a suitable levelling layer to create a flat surface for receiving the insulating layer and impact sound insulation.

35.03 Inadmissible heating of pipes

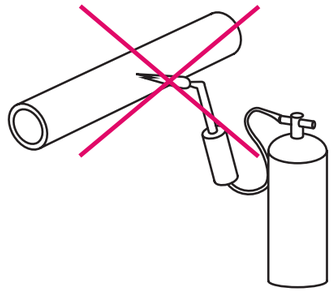


Fig. 35-2 Protect piping against inadmissible overheating

Make sure that during the construction phase pipes are, amongst other things, not subjected to excessive temperatures by other trades (e.g. when sealing bitumen sheeting, or welding or soldering in the direct vicinity of unprotected piping).

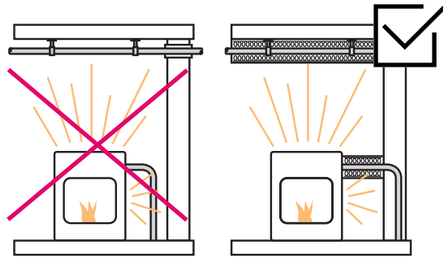


Fig. 35-3 Protection against thermal loads

- Piping close to devices with high thermal emissions must be insulated sufficiently and permanently protected against inadmissible heating.
- The maximum allowed operating pressure (e.g. operating temperature and duration) apply.

35.04 Laying on bitumen materials

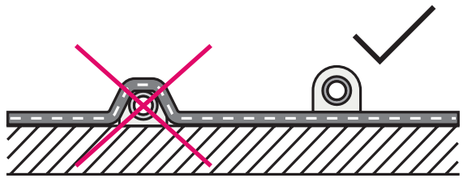


Fig. 35-4 Installation only allowed on a single layer of bitumen

Do not lay pipes underneath bitumen materials. This can result in damage to the piping or to the bitumen sheet.

- Before laying pipes onto solvent based bitumen materials or bitumen coatings, they must have dried thoroughly.
- Observe the curing time specified by the manufacturer.
- Prior to laying the pipe, always make sure no negative impact on the pipes or conveyed drinking water is possible.
- When installing pipes in combination with torch down bitumen materials, protect the piping sufficiently against heating.

Details on insulating and laying RAUTITAN piping in drinking water and heating installation can be found in the respective chapters.

35.05 Laying underneath hot asphalt screed

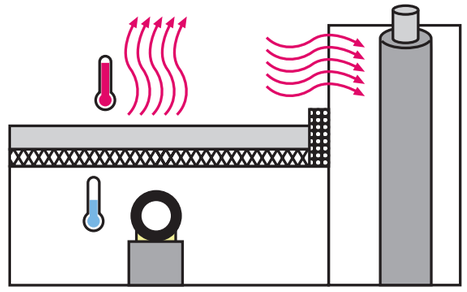


Fig. 35-5 Laying under hot asphalt screed

Hot asphalt screeds are laid at a temperature of approx. 250 °C. To protect the piping from overheating, proper steps need to be taken.
Since these are dependent on the structural conditions and cannot be influenced by REHAU, they must be coordinated with and approved by the planner.

- Take the appropriate measures to ensure that the drinking water and heating piping (e.g. pipes, fittings, compression sleeves, joints) and the pipe insulation do not at any point exceed 100 °C.

Agree with the contractor laying the hot asphalt screed on suitable insulating and protective measures for the installation and laying of the hot asphalt screed in order to prevent overheating of the piping.

35.06 External installation

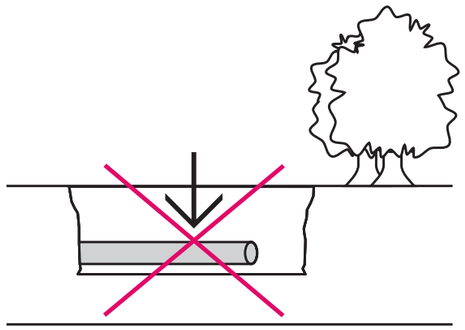


Fig. 35-6 Installation below ground not allowed

Fig. 35-7 External installations
Only for water conveying pipes with adequate protective measures have been taken

⚠

Piping:

- Do not use for laying below ground
- Protect against UV radiation
- Protect against frost
- Protect against high temperatures
- Protect against damage

35.07 Installation with UV exposure

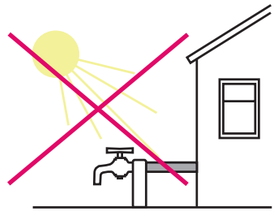


Fig. 35-8 Unprotected laying in areas exposed to UV radiation is not allowed
Example: Outdoors

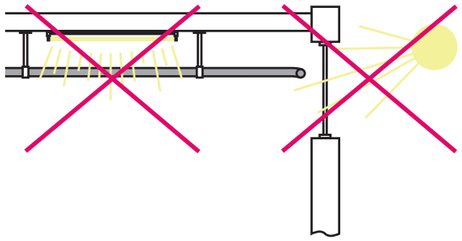


Fig. 35-9 Unprotected laying in areas exposed to UV radiation is not permitted
Example: Indoors

⚠

- Store and transport pipes protected against UV radiation.
- Protect piping from UV rays in areas where UV radiation can occur (e.g. sunlight, neon light).

35.08 Light transmission

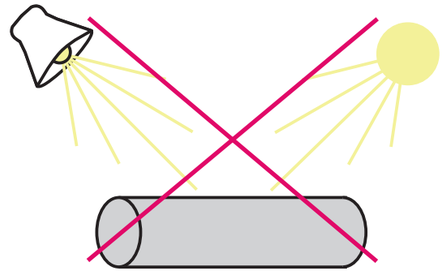


Fig. 35-10 Protect from light

⚠

Light can permeate through RAUTITAN flex pipes. Light transmission can be detrimental to the hygiene of the drinking water.

Protect pipes from light light (e.g. close to windows and lamps).

35.09 Trace heating

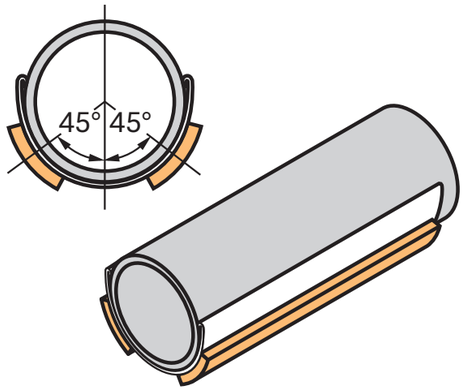


Fig. 35-11 Installation example with auxiliary heating

- If pipes are laid with the pipe support channel, the heating bands must be attached to the outside of the pipe support channel.
- Take the appropriate measures to ensure that the piping and connection components do not at any point exceed 70 °C.
- When installing heating strips on pipes, observe the laying instructions of the auxiliary heating manufacturer.

35.10 Earth bonding

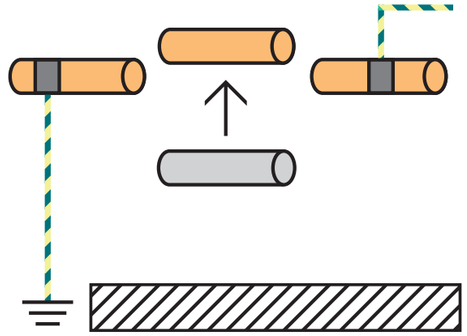


Fig. 35-12 Earth bonding when exchanging pipes

⚠

RAUTITAN piping must not be used as an earth conductor for electrical systems.

After replacement of existing metal pipe installations with the RAUTITAN system, earth bonding and the effectiveness of the electrical safety devices must be verified by an electrician.

36 Advice about system components before 2019

Some system components manufactured and sold by REHAU prior to 2019 can no longer be used at all or only in a limited way.
Please read the following advice on compatibility of these components carefully.

⚠

Only push polymer RAUTITAN PX compression sleeves onto polymer RAUTITAN PX fittings.

Fig. 36-1 Unapproved combination RAUTITAN PX fitting with brass compression sleeves

36.01 Fitting shapes in combination with the universal pipe RAUTITAN stabil, size: 16–32

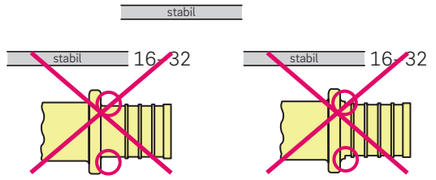


Fig. 36-2 Brass fitting without pre-stop, size 16–32

Fig. 36-3 Brass fitting with partially formed pre-stop, size 16–32

Fig. 36-4 Fitting with fully formed pre-stop, size 16–32

⚠

With universal pipes RAUTITAN stabil and brass fittings, always use brass parts with fully sformed pre-stop.
Since 1997, production at REHAU has been completely changed over to a fully formed pre-stop for in sizes 16–32.

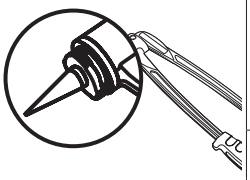
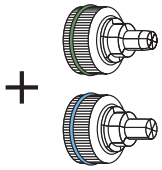
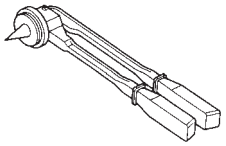
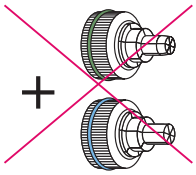
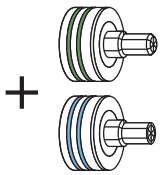
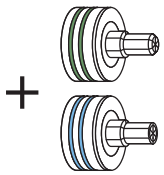
36.02 Notes on the compression jaws in size 40 up to 2009

	Jochsatz alt Ø 40	Schiebehülse RAUTITAN PX Ø 40
Jochsatz 40 (Goldgelb) 137805-001 138223-001		
Jochhsatz M1 40 (Goldgelb) 137374-001 138333-001		+ 
Jochsatz G1/G2 40 (Goldgelb) 137964-001		

Tab. 36-1 Compression jaws for RAUTITAN PX compression sleeves, size 40

36.03 Advice on manual expander tool QC and RO

Manual expander tools and compatible expander heads

Expanding tool QC		Expander heads	Expanding tool RO		Expander heads
Article number 214176-001		QC 	Article number 139592-001		QC 
		RO 			RO 

Tab. 36-2 Expanding tools and expander heads

The black expanding tool QC can be used without restriction with expander heads RO with thread connection and QC with bayonet lock.

⚠

The new expander heads QC, with a single marking ring shall not be used with the expanding tool RO (silver).

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37 Components summary

37.01 Components for universal pipe RAUTITAN stabil

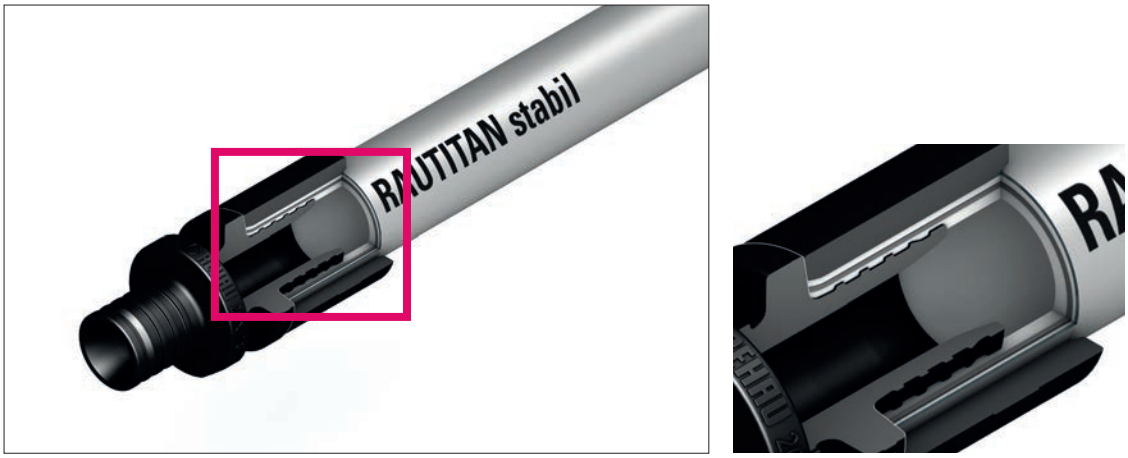
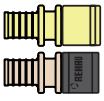
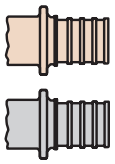
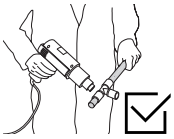
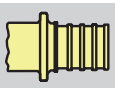
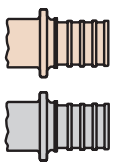
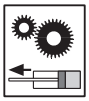
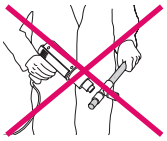


Fig. 37-1 Universal pipe RAUTITAN stabil with aluminium layer

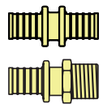
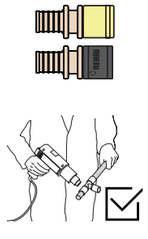
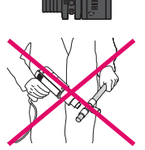
Area of application
- Drinking water installation
- Heating installation
- Underfloor heating/cooling

Size	Fittings	Compression sleeves	Pipe Cutter	Expanding	Expander head	Separating joint
16						
20						
25						
32						
40	SL-Fitting-Sets					
50						
63						

37.02 Components for pipes made from RAU-PE-Xa

Fig. 37-2 Pipes made from RAU-PE-Xa

Area of application
- Drinking water installation sizes 16-40
- Heating installation
- Underfloor heating/cooling

Size	Fittings	Compression sleeves	Pipe Cutter	Expanding	Expander head	Detaching joint
12						
16						
20						
25						
32						
40						

38 Standards, regulations and guidelines

§

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

Also observe the applicable laws, standards, guidelines and regulations (e.g. BS, DIN, EN, ISO, DVGW, VDE, VDI and CIBSE) as well as regulations on environmental protection, provisions of professional associations and regulations of the local public utility companies.

Areas of application not contained in this Technical Information (special applications) require consultation with our Applications Department.
For detailed advice, consult your REHAU sales office.

The planning and installation instructions are directly connected with the respective REHAU product. References are made to excerpts from publicly applicable standards and regulations.
Observe the latest valid issues of the guidelines, standards and regulations.
Further standards, regulations and guidelines with regard to the planning, installation and operation of drinking water, heating and building technology systems must also be taken into account, but are not a part of this Technical Information.

Reference is made to the following standards, regulations and directives in the Technical Information (the current status always applies):

DIN 1988
Codes of practice for drinking water installations (TRWI)

DIN 2000
Central drinking water supply - Guidelines regarding requirements for drinking water, planning, construction, operation and maintenance of plants

DIN 3546
Stop-valves for domestic water supply

DIN 4102
Fire behaviour of building materials and components

DIN 4102-1
Fire behaviour of building materials and building components - Part 1: Building materials; concepts, requirements and tests

DIN 4108
Thermal protection and energy economy in buildings

DIN 4109
Sound insulation in buildings

DIN 4726
Warm water surface heating systems and radiator connecting systems - Plastic piping systems

DIN 16892
Crosslinked polyethylene (PE-X) pipes - General requirements, testing

DIN 16893
Crosslinked polyethylene (PE-X) pipes - Dimensions

DIN 18560
Floor screeds in building construction

DIN 49019
Conduits for electrical installation

DIN 50916-2
Testing of copper alloys; stress corrosion and cracking test using ammonia; testing of components

DIN 50930-6
Corrosion of metals – Corrosion of metallic under corrosion load by water inside of tubes, tanks and apparatus - Part 6: Influence of the composition of drinking water

BS EN 442
Radiators and convectors

BS EN 806
Codes of practice for drinking water installations

BS EN 1057
Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications

BS EN 1717
Protection against pollution of potable water installations and general requirements of devices to prevent pollution by backflow

BS EN 1982
Copper and copper alloys - Ingots and castings

BS EN 10088

Stainless steels
BS EN 10226
Pipe threads where pressure-tight joints are made on the threads

BS EN 12164
Copper and copper alloys – Rod for free machining purposes

BS EN 12165
Copper and copper alloys – Wrought and unwrought forging stock

BS EN 12168
Copper and copper alloys - Hollow rod for free machining purposes

BS EN 12502-1
Protection of metallic materials against corrosion – Guidance on the assessment of corrosion likelihood in water distribution and storage systems

BS EN 12828
Heating systems in buildings – Design of water-based heating systems

BS EN 13163 bis BS EN 13171
Thermal insulation products for buildings

BS EN 13501
Fire classification of construction products and building elements

BS EN 13501-1
Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

BS EN 14291
Foam producing solutions for leak detection on gas installations

BS EN 14336
Heating systems in buildings

BS EN 16313
Connections for heating and cooling appliances - Detachable connection with outside threaded pipe G ¾ A and inside cone

BS EN ISO 6509
Corrosion of metals and alloys – Determination ofdez-incification resistance of brass

BS EN ISO 15875
Plastic piping systems for hot and cold water installations - Crosslinked polyethylene (PE-X)

BS EN ISO 21003
Multilayer piping systems for hot and cold water installations inside buildings

DIN VDE 0100
(Summary)
Electrical systems in building
Setting up high-voltage current systems
Setting up low-voltage current systems
Guidelines for electrical systems

DIN VDE 0100-701
Low-voltage electrical installations - Requirements for special installations or locations - Part 701: Locations containing a bath or shower

DVGW W 270
Reproduction of micro-organisms on materials for the drinking water area

DVGW W 534
Pipe connectors and connections in the drinking water installation

DVGW W 551
Drinking water heating and drinking water pipe systems

DVGW W 556
Hygienic-microbial irregularities in drinking water installations; methods and measures to remedy

DVGW W 557
Cleaning and disinfection of water distribution systems

EnEV
German Energy Saving Ordinance

Council directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption

Council directive relating to machinery (89/392/EEC) including amendments

ISO 7
Pipe threads where pressure-tight joints are not made on the threads

ISO 228
Pipe threads where pressure-tight joints are not made on the threads

ISO 10508
Plastic piping systems for hot and cold water installations - Guidance for classification and design

LBO
Regional building laws of the states of the Federal Republic of Germany

MBO
German Building Code for the states of the Federal Republic of Germany

MLAR
Sample Line Systems Guidelines

Muster-Feu-VO
Sample firing equipment regulation

NEN 1078
Gas supply at an operating pressure of 500 mbar

TrinkwV
Drinking Water Ordinance

VDI 2035
Prevention of damage in water heating installations

VDI 6023
Hygiene for drinking water supply systems

VOB
German Construction Contract Procedures

ZVSHK data sheets
German Central Association for Plumbing, Heating, Air-conditioning/Building and Energy Technology (ZVSHK/GED)

Notes

Notes

REHAU sales offices

www.rehau.com/uk

Below, you will find the individual sales offices with their addresses and phone numbers:

1 **Head Office**
REHAU Ltd.
Hill Court,
Walford,
Ross-on-Wye,
Herefordshire,
HR9 5QN.

+44 (0)1989 762600
+44 (0)1989 762601
enquiries@rehau.com

2 **Showroom**
The REHAU Hub,
The Building Centre,
26 Store Street,
Fitzrovia,
London,
WC1E 7BT.

+44 (0)1989 762600
+44 (0)207 307 8595
enquiries@rehau.com

3 **Dublin Sales Office**
REHAU Ltd.
9 St. John's Court,
Business Park,
Swords Road, Santry,
Dublin 9,
Republic of Ireland.

+353 (0)1 816 5020
+353 (0)1 816 5021
enquiries@rehau.com

4 **Glasgow Sales Office**
REHAU Ltd.
Phoenix House,
Phoenix Crescent,
Strathclyde Business Park,
Bellshill,
ML4 3NJ.

+44 (0)1698 503700
+44 (0)1698 503701
enquiries@rehau.com

5 **Manchester Sales Office**
REHAU Ltd.
Northbank Ind Est,
Brinell Drive,
Irlam,
Manchester,
M44 5BL.

+44 (0)161 777 7400
+44 (0)161 777 7401
enquiries@rehau.com

6 **Factory**
REHAU Ltd.
Tanygrisiau,
Blaenau Ffestiniog,
Gwynedd,
LL41 3RY.

+44 (0)1766 833700
+44 (0)1766 833701

7 **Logistics**
Runcorn Warehouse,
Greenwood Drive,
Blackheath Lane,
Runcorn,
WA7 1SE.

+44 (0)1928 248 865

www.rehau.uk/rautitan

Hill Court, Walford,
Ross-on-Wye, HR9 5QN

893621 EN 03.2022

Important instructions for connecting the pipes RAUTITAN flex, the compression sleeves RAUTITAN MX and fittings RAUTITAN RX+ in the sizes 50 and 63

Different system dimensions
Pipes RAUTITAN **flex**, Fittings RAUTITAN SX/RX+ und the compression sleeves MX in sizes 50 x 5.9 und 60 x 8.6 are not compatible with the pipes RAUTITAN **stabil** 50 x 4.5 und 60 x 6.0 , the fitting RAUITAN RX+ **stabil** and the compression sleeves RAUTITAN PX **stabil**.

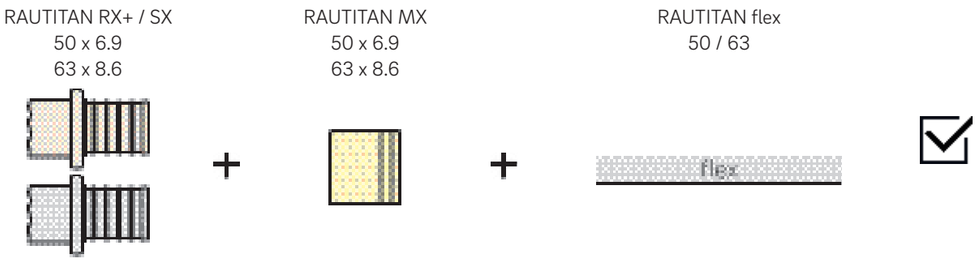


Fig. ??-? Permitted combination

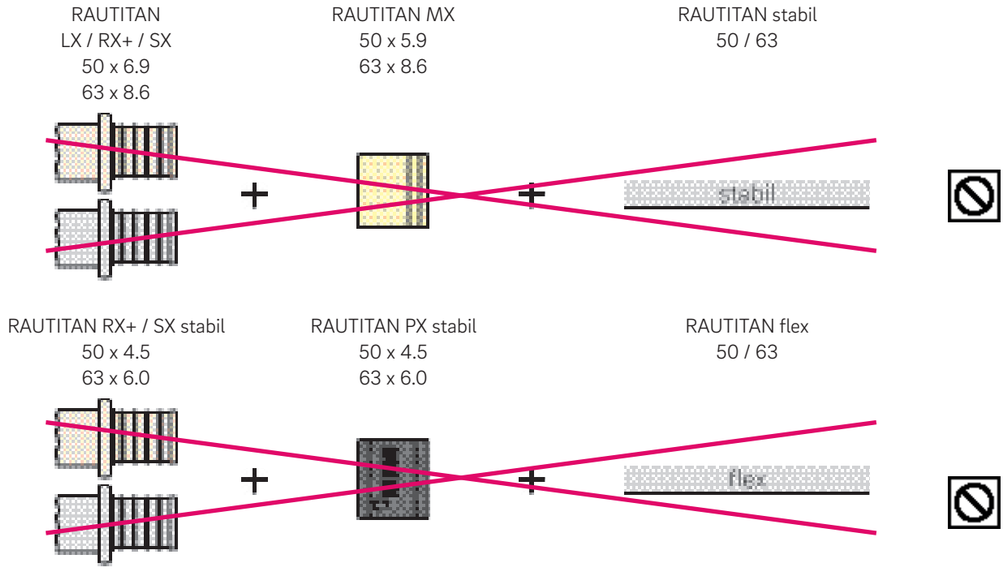


Fig. ??-? Prohibited combination

Compression Jaws and expander heads

For RAUTITAN flex
Ø 50 / 63

Mat.-Nr.
317436-001
317437-001

137624-001
137634-001

Mat.-Nr.
001135-001
001137-001

139891-001
139901-001

For RAUTITAN stabil
Ø 50 x 4.5 / 63 x 6.0

Mat.-Nr.
13258201001
13258211001

Mat.-Nr.
10011281001
10011331001

RAUTOOL A5

RAUTOOL G2

Different system dimensions
For the RAUTOOL A5, both expander heads and compression jaws for RAUTITAN **stabil Ø 50 x 4.5 / 63 x 6.0** are **NOT** compatible with the universal pipe RAUTITAN **flex** in Ø **50/63**, the fittings **SX/RX+** and **brass** compression sleeves RAUTITAN **MX**.

This addendum is to be read in conjunction with the main part of this technical information. It gives technical details specific to the universal pipes RAUTITAN flex in size 50 x 6.9 or 63 & 8.6.

Universal pipe RAUTITAN flex

Universal pipe RAUTITAN flex

- Pipe made from RAU-PE-Xa
  - Peroxide-crosslinked polyethylene (PE-Xa)
  - With oxygen diffusion barrier
  - Oxygen-tight according to DIN 4726
- Areas of application
  - Drinking water installation
  - Heating installation

RAUTITAN pipe delivered with pre-assembled stoppers for a transport and a storage under optimal hygienic conditions.

Approvals for Germany and quality certificates

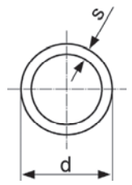
- DVGW registration for universal pipe RAUTITAN flex and compression sleeve jointing technique from REHAU with RAUTITAN connection components
- System approval:
  DVGW DW-8501AU2200
- The universal pipe RAUTITAN flex complies with DIN EN ISO 15875
- DIN CERTCO registration confirms the suitability of the pipes for use in the heating installation to DIN 4726/DIN EN ISO 15875 - application class 1–4 / 1 MPa (10 bar) and 5 / 0.8 MPa (8 bar) and the necessary tightness against oxygen diffusion

Pipe size

d [mm]	s [mm]	DN [1)] [mm]	Content [l/m]
50	6.9	40	1.029
63	8.6	50	1.633

1) The exact pipe inner diameter ist d – 2 x s and has to be used during the installation design.

Pipe size, universal pipe RAUTITAN flex

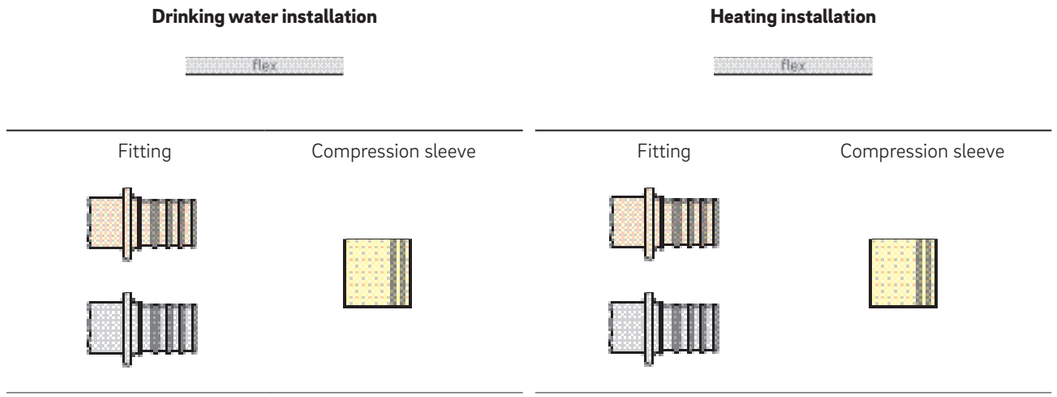


Diameter/Wall thickness

Fittings and compression sleeves

Fitting and Compression sleeves for Universal pipe RAUTITAN flex 50x6.5 & 63x8.6

Areas of application of the fittings and compression sleeves



Areas of application of the fittings and compression sleeves

Fittings for universal pipe RAUTITAN flex 50x6.5 & 63x8.6

- Application in plumbing and heating installation
- Permanently sealing compression sleeve jointing technique according to BS EN 806, DIN 1988 and DVGW-worksheet W 534
- Approved for flush-mounted installation in accordance with DIN 18380 (VOB)
- Without o-ring (pipe material seals itself)
- Easy visual check
- Can be immediately pressurised
- RAUTITAN RX+ fittings, through which drinking water flows, are made of lead free gunmetal according to DIN SPEC 2701
- DVGW registration (all sizes)
  - For the RAUTITAN pipes in the drinking water installation
  - For the REHAU compression sleeve jointing technique
- Manufacture of the compression sleeve joint with RAUTOOL
  - Especially coordinated with the RAUTITAN and RAUTHERM S systems
  - Development and service directly from REHAU

RAUTITAN LX (standard brass), RAUTITAN RX+ (gunmetal) and RAUTITAN SX (stainless steel) fittings

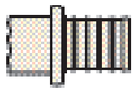
Size designation of the fittings and compression sleeves for the RAUTITAN system

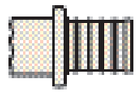
- 50 x 6.9
- 63 x 8.6

RAUTITAN RX+

Material	Lead free gunmetal according to DIN SPEC 2701 (material designation CuSn4Zn2PS)
Material marking	Rg+

Fittings for drinking water and heating

	Size 50–63
Threadless fittings	 RAUTITAN RX+
Material	Gunmetal

	Size 50–63
Fittings for screwing, soldering, clamping	 RAUTITAN RX+
Material	Gunmetal

Fittings for plumbing and heating installations

RAUTITAN MX compression seeve

RAUTITAN MX

Size	50 x 6.9mm	63 x 8.6mm
Material	Thermally anneated brass to DIN EN 1254-3	
Characteristic features	- Can only be pushed onto the fitting from one side - Brass finish -An encircling groove	

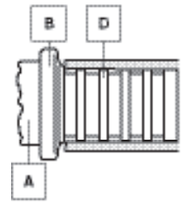
RUATITAN compression sleeves

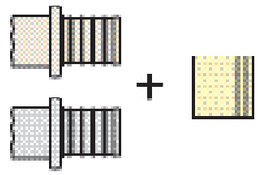
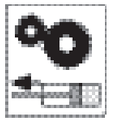
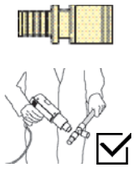
Components for Universal pipe RAUTITAN flex, sizes 50–63

Area of application
- Drinking water installation
- Heating installation

Correct position of the pipe on the RAUTITAN SX/RX/RX+ fitting

A Fitting body
B Fitting shoulder
D Sealing rib



Size	Fittings	Compression Sleeves	Pip Cutter	Expanding	Expander Head	Detaching Joint
50 - 63						

Pressure loss table RAUTITAN flex 50 x 6..9 & 63 x 8.6: Drinking water installation

RAUTITAN flex	50 x 6.9 DN40		63 x 8.6 DN50	
V Vs	**R** mbar/m	**v** ms	**R** mbar/m	**v** ms
0.1	0.1	0.1	0	0.1
0.2	0.2	0.2	0.1	0.1
0.3	0.4	0.3	0.1	0.2
0.4	0.6	0.4	0.2	0.2
0.5	0.9	0.5	0.3	0.3
0.6	1.3	0.6	0.4	0.4
0.7	1.7	0.7	0.6	0.4
0.8	2.2	0.8	0.7	0.5
0.9	2.7	0.9	0.9	0.6
1	3.2	1	1.1	0.6
1.1	3.8	1.1	1.3	0.7
1.2	4.4	1.2	1.5	0.7
1.3	5.1	1.3	1.7	0.8
1.4	5.8	1.4	1.9	0.9
1.5	6.6	1.5	2.2	0.9
1.6	7.4	1.6	2.4	1
1.7	8.3	1.7	2.7	1
1.8	9.2	1.7	3	1.1
1.9	10.1	1.8	3.3	1.2
2	11.1	1.9	3.6	1.2
2.1	12.1	2	4	1.3
2.2	13.2	2.1	4.3	1.3
2.3	14.3	2.2	4.7	1.4
2.4	15.4	2.3	5	1.5
2.5	16.6	2.4	5.4	1.5
2.6	17.8	2.5	5.8	1.6
2.7	19.1	2.6	6.2	1.7
2.8	20.4	2.7	6.7	1.7
2.9	21.7	2.8	7.1	1.8
3	23.1	2.9	7.5	1.8
3.1	24.5	3	8	1.9
3.2	26	3.1	8.5	2
3.3	27.5	3.2	9	2
3.4	29	3.3	9.5	2.1
3.5	30.6	3.4	10	2.1
3.6	32.2	3.5	10.5	2.2
3.7	33.9	3.6	11	2.3
3.8	35.6	3.7	11.6	2.3
3.9	37.3	3.8	12.1	2.4
4	39.1	3.9	12.7	2.4
4.1	40.9	4	13.3	2.5
4.2	42.7	4.1	13.9	2.6
4.3	44.6	4.2	14.5	2.6
4.4	46.5	4.3	15.1	2.7
4.5	48.5	4.4	15.7	2.8
4.6	50.5	4.5	16.4	2.8
4.7	52.6	4.6	17	2.9
4.8	54.6	4.7	17.7	2.9
4.9	56.7	4.8	18.4	3
5	58.9	4.9	19.1	3.1

Pressure loss table RAUTITAN flex 50 x 6..9 & 63 x 8.6: Heating installation (spread 1 K)

Water temperature: 60 °C Dynamic viscosity: 0.000467 kg/(m·s) Density: 983.2 kg/m³

R value			**m**
Pa/m	50 x 6.9	63 x 8.6	v
50	1478.5	2649.6	2649.6
	0.39	0.46	0.46
55	1561.2	2797.9	2797.9
	0.42	0.49	0.49
60	1640.8	2940.5	2940.5
	0.44	51	0.51
65	1717.6	3078.2	3078.2
	0.46	0.53	0.53
70	1791.9	3211.3	3211.3
	0.48	0.56	0.56
75	1864	3340.5	3340.5
	0.5	0.58	0.58
80	1934	3465.9	3465.9
	0.52	0.6	0.6
90	2068.6	3707.2	3707.2
	0.55	0.64	0.64
100	2197	3937.3	3937.3
	0.59	0.68	0.68
110	2320	4157.7	4157.7
	0.62	0.72	0.72
120	2438.3	4369.6	4369.6
	0.65	0.76	0.76
130	2552.4	4574.1	4574.1
	0.68	0.79	0.79
140	2662.8	4772	4772
	0.71	0.83	0.83
150	2769.9	4963.9	4963.9
	0.74	0.86	0.86
160	2873.9	5150.4	5150.4
	0.77	0.89	0.89
170	2975.2	5331.9	5331.9
	0.79	0.93	0.93
180	3074	5508.9	5508.9
	0.82	0.96	0.96
190	3170.4	5681.8	5681.8
	0.85	0.99	0.99
200	3264.8	5850.9	5850.8
	0.87	1.02	1.02
220	3447.5	6178.3	6178.3
	0.92	1.07	1.07
240	3623.2	6493.3	6493.3
	0.97	1.13	1.13
260	3792.8	6797.1	6797.1
	1.01	1.18	1.18
280	3956.9	7091.2	7091.2
	1.06	1.23	1.23
300	4116	7376.3	7376.3
	1.1	1.28	1.28
320	4270.6	7653.4	7653.4
	1.14	1.33	1.33
360	4567.9	8186.3	8186.3
	1.22	1.42	1.42
400	4851.4	8694.3	8694.3
	1.3	1.51	1.51
450	5189.2	9299.6	9299.6
	1.39	1.62	1.62
500	5511.2	9876.7	9876.7
	1.47	1.72	1.72
550	5819.7	10429.5	10429.5
	1.55	1.81	1.81
600	6116.3	10961.2	10961.2
	1.63	1.9	1.9
700	6679.5	11970.5	11970.5
	1.78	2.08	2.08
800	7209.2	12919.6	12919.6
	1.93	2.24	2.24
1000	8189.6	1467.7	14676.7
	2.19	2.55	2.55

Pressure loss table: Heating installation RAUTITAN flex 50 x 6.9 (spread 10, 15 and 20 K)

flex

Water temperature: 60°C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
	Flow rate	Speed	Pressure loss	Flow rate	Speed	Pressure loss	Flow rate	Speed	Pressure loss
Q	m	v	R	m	v	R	m	v	R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
4500	387	0.1	4.9	258	0.07	2.4	193.5	0.05	1.5
5000	430	0.12	5.9	286.7	0.08	2.9	215	0.06	1.8
5500	473	0.13	7	315.3	0.09	3.4	236.5	0.06	2.1
6000	516	0.14	8.1	344	0.09	4	258	0.07	2.4
6500	559	0.15	9.3	372.7	0.1	4.6	279.5	0.08	2.8
7000	602	0.16	10.6	401.3	0.11	5.2	301	0.08	3.2
7500	645	0.17	11.9	430	0.12	5.9	322.5	0.09	3.6
8000	688	0.19	13.4	458.7	0.12	6.6	344	0.09	4
8500	731	0.2	14.9	487.3	0.13	7.3	365.5	0.1	4.4
9000	774	0.21	16.5	516	0.14	8.1	387	0.1	4.9
9500	817	0.22	18.1	544.7	0.15	8.9	408.5	0.11	5.4
10000	860	0.23	19.8	573.3	0.15	9.7	430	0.12	5.9
11000	946	0.26	23.4	630.7	0.17	11.5	473	0.13	7
12000	1032	0.28	27.3	688	0.19	13.4	516	0.14	8.1
13000	1118	0.3	31.5	745.3	0.2	15.4	559	0.15	9.3
14000	1204	0.32	35.9	802.7	0.22	17.6	602	0.16	10.6
15000	1290	0.35	40.6	860	0.23	19.8	645	0.17	11.9
16000	1376	0.37	45.5	917.3	0.25	22.2	688	0.19	13.4
17000	1462	0.39	50.7	974.7	0.26	24.7	731	0.2	14.9
18000	1548	0.42	56.2	1032	0.28	27.3	774	0.21	16.5
19000	1634	0.44	61.9	1089.3	0.29	30.1	817	0.22	18.1
20000	1720	0.46	67.8	1146.7	0.31	32.9	860	0.23	19.8
21000	1806	0.49	74	1204	0.32	35.9	903	0.24	21.6
22000	1892	0.51	80.4	1261.3	0.34	39	946	0.26	23.4
23000	1978	0.53	87.1	1318.7	0.36	42.2	989	0.27	25.4
24000	2064	0.56	94	1376	0.37	45.5	1032	0.28	27.3
25000	2150	0.58	101.1	1433.3	0.39	49	1075	0.29	29.4
26000	2236	0.6	108.5	1490.7	0.4	52.5	1118	0.3	31.5
27000	2322	0.63	116.1	1548	0.42	56.2	1161	0.31	33.7
28000	2408	0.65	124	1605.3	0.43	59.9	1204	0.32	35.9
29000	2494	0.67	132	1662.7	0.45	63.8	1247	0.34	38.2
30000	2580	0.7	140.4	1720	0.46	67.8	1290	0.35	40.6
32000	2752	0.74	157.7	1834.7	0.5	76.1	1376	0.37	45.5
34000	2924	0.79	176	1949.3	0.53	84.8	1462	0.39	50.7
36000	3096	0.84	195.1	2064	0.56	94	1548	0.42	56.2
38000	3268	0.88	215.2	2178.7	0.59	103.5	1634	0.44	61.9
40000	3440	0.93	236.2	2293.3	0.62	113.5	1720	0.46	67.8
42000	3612	0.97	258.1	2408	0.65	124	1806	0.49	74
44000				2522.7	0.68	134.8	1892	0.51	80.4
46000				2637.3	0.71	146	1978	0.53	87.1
48000				2752	0.74	157.7	2064	0.56	94
50000				2866.7	0.77	169.8	2150	0.58	101.1
52000				2981.3	0.8	182.2	2236	0.6	108.5
54000				3096	0.84	195.1	2322	0.63	116.1
56000				3210.7	0.87	208.4	2408	0.65	124
58000				3325.3	0.9	222.1	2494	0.67	132
60000				3440.3	0.93	236.2	2580	0.7	140.4
62000				3554.7	0.96	250.7	2666	0.72	148.9
64000				3669.3	0.99	265.5	2752	0.74	157.7
66000							2838	0.77	166.7
68000							2924	0.79	176
70000							3010	0.81	185.4
73000							3139	0.85	200.1
75000							3225	0.87	210.1
77000							3311	0.89	220.4
80000							3440	0.93	236.2
83000							3569	0.96	252.5
86000							3698	1	269.3

Dynamic viscosity: 0.000467 kg/(m•s) Density: 983.2 kg/m³

Pressure loss table: Heating installation RAUTITAN flex 63 x 8.6 (spread 10, 15 and 20 K)

flex

Water temperature: 60°C

Heat output	Spread 10 K			Spread 15 K			Spread 20 K		
	Flow rate	Speed	Pressure loss	Flow rate	Speed	Pressure loss	Flow rate	Speed	Pressure loss
Q	m	v	R	m	v	R	m	v	R
W	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m	kg/h	m/s	Pa/m
7000	602	0.1	3.5	401.3	0.07	1.7	301	0.05	1.1
8000	688	0.12	4.5	458.7	0.08	2.2	344	0.06	1.3
9000	774	0.13	5.5	516	0.09	2.7	387	0.07	1.6
10000	860	0.15	6.6	573.3	0.1	3.2	430	0.07	2
11000	946	0.16	7.8	630.7	0.11	3.8	473	0.08	2.3
12000	1032	0.18	9.1	688	0.12	4.5	516	0.09	2.7
13000	1181	0.19	10.4	745.3	0.13	5.1	559	0.1	3.1
14000	1204	0.2	11.9	802.7	0.14	5.8	602	0.1	3.5
15000	1290	0.22	13.4	860	0.15	6.6	645	0.11	4
16000	1376	0.23	15.1	917.3	0.16	7.4	688	0.12	4.5
18000	1548	0.26	18.6	1032	0.18	9.1	774	0.13	5.5
20000	1720	0.29	22.4	1146.7	0.2	10.9	860	0.15	6.6
22000	1892	0.32	26.5	1261.3	0.21	12.9	946	0.16	7.8
24000	2064	0.35	31	1376	0.23	15.1	1032	0.18	9.1
26000	2236	0.38	35.7	1490.7	0.25	17.4	1118	0.19	10.4
28000	2408	0.41	40.8	1605.3	0.27	19.8	1204	0.2	11.9
30000	2580	0.44	46.1	1720	0.29	22.4	1290	0.22	13.4
32000	2752	0.47	51.8	1834.7	0.31	25.1	1376	0.23	15.1
34000	2924	0.5	57.7	1949.3	0.33	28	1462	0.25	16.8
36000	3096	0.53	63.9	2064	0.35	31	1548	0.26	18.6
38000	3268	0.56	70.5	2178.7	0.37	34.1	1634	0.28	20.4
40000	3440	0.59	77.3	2293.3	0.39	37.4	1720	0.29	22.4
42000	3612	0.61	84.4	2408	0.41	40.8	1806	0.31	24.4
44000	3784	0.64	91.8	2522.7	0.43	44.3	1892	0.32	26.5
46000	3956	0.67	99.4	2637.3	0.45	48	1978	0.34	28.7
48000	4128	0.7	107.4	2752	0.47	51.8	2064	0.35	31
50000	4300	0.73	115.6	2866.7	0.49	55.7	2150	0.37	33.3
52000	4472	0.76	124.1	2981.3	0.51	59.7	2236	0.38	35.7
54000	4644	0.79	132.9	3096	0.53	63.9	2322	0.39	38.2
56000	4816	0.82	141.9	3210.7	0.55	68.3	2408	0.41	40.8
58000	4988	0.85	151.3	3325.3	0.57	72.7	2494	0.42	43.4
60000	5160	0.88	160.9	3444	0.59	77.3	2580	0.44	46.1
62000	5332	0.91	170.7	3554.7	0.6	82	2666	0.45	48.9
64000	5504	0.94	180.9	3669.3	0.62	86.8	2752	0.47	51.8
66000	5676	0.97	191.3	3784	0.64	91.8	2838	0.48	54.7
68000	5848	0.99	202	3898.7	0.66	96.8	2924	0.5	57.7
70000				4013.3	0.68	102	3010	0.51	60.8
72000				4128	0.7	107.4	3096	0.53	63.9
74000				4242.7	0.72	112.8	3182	0.54	67.2
76000				4357.3	0.74	118.4	3268	0.56	70.5
78000				4472	0.76	124.1	3354	0.57	73.8
80000				4586.7	0.78	129.9	3440	0.59	77.3
82000				4701.3	0.8	135.9	3562	0.6	80.8
84000				4816	0.82	141.9	3612	0.61	84.4
86000				4930.7	0.84	148.1	3698	0.63	88
80000				5045.3	0.86	154.4	3784	0.64	91.8
90000				5160.0	0.88	160.9	3870	0.66	95.6
94000				5389.3	0.92	174.1	4042	0.69	103.4
98000				5618.7	0.96	187.8	4214	0.72	111.4
102000				5848.0	0.99	202.0	4386	0.75	119.8
106000							4558	0.78	128.5
110000							4730	0.80	137.4
114000							4902	0.83	146.6
118000							5074	0.86	156
122000							5246	0.89	165.8
127000							5461	0.93	178.3
132000							5676	0.97	191.3
137000							5891	1.00	204.7

Dynamic viscosity: 0.000467 kg/(m•s) Density: 983.2 kg/m³

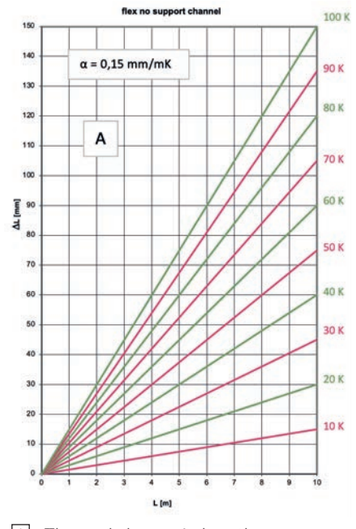
Thermal Expansion

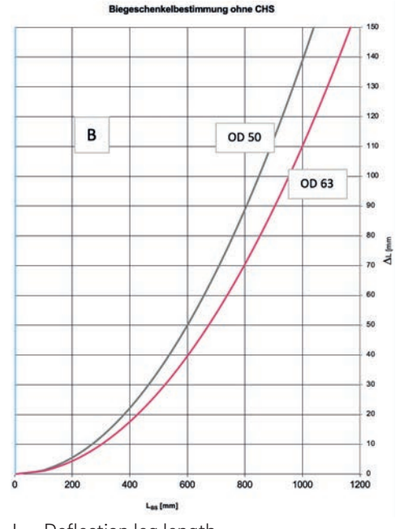
Pipe type		Pipe size	Coefficient of linear expansion $\alpha\,[\frac{mm}{m \cdot K}]$	Material constant C
Formula			$\Delta L = a \cdot L \cdot \Delta T$	$L_{BS} = C \cdot \sqrt{d_a \cdot \Delta L}$
Universal ppe RAUTITAN flex	flex	50-63 without support channel	0.15	12
		50-63 with support channel	0.1	

Coefficients of linear expansion (approximate values) and material constants for deflection leg calculation (approximate values)

Calculation diagrams to determine deflection legs

Universal pipe RAUTITAN flex, sizes 50–63 without support channel flex

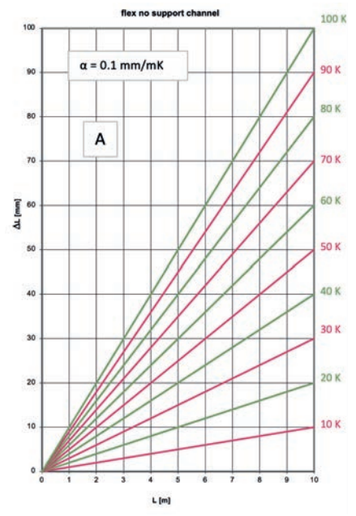


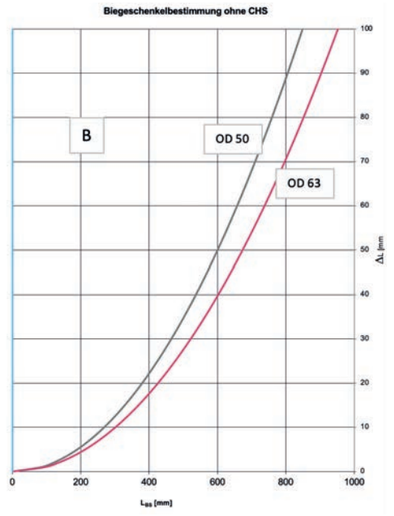


A Thermal change in length
B Deflection leg determination
ΔL Change in length
L Pipe length

L_{BS} Deflection leg length
ΔL Temperature difference
d_a Outer pipe diameter

Universal pipe RAUTITAN flex, sizes 50–63 with support channel flex





A Thermal change in length
B Deflection leg determination
ΔL Change in length
L Pipe length

L_{BS} Deflection leg length
ΔL Temperature difference
d_a Outer pipe diameter