



REHAU[®]

Unlimited Polymer Solutions



RAUVITHERM AND RAUTHERMEX PRE-INSULATED PIPE

TECHNICAL INFORMATION

www.rehau.co.uk/districtheating
Valid from August 2014
Subject to technical modifications

Building Solutions
Automotive
Industry

This Technical Information "REHAU RAUVITHERM and RAUTHERMEX systems for heat supply" is valid from April 2014.

With its publication the previous Technical Informations 817600EN (Date December 2013) and 463600EN (Date December 2013) become invalid.

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1 INFORMATION & SAFETY

Notes on this technical information

Validity

This Technical Information is valid for the UK.

Navigation

At the start of this Technical Information you will find a detailed table of contents with the hierarchical headings and the corresponding page numbers.

Pictograms and logos



Safety warning



Legal information



Important information which must be noted



Information on the internet



The advantages for you



Currentness of the Technical Information

For your own safety and for the correct application of our products please check at regular intervals whether a more recent version of your Technical Information is available.

The issue date of your Technical Information is always printed on the bottom left-hand side of the back page.

You can obtain the current Technical Information from your REHAU sales office, specialist wholesaler or you can download it from the internet at: www.rehau.co.uk/district heating

Safety warnings and operating instructions

- For your own safety and the safety of other people, please read through all safety warnings and operating instructions carefully and completely prior to commencing assembly.
- Keep the operating instructions safe and have them available.
- If you have not understood the safety instructions or the individual assembly guidelines or find them unclear, please contact your REHAU sales office.
- **Non-compliance with the safety information may lead to damage to property and personal injury.**

Use in line with the specification

The REHAU pipe systems must only be designed, installed and operated as described in this Technical Information or in the assembly instructions associated with the individual components. Any other use is not in accordance with the specification and is therefore not permitted.

Please contact your REHAU sales office for more detailed advice. Use in line with specification means compliance with all of the information in this Technical Information as well as the assembly, operating and maintenance instructions. No liability can be accepted for any use which is not in line with the specifications or inadmissible alterations to the product.



Observe all applicable national and international regulations relating to laying, installation, safety and the prevention of accidents when installing pipe systems, as well as the instructions in this Technical Information. Also observe the applicable laws, standards, guidelines and regulations (e.g. DIN, EN, ISO, DVGW, TRGI, VDE and VDI) as well as regulations on environmental protection, regulations of the Employer's Liability Insurance Association and specifications of the local public utilities companies. Please note the relevant status of the guidelines, standards and regulations in each case.

The design and assembly instructions relate directly to the REHAU product in each case. Some sections refer to generally applicable standards or regulations.

More detailed standards, specifications and guidelines relating to the design, installation and operation of drinking water and heating systems or systems for building services must also be observed and do not form part of this Technical Information.

Areas of application that are not included in this Technical Information (custom applications), require consultation with our technical applications department. Contact your REHAU sales office.



Prerequisites for personnel

- Our systems must only be assembled by authorised and trained persons.
- Work on electrical installations or pipework components must only be carried out by trained and authorised persons.

General precautions

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

Working clothing

- Wear protective goggles, suitable working clothes, safety shoes, a hard hat and a hairnet if you have long hair.
- Do not wear loosely fitting clothes or jewellery, these may get caught in moving parts.

During assembly

- Always read and follow the operating instructions for the REHAU assembly tool used.
- Incorrect handling of tools can cause serious cut injuries, crushing or removal of limbs.
- Incorrect handling of tools can damage connecting components or cause leaks.
- The REHAU pipe cutters have a sharp blade. Store and handle these in such a way that there is no risk of injury from the REHAU pipe cutters.
- When cutting the pipes to length, keep a safe distance between the hand holding the pipe and the cutting tool.
- Never put your hand in the tool's cutting zone or tool or on moving parts during the cutting process.
- Following the expansion process the expanded ends of the pipe return to their original shape (memory effect). Do not insert any foreign objects into the expanded ends of the pipe during this phase.
- Never put your hand into the compression zone of the tool or on moving parts during the cutting process.
- Until the compression process is complete, the fitting may still fall out of the pipe. Risk of injury!
- During maintenance or retooling work and when changing the assembly area, always unplug the tool and prevent it from being switched on accidentally.



Operating parameters

- If the operating parameters are exceeded, this leads to overstressing of the pipes and connections. Exceeding the operating parameters is therefore not permitted.
- Compliance with the operating parameters is to be ensured through safety and control systems (e.g. pressure reducer, safety valves and similar).

System-specific safety warnings

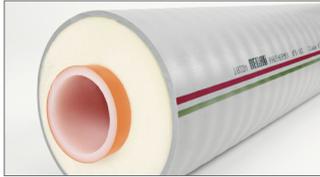
- Deburr or remove edges on insulating sleeves, in order to prevent possible injuries.
- When working with PUR foam cartridges (polyol and isocyanate components) the safety data sheets must be observed and chemical-resistant protective gloves and protective goggles worn at all times.
- When sawing or sanding foamed PUR a dust mask must be worn.
- When welding electrofusion couplers and foaming with a PUR foam cartridge the component heats up.
- When working with tension belts to fix the pipes there is a crushing risk. Stand clear of the hazardous areas.

2 INTRODUCTION

2.1 Scope

This Technical Information applies to the design, installation and use of the pre-insulated pipe systems RAUVITHERM and RAUTHERMEX.

This includes:



RAUTHERMEX pipes



RAUVITHERM pipes



Compression sleeve technology



Screw/clamping jointing technique
(Source: BEULCO)



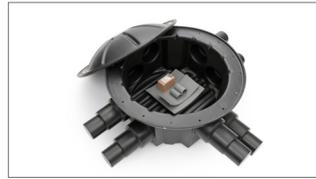
Clip shroud system



Heat-shrink shroud system



Foam cartridge for insulating shrouds



Custom accessories,
eg. district heating chamber



Solutions for house connections,
e.g. wall sealing flange

2.2 REHAU heat supply systems

In view of the increasing need for efficient and renewable energy supply, district heating technology is becoming ever more important. With the number of new supply networks being set up, the requirements for a flexible and efficient district heating pipe system are also increasing.

Pioneering technologies and combining optimum functionality with low energy losses form the basis for the pre-insulated pipe systems RAUVITHERM and RAUTHERMEX from REHAU.



2.3 Areas of application

The flexible pre-insulated pipe systems from REHAU are preferably used in:

- Local and district heating supply
- Drinking and hot water supply
- Swimming pool technology
- Cooling technology
- Industry and agriculture
- Connection of air-water-heat pumps
- Ground-source connecting pipes

Below are some project examples for different areas of application:

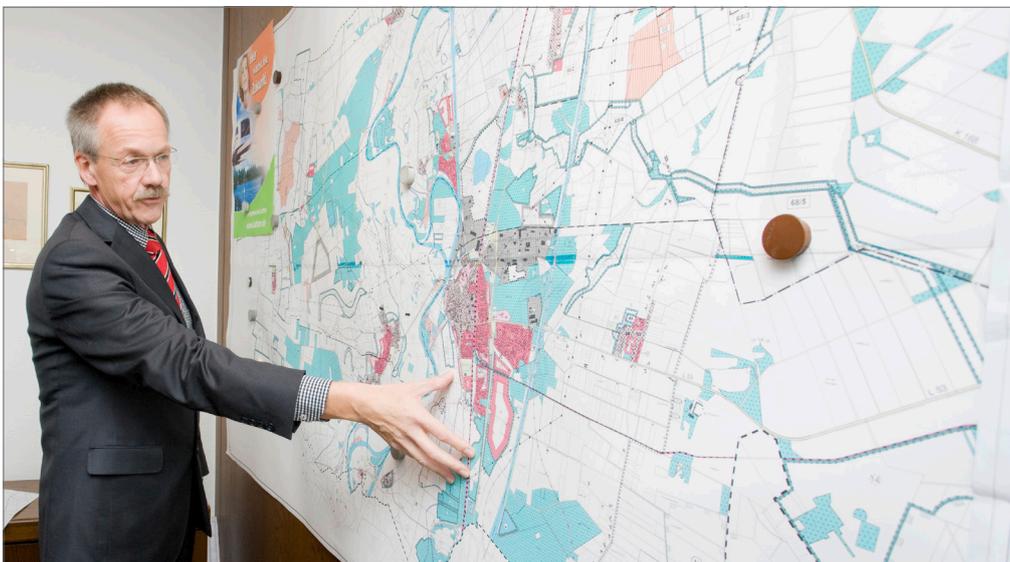


Plant manager Hans Schmid, Abensberg public utilities company, in front of his heating system, that supplies several communal premises with renewable heat.

Project:	Distribution network in Abensberg old town
Inhabitants:	Approx. 12,800
Operator:	Abensberg public utilities
Aim:	Reducing the heating costs for private and public buildings in the old town
Heat source:	Base load pellet boiler with 600 kW _{th} Peak load gas boiler with 460 kW _{th}
Commissioning:	2010
Adjoining buildings:	14 buildings incl. town hall, office for rural development, hotel as well as various residential buildings
Length of the heating network:	Approx. 700 m



The connected town hall in Abensberg.



Mayor Karl-Heinz Weber, joint community Lathen, in front of the heat infrastructure plan for his community.

Project:	Heating network joint community Lathen
Inhabitants:	Approx. 11,000
Operator:	Energy association Nahwärme Emstal eG
Aim:	Independent of oil through the supply of 100% of the communal premises and more than 50% of the private houses with local heat
Heat source:	Base load via several biogas combined heat and power Average load via a biomass CHP Peak load via a gas boiler
Commissioning:	2009 to 2013 (continuous development)
Adjoining buildings:	Training centre, primary school, outdoor swimming pool, church, fire station, town hall, nursery, credit union, as well as approx. 600 house connections
Length of the heating network:	> 60,000 m



Several biogas units serve as the heat source.



The supply from domestic renewable energies has been achieved in Schlatt with a connection rate of 90%.

Project:	Bio energy village Schlatt
Inhabitants:	Approx. 450
Operator:	Solarcomplex
Aim:	To cover the heat requirement of 90% of all of the
Heat source:	Base load biogas unit with 250 kW _{th} Peak load 2 chip-fired boilers each with 450 kW _{th}
Commissioning:	2009
Adjoining buildings:	90
Length of the heating network:	4,000 m



Biogas unit as the base load generator at the edge of the town of Schlatt.



Due to its flexibility and ease of assembly, those responsible for the "Sir Chris Hoy Velodrome" cycling track chose the RAUVITHERM pipe system to supply heat and cold.

Project:	"Sir Chris Hoy Velodrome" cycling track Glasgow
Spectator capacity:	4,500
Operator:	City of Glasgow
Aim:	Highly-flexible and time-saving achievement of heat and cold supply with the minimum number of connection points due to the pre-fabricated pipe lengths of up to 250 m
Heat source/cold source:	Gas combined heat and power unit
Commissioning:	2012
Adjoining parts of the building:	3
Length of the heat distribution:	1,000 m



Media main line mounted to the wall under the cycling track.

2.4 Solutions for heat supply

2.4.1 RAUVITHERM - The highly flexible solution

Thanks to several soft insulating foam layers and the corrugated, resistant outer jacket RAUVITHERM is a pipe system that is highly flexible and very robust at the same time. This also enables extremely complex connections in heating networks as well as connections under cramped space conditions.



Fig. 2-1 Non-bonded pipe system RAUVITHERM

System properties

- Fully bonded outer jacket to the top layer of insulation
- Profiled outer jacket ensures flexibility with low bending forces and small bending radii
- Robust, solid jacket suitable for construction sites
- High thermal insulation due to the multi-layer composition and low thermal conductivity of the insulating layers
- High operating safety thanks to the corrosion resistance of the materials
- Coil lengths of up to 300 m reduces the use of connecting sleeves
- Complete pipe and fittings product range:
 - UNO pipes (up to 125 mm pipe diameter)
 - Efficient DUO pipes (up to 2 x 63 mm pipe diameter)



Fig. 2-2 RAUVITHERM pre-insulated pipe

2.4.2 RAUTHERMEX - The highly efficient solution

The excellent thermal insulation properties of the polyurethane foam insulation and the corrugated outer jacket make RAUTHERMEX a pipe system that keeps losses during heat transport particularly low, without lacking a high degree of flexibility.



Fig. 2-3 RAUTHERMEX bonded pipe system

System properties

- Highest thermal insulation in its class due to the special process technology, fine-pored PU foam and additional insulation thickness (Plus dimension)
- Coil lengths of up to 570 m enable very long sections without joints
- No expansion bellows or compensators required during installation
- Durable due to the corrosion-free materials, watertight secondary insulation and fully bonded pipe system
- Complete pipe and fittings product range:
 - UNO pipes (up to 160 mm pipe diameter)
 - DUO pipes (up to 2 x 63 mm pipe diameter)



Fig. 2-4 RAUTHERMEX pre-insulated pipe

3 MATERIAL PROPERTIES

3.1 Carrier pipes

The water-bearing carrier pipe in RAUTHERMEX and RAUVITHERM is made from high pressure crosslinked polyethylene (PE-Xa). The carrier pipes are crosslinked via the addition of peroxide under high pressure and at a high temperature during manufacturing. During this process the macromolecules combine to form a three-dimensional, stable network.

PE-Xa pipes are produced to DIN 16892 / DIN 16893 and DIN EN ISO 15875 in the pressure levels SDR 11 or SDR 7.4 (in accordance with the DVGW Worksheet W 544, W 270 and BGA KTW).



The term “SDR” stands for “Standard Dimension Ratio” and describes the ratio of the external diameter to the wall thickness of the pipe, see Fig. 3-1. The SDR number therefore serves indirectly to determine the pressure resistance. The smaller the SDR number, the thicker the walls of, and the more pressure-resistant the pipe.

SDR 11 demonstrates a high pressure resistance.

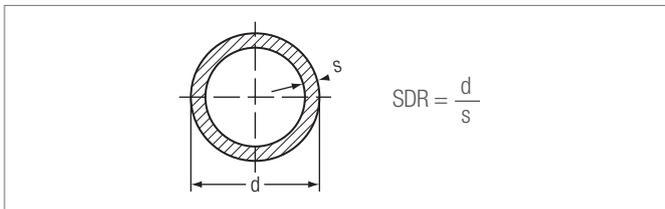


Fig. 3-1 SDR

- d* External diameter [mm]
- s* Wall thickness [mm]

Technical data carrier pipe

Description	Value	Standard
Density ρ	0.94 g/cm ³	ISO 1183
Average thermal coefficient of linear expansion (0 °C - 70 °C)	$1.5 \cdot 10^{-4}$ /K	–
Thermal conductivity λ	0.35 W/m·K	Based on ASTM C 1113
Modulus of elasticity E at 20 °C	600 N/mm ²	ISO 527
Modulus of elasticity E at 80 °C	200 N/mm ²	ISO 527
Surface resistance	10^{12} Ω	–
Building material class	B2 (normal flammability)	DIN 4102
Surface friction coefficient k	0.007 mm	–
Oxygen impermeability at 40 °C	0.16 mg/(m ³ ·d)	DIN 4726
at 80 °C	1.8 mg/(m ³ ·d)	

Tab. 3-1 Material properties PE-Xa carrier pipe



- Very high chemical resistance (DIN 8075 Supplementary sheet 1)
- Very low roughness ($k = 0.007$ mm)
- Permanently low pressure loss
- Long-term corrosion resistance
- High shape retention
- High temperature resistance, in the event of malfunctioning energy source control system
- High pressure resistance
- Robust and flexible at the same time
- Excellent resistance to point loads

3.1.1 Carrier pipe SDR 11

The PE-Xa carrier pipes SDR 11 are predominantly used for the transport of recirculated water in the area of heating and cooling. For this reason, they have an additional oxygen diffusion barrier made of EVOH to DIN 4726. The colour of these pipes is orange.



Fig. 3-2 Carrier pipes SDR 11

Pressure and temperature resistance

The following temperature and pressure limits apply to DIN 16892 and DIN 16893 at continuous temperatures for carrier pipes SDR 11. (Application: water; safety factor 1.25)

Temperature [C]	Max. pressure [bar]	Minimum service life [years]
40	11.9	50
50	10.6	50
60	9.5	50
70	8.5	50
80	7.6	25
90	6.9	15
95	6.6	10

Tab. 3-2 Pressure and temperature resistance SDR 11

In the case of varying pressures and temperatures the expected service life can be calculated according to the DIN 13760 "Miner's rule" (see section 6.6. on Page 51).

Application temperatures

- Permanent operating temperature maximum 85 °C
- Heating medium temperature maximum 95 °C (sliding)
- Short-term excess temperature up to 110 °C (failure)

3.1.2 Continuous quality inspection

REHAU is ISO 9001 certified and the quality of the carrier pipes is tested continuously by in-house accredited laboratories as well as external institutes.



Fig. 3-3 Point load test



Fig. 3-4 Tensile test



Fig. 3-5 Burst pressure test

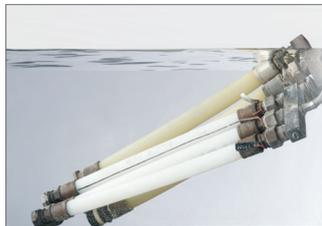


Fig. 3-6 Pressure test



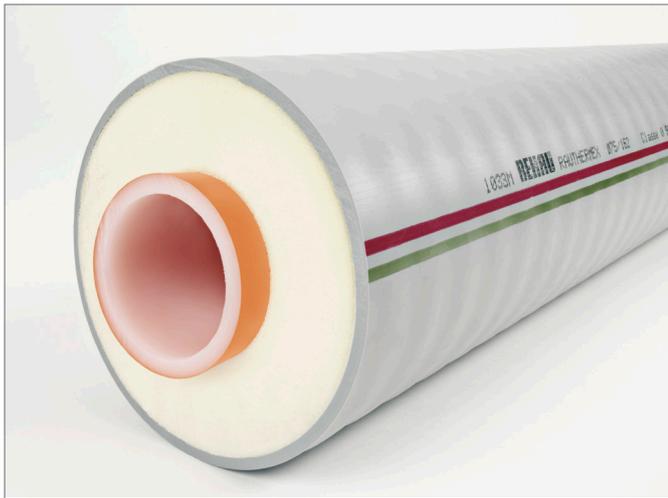


Fig 3-7 RAUTHERMEX composite pipe

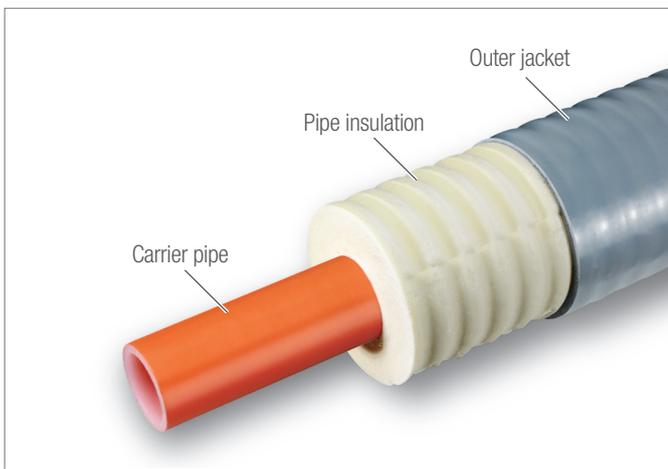


Fig 3-8 RAUTHERMEX pipe main components

3.2.1 Pipe insulation

The insulation of the RAUTHERMEX pipes in SDR 11 consists of pentane-blown PU foam. For coiled bundles the insulation is continuous, for cut lengths and custom components intermittent. The PU foam is therefore free from CFCs and HCFCs.



- Very fine-pored insulating foam structure
- Closed-cell factor $\geq 90\%$
- High water vapour transfer coefficient

Technical data pipe insulation

Properties	Blowing agent pentane	Standard
Thermal conductivity $\lambda_{50, initial}$	W/m·K $\leq 0,0216$ (0,0260 for rigid systems)	EN 15632
GWP (greenhouse potential)	0,5	
ODP (ozone depletion potential)	0	
Density ρ	kg/m ³ > 50	EN 253
Compression strength	MPa 0,2	
Water absorption	% ≤ 10	EN 15632-1
Axial shear strength	kPa ≥ 90	EN 15632-2
Building material class	B2 (normal flammability)	DIN 4102

Tab. 3-3 Properties RAUTHERMEX pipe insulation

3.2.2 Outer jacket

RAUTHERMEX pipes have a corrugated outer jacket. The corrugation improves the structural properties, increases the flexibility and enables low bending radii. To increase the flexibility the outer jacket of the RAUTHERMEX pipes are made from the flexible material PE-LLD.



- Very good bond with the PU foam
- Extruded seamlessly around the PU foam

Technical data outer jacket

Description	Value	Standard
Thermal conductivity λ	0,33 W/m·K	DIN 52612
Crystallite melting range	122 °C	ISO 11357-3
Density ρ	0,92 g/cm ³	ISO 1183
Modulus of elasticity E	325 N/mm ²	–
Building material class	B2 (normal flammability)	DIN 4102

Tab. 3-4 Properties RAUTHERMEX outer jacket

3.2.3 Dimensions

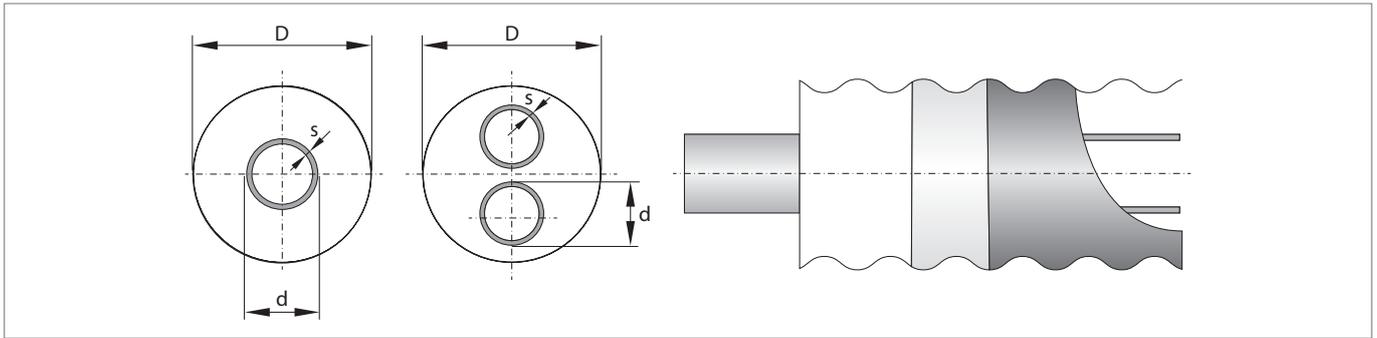


Fig. 3-9 RAUTHERMEX section

Size	d [mm]	s [mm]	D ²⁾ [mm]	Volume inner pipe [l/m]	Weight empty [kg/m]	max. coil length		U-Value [W/m·K]
						2.8 m x 0.8 m [m]	2.8 m x 1.2 m [m]	
UNO 25/91	25	2.3	93	0.327	1.28	370	570	0.099
UNO 32/91	32	2.9	93	0.539	1.38	370	570	0.121
UNO 40/91	40	3.7	93	0.835	1.48	370	570	0.151
UNO 50/111	50	4.6	113	1.307	2.11	275	400	0.155
UNO 63/126	63	5.8	128	2.075	2.86	195	305	0.177
UNO 75/162	75	6.8	164	2.961	4.37	95	150	0.162
UNO 90/162	90	8.2	164	4.254	5.02	95	150	0.206
UNO 110/162	110	10	164	6.362	5.78	95	150	0.296
UNO 125/182	125	11.4	185	8.203	7.20	52	86	0.303
UNO 140/202	140	12.7	202	10.315	8.38	46	75	0.308
UNO 160/250	160	14.6	257	13.437	14.17	12 m lengths	–	0.303
DUO 25 + 25/111	25	2.3	113	2 x 0.327	1.85	275	400	0.139
DUO 32 + 32/111	32	2.9	113	2 x 0.539	2.11	275	400	0.183
DUO 40 + 40/126	40	3.7	128	2 x 0.835	2.75	195	305	0.211
DUO 50 + 50/162	50	4.6	164	2 x 1.307	4.25	95	150	0.195
DUO 63 + 63/182	63	5.8	185	2 x 2.075	5.45	52	86	0.238

Tab. 3-5 Dimensions RAUTHERMEX, SDR 11

¹⁾ maximum diameter at the peak

Size	d ₁ [mm]	s ₁ [mm]	D ¹⁾ [mm]	Volume inner pipe [l/m]	Weight empty [kg/m]	max. coil length		U-Value [W/m·K]
						2.8 m x 0.8 m [m]	2.8 m x 1.2 m [m]	
UNO 32/111	32	2.9	113	0.539	1.69	275	400	0.103
UNO 40/126	40	3.7	128	0.835	2.18	195	305	0.111
UNO 50/126	50	4.6	128	1.307	2.64	195	305	0.136
UNO 63/142	63	5.8	144	2.075	3.49	140	225	0.154
UNO 90/182	90	8.2	185	4.254	5.61	52	86	0.175
UNO 110/182	110	10	185	6.362	6.64	52	86	0.236
DUO 32 + 32/126	32	2.9	128	2 x 0.539	2.50	195	305	0.157
DUO 40 + 40/142	40	3.7	144	2 x 0.835	3.32	140	225	0.174
DUO 50 + 50/182	50	4.6	185	2 x 1.307	4.90	52	86	0.166
DUO 63 + 63/202	63	5.8	206	2 x 2.075	5.90	46	75	0.208

Tab. 3-6 Dimensions RAUTHERMEX Plus, SDR 11

¹⁾ maximum diameter at the peak



Fig. 3-10 RAUVITHERM pipe

The insulation of the RAUVITHERM pipe SDR 11 consists of crosslinked PEX foam sheets and, for DUO pipes, additionally a foamed PE moulding (bone).



- Very fine-pored insulating foam structure
- Closed-cell factor $\geq 99\%$
- High water vapour transfer coefficient

Technical data pipe insulation

Description	Value	Standard
Thermal conductivity $\lambda_{50, initial}$	$\leq 0,043 - 0,044$ W/m-K	EN 15632
Density ρ insulating foam	≥ 30 kg/m ³	DIN 53420
Density ρ bone	≤ 45 kg/m ³	–
Compression load deflection	0,073 N/mm ²	DIN 53577
Water absorption	$\leq 1\%$ Vol	DIN 53428
Long-term temperature resistance	≥ 95 °C	–

Tab. 3-7 Properties RAUVITHERM pipe insulation

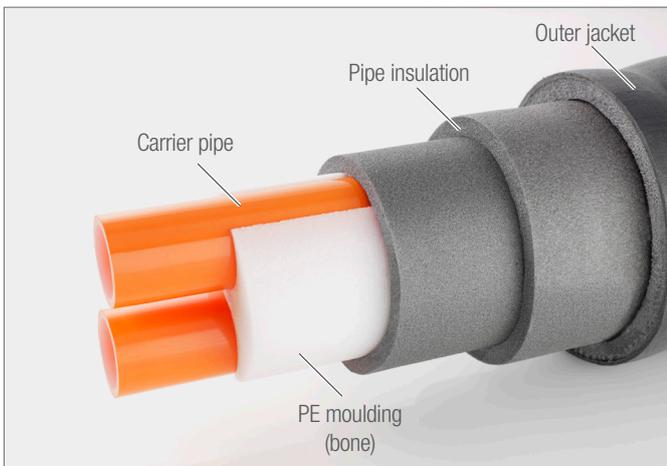


Fig. 3-11 RAUVITHERM pipe main components

3.3.2 Outer jacket

The RAUVITHERM pipes have a corrugated outer jacket. The corrugation of the outer jacket improves the structural properties and the flexibility of the pipe.



- Extruded seamlessly around the PEX foam
- Highly robust, wall thickness
- Fully bonded to DIN 15632-2

Technical data outer jacket

Description	Value	Standard
Thermal conductivity λ	0,09 W/m-K	DIN 52612
Crystallite melting range	125 °C	ISO 11357-3
Density ρ	0,65 g/cm ³	ISO 1183
Modulus of elasticity E	150 N/mm ²	–
Building material class	B2 (normal flammability)	DIN 4102

Tab. 3-8 Properties RAUVITHERM outer jacket

3.3.3 Dimensions

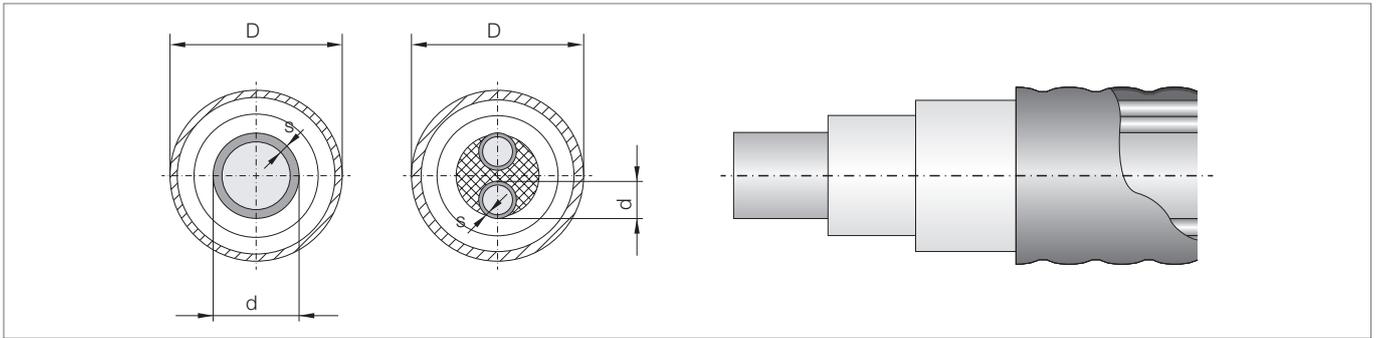


Fig. 3-12 RAUVITHERM section

Size	d	s	D	Volume inner pipe	Weight empty	Wall thickness outer layer	max. coil length 3 m x 1.2 m	U-Value
	[mm]	[mm]	[mm]	[l/m]	[kg/m]	[mm]	[m]	[W/m·K]
UNO 25/120	25	2.3	113	0.327	0.98	2	290	0.16
UNO 32/120	32	2.9	114	0.539	1.07	2	290	0.19
UNO 40/120	40	3.7	116	0.835	1.22	2	290	0.22
UNO 50/150	50	4.6	144	1.307	1.75	2	230	0.23
UNO 63/150	63	5.8	145	2.075	2.08	2	230	0.28
UNO 75/175	75	6.8	170	2.961	2.99	2	130	0.28
UNO 90/175	90	8.2	175	4.254	3.64	2.5	130	0.34
UNO 110/190	110	10	187	6.362	4.60	2.5	100	0.41
UNO 125/210	125	11.4	209	8.203	6.10	3	80	0.42
DUO 25 + 25/150	25	2.3	144	2 x 0.327	1.66	2	230	0.25
DUO 32 + 32/150	32	2.9	146	2 x 0.539	1.87	2	230	0.26
DUO 40 + 40/150	40	3.7	148	2 x 0.835	2.24	2	175	0.32
DUO 50 + 50/175	50	4.6	177	2 x 1.307	3.31	2.5	130	0.34
DUO 63 + 63/210	63	5.8	208	2 x 2.075	4.77	3	90	0.38

Tab. 3-9 Dimensions RAUVITHERM SDR 11

4 JOINTING TECHNIQUE AND SECONDARY INSULATION

4.1 Compression sleeve jointing technique



Fig. 4-1 Compression sleeve connection

The compression sleeve jointing technique is a patented method developed by REHAU for the rapid, safe and permanently leaktight connection of PE-Xa pipes. It consists simply of a fitting and the compression sleeve. Additional sealing elements are not required, as the pipe itself acts as a seal. Four sealing ribs guarantee a completely secure connection, which also withstands the tough application conditions on construction sites. Specially designed ribs on the compression sleeves prevent the connection coming loose during operation.

The fittings are made from brass, red brass or steel. The compression sleeves are made from brass or red brass.



- Non-detachable connection on the construction site to AGFW FW420 that can be checked visually
- Practically no cross-section reduction, as carrier pipes are expanded to make the connection. Pressure loss negligible as a result
- Quick and safe assembly
- Can be pressurised immediately, no „tightening up“ required
- Works under any weather conditions
- No additional sealing elements, e.g. O rings, hemp, etc. required



Application options:

- Pressure level SDR 11 for the dimensions 25-160 mm

All of the fittings dimensions are listed in the current price list.

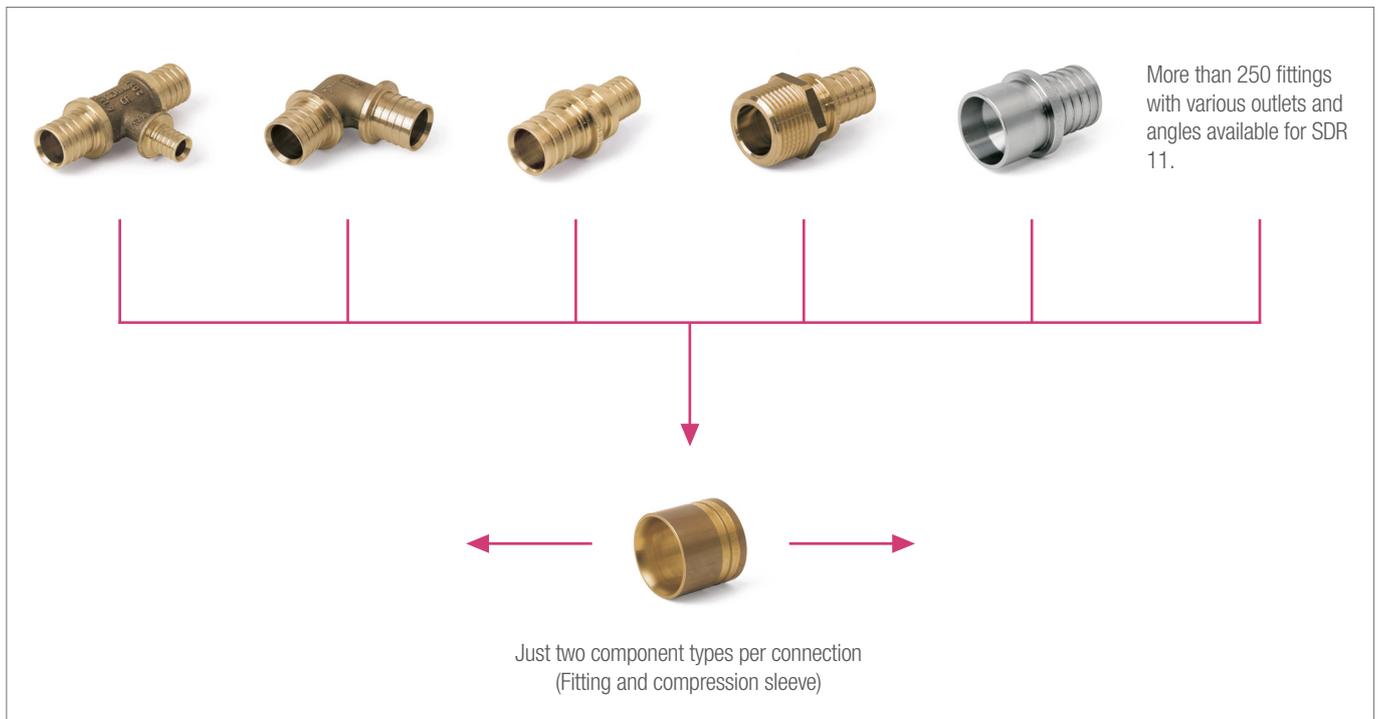


Fig. 4-2 Compression sleeve-connection combinations

RAUTOOL tools

The RAUTOOL tools from REHAU are available for processing the REHAU compression sleeve technology. Depending on the area of application manual, hydraulic or electrohydraulic designs are used:

RAUTOOL M1 – manual

Manual tool with double jaw for 2 dimensions in each case (Fig. 4-3)
Area of application: Dimensions 20 – 40
The compression jaws M1 are to be used exclusively with the RAUTOOL M1.

RAUTOOL H2 – mechanical hydraulic

Tool with foot pump and hydraulic hose
Area of application: Dimensions 20 – 40

RAUTOOL A light2 – Battery hydraulic

Tool with battery-operated hydraulic unit
Area of application: Dimensions 20 – 40

RAUTOOL A3 – Battery hydraulic

Tool with battery-operated hydraulic unit (Fig. 4-4)
Area of application: Dimensions 20 – 40

RAUTOOL H/G1 – mechanical hydraulic

Tool with foot pump and hydraulic hose
Area of application: Dimensions 50 – 63
Can be expanded up to Dimension 40 as well as Dimension 110 with the appropriate expansion set

RAUTOOL G2 – Electro/battery hydraulic

Tool with hydraulic unit including Li-Ion battery and hydraulic hose (Fig. 4-5)
Area of application: Dimensions 50 – 63
Can be expanded up to Dimension 40 as well as Dimension 110 with the appropriate expansion set

RAUTOOL G1 125-160 – electrohydraulic

The compression jaws are powered by two parallel cylinders (Fig. 4-6)
Area of application: Dimensions 125 – 160



Fig. 4-3 RAUTOOL M1



Fig. 4-4 RAUTOOL A3



Fig. 4-5 RAUTOOL G2



Fig. 4-6 RAUTOOL G1 125-160

4.2 Screw jointing technique



Fig. 4-7 Screw connections (Source: BEULCO)

Screw connections for PE-Xa carrier pipes are connection systems that are easy to handle in the dimensions d 25 to d 110. This compression technology consists of a few individual components and can be fitted without special tools.

The screw systems must be suitable for absorbing the pipe reaction forces that occur (e.g. due to thermal expansion) and be able to withstand these permanently. See Section 5.6 on Page 34.



Screw connections must only be used at the accessible connection points of heating pipes. Usually this concerns the transitions into the house connection area.

In heating pipe sections in underground networks the connections of PE-Xa carrier pipes must be carried out using compression sleeve technology in order to create permanently leaktight and non-detachable connections to AGFW FW 420.

Only screw systems that have been approved by the respective manufacturer for the specific application case must be used with the suitable assembly tool. The respective assembly instructions must be observed.



- Assembly possible without a special tool
- Detachable jointing technology for fitting connections
- Temperature-resistant from -40 °C to $+95\text{ °C}$
- Dimension range 20 – 110
- Suitable for SDR 11

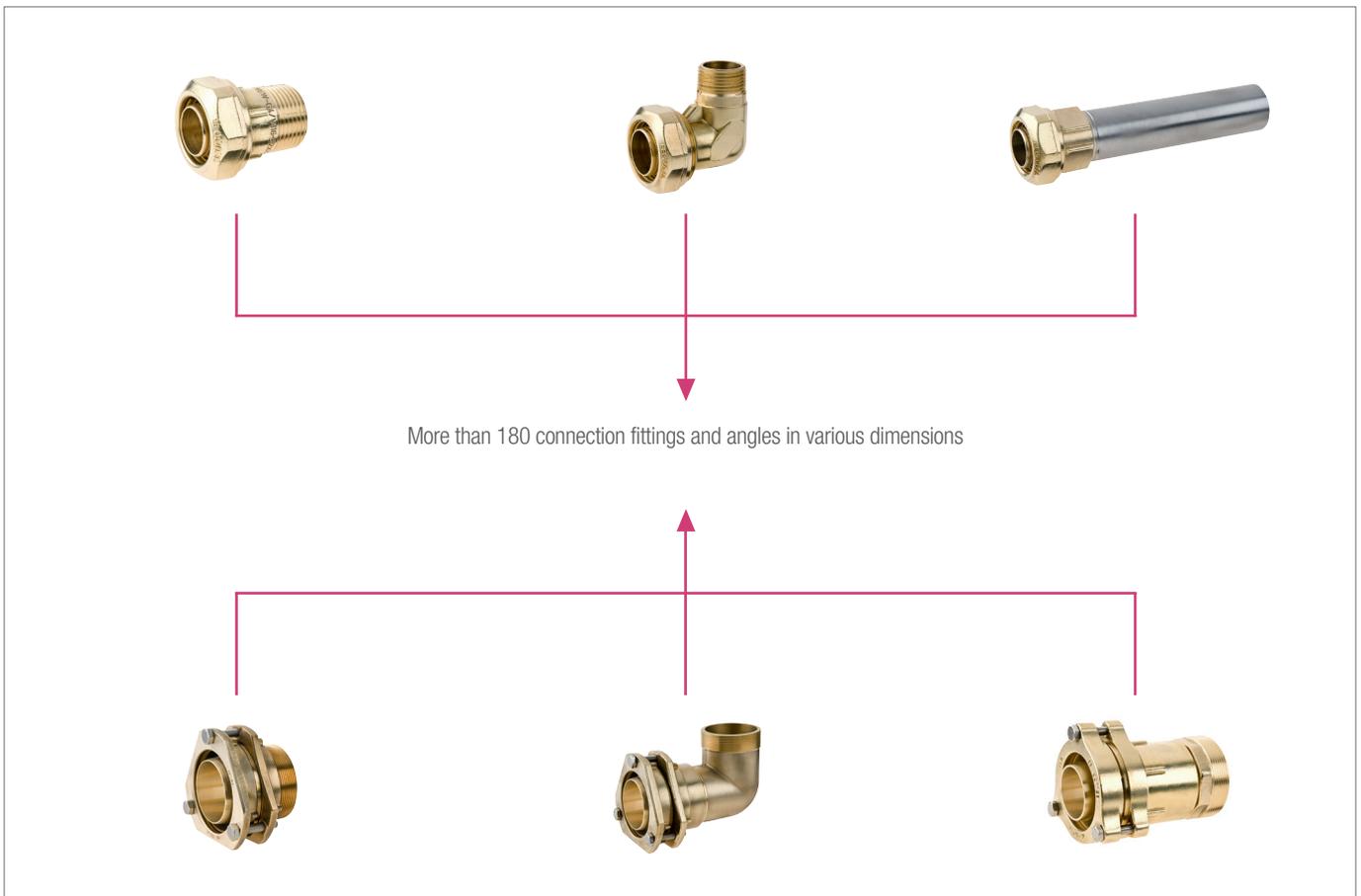


Fig. 4-8 Screw/clamping connection options (Source individual images: BEULCO)

Tool for screw/clamping connections

A special tool is not required to fit screw fittings. The manufacturer's information regarding the assembly tool must however be observed.



Fig. 4-9 Assembly tool

Fitting screw connections

Screw connections are a detachable connection technology with regard to the system. In order to ensure a secure connection of heated carrier pipes with screw connections, the assembly guidelines of the screw/clamp connection manufacturer must be observed.

When used for hot water or space heating, once the screw connections have been created, the heating pipes must be heated to a temperature of 60 - 80 °C and then all of the connections tightened.

During subsequent operation these connections must be checked regularly and tightened again where necessary.

For this reason connections must only be created at accessible places that can be inspected..

Example application of screw connections in combination with preinsulated pipe systems



Fig. 4-10 Heat pump connection

4.3 Clip shroud system



Fig. 4-11 Clip shroud in T, I and L shape

Connecting points in the ground, for example couplers or T-pieces, are to be insulated and sealed to an insulation quality equivalent to that of the pipes.

The clip shrouds specially developed for **RAUTHERMEX** comprises two support channels that are placed over the carrier pipe connection and simply pressed together with tightening clips in accordance with the toggle lever principle. The seal between the shroud and the pipe is carried out by means of an innovative sealing ring concept. Track grooves ensure the correct position of the shroud. Combined sealing and vent plugs additionally ensure rapid and simple installation.

For secondary insulation high-quality two-component PU foam is used in the shrouds (see Section 4.5 on Page 22).



- Efficient and safe insulation of branches and connections to underground-RAUTHERMEX heating pipes
- Installation without tools
- Simple positioning of the support channels via track grooves
- Quick adjustment to pipe dimensions thanks to flexible sealing ring system
- Outer ribbing guarantees stability even in the event of large static loads
- Injection moulded support channels made from high-quality ABS plastic

The clip shrouds (see Fig. 4-11) are available as T, I and L mouldings in two sizes in each case.

Material properties ABS

Yield stress	40 MPa
Tensile modulus	2200 MPa
Ultimate elongation	>15 %
Heat distortion temperature 1,8 Mpa	94 °C
Flammability (UL 94; 1.6 mm)	HB

Tab. 4-1 Material properties ABS



Fig. 4-12 Sealing rings for the clip shroud system

To seal the clip shrouds, an innovative sealing ring concept made from EPDM (ethylene-propylene diene monomer rubber) is used, which enables adjustment to the various pipe jacket diameters. For the three pipe outlets, an appropriately sized sealing ring is used in each case.

Material properties EPDM

Shore hardness A	35 ± 5 Shore
Density	1.16 ± 0.02 g/cm ³
Tensile strength	8 MPa
Elongation at break	600 %
Compression set 22h at 70 °C	0.18
Compression set 22h at 100 °C	0.5

Tab. 4-2 Material properties EPDM



Fig. 4-13 Clip shroud connection

4.4 Heat-shrink shroud system



Fig. 4-14 Heat-shrink shrouds in T, I and L shape

The universal heat-shrink shrouds ensure the secondary insulation of connections, branches and direction changes of pipe systems **RAUVITHERM** and **RAUTHERMEX**.

The shrouds are made of extremely robust and impact-resistant PE-HD. In addition to this, a sanding belt, temperature indicator strips and a Forstner bit are available as accessories for fitting the shrouds correctly.



- Simple and safe sealing due to the tried and tested heat-shrink technology
- No increased heat loss
- Robust components suitable for construction sites
- Area of application includes RAUVITHERM, RAUTHERMEX as well as various pipe combinations and connections to other manufacturer's systems
- Can be used flexibly on the construction site

The heat-shrinkable shrouds (see Fig. 4-14) are available as T, I and L mouldings in two sizes in each case.

Material properties shroud shells (PE-HD)

Thermal conductivity λ	0.43 W/m-K
Crystallite melting range	105 – 110 °C
Density ρ	0.93 N/mm ²
Modulus of elasticity E	600 N/mm ²
Building material class (DIN 4102)	B2 (normal flammability)

Tab. 4-3 Properties of coupling system PE-HD



Fig. 4-15 T-shroud set

Heat-shrink sleeve for shroud set

The heat-shrink sleeving is coated inside with a hot melt adhesive to seal the sleeve to the RAUVITHERM and RAUTHERMEX pipe.

Material properties of heat-shrink sleeve

Tensile strength	14 MPa
Max. expansion	300 %
Density ρ	1.1 g/cm ³
Water absorption	< 0.1 %
Adhesive softening temperature	80 – 90 °C
Building material class (DIN 4102)	B2 (normal flammability)

Tab. 4-4 Material properties heat-shrinkable shroud

REHAU heat-shrinkable shrouds can be used universally. They can be used for connecting RAUVITHERM and RAUTHERMEX pipes as well as for combinations with various other pipe systems or custom components..



Fig. 4-16 Fitting the T-heat shrinkable shroud

4.5 Foam cartridge for secondary insulation



Fig. 4-17 REHAU shroud foam set

The insulation of the REHAU shroud is made from two-component PU foam. The foam is supplied with the set and comprises:

- Foam flange components A + B
- Filler attachment
- Installation instructions



Prior to using the foam products you must read the enclosed safety data sheets and assembly instructions carefully. During assembly the appropriate personal protective equipment is to be worn.

Technical data for component A, colour brown

Flashpoint	> 200 °C
Vapour pressure (20 °C)	1 hPa
Density ρ (20 °C)	1.23 g/cm ³

Tab. 4-5 Technical data for foam component A

Technical data for component B, colour yellowish

Flammpunkt	-5 °C
Dampfdruck (20 °C)	345 hPa
Dichte ρ (20 °C)	1.06 g/cm ³

Tab. 4-6 Technical data for foam component B

Technical data for foam at 20 °C

Mix ratio for weight (A : B)	146 : 100
Mix ratio for volume (A : B)	130 : 100
Start time	54 s
Thread time	335 s
Pipe density (unrestricted foaming)	43 kg/m ³
Pipe density (core)	> 60 kg/m ³
Closed-cell factor	> 88 %

Tab. 4-7 Technical data PU-foam at 20 °C

Foam processing time

Temperature	Mixing/Shaking time	Processing time
25 °C	20 s	30 s
20 °C	25 s	40 s
15 °C	40 s	50 s

Tab. 4-8 Processing time for shroud foam



Fig. 4-18 Shroud filling process



- In order to avoid a burst risk and achieve proper foaming of the shroud:
- Ensure that the temperature of the foam components is between 15° and 25 °C during processing. If necessary the foam components must be brought up to temperature beforehand.
 - Observe the shaking and processing times in accordance with Tab. 4-8.

4.6 Custom accessories

4.6.1 District heating chamber



Fig. 4-19 District heating chamber

The REHAU district heating chamber enables a variety of installation options for fittings as well as branches in heating networks with the RAUVITHERM and/or RAUTHERMEX pipe systems.

Application options:

- Alternative to local accumulations of branches, e.g. T-shrouds
- Installation option for fittings, e.g. shutting off, filling, ventilating, etc.
- Direct connection of two UNO pipes (d 50 – d 110) with DUO branch line (for d 25 – d 40 only with RAUTOOL M1 to A3)
- Blind ends for simple subsequent expansion of the network



- Very robust design using the material PE-HD
- Easy to install due to large opening
- Easy pipe connection due to offset connecting sockets
- Watertight complete system due to integrated cover seal
- Eight connecting sockets all the way around for versatile and flexible connection options

Pipe connection options

The district heating chamber is generally suitable for pipes up to max. 185 mm external diameter. The pipe inlets in the district heating chamber are sealed using heat-shrinkable shrouds.



RAUTHERMEX UNO 140 and UNO 160 pipes cannot be connected. For RAUVITHERM DUO 63 and UNO 125 it is to be noted that the outer foam layer must be removed in the area of the pipe inlet.

Connection technology in the district heating chamber



Fig. 4-20 Example pipe connection variants in the district heating chamber

When selecting the components or pipe connections the space required for the connection technology must be checked individually.



The maximum clear internal dimension of the chamber is 770 mm. When selecting the connection combinations the additional working space required for using the tool is to be taken into account.

For special installation situations pre-fabricated custom fittings can be obtained. Different secondary insulation options for internal components are possible on the construction site, but are not essential.

Installation diagram

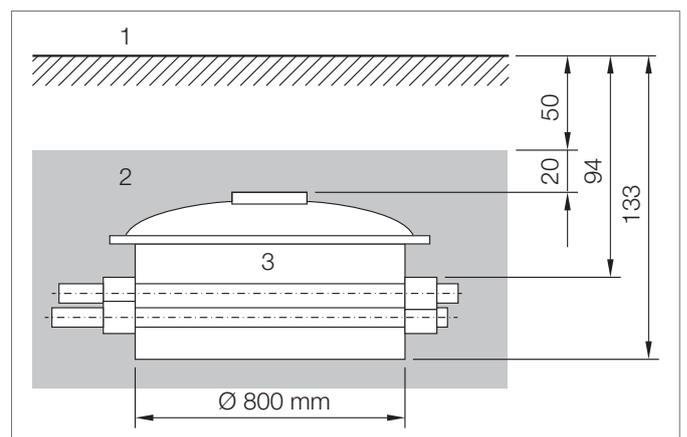


Fig. 4-21 Installation diagram district heating chamber (dimensions in cm, if not otherwise specified)

- 1 Ground level
- 2 Compacted sand
- 3 District heating chamber



If the chamber is installed under traffic loads a load distribution plate must additionally be provided above the chamber, see assembly instructions. The maximum surface load must not exceed $q = 33.3 \text{ kN/m}^2$. (SWL 60 to DIN 1055).

4.6.2 Y-pipe

The pre-fabricated Y-pipe component is used as a transition from two UNO pipes to one DUO pipe.

The Y-pipe is available for the dimensions 25 to 63 mm and can be used for both RAUVITHERM and RAUTHERMEX.

Properties:

- Carrier pipe made from crosslinked polyethylene (PE-Xa) to DIN 16892/93 and an oxygen diffusion barrier to DIN 4726
- Insulation made from CFC-free, pentane-blown hard foam
- Smooth pipe jacket made from PE-HD, colour black
- Bends produced by butt welding

Assembly information

The connection of the Y-pipe to the carrier pipes generally takes place using the compression sleeve technology.

The connection of the outer jacket can either be carried out with the REHAU clip shroud system or heat-shrink shroud system. For easier assembly and subsequent backfilling of the pipe trench it is recommended to install Y-pipes with spacing of ≥ 2 m at the necessary points (e.g. T branches).



In order to ensure proper backfilling and compacting, the Y-pipe is to be installed largely horizontally.

The allocation of the flow and return must be checked prior to installation and observed during installation.

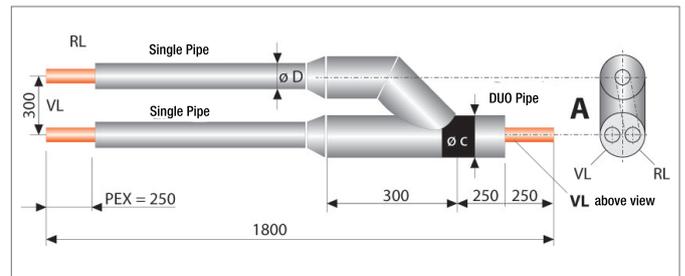


Fig. 4-22 Dimensions Y-pipe



Fig. 4-23 Y-pipe installation in practise

Installation example

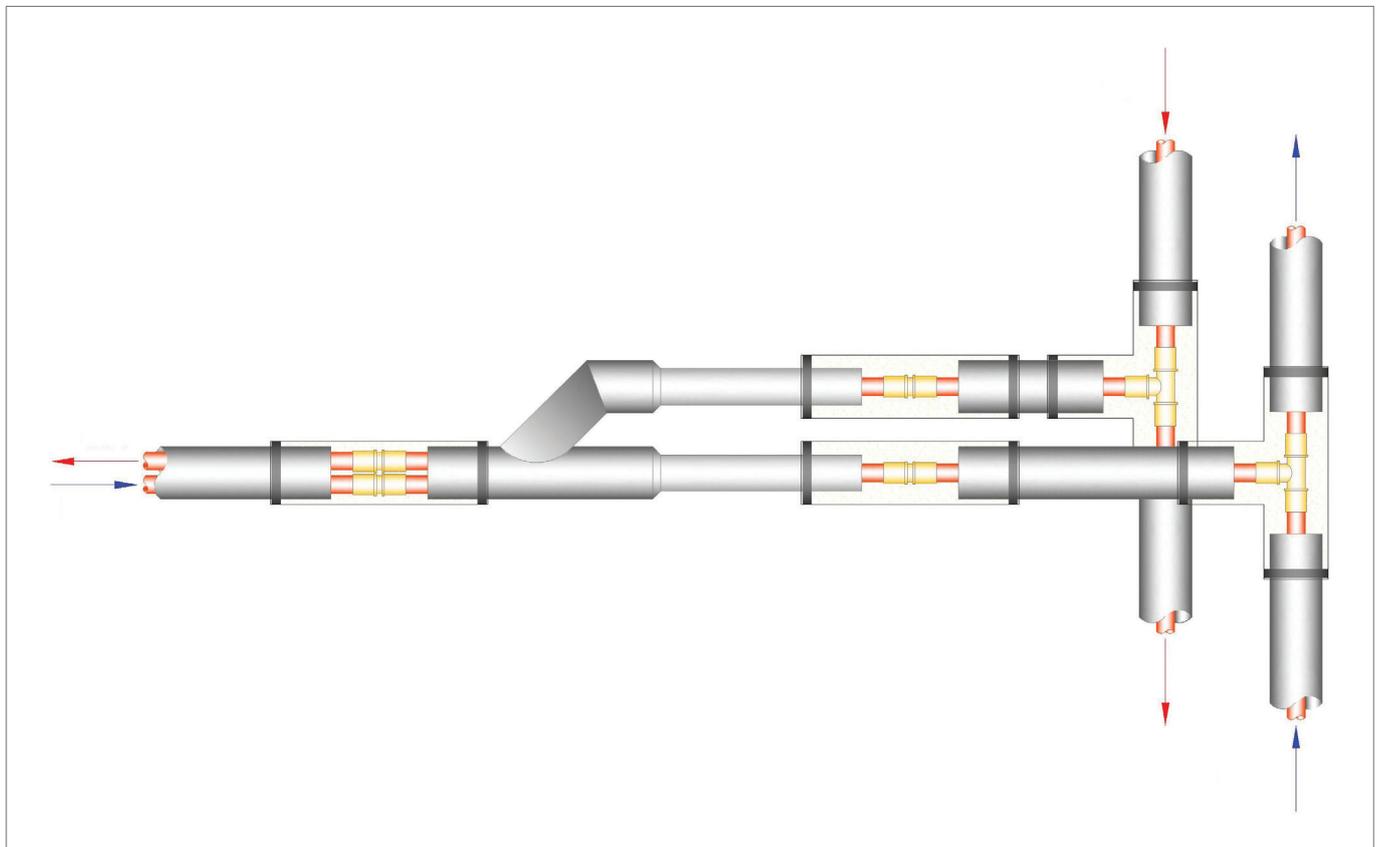


Fig. 4-24 Installation diagram/components for a branch with Y-pipe connection (top view)

4.6.3 Pre-insulated isolation valve



Fig. 4-25 UNO pre-insulated isolation valve with spindle extension and key

The pre-insulated, very compact REHAU pre-insulated isolation valves with ball valve have a hexagonal connection for a spindle extension (1 m) and a hexagonal key.

Compression sleeve adapters are installed in the factory for the connection with RAUVITHERM or RAUTHERMEX (SDR 11 in each case). The required compression sleeves are included in the scope of supply.



The connection to pipes take place using I shrouds or reducing sleeves. When doing this the external diameter of the pipe jacket according to Tab. 4-10 must be observed.

Materials

Pre-insulated isolation valve	Steel St 37
Insulating material	PU-foam
Over jacket	PE-HD, smooth

Tab. 4-9 Isolation valve materials

Assembly and installation information

For DUO pre-insulated isolation valves the position of the carrier pipes is not vertical and must be aligned above the pipe lines. For easy assembly spacing of ≥ 3 m at the necessary points must be observed.



To retain the function in the long-term the valve must be exercised fully at least once every 6 months.

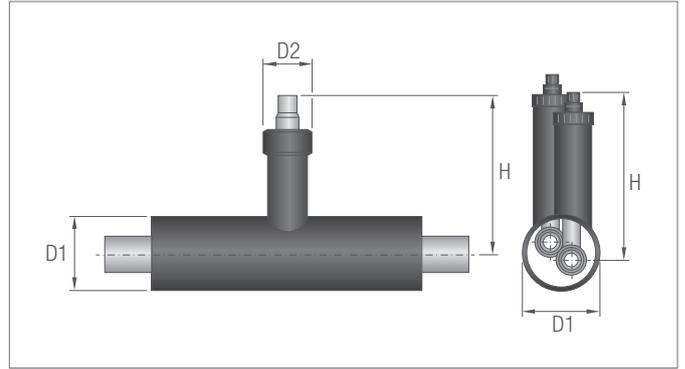


Fig. 4-26 Sketch UNO/DUO pre-insulated isolation valve

Dimension Fitting	Ø D1 Pipe Jacket [mm]	Height H [mm]	Ø D2 [mm]	SW Hexagonal [mm]
UNO 25	110	475	110	19
UNO 32	110	480	110	19
UNO 40	125	485	110	19
UNO 50	125	495	110	19
UNO 63	140	500	110	19
UNO 75	160	505	110	19
UNO 90	180	515	110	19
UNO 110	225	525	125	27
UNO 125	250	545	125	27
DUO 25	140	475	110	19
DUO 32	140	480	110	19
DUO 40	160	485	110	19
DUO 50	182	495	110	19
DUO 63	225	500	110	19

Tab. 4-10 Dimensions pre-insulated isolation valves

Installation diagram pre-insulated isolation valve

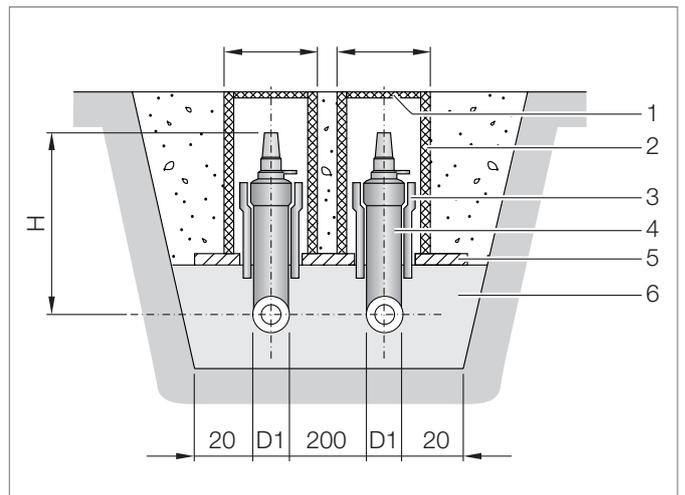


Fig. 4-27 Installation diagram pre-insulated isolation valve (dimensions in cm)

- 1 Cast lid, can be driven over (construction site)
- 2 Concrete pipe (construction site)
- 3 Expansion bellow (construction site)
- 4 Pre-insulated isolation valve
- 5 Supporting plate (construction site)
- 6 Sand filler, grain size 0 – 8 mm

4.6.4 Pre-insulated T-branches 125 –160 (steel)

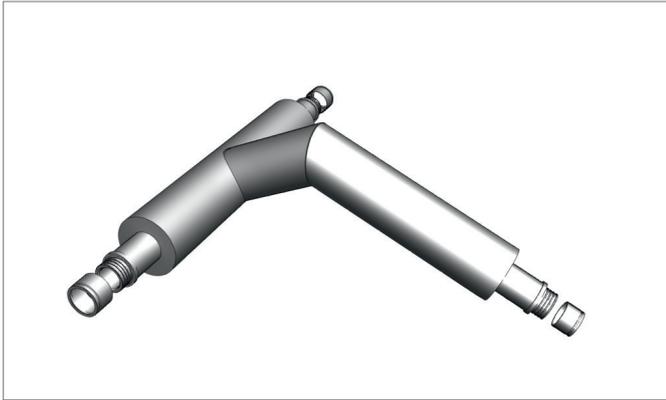


Fig. 4-28 Pre-insulated T-branch

The pre-insulated SDR 11 steel T-pieces from REHAU including compression sleeves are available in two designs:

- Outlet angled 45° (see Fig. 4-28)
- Outlet straight

The connecting fittings are pre-assembled in the factory and the compression sleeves are included in the scope of supply.

The outlet can be fabricated on request according to the dimension d 25 – d 160 required. The connecting passage is also available in the variants 125, 140 and 160.

Materials

T-piece	Steel St 37
Insulating material	PU-foam
Outer Jacket	PE-HD, smooth
Compression sleeve d. 25-63	Brass
Compression sleeve d. 75-160	Red brass Rg 7

Tab. 4-10 Materials pre-insulated T-piece



The connection to pipes is created using I-heat-shrinkable shrouds (d 25 – d 140) or using a custom dimension connection sleeve set (d 160).

The branch dimensions available on request can be found in Tab. 4-11.

Combination options pre-insulated T-branch

Dimension Branch	Any clearance		
	125/200	140/225	160/250
25/90	X	X	X
32/90	X	X	X
40/90	X	X	X
50/110	X	X	X
63/125	X	X	X
75/160	X	X	X
90/160	X	X	X
110/160	X	X	X
110/180	X	X	X
125/180	X	X	X
140/225	–	X	X
160/250	–	–	X

Tab.4-11 Combination options pre-insulated T-branch

5 BUILDING CONNECTION AND WALL ENTRY



Heat source/Heating system

Heat interface unit (HIU)



Fig. 5-1 Heating system



Fig. 5-2 Transfer station

The outlet point of each heating network is the heating system, in which the heat is generated or is available elsewhere in the form of waste heat (for example from an industrial process).

The heat to be distributed is mostly transferred using a heat exchanger or buffer storage tank. Usually the heating network is supplied with flow temperatures of approx. 80 - 85 °C.

The decentralised transfer to the individual consumers takes place in turn via the heat interface unit (HIU), with which the heat is transferred to the house installation.

Once the required amount of heat has been extracted, the cooled heating medium is transported back to the heating system at approx. 55 - 60 °C. A closed circuit is created.

5.1 Integration into the wall penetrations



Fig. 5-3 Wall seal/Labyrinth seal

Wall seals are used in the masonry to seal pipe inlets in non-pressing water up to 0.2 bar. They are available for both RAUVITHERM and RAUTHERMEX.



For RAUVITHERM pipes butyl tape must additionally be applied in the contact area of the wall seal on the pipe.

Installation information

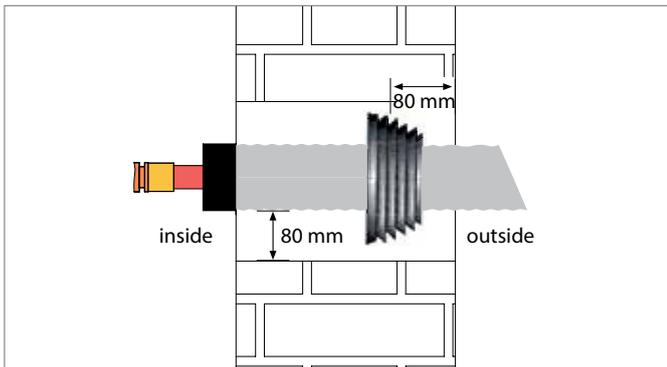


Fig. 5-4 Cross section of wall penetration

The square end of the wall seal must face towards the inside of the building and the sloped, stepped end must face outward. The horizontal spacing of the wall seal should be at least 80 mm from outside wall surface. Sealing is carried out using conventional self expanding mortar.

For proper backfilling with conventional self expanding mortar vertical spacing of approx. 80 mm between the pipe jacket and the wall must be maintained. This will result in the dimensions mentioned in Tab. 5-1 for the wall penetration dimensions.

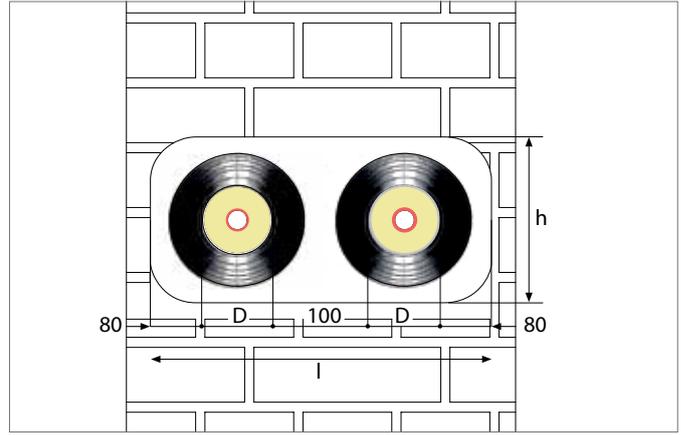


Fig. 5-5 Wall penetration dimensions

External diameter pipe jacket D [mm]	Wall penetration for 1 pipe.approx. h x l [mm]	Wall penetration for 2 pipes approx. h x l [mm]
76	225 x 225	225 x 400
91	250 x 250	250 x 450
111	275 x 275	275 x 500
120	300 x 300	300 x 550
126	300 x 300	300 x 550
142	325 x 325	325 x 600
150	325 x 325	325 x 600
162	325 x 325	325 x 600
175	350 x 350	350 x 650
182	350 x 350	350 x 650
190	350 x 350	350 x 650
202	375 x 375	375 x 700
210	375 x 375	375 x 700
250	400 x 400	400 x 750

Tab. 5-1 Dimensions of wall penetrations

5.2 Integration into the core drill hole

5.2.1 Wall seal and self expanding mortar

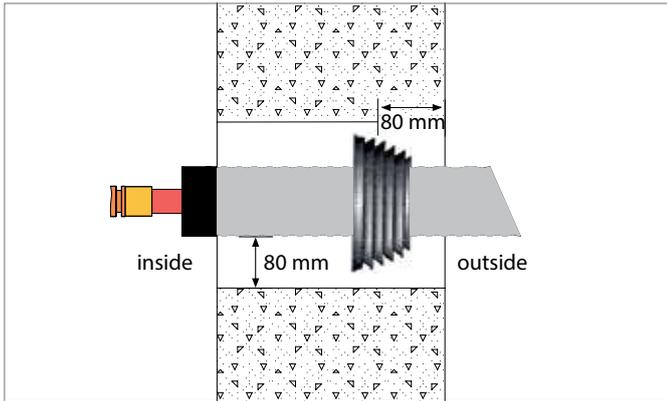


Fig. 5-6 Cross-section wall duct in core drill hole

With this method both RAUVITHERM pipes as well as RAUTHERMEX pipes can be integrated into core drill holes with a wall seal.



For RAUVITHERM pipes butyl tape must additionally be applied in the contact area of the wall seal on the pipe.

Installation instructions and dimensions core drill hole

The square end of the sealing ring faces the inside of the building and the sloped, stepped end faces outward. The horizontal spacing of the wall seal from the outside wall surface should be at least 80 mm, see Fig. 5-6.

For proper backfilling with conventional self expanding mortar vertical spacing of approx. 80 mm between the pipe jacket and the concrete must be maintained. This will result in the dimensions mentioned in Tab. 5-2 for the core drill hole dimensions.

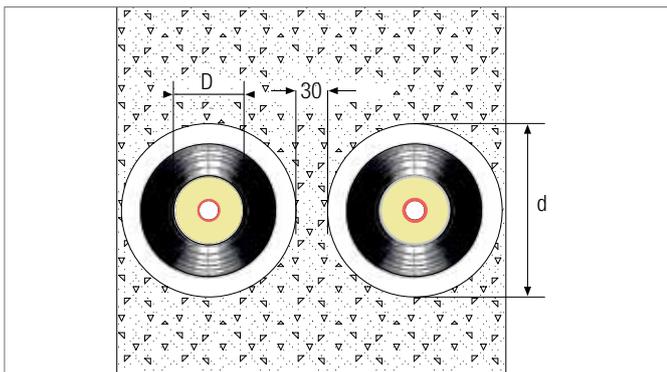


Fig. 5-7 Core drill hole dimensions

External diameter pipe jacket D [mm]	Minimum diameter core drill hole d [mm]
76 – 111	250
120 – 150	300
162 – 190	350
202 – 250	400

Tab. 5-2 Core drill hole diameters

5.2.2 Sealing flange



Fig. 5-8 Sealing flange

Ducts for RAUTHERMEX pipes through concrete walls/components can be sealed using the sealing flange. Sealing is carried out in a core drill hole or casing pipes.



The sealing flange must only be used for RAUTHERMEX pipes.

Installation instructions and dimensions core drill hole

For several ducts next to each other the spacing between core drill holes or casing pipes must be at least 30 mm.

The RAUTHERMEX pipes must have a maximum deviation of 7° in the hole. The position of the pipe in the casing pipe or in the core drill hole must be secured.

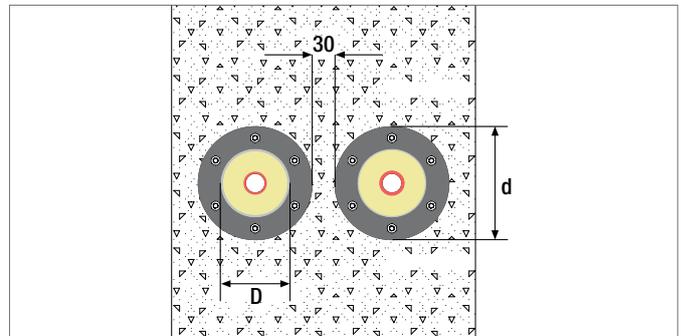


Fig. 5-9 Core drill hole dimensions

External diameter pipe jacket D [mm]	Diameter core drill hole d [mm]
76	125 ± 2
91	150 ± 2
111 – 142	200 ± 2
162 – 182	250 ± 2
202	300 ± 2
250	350 ± 2

Tab. 5-3 Core drill hole diameters



Core drill holes must be sealed prior to installing the sealing flange with REHAU Epoxy Resin to preserve the borehole.

5.2.2.1 Sealing flange FA 80 in pressured water up to 1.5 bar

The sealing flange FA 80 is used in pressured water up to 1.5 bar.

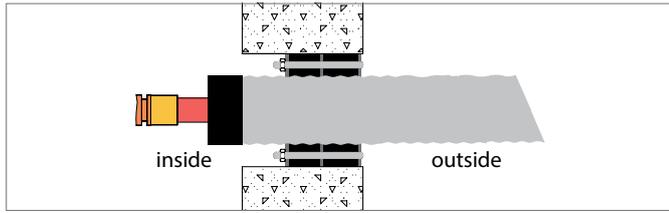


Fig. 5-10 Sealing flange FA 80



The sealing flange should seal flush against the outside of the wall. It must be prevented from protruding out of the outside wall.

For wall thicknesses ≥ 25 cm the sealing flange FA 40 can additionally be used for stabilisation and to secure the position of the pipe in the core drill hole.

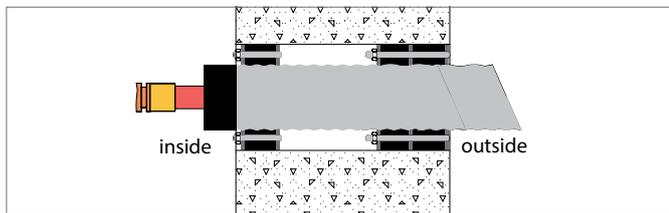


Fig. 5-11 Sealing flange FA 80 with FA 40

5.2.2.2 Sealing flange FA 40 in pressured water up to 0.5 bar

The sealing flange FA 40 is used in pressured water up to 0.5 bar.

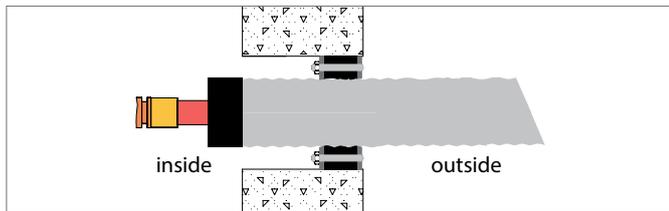


Fig. 5-12 Sealing flange FA 40



The sealing flange should seal flush against the outside of the wall. It must be prevented from protruding out of the outside wall.

For wall thicknesses ≥ 25 cm another sealing flange FA 40 can be used for stabilisation and to secure the position of the pipe in the core drill hole.

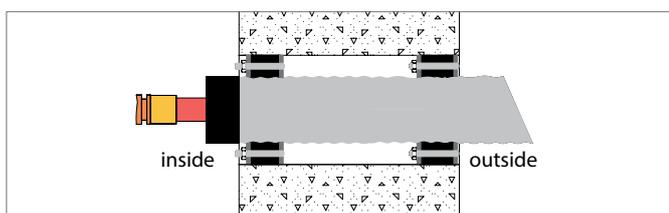


Fig. 5-13 Sealing flange FA 40, used twice

5.2.2.3 Assembly instructions sealing flange



Fig. 5-14 Assembly with a torque wrench



So that the seal can be accessed during operation, the nuts of the seal must face towards the inside of the building.

1. Unroll the RAUTHERMEX pipes.
2. Push the RAUTHERMEX pipes into the seal opening.
3. Fix the RAUTHERMEX pipes in the pipe trenches.
4. Raise the sealing flange and position in the core drill hole.
5. Tighten the sealing flange nuts with the appropriate torque wrench, see Tab. 5-4.
6. Trace nuts.

External diameter RAUTHERMEX	Screws	Wrench size [mm]	Torque [Nm]
76	M 6	10	5
91	M 6	10	5
111 – 142	M 8	13	10
162 – 182	M 8	13	10
202	M 8	13	10
250	M 8	13	10

Tab. 5-4 Screws, wrench size and torque

5.3 Sealing with a casing pipe



Fig. 5-15 Casing pipe (roughened surface)

For connecting the pipes in in-situ concrete components (e.g. floor sections, cellar exterior walls, etc.) the casing pipe made from PVC with roughened surface can be installed. The REHAU pipes can subsequently be connected to the heat-shrinkable shroud through this opening. This system is watertight up to 2 m head of water (particularly RAUVITHERM).

Dimensions RAUVITHERM		Diameter sleeve
UNO	DUO	[mm]
25 – 40	–	160
50 – 90	25 – 50	225
110 – 125	63	280

Tab. 5-5 Diameter of the wall opening for pipe inserts with roughened surface

Alternatively, in core drill holes a smooth casing pipe with heat-shrink shroud and compact seal can also be installed.



Fig. 5-16 Casing pipe (smooth surface) with compact seal

Dimensions RAUVITHERM		Diameter of the core drill hole
UNO	DUO	[mm]
25 – 40	–	250 ± 2
50 – 90	25 – 50	300 ± 2
110 – 125	63	350 ± 2

Tab. 5-6 Diameter of the tapping borehole for smooth pipe insert surface



Fig. 5-17 Assembly example casing pipe and compact seal

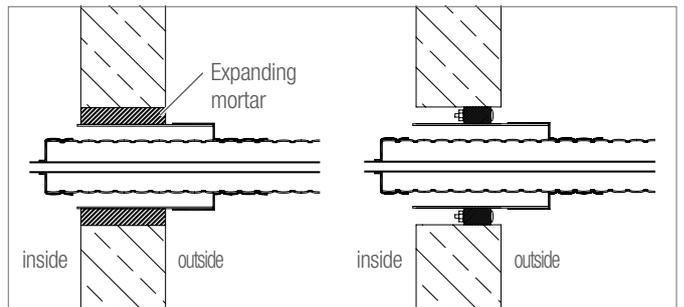
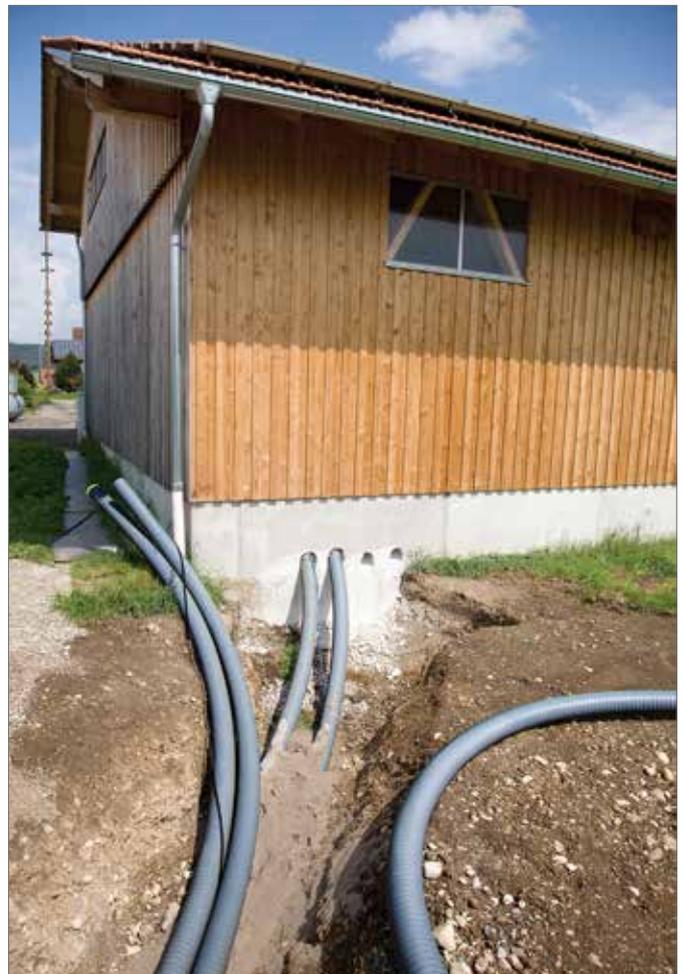


Fig. 5-18 Installation diagram casing pipe with roughened surface (left) and smooth surface (right)

The various sealing variants enable maximum flexibility of the pipework up to directly into the building.



5.4 Pre-fabricated house connection

5.4.1 Pre-fabricated lead-in bend (rigid)



Fig. 5-19 Pre-fabricated lead-in bends UNO and DUO

The REHAU pre-fabricated lead-in bends enable the creation of tensionless wall entries that are bent up to 90 degrees to the piping. This mostly occurs when installing pipes going into a building without a basement.

The pre-fabricated lead-in bends are available in the dimensions 25 - 125 (UNO) and 25 - 63 (DUO). They can be used for RAUVITHERM and RAUTHERMEX.

Dimensions and materials

The shank length is 1.60 m x 1.10 m.

Materials:

Carrier pipe	Crosslinked polyethylene (PE-Xa)
Insulating material	CFC-free PU foam
Outer jacket	Polyethylene PE-HD, smooth
Angle	Made up of segments produced by means of butt welding

Tab. 5-7 Materials rigid pre-fabricated lead-in bend

Installation

1. Fit the wall seal and position the pre-fabricated lead-in bends underground.
2. Fix the vertical shank.
3. Cast the floor/foundation.
4. Connect other pipes using the standard I-shroud connection.

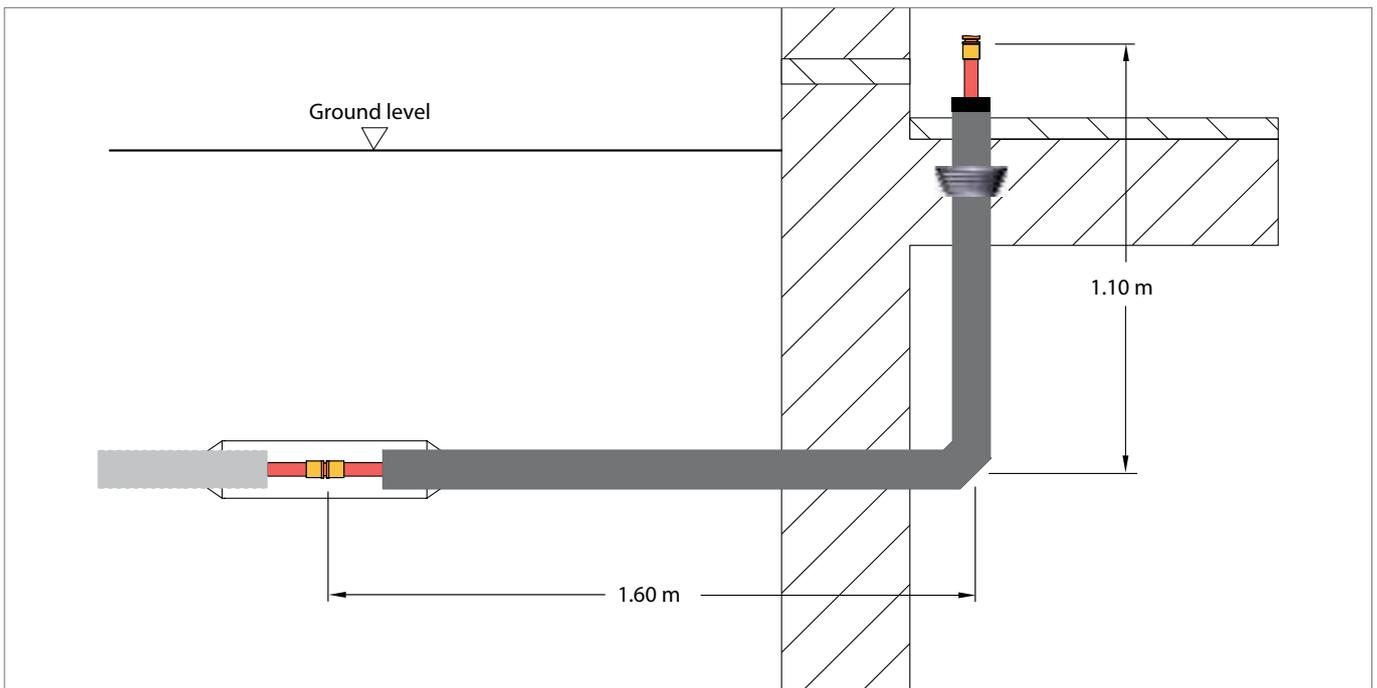


Fig. 5-20 Connect other pipes using the standard I-shroud connection.

5.5 End caps

End caps are used to close off the pipes at the wall entries. Depending on the pipe used the following end caps can be used:

- RAUVITHERM
 - Rubber end caps
 - Heat-shrink end caps
- RAUTHERMEX
 - Heat-shrink end caps
 - Slip-on end caps
 - Rubber end caps

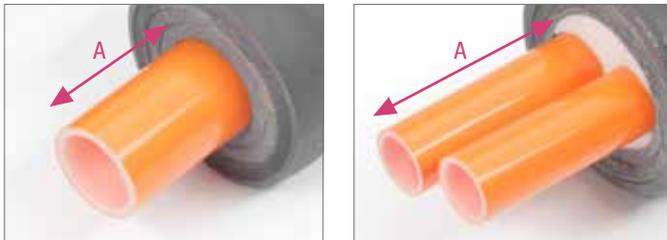
Rubber and heat-shrink end caps fit tightly to the pipe and serve to ensure that moisture and vermin cannot penetrate the pipe jacket, or only with difficulty.

5.5.1 End caps for RAUVITHERM



Fig. 5-25 Rubber end caps

Exposed lengths



Dimensions		Exposed length A [mm]
UNO	DUO	
25 – 40	25 – 40	150
50 – 110	50 – 63	175
125	–	200

Tab. 5-9 Exposed lengths RAUVITHERM

5.5.2 End caps for RAUTHERMEX



Fig. 5-26 Heat-shrinkable end caps



Fig. 5-27 Slip-on end caps

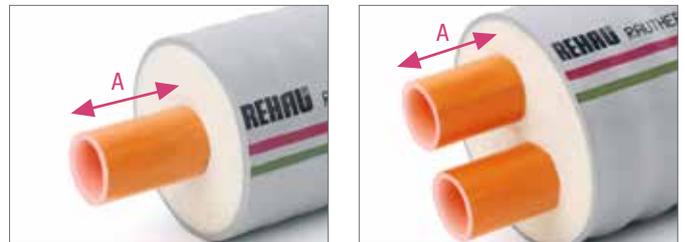


Heat-shrinkable end caps must be fitted prior to assembling the connecting fittings.

Shrink the end caps carefully on to the carrier pipes; do not overheat the carrier pipes when doing this. Allow to cool completely prior to further assembly of the carrier pipes.

If the pipe insulation ends with only partially insulated pipes (e.g. plumbing pipe) it is essential to fit heat-shrinkable end caps. Slip-on end caps are not permitted in this case.

Exposed lengths



Dimensions		Exposed length A	
UNO	DUO	Heat-shrink end cap [mm]	Slip-on end cap [mm]
25 – 40	25 – 40	150	100
50 – 110	50 – 63	175	125
125 – 160	–	200	150

Tab. 5-10 Exposed lengths RAUTHERMEX

5.6 Fixing clamps

For RAUVITHERM and RAUTHERMEX no expansion bellows or compensators must be used during underground installation. Pipe friction in the ground is greater than the expansion forces of the plastic pipe.

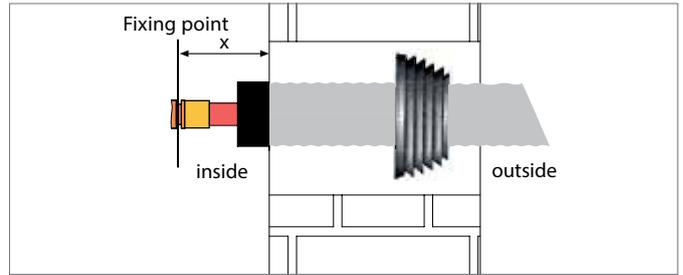
In order to absorb the reaction forces of the carrier pipes in the area of the wall entries, that are caused by the thermal expansion and shrinkage, conventional fixing clamps must be used that can absorb the forces according to Tab. 5-11.

REHAU pipes must only protrude beyond the interior wall of the building into the building in a house connection with the dimensions mentioned in Tab. 5-11, in order to limit the thermal length change.



Fixing clamps must be fixed at the fitting grooves or at the adjacent rigid pipes.

Fixing clamps must not be fixed to the compression sleeves.



SDR 11 carrier pipe

Dimensions external diameter x wall thickness [mm]	Protrusion into the building X (min. – max.) [mm]	Fixing point forces for each carrier pipe [kN]
20 x 1.9	220 – 270	0.6
25 x 2.3	220 – 270	0.9
32 x 2.9	220 – 270	1.3
40 x 3.7	220 – 270	2.0
50 x 4.6	220 – 270	2.9
63 x 5.8	260 – 300	4.2
75 x 6.8	260 – 300	5.3
90 x 8.2	260 – 300	6.0
110 x 10	260 – 300	6.3
125 x 11.4	300 – 350	7.8
140 x 12.7	300 – 350	9.8
160 x 14.6	300 – 350	12.8

Tab. 5-11 Fixing point forces of SDR 11 carrier pipes



6 DESIGNING AND SIZING HEATING NETWORKS



A heating network generally consists of three components:

- Heat source
- Heat distribution/Pipe system
- Heat exchangers (heat interface units)

Various energy sources and technologies can be used as a heat source. One possibility is to use the waste heat from the process of conversion into electricity in biogas units using combined heat and power units (CHP), but wood chip/pellet boilers also frequently serve as heat sources. Buffer stores are also often integrated into the heating system, in order to separate the timing of the heat generation and heat requirement.

The heat distribution is achieved using a pipe network. The heat transfer fluid, usually water, is transported in specially designed flexible, underground district heating pipe systems for hot/warm water applications. The REHAU RAUVITHERM and RAUTHERMEX pipe systems are best suited for this. These pipe systems are however not only used for large heating networks, but also for short connection lines.

District heating networks are usually designed as two-circuit systems (flow/return). The flow transports the hot water from the heat source to the consumers. Return pipes take the cooler water back to the heat source.

In a district heating network a hydraulic separation of the primary circuit (district heating network) and the secondary circuit (consumer) is carried out by the heat exchanger. A plate heat exchanger is usually used to do this. But the separation is also possible using a decentralised buffer store with pipe heat exchanger (see Section 6.3.2 on Page 40). For small networks or connection lines a hydraulic separation is avoided in some cases.



6.1 Types of heat network

The type of heat distribution network is primarily determined by site conditions (design and layout of the road, arrangement of the houses to be connected, etc.), network size and integration of the heat source.

Essentially there are three types of networks:

Radial systems

Radial systems are mostly used for smaller district heating networks due to their simple structure. The short piping paths and small diameter result in lower construction costs and heat losses. The disadvantage is that future extensions are only possible to a small extent due to the specified limited network capacity.

Advantages:

- Simple network planning
- Network type always possible

Disadvantage:

- Future extensions only possible to a small extent

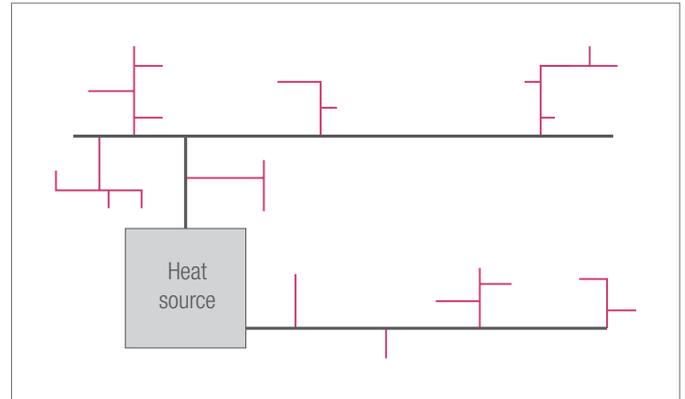


Fig. 6-1 Radial system

Ring networks

The ring network is often used for large supply areas with one or more heat sources. With the ring type not only can several heat sources be integrated, but it also results in higher supply security, as most customers can be reached via two piping paths. This makes future extension or adding new connections easy. The overall stretch is longer than of a radial system, thus the investment costs and heat losses may be higher. Additional costs can be moderated or compensated for through the effect of the diversity (see Section 'Determining the diversity' on Page 41). Under certain circumstances the dimension of the header pipe can be reduced due to the specifics of a ring network design.

Advantages:

- Integration of several heat sources
- Increased supply security

Disadvantage:

- Only possible with suitable network topology

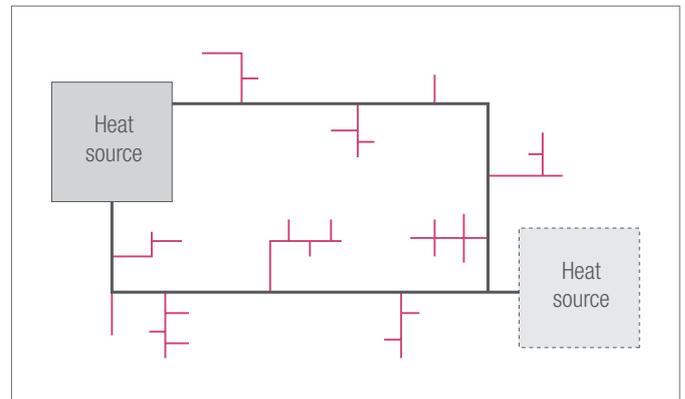


Fig. 6-2 Ring network

Meshed networks

Meshed networks are ring networks that are nested inside each other. These offer optimum supply security and better expansion opportunities. Due to the high investment costs they are mostly used for large heat distribution networks in inner-city areas.

Advantages:

- Optimum supply security
- Extension possible

Disadvantage:

- High costs, designed mostly for large networks

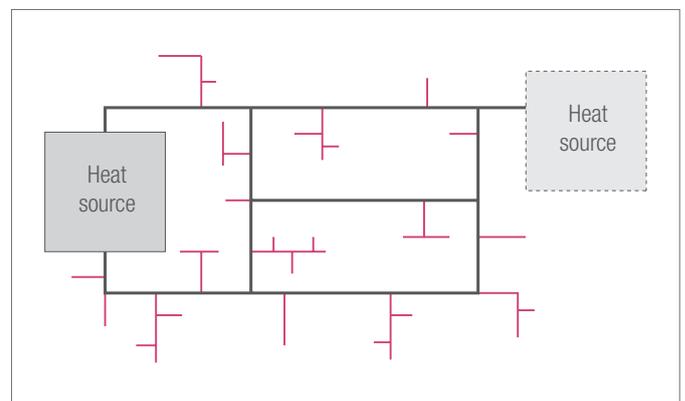


Fig. 6-3 Meshed network

6.2 Connecting options

The following options can be used to connect the heat consumer to the heat network:

Branch method

This method is the standard variant for connecting the consumer to a heating network. Every customer is connected to the heating network separately, directly or in groups.

Advantages:

- Flexible in design
- Easy installation in advance in the land
- Branches can be connected to the main line at a later stage



Fig. 6-4 Branch method

'Daisy Chain' line arrangement/building to building piping

In a „house-to-house“ line arrangement houses are connected to each other and only connected to a main line as a group.

Building to building piping is only used in an individual case.

Advantages:

- No connections in the ground
- Little installation in sealed land



Fig. 6-5 „House-to-house“ line arrangement / building to building piping

Connecting different pipe systems

Various pipe systems are available for heat distribution. These can be combined with each other, e.g. in a network extension to an existing heat network made from a plastic pipe jacket (KMR) the connection lines if the house to be connected can be created with a flexible plastic carrier pipe (PMR) such as RAUTHERMEX. A combination of various PMR systems such as RAUTHERMEX and RAUVITHERM can also make sense due to their different properties.



Fig. 6-6 Connecting different pipe systems

6.3 Network sizing

A district heating network is generally operated all-year-round. It is designed on the peak load in winter. For the majority of the year the heating network is only operated at part load and the maximum output is only required for a few hours a year. This is evident from the annual load duration curve (see Fig 6-7) of a district heating network.

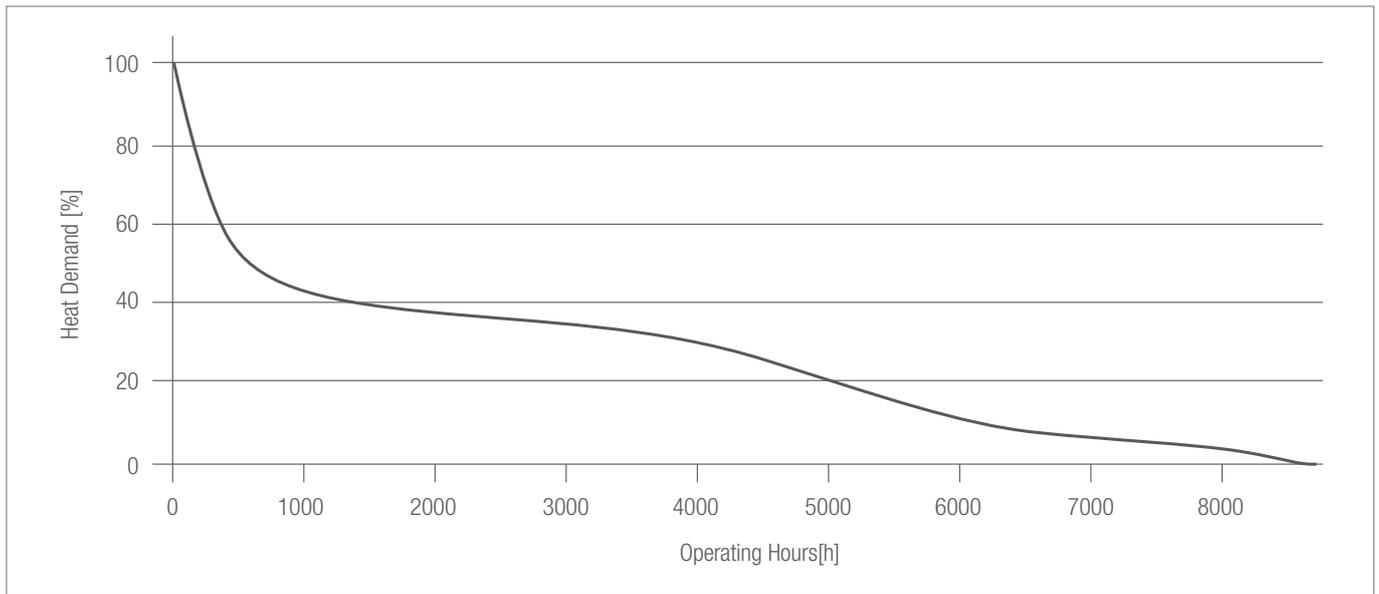


Fig. 6-7 Annual load duration curve

Generally the district heating network should be designed as efficient as possible. Efficient planning and design is the basis for a technically practical, as well as economically feasible district heating network.



The following steps are to be considered:

1. Preliminary investigation of the connection points / Establishing the heat requirement
2. Clarification of the heat supply and buffer store concept
3. Establishing the pipe layout
4. Determining the diversity
5. Design of the heat source and buffer store
6. Establishing the required flow and return temperatures
7. Initial sizing of the district heating pipe/Determining the critical line
8. Final pipe sizing
9. Pump sizing

6.3.1 Preliminary investigation of the connection points / Establishing the heat requirement

For an early estimate of the cost-efficiency a rough pipe layout is to be created on the basis of initial consumer surveys. As the pipe length, the number of connection points and their nominal output have a big influence on the efficiency of a district heating network and funding-relevant key figures, e.g. heat density or the percentage heat loss.

The cost efficiency of a district heating network usually increases with the number of consumers connected to it. By improving the areas connection rate the average distance between connections can also be reduced. However, not connecting individual connection points that are located further away may have a positive effect on the overall efficiency under certain circumstances.

Once the consumer structure has been fixed, the nominal output or the heat requirement of each individual connection point is to be established. Knowing the exact heat requirement is an important prerequisite for an efficient and cost-effective design. Inadequate heat requirement calculations usually lead to the heating network being over-dimensioned.

The principles for the heat requirement calculation are set out in DIN 12831 and in DIN 4701 (calculation of the standard heat load).

In practice a heat load calculation is mostly not carried out for an initial estimate calculation. For the calculation two variants have proven to be useful for calculating the heat load / the heat requirement:

- Energy consumption from previous years taking into account the efficiency rate and the full utilisation hours of the boiler
- Energy consumption characteristic value (energy consumption with regard to the living area to be heated) and the full utilisation hours

6.3.2 Clarification of the heat supply and buffer store concept



Fig. 6-8 Central heat store

Even at an early stage of planning a district heating network it must be clarified which heat supply or which buffer store concept is meant to be chosen. In most cases the heat is generated centrally and distributed by the heating system. However, the integration of several heat sources at different supply points is also possible.

Another aspect that is to be clarified early on is the buffer management. As the heat requirement in a district heating network is subject to load changes that vary not only seasonally but also daily, the use of buffer stores is sensible. In this way the timing of the heat generation and the heat requirement can be separated.



The use of central buffer stores has an influence just on the heat generation. If in contrast decentralised buffer stores are installed for each individual connection point, this also has a positive effect on the pipe dimensioning, as the heat is transported consistently over the course of time.



Fig. 6-9 Decentralised heat store

Depending on whether a central or decentralised buffer store concept is planned and how the heat supply concept is envisaged, this parameter must be taken into account during the subsequent simultaneous consumption calculation.

6.3.3 Establishing the pipe layout and location of the heating system

In parallel to the activities described previously a provisional pipe layout must be established. This is necessary in order to be able subsequently to calculate the diversity of the individual pipe sections (see Section 6.3.4). Site local conditions, e.g. courses of rivers, roads to be crossed, etc. are to be taken into account and considered in the layout.

In connection with this it must be clarified where the heating system can be set up. For efficiency reasons it is advantageous to place this as near as possible to the area to be supplied, to install satellite combined heat and power units or to allow for other decentralised heat providers.

6.3.4 Determining the diversity

It is unlikely for all customers to use their peak heat load at the same time. This effect is described as diversity and is responsible for ensuring that the actual required maximum total output is reduced compared to the total individual maximum outputs

$$DF = \frac{Q_{\max, \text{required}}}{\sum Q_{\text{nominal}}}$$

DF Diversity factor
 $Q_{\max, \text{required}}$ actual maximum required total output
 Q_{nominal} Total nominal output of all connection points

The effect of the diversity has an effect both on the generation of heat as well as on the heating network itself. As a consequence these can be dimensioned to be more streamlined and efficient.

Historical values and investigations show that the greater the number of consumers the lower the diversity achieved. The actual required maximum total output of the heating system in relation to the total individual maximum outputs reduces with an increasing number of consumers (see Fig. 6-10). Depending on the number of consumers this results in a diversity factor for the total heat requirement of a factor of between 0.5 and 1.

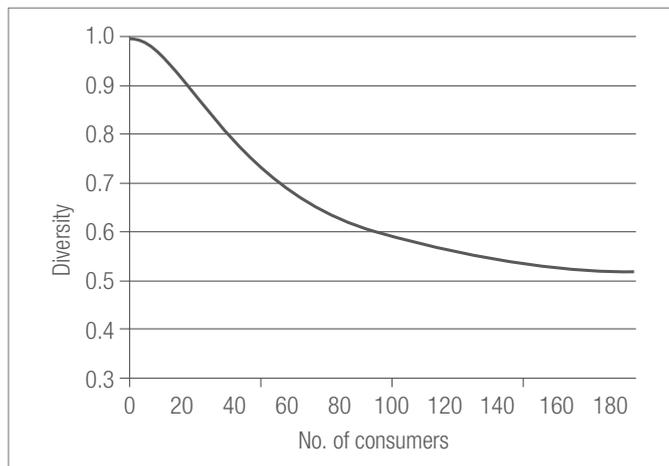


Fig. 6-10 Schematic diagram: Diversity of the total heat requirement depending on the number of consumers for a homogeneous consumer structure

Example:
 Number of connection points: 80
 Nominal output per connection point: 15 kW
 Actual maximum required total output: 756 kW

$$DF = \frac{Q_{\max, \text{required}}}{\sum Q_{\text{nominal}}} = \frac{756 \text{ kW}}{80 * 15 \text{ kW}} = 0.63$$

This results in a diversity factor of 0.63. For the total nominal output of all connection points as a result 1200 kW doesn't have to be supplied, but just 756 kW transported through the main line.

The diversity of the total heat requirement depends not only on the number of connection points, but also on their nominal output, the type of building and the buffer store concept. When using decentralised buffer stores a separate analysis is required. The peak loads that occur are absorbed by the buffer store on the secondary side in some cases and therefore evened out. The decentralised buffer store can therefore be loaded continuously.

In summary the following influencing factors must be taken into account when calculating the diversity factor:

- Number of connection points
- Nominal output of the individual connection points
- Connection point building type
- Buffer store concept

As the diversity factor is dependent on several factors there is not a standard factor for a district heating network. It must be calculated for each individual pipe or individual section. Generally the diversity factor is lowest at the main pipe to the heating system and increases towards the end of the network at the house connection pipes.



The REHAU design centre can calculate the diversity for individual specific projects and incorporate the results into the layout.



It is essential to take the diversity factor into account for an efficient layout. If the diversity factor is not taken into account, the network could be oversized, which leads to unnecessarily high capital and operating costs!

6.3.5 Design of the heat source and buffer store

The maximum required output for the heat network is crucial for the layout of the heat source/s and buffer store. Usually the heat supply is achieved with several heat sources.

A modular output distribution is discussed if, depending on the uptake, different heat sources are used that can work in the respective work areas:

- Base load (e.g. via the block-type thermal power station of a biogas unit)
- Average load (e.g. with a wood chip boiler)
- Peak load (e.g. with an oil boiler)

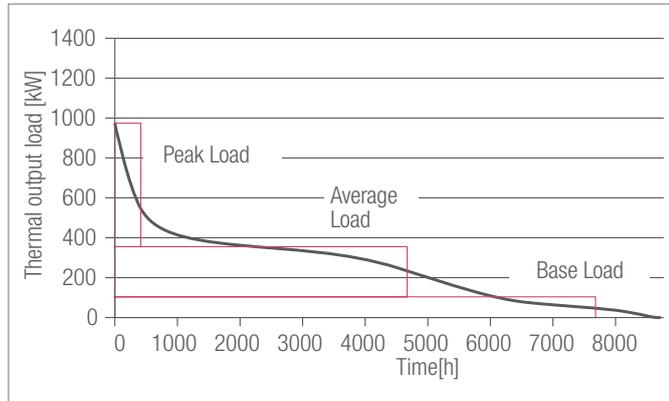


Fig. 6-11 Ordered annual load duration curve with modular heat source

The selection of the heat source must be matched to the resources available locally.

In order to further minimise the rate of the heat source (medium load and peak load), it is useful to use buffer stores. As already mentioned in Section 6.3.2, these can be integrated centrally or decentralised in the network. The dimensioning of the buffer store must be coordinated with the heat source, the varying heat requirement over time and the constructional conditions.

6.3.6 Establishing the required flow/return temperatures

If the pipe layouts and heat requirements are known, the required volume flows can be calculated for the actual sizing of the district heating pipe. To do this the delta T aimed for in the network - the difference between the flow temperature and the return temperature - must be defined.

$$V = \frac{Q}{c_p \cdot (\vartheta_V - \vartheta_R) \cdot \rho}$$

V Flow rate [l/s]

Q Heat flow [kW]

c_p specific heat capacity water [kJ/kg·K]

ϑ_V Flow temperature in the network [°C]

ϑ_R Return temperature in the network [°C]

ρ Density [kg/l]

Typical flow temperatures in district heating networks are 65 - 85 °C, return temperatures 45 - 65 °C. Usually in practice the differences are between 20 K and 30 K. Differences that are as high as possible are aimed for, as in this case the flow rate at a consistent required output can be reduced. Generally the system temperatures should however be kept as low as possible in order to avoid unnecessary heat losses.

Flow rates and temperature difference are however not constant at the same value throughout the year. The maximum required output is only required in the winter months, which is why it also doesn't have to be maintained throughout the year. Accordingly the network is managed in most cases by a mix of flow rate control and temperature control. With this type of combined control process short-term load peaks can be reacted to quickly by increasing the flow from a buffer. Temporal and seasonal load changes can be compensated for by controlling the temperature of the network, so that when the output required is less the heat losses are also lower (see Fig. 6-12).

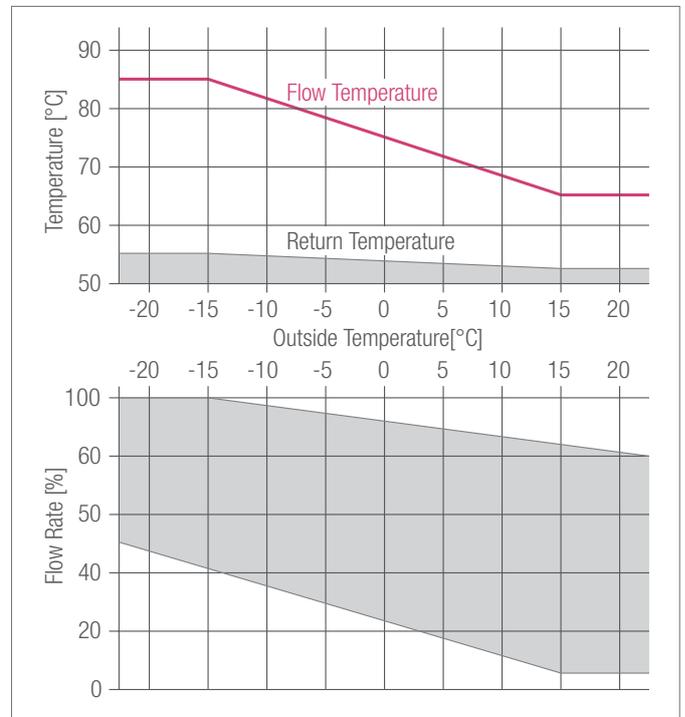


Fig. 6-12 Network control, combined process of temperature and flow control

6.3.7 Initial sizing the district heating line/Identifying the critical line

The basis for sizing is the maximum required flow rates of the individual pipes. For the sizing the principle applies: as small as possible, as big as necessary. Using the following graph the effect on the costs of the selected pipe dimension is illustrated:

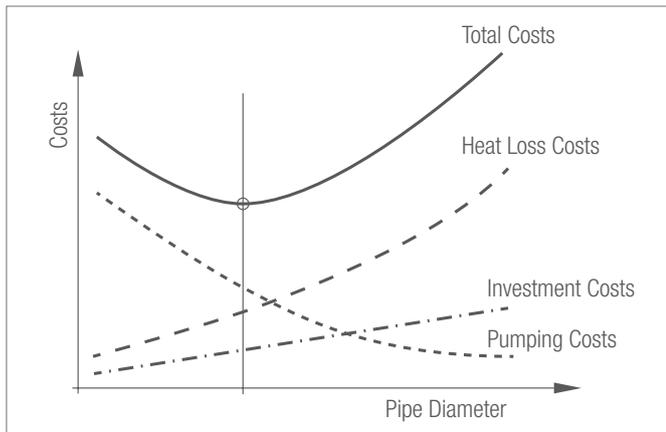


Fig. 6-13 Heating network costs depending on the pipe diameter

On one hand the investment costs as well as heat loss costs rise with increasing pipe diameter. On the other hand the pumping costs are reduced due to the lower pressure losses in the network. Optimum sizing minimises the overall costs.

The REHAU SDR 11 pipe systems for heating networks are designed for common basic conditions for operating pressures from 5 to 7 bar. As the maximum output is only required for a few hours a year, an efficient heating network with REHAU pipe systems should always be designed on the maximum possible total pressure, in order to dimension the pipes to be as streamlined as possible.

The total load on the pipe system consists of three components:

- Excess operating pressure
- Geodetic pressure (static)
- Flow pressure loss (pipe, fittings, valves and accessories)

The operating pressure (mostly approx. 1.5 bar) and the geodetic pressure determine the permitted pressure loss that, in support of smaller pipe dimensions, for efficiency reasons should be completely exhausted.



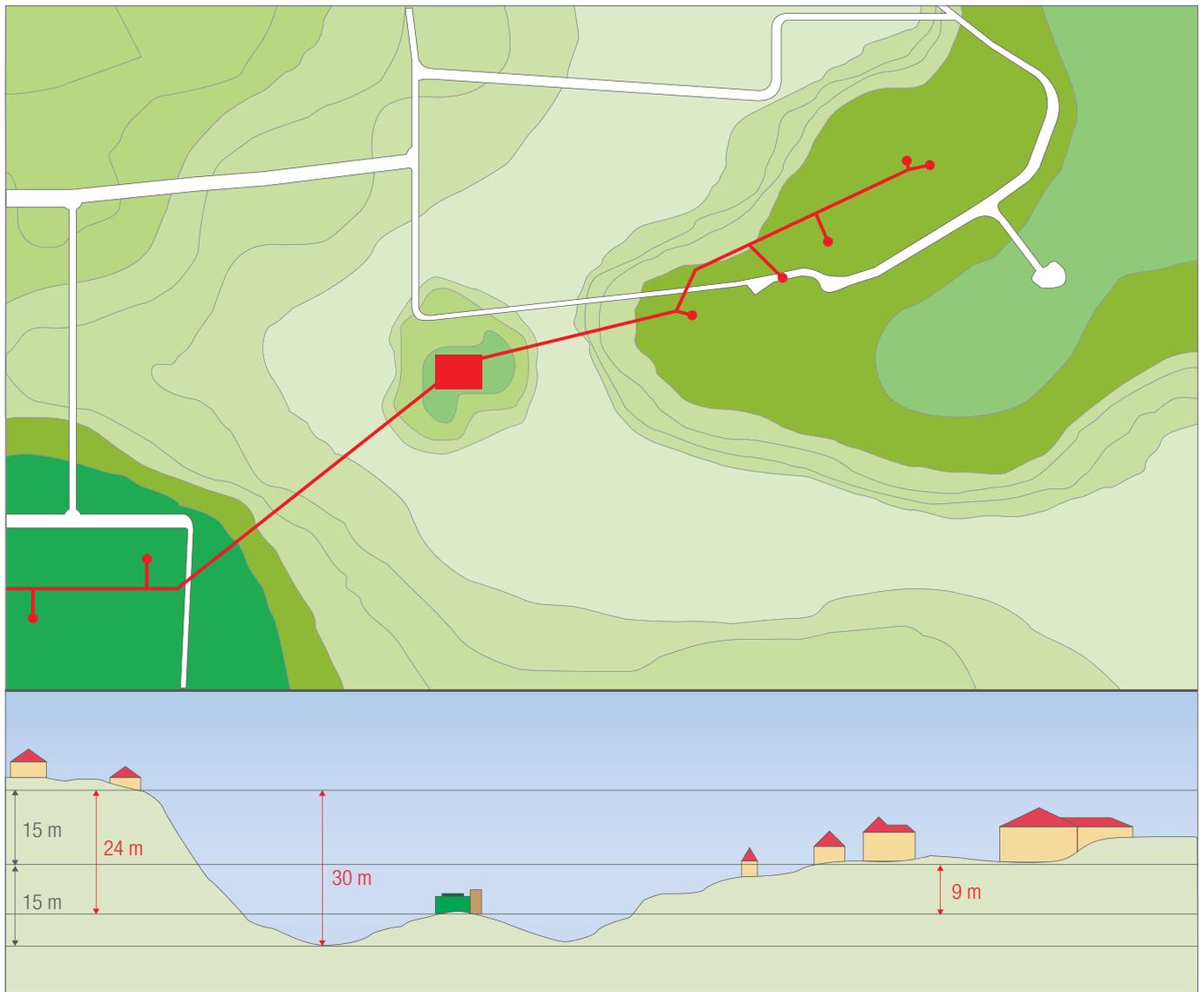


Fig. 6-14 Example height profile of a heating network

The specific pressure loss is drawn upon as a layout parameter for the initial sizing. Depending on the network size 200 - 250 Pa/m is used as an approximate value in practice. The aim of sizing is to identify the critical line and its pressure loss in the entire network.

It is then necessary to optimise this pipe section through appropriate sizing of the individual branches to the possible total pressure loss in the network.

Dimensioning and pressure loss calculation, SDR 11 pipes

The tables on the following pages can be used for the dimensioning of the pipes and calculation of the pressure losses. These tables apply for both UNO and DUO pipes. For cost and efficiency reasons DUO pipes should preferably be used.

The procedure is outlined in the following example.

Example and step-by-step process:

Starting basis: 46 kW should be transported across a 100 m long course. There is a temperature difference of 20 K in the network.

1. Calculating the output to be transported in the section and the rate of flow:
46 kW with a difference of 20 K gives you a flow rate of 0.55 l/s
2. Pre-dimensioning:
The pipe should be sized to be as small as possible, but not exceed the specific pressure loss of 200 - 250 Pa/m: Select the dimension 40 x 3.7 (specific pressure loss is 135.4 Pa/m)
3. Determining the pressure loss:
For a course length of 100 m this gives you a total pipe length of 200 m
 $R_{\text{total}} = 200 \text{ m} \cdot 135.4 \text{ Pa/m} = 27080 \text{ Pa} = 0.27 \text{ bar}$

If all pipes are sized for this type, the total pressure losses of the individual branches of the critical line can be calculated. In most cases this is the connection point that is furthest away.

6.3.8 Final sizing

In many cases the pipes that are not on the critical line can be sized to be even more streamlined. Here there can be a variation from the approximate value of the specific pressure loss. A higher pressure loss in the branches compensates for the hydraulic balance that is required anyway. In addition to this, a more streamlined sizing of the non-critical secondary branches reduces investment and heat loss costs.

Two aspects are to be considered for this subsequent dimensioning:

- The velocity in the pipes depending on the specific dimensions should be in the range of 0.7 – 2.0 m/s (see Tab. 6-1 Page 46 area marked in a different colour)
- Through the adjustment of the dimensions to the branches their pressure loss must not exceed the pressure loss of the original most critical line.

The following special network situations must be considered separately again, for example

- Specifying pre-insulated isolation valves
- Transition from UNO to DUO pipes
- Use of Y-pipes at house connections
- Consolidation and connection of neighbouring connection points to the header pipe/branch

Changes as a result of this must then be incorporated in the layout of the network.



All steps described from Section 6.3.1 to Section 6.3.8 are to be considered for the efficient layout of a district heating network.

6.3.9 Pump sizing

The high lift height and the maximum volume flow to be transported are important for the pump sizing and are derived from the actual network planning.

For efficiency reasons the use of regulated pumps is recommended in heating networks.

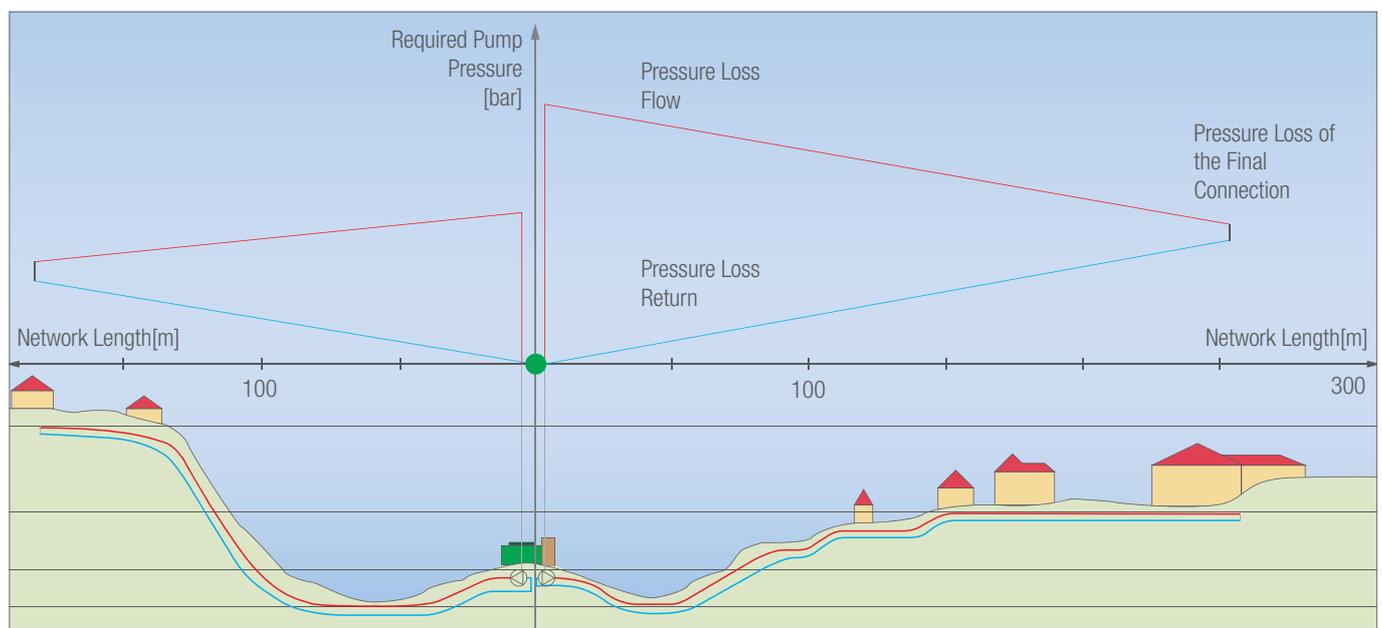


Fig. 6-15 Pump sizing

Pressure loss SDR 11 carrier pipes at 80 °C

Flow rate		Output at a difference of				20 x 1.9		25 x 2.3		32 x 2.9		40 x 3.7		50 x 4.6		63 x 5.8	
[l/s]	[m³/h]	15 K [kW]	20 K [kW]	25 K [kW]	30 K [kW]	v [m/s]	R [Pa/m]										
0.06	0.2	3.8	5.0	6.3	7.5	0.29	75.1	0.18	25.0	–	–	–	–	–	–	–	–
0.07	0.3	4.4	5.9	7.3	8.8	0.34	98.6	0.21	32.7	–	–	–	–	–	–	–	–
0.08	0.3	5.0	6.7	8.4	10.0	0.39	124.9	0.24	41.4	–	–	–	–	–	–	–	–
0.09	0.3	5.7	7.5	9.4	11.3	0.44	154.0	0.28	50.9	–	–	–	–	–	–	–	–
0.10	0.4	6.3	8.4	10.5	12.6	0.49	185.8	0.31	61.4	–	–	–	–	–	–	–	–
0.11	0.4	6.9	9.2	11.5	13.8	0.53	220.3	0.34	72.6	–	–	–	–	–	–	–	–
0.12	0.4	7.5	10.0	12.6	15.1	0.58	257.4	0.37	84.8	–	–	–	–	–	–	–	–
0.13	0.5	8.2	10.9	13.6	16.3	0.63	297.2	0.40	97.7	0.24	29.4	–	–	–	–	–	–
0.14	0.5	8.8	11.7	14.7	17.6	0.68	339.5	0.43	111.5	0.26	33.6	–	–	–	–	–	–
0.15	0.5	9.4	12.6	15.7	18.8	0.73	384.4	0.46	126.2	0.28	37.9	–	–	–	–	–	–
0.16	0.6	10.0	13.4	16.7	20.1	–	–	0.49	141.6	0.30	42.5	–	–	–	–	–	–
0.18	0.6	11.3	15.1	18.8	22.6	–	–	0.55	174.9	0.33	52.4	–	–	–	–	–	–
0.20	0.7	12.6	16.7	20.9	25.1	–	–	0.61	211.3	0.37	63.2	–	–	–	–	–	–
0.22	0.8	13.8	18.4	23.0	27.6	–	–	0.67	250.9	0.41	74.9	–	–	–	–	–	–
0.24	0.9	15.1	20.1	25.1	30.1	–	–	0.73	293.5	0.45	87.5	–	–	–	–	–	–
0.26	0.9	16.3	21.8	27.2	32.7	–	–	0.80	339.3	0.48	101.0	0.31	35.3	–	–	–	–
0.28	1.0	17.6	23.4	29.3	35.2	–	–	0.86	388.1	0.52	115.4	0.34	40.3	–	–	–	–
0.30	1.1	18.8	25.1	31.4	37.7	–	–	0.92	439.9	0.56	130.7	0.36	45.5	–	–	–	–
0.35	1.3	22.0	29.3	36.6	44.0	–	–	–	–	0.65	172.5	0.42	60.0	–	–	–	–
0.40	1.4	25.1	33.5	41.9	50.2	–	–	–	–	0.74	219.6	0.48	76.3	–	–	–	–
0.45	1.6	28.3	37.7	47.1	56.5	–	–	–	–	0.83	272.0	0.54	94.3	0.34	31.9	–	–
0.50	1.8	31.4	41.9	52.3	62.8	–	–	–	–	0.93	329.4	0.60	114.0	0.38	38.6	–	–
0.55	2.0	34.5	46.0	57.6	69.1	–	–	–	–	1.02	392.0	0.66	135.4	0.42	45.8	–	–
0.60	2.2	37.7	50.2	62.8	75.3	–	–	–	–	1.11	459.6	0.72	158.6	0.46	53.5	–	–
0.70	2.5	44.0	58.6	73.3	87.9	–	–	–	–	–	–	0.84	209.8	0.54	70.7	–	–
0.80	2.9	50.2	67.0	83.7	100.5	–	–	–	–	–	–	0.96	267.7	0.61	90.0	–	–
0.90	3.2	56.5	75.3	94.2	113.0	–	–	–	–	–	–	1.08	332.0	0.69	111.4	0.43	36.4
1.00	3.6	62.8	83.7	104.7	125.6	–	–	–	–	–	–	1.20	402.8	0.76	134.9	0.48	44.1
1.10	4.0	69.1	92.1	115.1	138.1	–	–	–	–	–	–	–	–	0.84	160.5	0.53	52.3
1.20	4.3	75.3	100.5	125.6	150.7	–	–	–	–	–	–	–	–	0.92	188.1	0.58	61.3
1.30	4.7	81.6	108.8	136.0	163.3	–	–	–	–	–	–	–	–	0.99	217.8	0.63	70.8
1.40	5.0	87.9	117.2	146.5	175.8	–	–	–	–	–	–	–	–	1.07	249.5	0.67	81.0
1.50	5.4	94.2	125.6	157.0	188.4	–	–	–	–	–	–	–	–	1.15	283.2	0.72	91.9
1.60	5.8	100.5	134.0	167.4	200.9	–	–	–	–	–	–	–	–	1.22	318.8	0.77	103.4
1.70	6.1	106.7	142.3	177.9	213.5	–	–	–	–	–	–	–	–	1.30	357.5	0.82	115.8
1.80	6.5	113.0	150.7	188.4	226.0	–	–	–	–	–	–	–	–	1.38	396.2	0.87	128.2
1.90	6.8	119.3	159.1	198.8	238.8	–	–	–	–	–	–	–	–	–	–	0.92	141.8
2.00	7.2	125.6	167.4	209.3	251.2	–	–	–	–	–	–	–	–	–	–	0.96	155.4
2.20	7.9	138.1	184.2	230.2	276.3	–	–	–	–	–	–	–	–	–	–	1.06	185.1
2.40	8.6	150.7	200.9	251.2	301.4	–	–	–	–	–	–	–	–	–	–	1.16	217.2
2.60	9.4	163.3	217.7	272.1	326.5	–	–	–	–	–	–	–	–	–	–	1.25	251.8
2.80	10.1	175.8	234.4	293.0	351.6	–	–	–	–	–	–	–	–	–	–	1.35	288.7
3.00	10.8	188.4	251.2	314.0	376.7	–	–	–	–	–	–	–	–	–	–	1.45	327.9

Tab. 6-1 Pressure loss table SDR 11 carrier pipes at 80 °C

Recommended design range for REHAU SDR 11 carrier pipes including REHAU:

Joining technique: Compression sleeve joining technique

Pressure loss SDR 11 carrier pipes at 80 °C

Flow rate		Output at a difference of				75 x 6.8		90 x 8.2		110 x 10		125 x 11.4		140 x 12.7		160 x 14.6	
[l/s]	[m³/h]	15 K [kW]	20 K [kW]	25 K [kW]	30 K [kW]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]
2.4	8.6	151	201	251	301	0.81	91.3	0.56	37.9	–	–	–	–	–	–	–	–
2.6	9.4	163	218	272	327	0.88	105.7	0.61	43.8	–	–	–	–	–	–	–	–
2.8	10.1	176	234	293	352	0.95	121.0	0.66	50.1	–	–	–	–	–	–	–	–
3.0	10.8	188	251	314	377	1.01	137.4	0.71	56.8	–	–	–	–	–	–	–	–
3.3	11.9	204	272	340	408	1.10	159.2	0.76	65.8	–	–	–	–	–	–	–	–
3.5	12.6	220	293	366	440	1.18	182.4	0.82	75.3	–	–	–	–	–	–	–	–
3.8	13.7	235	314	392	471	1.27	207.2	0.88	85.5	–	–	–	–	–	–	–	–
4.0	14.4	251	335	419	502	1.35	233.4	0.94	96.2	–	–	–	–	–	–	–	–
4.3	15.5	267	356	445	534	1.44	261.2	1.00	107.6	0.67	40.4	–	–	–	–	–	–
4.5	16.2	283	377	471	565	1.52	290.4	1.06	119.5	0.71	44.8	–	–	–	–	–	–
4.8	17.3	298	398	497	597	–	–	1.12	132.0	0.75	49.5	–	–	–	–	–	–
5.0	18.0	314	419	523	628	–	–	1.18	145.1	0.79	54.4	–	–	–	–	–	–
5.3	19.1	330	440	549	659	–	–	1.23	158.8	0.83	59.5	–	–	–	–	–	–
5.5	19.8	345	460	576	691	–	–	1.29	173.0	0.86	64.8	–	–	–	–	–	–
5.8	20.9	361	481	602	722	–	–	1.35	187.9	0.90	70.3	–	–	–	–	–	–
6.0	21.6	377	502	628	753	–	–	1.41	203.3	0.94	76.0	–	–	–	–	–	–
6.3	22.7	392	523	654	785	–	–	1.47	219.3	0.98	81.9	–	–	–	–	–	–
6.5	23.4	408	544	680	816	–	–	1.53	235.8	1.02	88.0	–	–	–	–	–	–
7.0	25.2	440	586	733	879	–	–	–	–	1.10	100.9	0.85	54.3	–	–	–	–
7.5	27.0	471	628	785	942	–	–	–	–	1.18	114.6	0.91	61.6	–	–	–	–
8.0	28.8	502	670	837	1.005	–	–	–	–	1.26	129.2	0.98	69.4	–	–	–	–
8.5	30.6	534	712	890	1.067	–	–	–	–	1.34	144.5	1.04	77.6	–	–	–	–
9.0	32.4	565	753	942	1.130	–	–	–	–	1.41	160.7	1.10	86.2	–	–	–	–
9.5	34.2	597	795	994	1.193	–	–	–	–	1.49	177.6	1.16	95.3	–	–	–	–
10.0	36.0	628	837	1.047	1.256	–	–	–	–	1.57	195.4	1.22	104.7	0.97	59.8	–	–
10.5	37.8	659	879	1.099	1.319	–	–	–	–	–	–	1.28	114.6	1.02	65.5	–	–
11.0	39.6	691	921	1.151	1.381	–	–	–	–	–	–	1.34	125.0	1.07	71.3	–	–
11.5	41.4	722	963	1.203	1.444	–	–	–	–	–	–	1.40	135.9	1.11	77.6	–	–
12.0	43.2	753	1.005	1.256	1.507	–	–	–	–	–	–	1.46	146.9	1.16	83.8	–	–
12.5	45.0	785	1.047	1.308	1.570	–	–	–	–	–	–	1.52	158.7	1.21	90.5	–	–
13.0	46.8	816	1.088	1.360	1.633	–	–	–	–	–	–	1.58	170.4	1.26	97.2	–	–
13.5	48.6	848	1.130	1.413	1.695	–	–	–	–	–	–	1.65	183.1	1.31	104.3	–	–
14.0	50.4	879	1.172	1.465	1.758	–	–	–	–	–	–	1.71	195.7	1.36	111.5	1.04	58.4
14.5	52.2	910	1.214	1.517	1.821	–	–	–	–	–	–	–	–	1.41	119.1	1.08	62.3
15.0	54.0	942	1.256	1.570	1.884	–	–	–	–	–	–	–	–	1.45	126.7	1.12	66.3
16.0	57.6	1.005	1.340	1.674	2.009	–	–	–	–	–	–	–	–	1.55	142.9	1.19	74.7
17.0	61.2	1.067	1.423	1.779	2.135	–	–	–	–	–	–	–	–	1.65	160.0	1.27	83.6
18.0	64.8	1.130	1.507	1.884	2.260	–	–	–	–	–	–	–	–	1.75	178.0	1.34	92.9
19.0	68.4	1.193	1.591	1.988	2.386	–	–	–	–	–	–	–	–	–	–	1.41	102.8
20.0	72.0	1.256	1.674	2.093	2.512	–	–	–	–	–	–	–	–	–	–	1.49	113.0
21.0	75.6	1.319	1.758	2.198	2.637	–	–	–	–	–	–	–	–	–	–	1.56	123.8
22.0	79.2	1.381	1.842	2.302	2.763	–	–	–	–	–	–	–	–	–	–	1.64	135.0
23.0	82.8	1.444	1.926	2.407	2.888	–	–	–	–	–	–	–	–	–	–	1.71	146.9
24.0	86.4	1.507	2.009	2.512	3.014	–	–	–	–	–	–	–	–	–	–	1.79	158.8
25.0	90.0	1.570	2.093	2.616	3.140	–	–	–	–	–	–	–	–	–	–	1.86	171.6

Tab. 6-2 Pressure loss table SDR 11 carrier pipes at 80 °C
 Recommended design range for REHAU SDR 11 carrier pipes including REHAU:
 Joining technique: Compression sleeve joining technique

6.4 Heat losses RAUTHERMEX and RAUVITHERM pipes

At a ground temperature of 10 °C, a conductivity of the ground of 1.0 W/mK, a depth of 0.8 m and a pipe spacing of 0.1 m the following heat losses occur at the respective average operating temperature per pipe metre. The specified heat losses apply for 1 m RAUTHERMEX or RAUVITHERM pipe.

Calculation basis

Installation type UNO pipe:	2 pipes underground
Installation type DUO pipe:	1 pipe underground
Pipe spacing for UNO pipe:	$a = 0.1 \text{ m}$
Top fill height:	$h = 0.8 \text{ m}$
Ground temperature:	$\vartheta_E = 10 \text{ °C}$
Conductivity of the ground:	$\lambda_E = 1.0 \text{ W/mK}$
Conductivity of the PUR foam:	$\lambda_{PU} = 0.0216 \text{ W/mK}$
Conductivity of the PE-Xa pipe:	$\lambda_{PE-XA} = 0.38 \text{ W/mK}$
Conductivity of the PE pipe jacket:	$\lambda_{PE} = 0.33 \text{ W/mK}$

Heat losses during operation

$$Q = U (\vartheta_B - \vartheta_E) \text{ [W/m]}$$

U = thermal heat transfer coefficient [W/mK]

ϑ_B = average operating temperature [°C]

ϑ_E = soil temperature [°C]

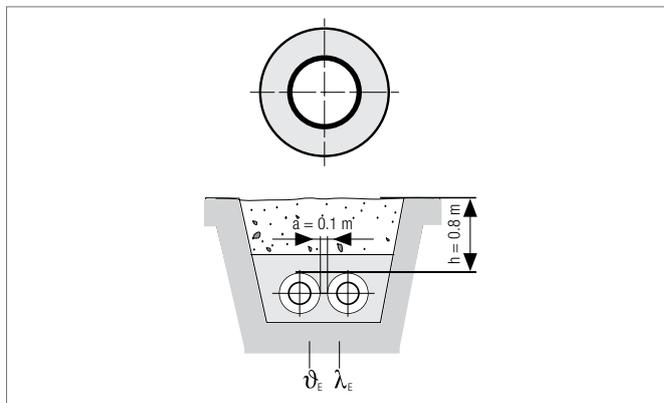


Fig. 6-16 Installation type UNO

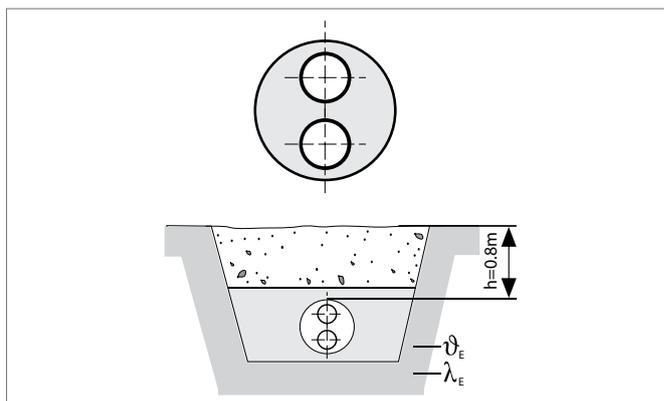


Fig. 6-17 Installation type DUO

Example for the dimension of RAUTHERMEX UNO 63/126:

Flow temperature: $\vartheta_V = 80 \text{ °C}$

Return temperature: $\vartheta_R = 60 \text{ °C}$

average operating temperature: $\vartheta_B = (80 \text{ °C} + 60 \text{ °C})/2 = 70 \text{ °C}$

Read heat loss: $Q = 10.6 \text{ W/m}$

Heat loss with regard to the flow and return : $Q = 10.6 \text{ W/m} \cdot 2 = 21.2 \text{ W/m}$

(for DUO pipes the heat loss can be read directly, the factor of 2 is not required)

RAUTHERMEX UNO	Heat losses Q [W/m]					
	average operating temperature ϑ_B					
	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
25/91	2.0	3.0	4.0	5.0	6.0	7.0
32/91	2.4	3.6	4.8	6.1	7.3	8.5
32/111	2.1	3.1	4.1	5.1	6.2	7.2
40/91	3.0	4.5	6.0	7.6	9.1	10.6
40/126	2.2	3.3	4.4	5.6	6.7	7.8
50/111	3.1	4.7	6.2	7.8	9.3	10.9
50/126	2.7	4.1	5.4	6.8	8.2	9.5
63/126	3.5	5.3	7.1	8.8	10.6	12.4
63/142	3.1	4.6	6.2	7.7	9.2	10.8
75/162	3.2	4.8	6.5	8.1	9.7	11.3
90/162	4.1	6.2	8.2	10.3	12.3	14.4
90/182	3.5	5.2	7.0	8.7	10.5	12.2
110/162	5.9	8.9	11.8	14.8	17.7	20.7
110/182	4.7	7.1	9.4	11.8	14.1	16.5
125/182	6.1	9.1	12.1	15.1	18.2	21.2
140/202	6.2	9.3	12.3	15.4	18.5	21.6
160/250	6.1	9.1	12.1	15.1	18.2	21.2

Tab. 6-3 Example heat loss



RAUTHERMEX UNO	Heat losses Q [W/m] average operating temperature ϑ_b					
	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
25/91	2.0	3.0	4.0	5.0	6.0	7.0
32/91	2.4	3.6	4.8	6.1	7.3	8.5
32/111 ¹⁾	2.1	3.1	4.1	5.1	6.2	7.2
40/91	3.0	4.5	6.0	7.6	9.1	10.6
40/126 ¹⁾	2.2	3.3	4.4	5.6	6.7	7.8
50/111	3.1	4.7	6.2	7.8	9.3	10.9
50/126 ¹⁾	2.7	4.1	5.4	6.8	8.2	9.5
63/126	3.5	5.3	7.1	8.8	10.6	12.4
63/142 ¹⁾	3.1	4.6	6.2	7.7	9.2	10.8
75/162	3.2	4.8	6.5	8.1	9.7	11.3
90/162	4.1	6.2	8.2	10.3	12.3	14.4
90/182 ¹⁾	3.5	5.2	7.0	8.7	10.5	12.2
110/162	5.9	8.9	11.8	14.8	17.7	20.7
110/182 ¹⁾	4.7	7.1	9.4	11.8	14.1	16.5
125/182	6.1	9.1	12.1	15.1	18.2	21.2
140/202	6.2	9.3	12.3	15.4	18.5	21.6
160/250	6.1	9.1	12.1	15.1	18.2	21.2

Tab. 6-4 Heat losses RAUTHERMEX UNO, SDR 11

¹⁾ Plus dimensions with high insulation thickness

RAUTHERMEX DUO SDR 11



RAUTHERMEX DUO	Heat losses Q [W/m] average operating temperature ϑ_b					
	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
25+25/111	2.8	4.2	5.6	7.0	8.4	9.7
32+32/111	3.7	5.5	7.3	9.1	11.0	12.8
32+32/126 ¹⁾	3.1	4.7	6.3	7.9	9.4	11.0
40+40/126	4.2	6.3	8.4	10.5	12.6	14.8
40+40/142 ¹⁾	3.5	5.2	7.0	8.7	10.4	12.2
50+50/162	3.9	5.9	7.8	9.8	11.7	13.7
50+50/182 ¹⁾	3.3	5.0	6.6	8.3	10.0	11.6
63+63/182	4.8	7.1	9.5	11.9	14.3	16.7
63+63/202 ¹⁾	4.2	6.2	8.3	10.4	12.5	14.6

Tab. 6-5 Heat losses RAUTHERMEX DUO, SDR 11

¹⁾ Plus dimensions with high insulation thickness



RAUVITHERM UNO SDR 11 

RAUVITHERM UNO	Heat losses Q [W/m]					
	average operating temperature ϑ_b					
	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
25/120	3.3	4.9	6.5	8.2	9.8	11.4
32/120	3.8	5.7	7.6	9.5	11.4	13.3
40/120	4.5	6.7	8.9	11.2	13.4	15.6
50/150	4.5	6.8	9.0	11.3	13.5	15.8
63/150	5.5	8.3	11.1	13.8	16.6	19.4
75/175	5.7	8.5	11.4	14.2	17.0	19.9
90/175	6.8	10.2	13.5	16.9	20.3	23.7
110/190	8.2	12.2	16.3	20.4	24.5	28.6
125/210	8.5	12.7	16.9	21.2	25.4	29.6

Tab. 6-6 Heat losses RAUVITHERM UNO, SDR 11

RAUVITHERM DUO SDR 11 

RAUVITHERM DUO	Heat losses Q [W/m]					
	average operating temperature ϑ_b					
	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
25+25/150	4.9	7.4	9.8	12.3	14.7	17.2
32+32/150	5.2	7.8	10.4	13.0	15.5	18.1
40+40/150	6.4	9.6	12.8	16.1	19.3	22.5
50+50/175	6.7	10.1	13.4	16.8	20.2	23.5
63+63/210	7.7	11.5	15.4	19.2	23.0	26.9

Tab. 6-7 Heat losses RAUVITHERM DUO, SDR 11



6.5 Temperature and pressure limits

The following pressure limits apply for REHAU SDR 11 carrier pipes for the RAUVITHERM and RAUTHERMEX pipe systems depending on a continuous operating temperature and operating duration:

Operating temperature	Pressure limit for operating duration				
	1 Year	10 Years	15 Years	25 Years	50 Years
40 °C	12.5 bar	12.1 bar	12.0 bar	12.0 bar	11.9 bar
50 °C	11.1 bar	10.8 bar	10.8 bar	10.7 bar	10.6 bar
60 °C	9.9 bar	9.7 bar	9.6 bar	9.5 bar	9.5 bar
70 °C	8.9 bar	8.6 bar	8.5 bar	8.5 bar	8.5 bar
80 °C	8.0 bar	7.7 bar	7.6 bar	7.6 bar	–
90 °C	7.2 bar	6.9 bar	6.9 bar	–	–
95 °C	6.8 bar	6.6 bar	–	–	–

Tab. 6-8 Temperature and pressure limit

In this way the minimum requirements on the endurance properties according to DIN 16892/93 are fulfilled completely. The permitted operating pressures are based on a safety factor of 1.25. Corresponding reference measurements are taken regularly by external testing institutes and the long-term hydrostatic pressure resistance confirmed.



Fig. 6-18 The leak-tightness of the pipes is investigated during the long-term test

6.6 Service life calculation with the Miner's rule

In practice a heating network is operated with changing flow and return temperatures T_1 up to T_n . The resulting service life of the REHAU PE-Xa carrier pipe can be calculated according to ISO 13760 using the Miner's rule. The service life D is calculated using the following formula:

$$D = \left(\frac{f_1/8760}{D_1} + \frac{f_2/8760}{D_2} + \dots + \frac{f_n/8760}{D_n} \right)^{-1}$$

D Service life in years for operation with changing temperatures between T_1 to T_n

D_i to D_n Service life in years for operation at a constant temperatures T_1 to T_n

f_1 to f_n Proportional annual operating hours for operation at an average temperature T_1 to T_n

Example of the service life calculation

A typical temperature collective in heating networks over a year for fluctuating operation is used as a basis:

- Flow fluctuating depending on the time of year	70°C - 90°C
- Return	50 - 55°C
- Operating pressure	6 bar
- 1 Year	365 days = 8,760 h

In the following table only the flow leg that is subjected to a high thermal load is analysed:

Temperature	Operating hours	Service life
T_1 60 °C	f_1 0 h	D_1 50 Years
T_2 65 °C	f_2 0 h	D_2 50 Years
T_3 70 °C	f_3 3,528 h	D_3 50 Years
T_4 75 °C	f_4 840 h	D_4 35 Years
T_5 80 °C	f_5 3,720 h	D_5 25 Years
T_6 85 °C	f_6 504 h	D_6 20 Years
T_7 90 °C	f_7 168 h	D_7 15 Years
T_8 95 °C	f_8 0 h	D_8 10 Years
Total	8,760 h	

Resulting service life D to ISO 13760: 31.3 years

7 INSTALLING DISTRICT HEATING LINES



7.1 Transport and storage



Storage time

To prevent foreign material penetrating the pipes and damage to the carrier pipe from UV radiation, the REHAU district heating pipes must be kept sealed at the cut ends. Contact with potentially damaging substances (see Supplementary sheet 1 to DIN 8075) is to be avoided. REHAU pipes can only be stored in direct sunlight for a limited time. Experience has shown that, in Central Europe, pipes can be stored outside for up to 2 years after manufacture without this affecting the strength of the pipes. For prolonged periods of storage outside or in areas with intense solar radiation, e.g. sea, in southern countries, or at altitudes over 1500 m, the pipes must be protected from sunlight. When covering with tarpaulins, the UV resistance of the pipes must be taken into account and good ventilation of the pipes must be ensured to prevent any build-up of heat. Unlimited storage is possible if the pipes are protected from any light.

Incorrect transport or storage can result in damage to pipes, accessories and fittings, which could affect the functional safety, particularly the excellent thermal insulation properties. The pipes and pipeline components are to be checked for any transport and storage damage before being placed in the trench. Damaged pipes and pipeline components must not be installed. Due to the coiling of the pipes irregular corrugations can occur on the inside of the pipe, which generally do not impair the pipe quality. These disappear once the pipes have been installed.

Transport

Pipe coils are to be transported horizontally, lying completely flat on a load area, and must be secured to prevent slipping. The load area must be cleaned prior to loading.



Lifting with a digger

When lifting a pipe coil, ensure that the lower part of the coil, which is still touching the ground and carrying part of the total weight, is not dragged across the ground or load area. Do not use ropes for lifting, only transport straps of at least 50 mm wide. Take extra care when putting down the pipe coils.



Lifting with a forklift

When using a forklift, ensure that the forks are covered with a soft material (cardboard, plastic tubes). When using plastic tubes, make sure they are secured properly to prevent them from slipping off.



Storage

We recommend storing pipe coils horizontally on wooden planks. This will largely avoid any pipe damage and allow easy lifting of the pipe coils when moved at a later stage. Under no circumstances are pipe coils to be stored on top of sharp-edged objects.



Risk of injury due to the pipe coil falling over!

Pipe coils must not be stored upright due to the risk of them falling. Only store the pipe coils horizontally.



In the case of vertical storage objects in the outer jacket can be pressed into the relatively small supporting surface due to the weight pressure.

7.2 Installation methods

7.2.1 General information

Notes about pipe trenches

The width at the bottom of the trench depends on the external diameter of the pipe, and also whether or not additional accessible working space is required to lay the pipes. It is to be noted that the sizes of the pipe trench influence the size and distribution of the soil and moving loads and therefore the load-bearing capacity of the pipeline.

For REHAU district heating pipes, accessible working space is only required in the area of the sleeve connections, as stipulated in DIN 4124.

The minimum cover over the pipe is 60 cm. The maximum cover is 2.6 m. More or less cover must be confirmed by means of a static load calculation.



Generally the pipes should be installed at the frost protection depth.

The trench base is to be created with a sand bed (thickness 10 cm, grain size 0/4) in the width and depth in such a way, that the pipe lies across the whole length.



Fig. 7-1 Suitable trench base

The base of the trench must not be loose. Before the pipes are laid, any loose, cohesive soil is to be removed down to where the loose soil begins and this is to be replaced with non-cohesive soil or a special pipe support. Loose, non-cohesive soil must be compacted again.



Fig. 7-2 Pipe trench with pipe support

Traffic loads

Laying underneath roads must comply with loading classifications SWL 30 (= 300 kN total load) or SLW 60 in accordance with DIN 1072. With the appropriate surface structure according to the guidelines for the standardisation of the surface structure of traffic areas (RStO) the pipes can be driven over with SWL 60.

Without a traffic load the minimum trench depth T can be reduced to 20 cm (see Section 7.3.1 „Trench widths“) where higher heat losses then occur and, where necessary, special measures must be employed to prevent freezing.

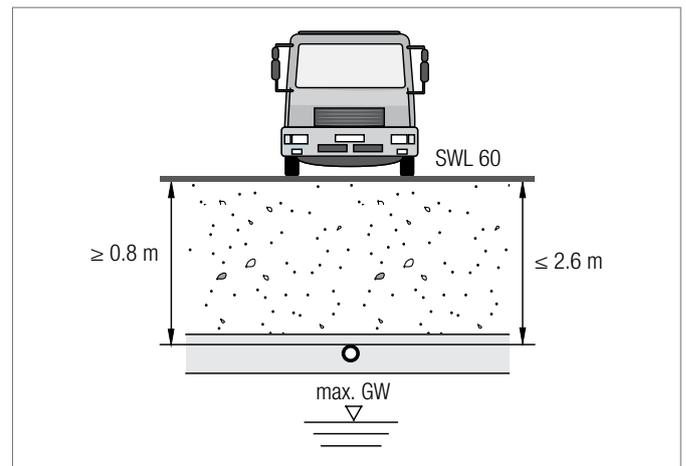


Fig. 7-3 Trench depth in moving loads

7.2.2 Open-cut technique

The standard installation type is the open-cut technique. The pipe trenches can be designed to be very narrow here. Sufficient working space only has to be available at the connection points. The process can be carried out for all soil types and by any civil engineering company.



Fig. 7-4 Installation with the open-cut technique



- Flexible laying without special tools
- Simple and cost-effective
- Additional connections can be made at any time
- Minimum trench width, accessible trench widths are only required at the connection points



- In tarmacked areas the surface needs to be completely reinstated
- The pipe is moved into the open trench without an aid



Fig. 7-5 Schematic diagram open design

7.2.3 Pull-through technique

With the pull-through method, REHAU district heating pipes can be pulled through disused sewers or empty pipes that have already been laid. It also enables the district heating pipe to be pulled through under sewers, pipes and other supply lines very flexibly.



Fig. 7-6 Pipe uncoiling trailer



- Cost-effective laying through empty pipes that already exist or have been installed using horizontal directional drilling
- For RAUTHERMEX high insertion forces can be used due to the composite design. This, in turn, allows large distances to be covered



- When pulling in around sharp edges deflection pulleys must be used in order to avoid damage to the district heating pipe
- Preferably an unwinding device should be used

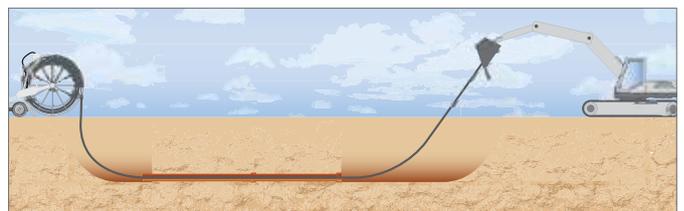


Fig. 7-7 Schematic diagram pull-through technique

7.2.4 Ploughing-in technique for RAUTHERMEX

Using the ploughing-in technique the pipes are laid quickly and without any great effort directly using the ploughing equipment into the ploughed base. The process can be used in largely stone-free soil. For this installation type a specialist firm is required and it is only economic above a length of 500 m.



Fig. 7-8 Installation with a pipe plough



- No need for pipe trenches
- High installation efficiency possible up to 5 km per day, dependent upon the pipe diameter
- Cost-effective installation method for long runs



- The installation is only possible in unsurfaced areas and with RAUTHERMEX
- There must not be any crossing of the pipes in the pipe course
- For installation using the ploughing-in technique there are special firms with the appropriate equipment and know-how
- Can only be used in suitable ground conditions

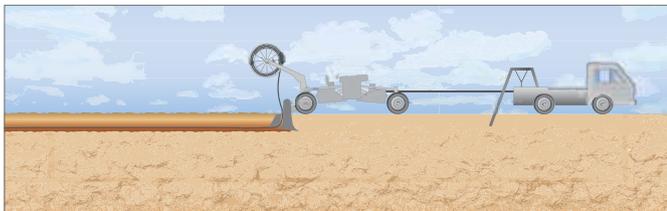


Fig. 7-9 Schematic diagram ploughing-in technique

7.2.5 Horizontal directional drilling technique for RAUTHERMEX

With horizontal directional drilling the drilled-out material is moved out using the rinsing liquid from the borehole. In the opposite direction the pipe is pulled in underground. This is used for complex crossings (building, motorway or river crossings). It generally cannot be used in sandy or very rocky soil.



Fig. 7-10 Installation with horizontal directional drilling unit



- High-quality surfaces can be bypassed cost effectively
- Possible to pass beneath water and frequently used roads
- High installation efficiency with over 100 m per day



- Horizontal directional drilling is only possible with RAUTHERMEX
- The maximum forces that the pipe is subjected to must be below the permitted forces (see Tab. 7-1 "Maximum permitted forces RAUTHERMEX SDR 11")
- The horizontal directional drilling radius depends on the drill pipe, not on the bending radius of the pipe
- The location of existing supply lines must be known exactly so that these can be avoided
- Start and end trenches as well as 6 - 10 m space for the machine will be required
- Pulling in a protective sleeve that has been inserted previously should be favoured over installation using horizontal directional drilling

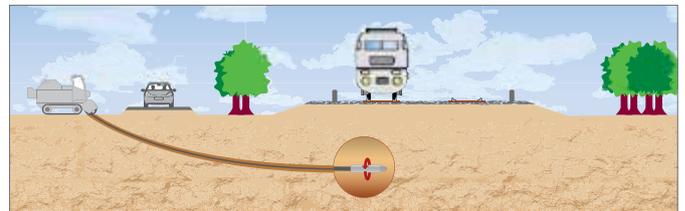


Fig. 7-11 Schematic diagram horizontal directional drilling

Notes about horizontal directional drilling

The connection of the RAUTHERMEX pipe to the drill head must be carried out via the inner pipe or, for DUO, via both inner pipes and the jacket.

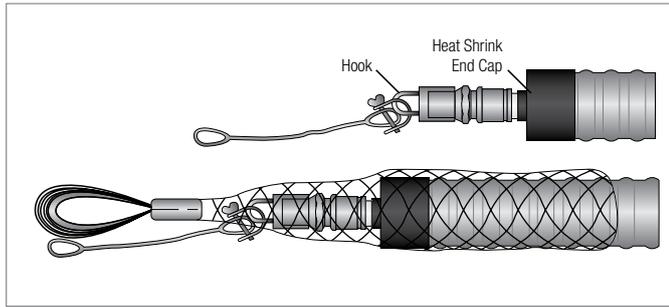


Fig. 7-12 Connecting RAUTHERMEX – drill head



Maximum permitted force that the pipe can be subjected to:

RAUTHERMEX SDR 11	
Dimension	Maximum permitted force [kN]
UNO 25	3
UNO 32	4
UNO 40	5
UNO 50	6
UNO 63	8
UNO 75	9
UNO 90	11
UNO 110	12
UNO 125	14
UNO 140	16
DUO 25+25	5
DUO 32+32	8
DUO 40+40	9
DUO 50+50	11
DUO 63+63	11

Tab. 7-1 Maximum permitted forces RAUTHERMEX SDR 11



Laying RAUVITHERM and RAUTHERMEX in groundwater or temporary standing water is possible in principle, but is not recommended due to the expected increased heat losses. Pipe connections in permanent standing ground water are generally not permitted!

Boggy conditions and marshland

If in boggy conditions and marshland pipes are laid in the area of fluctuating water levels or underneath traffic areas, solid obstacles under the pipes that could influence the bedding of the pipes must be removed. When doing this it must be ensured that there is a sufficient distance from such solid objects.

In the case of a non-load-bearing and heavily water-saturated trench base the pipe must be secured using suitable construction measures, e.g. non-woven material. This also applies if the trench base has varying load-bearing capacity due to varying soil layers.

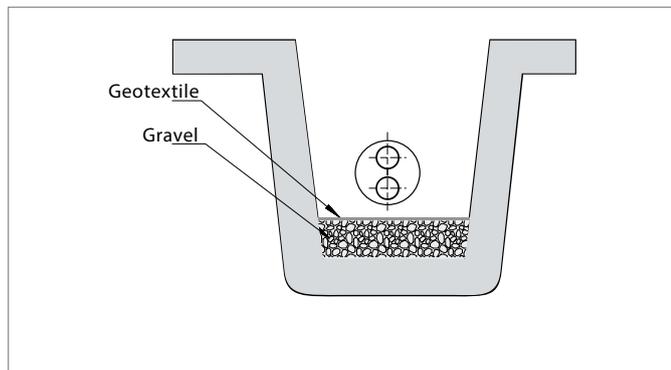


Fig. 7-17 Securing the pipe

Sloped trenches

On slopes, cross brackets are required to prevent the bedding from being washed away. A drain must be provided where necessary.

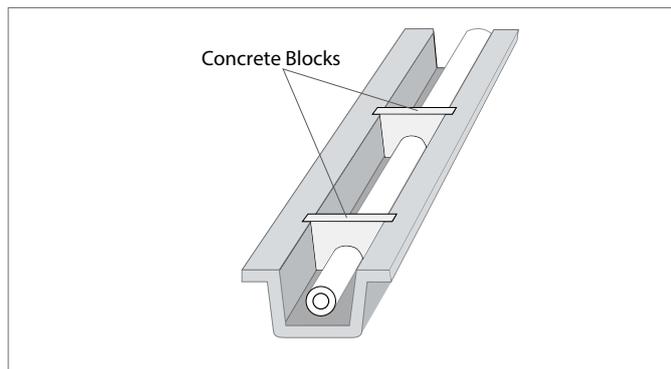


Fig. 7-18 Cross brackets on slopes

The high flexibility of the REHAU pipes allows easy and quick laying. Obstacles can be bypassed and changes of direction in trenches are possible without the need for fittings. However, the minimum bending radii and bending forces according to the Tables in Section 7.5 „Bending radii and bending forces“ are to be observed depending on the pipe temperature.



Fig. 7-19 Passing beneath crossing lines

Where necessary, e.g. laying temperatures below 10 °C or a large pipe diameter, the bundled coils should be warmed up in a heated hall or under a heated tarpaulin.



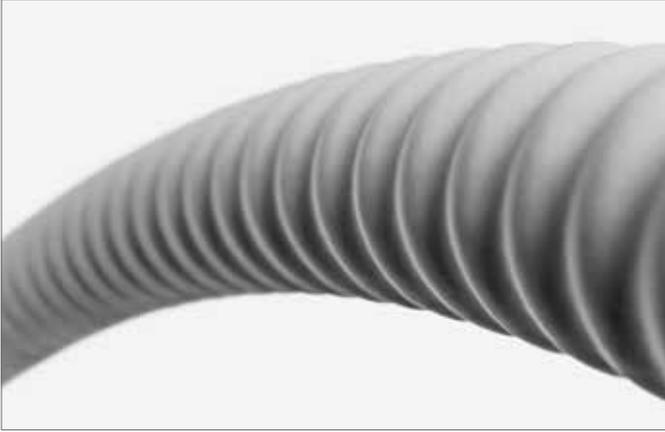
Fig. 7-20 Direction change without fittings



Fig. 7-21 Simple installation due to the flexible pipe routing

7.5 Bending radii and bending forces

7.5.1 Bending radii



If the above bending radii mentioned here are meant to be achieved at lower pipe jacket temperatures, the bend area must be preheated with a low burner. When working at freezing and below the bend area must generally be preheated.



Damage to the pipes

If the minimum bending radii are not met, the carrier pipes may kink or can be damaged.

Note the minimum bending radii, see Tab. 7-3 "Minimum bending radii RAUTHERMEX" and Tab. 7-4 "Minimum bending radii RAUVITHERM".



In order to handle the reduced pipe flexibility at low temperatures at freezing and below, the coil can be warmed up for a few hours in a heated hall or under a heated tarpaulin to facilitate installation.

Minimum bending radius RAUTHERMEX

External diameter D	Minimum bending radius R at 10 °C pipe jacket temperature
91 mm	0.8 m
111 mm	0.9 m
126 mm	1.0 m
142 mm	1.1 m
162 mm	1.1 m
182 mm	1.3 m
202 mm	1.4 m

Tab. 7-3 Minimum bending radii RAUTHERMEX

Minimum bending radius RAUVITHERM

External diameter D	Minimum bending radius R at 10 °C pipe jacket temperature
120 mm	0.9 m
150 mm	1.0 m
175 mm	1.1 m
190 mm	1.2 m
210 mm	1.4 m

Tab. 7-4 Minimum bending radii RAUVITHERM

7.5.2 Bending forces

The outdoor temperature, the pipe composition as well as the pipe diameter have a major influence on the bending and installation forces. The bending forces required in practice are considerably lower for the RAUVITHERM pipe system than for RAUTHERMEX.

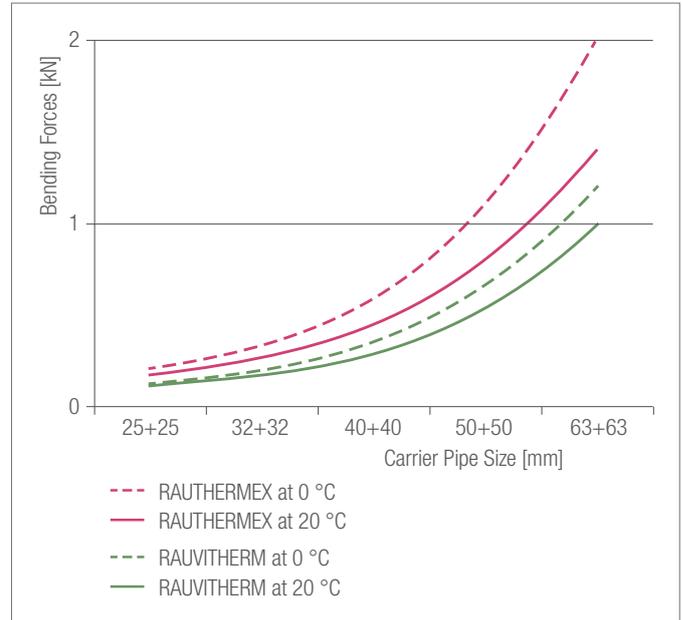


Fig. 7-22 Bending forces DUO

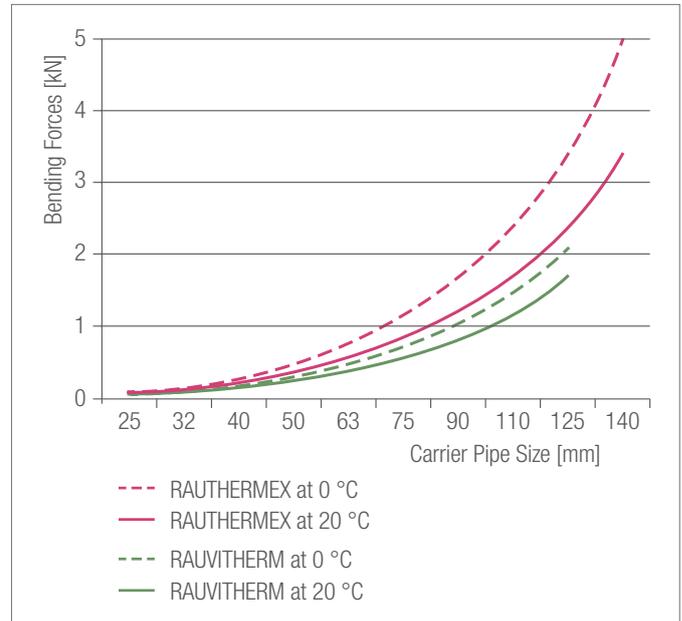


Fig. 7-23 Bending forces UNO



Pipes springing out

When undoing the bundled coil bindings, pipe ends can spring out!
Do not stand in the danger zone.

Cutting the straps

Always cut bindings layer by layer.



Kinking risk

Ensure that the uncoiled pipe section does not twist, as otherwise kinks may form.
The straps are therefore to be opened layer by layer. This also makes it easier to unroll them manually.

Open the coil layer by layer



Uncoiling

For pipes with an outer diameter of up to 150 mm, the coils are usually uncoiled in an upright position. For larger pipe sizes, we recommend using a mechanical uncoiler. The bundled coils can then, for example, be positioned horizontally on the unwinding device and unwound by hand or with a slow-moving vehicle.

For DUO pipes the flow and return must be laid on top of each other so that the side connections can be branched more easily.
Turning the DUO pipes in a partially backfilled trench is only possible in some cases or sometimes not at all. Turn the pipes before backfilling.



Connecting pipes

In the case of couplings and branches it must be ensured that the ends of the pipes run straight toward, or at right angles to the connections if possible (see image left and below).

Between the axis of the pipe to be connected and the sleeve axis the angle α must not be greater than 10° .



Creating the connection elements

In order to have more space to move when creating the jointing technique, these should be completed before the pipe trench is backfilled. When doing this the respective assembly instructions for compression sleeves or insulating sleeve connections must be followed precisely.



Backfilling pipe trenches

Fill pipe trench up to 10 cm over the top of the pipes using sand of grade 0/4 and compact it by hand.

**Apply warning tape**

For better identification during future excavation work, identification tape should be laid 40 cm above the pipes. The identification tape should be labelled “Caution – District Heating Pipeline”. For easier location of the installed pipeline, identification tape with metallic strips can be used.

**Restoring the surface**

Backfill the trench and relay the original surface.

7.7 Special installation situations

Pipe transitions to custom components/foreign systems

With the REHAU jointing technology to create connections to all common custom components (pre-insulated shut-off valve, Y-pipe, welded T-piece, etc.) as well as to foreign systems (e.g. carrier pipes made from steel). See also Section 4.1 to Section 4.3.

The universal REHAU heat-shrink shrouds (see Section 4.4) seal the connection point securely. The heat-shrinkable shroud technology can also be used for smooth outer jackets, e.g. transition from pre-insulated steel pipes or other custom components.



Fig. 7-24 Pipe transitions

Wall assembly/open installation

In the standard case district heating pipes are laid underground, open installation/wall assembly is however possible.

The following are to be noted for open installation/wall assembly:

- Fix pipes with pipe clamps with a spacing of 1 m.
- Protect pipes from sunlight, e.g. with a cover plate.
- Take special fire protection measures where necessary.
- Take additional protective measures against freezing where necessary.

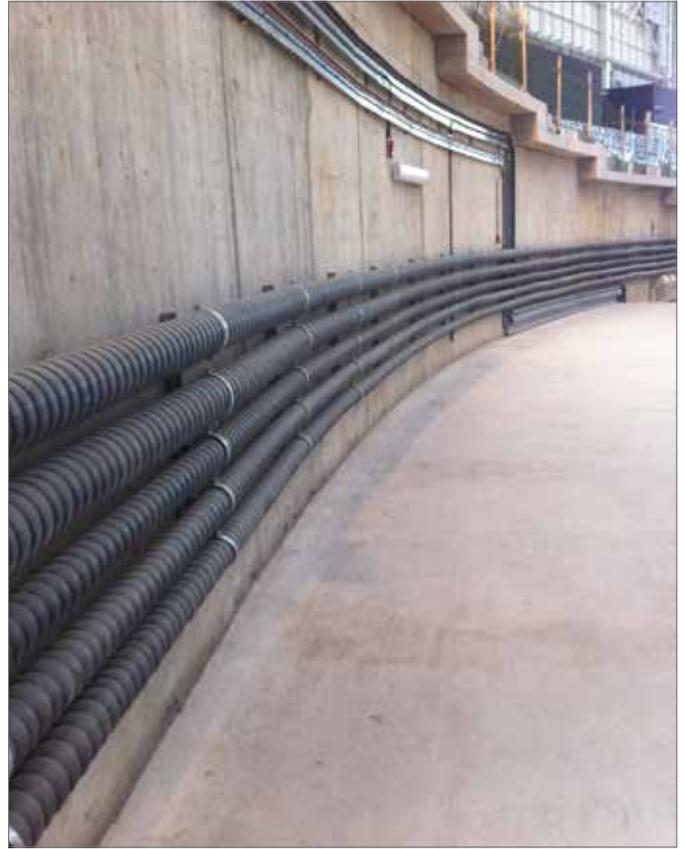


Fig. 7-25 Example open installation/wall assembly

7.8 Tapping into existing lines

When tapping into existing sections of pipe of a district heating network that cannot be shut off or, in the case of repair measures, the carrier pipe can be squeezed before and after the point concerned with squeeze-off tools. The flow of the medium under pressure can therefore be blocked in this way without a pre-insulated shut-off valve.

Squeezing takes place in accordance with the DVGW code of practice GW 332.



Squeezing should not be carried out at outdoor temperature below 5 °C.



Due to the memory effect the carrier pipe goes back to its original shape after being squeezed by itself. Squeezing does not have a negative effect on the carrier pipe.

Following completion of the integration or repair work the squeezing can be removed and expanded. The usual operating pressures and temperatures can then be used again with immediate effect. At the usual operating temperatures of district heating networks the squeezed carrier pipe returns to the original condition very quickly, so that separate rerounding with rerounding clamps is usually not necessary.

The distance between the clamps must be maintained during squeezing, which must be ensured using the limit stop.



Fig. 7-26 Squeezing UNO carrier pipe

Carrier pipe dimension	Minimum spacing of the clamps at the limit stop
25 x 2.3	3.7 mm
32 x 2.9	4.6 mm
40 x 3.7	5.9 mm
50 x 4.6	7.4 mm
63 x 5.8	9.3 mm
75 x 6.8	10.9 mm
90 x 8.2	13.1 mm
110 x 10	16.0 mm

Tab. 7-5 Clamp spacing at a squeezing level of 0.8



Fig. 7-27 Squeezing DUO carrier pipe

7.9 Installation aids

7.9.1 Horizontal unwinding device

To unwind the bundled coils easily, even in tight space conditions, the use of an unwinding device is recommended. The bundled coil is fitted to the unwinding device and can be unwound horizontally. This unwinding device is particularly suited for DUO pipes, as the carrier pipes lie vertically on top of one another in the trench due to the unwinding.

Depending on the basic conditions the unwinding can be carried out in one of two ways:

Mobile horizontal unwinding device on a trailer

The unwinding device can be mobile on a trailer and move alongside the trench. The pipe is unwound directly into the trench.



Fig. 7-28 Mobile horizontal unwinding device on a trailer

Stationary horizontal unwinding device

If you have to pass beneath crossing lines, the unwinding device can be stationary at the end of the pipe trench, where the pipe can be pulled out into the trench.



Fig. 7-29 Stationary horizontal unwinding device at the end of the trench

7.9.2 Vertical unwinding device

For UNO pipes a vertical unwinding device can also be used, as there is only one carrier pipe here. The coil is put into a cage and unwound from there. The vertical unwinding device is also flexible, as it used as a trailer.



Fig. 7-30 Vertical mobile unwinding device

7.9.3 Pipe twisting tool (DUO pipes)

When connecting DUO pipes the carrier pipes must not lie horizontally next to each other but vertically on top of each other. As this is not always the case the pipes must be rotated into the vertical position prior to connection. The pipe twisting tool is used to do this.



Fig. 7-31 Pipe twisting tool

7.10 Average approximate times for installation and assembly in practice.

Laying pipes in open trenches (without groundworks)

	Pipe type	RAUTHERMEX		RAUVITHERM	
		Required work force	Total working time (minutes/metre)	Required work force	Total working time (minutes/metre)
Incl. crossings, obstacles, introducing house connections taking into account the use of a machine for laying the pipe (digger, cable winch, etc.)	UNO 25, 32, 40	2	3	2	3
	UNO 50, 63	2 – 3	5	2	4
	UNO 75	2 – 3	7	2 – 3	5
	UNO 90, 110	3	10	2 – 3	8
	UNO 125, 140	3	12	3	10
	DUO 25, 32, 40	2	5	2	4
	DUO 50, 63	2 – 3	7	2	5

Tab. 7-6 Approximate times for pipe installation

Connecting carrier pipes in open trenches

	Pipe type	RAUTHERMEX		RAUVITHERM	
		Required work force	Total working time (minutes/pc)	Required work force	Total working time (minutes/pc)
Creating a T-branch: Incl. stripping the pipes, assembling the fittings, compression sleeve pressing, sealing ring or heat-shrinkable shroud. Taking into account the use of tools and preparatory and follow-up work typical for a construction site	UNO 25, 32, 40	2	80	2	50
	UNO 50, 63	2 – 3	100	2 – 3	70
	UNO 75	3	140	2 – 3	100
	UNO 90	3	170	3	120
	UNO 110	3	200	3	150
	UNO 125	3	220	4	170
	UNO 140	3	240	–	–
	DUO 25, 32, 40	2	180	2	150
	DUO 50, 63	3 – 4	220	3 – 4	180
Creating an I/L connection: Incl. stripping the pipes, assembling the fittings, compression sleeve pressing, sealing ring or heat-shrinkable shroud. Taking into account the use of tools and preparatory and follow-up work typical for a construction site	UNO 25	2	20	2	20
	UNO 32, 40	2	50	2	40
	UNO 50, 63	2	75	2	65
	UNO 75	2	100	2	80
	UNO 90	2 – 3	110	2	90
	UNO 110	3	130	2	100
	UNO 125	3 – 4	160	2 – 3	130
	UNO 140	3	180	–	–
	DUO 25	2	40	2	30
	DUO 32, 40	2	100	2	70
DUO 50, 63	2	150	2	130	

Tab. 7-7 Approximate times for connecting carrier pipes

Completing the wall entry (without wall penetrations or core drill holes)

	Pipe type	RAUTHERMEX		RAUVITHERM	
		Required work force	Total working time (minutes/pc)	Required work force	Total working time (minutes/pc)
Incl. stripping the ends of the pipes, assembling the end fittings or ball valve, setting the wall sealing ring by backfilling with expansive mortar	UNO 25 – 50	1	50	1	50
	UNO 63 – 110	1 – 2	75	1	65
	UNO 125 – 140	1	90	1 – 2	80
	DUO 25 – 32	1	60	1	50
	DUO 40 – 63	1	80	1	70

Tab. 7-8 Approximate times for completing the wall entry

Insulation of the pipe connections in the trench

Incl. waiting and cooling times, taking into account the use of tools and preparatory and follow-up work typical for a construction site	Dimension	Clip shroud system		Heat-shrinkable shroud system	
		Required work force	Total working time (minutes/pc)	Required work force	Total working time (minutes/pc)
T-branch incl. secondary insulation	Small	1	45	1	60
	Large	1	50	1	70
I/L connection incl. secondary insulation	Small	1	25	1	35
	Large	1	30	1	40

Tab. 7-9 Approximate times for secondary insulation

Fitting custom components

Examples of fitting custom components incl. all preparation, connections and secondary insulation	Pipe type	Clip shroud system		Heat-shrinkable shroud system	
		Required work force	Total working time (minutes/pc)	Required work force	Total working time (minutes/pc)
Complete assembly Y-pipe	DUO 25	2	150	2	150
	DUO 40	2 - 3	310	2	260
	DUO 63	3	380	2 - 3	320
Assembly of the pre-insulated shut-off valve (without backfilling, compacting and protective cover)	UNO 25	2	90	2	90
	UNO 63	2	200	2	180
	UNO 110	3	260	2 - 3	200
	DUO 25	2	140	2	120
	DUO 63	2 - 3	300	2 - 3	220
Complete assembly of lead-in bends (without completing the entry)	UNO 75	2	140	2	120
	UNO 125	3 - 4	230	3 - 4	170

Tab. 7-10 Approximate times for fitting custom components



8 NOTES ABOUT COMMISSIONING AND OPERATION

8.1 Requirements on heating water

8.1.1 General

The conditions for commissioning and operating warm water heating systems have a great influence on the occurrence of corrosion damage and mineral deposits. In order to avoid any damage to the network as a result of this, certain water parameters must be considered and appropriate limit values observed. The pipe system must only be operated using the appropriately suited and treated water. During operation it is imperative to conduct regular checks of the hot water quality.

When using an unsuitable operating medium a variety of damage can occur.

Deposits

Raw water (drinking water, mains water) more or less contains large quantities of gases and salts that have been released. The carbon hardness and the overall hardness of the water are the deciding factors for the formation of deposits. Hardness components are hydrogen carbonates as well as calcium and magnesium ions. Particularly with increasing temperatures precipitation reactions occur that can lead to deposits and blockages in components. Deposits containing iron such as iron oxide and hydroxide (rust) or magnetic iron ore can form in plate heat exchangers or other components.

Corrosion

There are very different types of corrosion and corrosion mechanisms, where most are formed chemically. Here, amongst other things, the chemical composition of the heating water as well as the materials used in the system influence the corrosion. The oxygen content plays a central role in the corrosion of metals. Additionally, the pH value (acid concentration), the acid capacity (buffer capacity) as well as the salt content are influencing factors for the occurrence of corrosion.

In Tab. 8-1 guide values for the water quality of the heating water are listed. A differentiation is made here between low-salt and salty methods of operation:

Properties	Unit	Low-salt		Salty
Electrical conductivity at 25 °C	µS/cm	10 – 30	> 30 – 100	≥ 100 – 1.500
Appearance		clear, free from suspended substances		
pH value ¹⁾ at 25 °C		9 – 10,0	9,0 – 10,5	9,0 – 10,5
Oxygen ²⁾	mg/l	< 0.1	< 0.05	< 0.02
Hardness ³⁾ (alkaline earths)	mmol/l °dH	< 0.02 < 0.1	< 0.02 < 0.1	< 0.02 < 0.1

Tab. 8-1 Guide values water quality heating water to AGFW FW510 or VdTÜV-TCh 1466

¹⁾ Depending on the materials used, for ferrous metals corrosion stops at the specified value

²⁾ Oxygen content < 0,1 mg/l, but as low as possible

³⁾ Recommendation Danfoss water quality guide, according to VdTÜV-TCh 1466 Total hardness < 0,1 °dH

8.1.2 Commissioning

Specialist firms should be commissioned for the preparation of the heating water as well as its testing.

During the operation the water quality must lie within the specified range regarding oxygen concentration, pH value and electrical conductivity. If the guide values for the heating water/district heating water are not observed, appropriate measures are required. As a salty method of operation is common in practice in the area of district heating, the following recommendations apply. In addition to the measures listed the state of the art is to be observed. In particular it is mandatory to apply the specifications of VDI 2035, extracts of which are mentioned here, and in a manner that fits the system.

- The raw water must be completely softened by using cationic exchanger that can be renewed with table salt (NaCl).
- To achieve the pH value sodium hydroxide (NaOH) or sodium phosphate (Na₂PO₄) should be used.
- In the case of professional planning, installation and regular maintenance and servicing it is to be assumed that the oxygen content will be set at values below 0.02 mg/l during regular operation of systems that are sealed to prevent corrosion.
- Sodium sulphite (Na₂SO₃) should not be used for oxygen binding, as with the oxygen binding the sulphite is converted into sulphate and then reduced to sulphide by bacteria. This creates a corrosive environment for copper and stainless steel.
- A higher level of oxygenation is not to be expected in underground RAU-THERMEX or RAUVITHERM heating pipes as a result of using REHAU PE-Xa carrier pipes.
- See also Tab. 3-1 on Page 10, row oxygen-impermeability.
- Prior to commissioning the system must be thoroughly rinsed with treated or fully softened water.
- The pressure test with fill-up water should take place immediately after rinsing.
- Emptying a heating system after a pressure test with raw water should be avoided, as water residue will inevitably be left in parts of the system. The conditions for corrosion reactions are created by the atmospheric oxygen that infiltrates: Small local areas of attack (water line corrosion) form in the area of the three-phase boundary of water/material/air. This initial damage can continue to grow during subsequent operation with the infiltration of oxygen and lead to breaks in the wall. The same processes can also occur in decommissioning with emptying of a heating system or parts of it.
- Temporary use of water/anti-freeze mixtures (e.g. in the construction phase) and the subsequent filling with make-up water without anti-freeze should be avoided.
- The professional installation and commissioning of the pressure maintenance is essential as a corrosion protection measure (see also VDI 4708 Sheet 1). This is the most important technical measure to minimise the ingress of oxygen.
- Complete ventilation of the system at maximum operating temperature is essential to avoid gas cushions and gas bubbles.

- Operational checks with regard to malfunctions, leaks and noises must be carried out following commissioning of the system at the maximum operating temperature.
- The addition of heating water additives (chemicals) is generally only required as a corrosion protection measure in warm water heating systems that have not been sealed against corrosion. The information of the manufacturer of the additive must be noted.
- Additives can promote the formation of a biofilm.

The commissioning parameters must be documented in a system book (e.g. according to Attachment C VDI 2035 Sheet 2). This system book must be handed over to the system operator following commissioning of the system by the installer or specifier. The operator is responsible for keeping the system book as of this time. The system book is part of the system.

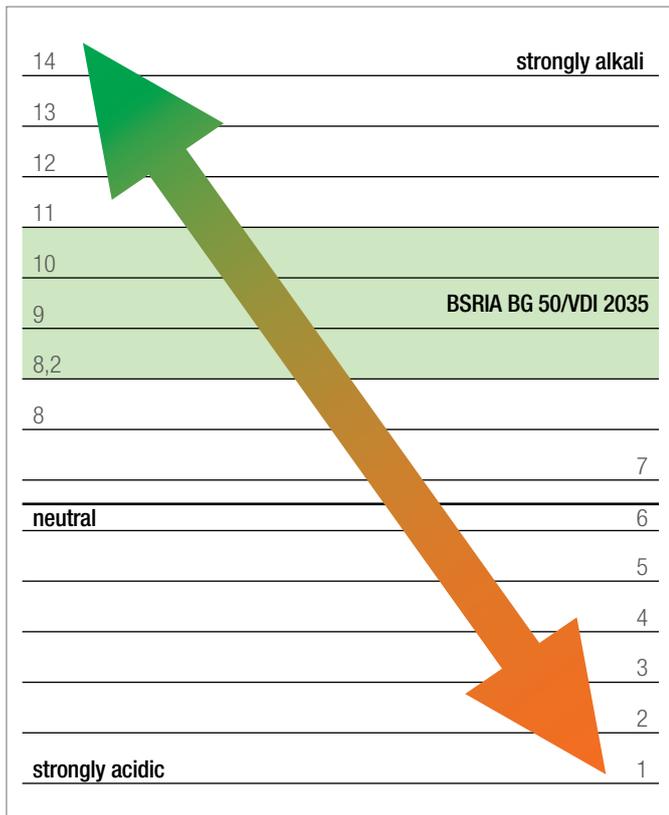


Fig. 8-1 ph-values

8.1.3 Operation, maintenance, servicing

Warm water heating systems must be serviced at least once a year. The operator is responsible for the servicing.

The most important operational servicing measure is checking the system pressure, in particular in order to avoid a negative pressure condition with the ingress of oxygen into the heating water of the system. Not meeting the permitted system pressure during operation is a sign of deficient pressure maintenance or a leak. Appropriate maintenance measures must be carried out.

A shortfall in pressure that is not permitted leads to the formation of gas pockets at the highest point of the system with interruptions to the circulation of the heating water and prevention of heat transfer. After rectifying the pressure maintenance or leak the system must be ventilated and refilled with make-up water.

The following also apply:

- For all systems for which treatment of the fill-up water and make-up water takes place, the conductivity and the pH value must be measured and documented according to the manufacturer's instructions at least once a year. The same applies for systems with more than 600 kW nominal heat output regardless of water treatment.
- If the guide values for conductivity according to Tab. 8-1 on Page 69 are exceeded, measures must be taken to reduce the conductivity (e.g. „depositing“ the heating water).
- In the case of water treatment test parameters and the associated target value ranges must be specified and documented by the specifier or installer.
- The frequency of the tests as well as the actions required in the case of deviations from the target value range must also be specified by the specifier. These must be documented.
- In the case of systems with high make-up volumes (e.g. over 10% of the system content per year) the cause must be investigated immediately and the defect rectified. It is to be noted that, in the case of a constantly high feed of fill-up and make-up water, an increased probability of corrosion also exists for the components in the direction of flow after the inlet point.

8.1.4 Water treatment

Water treatment through the addition of chemicals should be restricted to exceptions.

The selection of water treatment measures and changes to the water treatment requires expert knowledge and should be carried out by specialist firms. All water treatment measures must be accounted for and documented in the system book.

8.1.5 Water sample for external analysis in the laboratory



Scalding hazard

Contact with the emerging heating water can cause serious scalding. Use suitable protective equipment.

The sample container that is used to collect the water sample must fulfil the following requirements:

- At least 1 litre capacity
- Clean and without chemical residue
- Tightly sealing
- Break-proof (e.g. drinking water PET bottle)
- Can be labelled

The sample must be taken from the main flow of the hydraulics. Dead legs must be emptied accordingly for this purpose:

1. Allow at least two litres of system water to run out of the suitable tap.
2. Fill the sample container completely until it overflows.
3. Seal the sample container tightly. There should not be any air in the sample container after it has been sealed.
4. Label the sample container properly in order to ensure clear identification of the sample.

8.1.6 Central filter station

The use of a combined mechanical-magnetic filter in the secondary flow allows the particulate matter (magnetite, Cu chips, etc.) to be filtered out during operation. This prevents any disruptions in the heating network (erosion/corrosion, abrasive effect of Cu chips in plastic pipes, additional mechanical stress in the pumps, magnetite deposits in heat exchangers, blockages in the valves). These foreign materials can end up in the district heating network water in particular in direct house stations if repairs are not carried out properly.

Whilst in a large heating network only 5 - 15 % of the total circulation water in the secondary flow is cleaned, in small circuit systems 100% filtration can also be cost-effective. Here it is however to be borne in mind that with the help of an automatic bypass, it is possible to operate the system even with a clogged, full filter.

One solution option according to VDI 2035

Chemical-free water processing using the example of EnwaMatic® (ENWA Water Treatment UK)

Requirement Sheet 1:

- Simple filling of a heating system with demineralised / fully softened water using a cartridge

Requirement Sheet 2:

- Permanent filter grade of 5 µm with automatic backflush
- Self-regulating pH value setting 9 – 10 for ferrous materials
- Self-reduction of total hardness that is too high
- Bacteria barriers
- Separation of microbubbles

8.2 Pressure and leak-tightness test

8.2.1 Principles of the pressure test



The successful conducting and documentation of a pressure test is a requirement for any claims as part of the REHAU warranty.

For safety reasons it is recommended to carry out the pressure testing of the heating network with water. Testing with compressed air is associated with considerable risks due to the high pipe volume.

According to DIN EN 806-4 and DIN 1988, a pressure test must be carried out on the finished but not yet covered pipes prior to commissioning.

Statements concerning the leaktightness of the system based on the test pressure course (constant, dropping, increasing) can only be made conditionally.

- The leaktightness of the system can only be checked by way of a visual inspection of uncovered pipes.
- Small leaks can only be located by way of a visual inspection (water coming out) at high pressure.

Dividing the heating network system into smaller test sections increases the accuracy of the testing.

8.2.2 Leak-tightness testing with water

Preparing the pressure test with water

1. Pipes must be accessible and must not be covered.
2. Dismantle safety and counting devices where required and replace with pipe pieces or pipe end stops.
3. Fill pipes from the deepest point of the system, excluding any air, with filtered drinking water. Here the water temperature must match the ambient temperature ($\Delta\theta \leq 10$ K ambient temperature to water temperature)
4. Bleed the draw-off points until no air can be determined in the expelled water.
5. Use a pressure testing device with an accuracy of 100 hPa (0.1 bar) for the pressure test.
6. Connect the pressure testing device at the deepest point of the heating network system.
7. Carefully close all draw-off points.



The pressure test can be heavily influenced by temperature changes in the pipe system, e.g. a temperature change of 10 K can cause a pressure change of 0.5 to 1 bar.

Due to the pipe material properties (e.g. pipe elongation with increasing pressurisation) a pressure fluctuation can occur during the pressure test.

The pressure test as well as the pressure course that occurs during the test does not allow any sufficient conclusions to be drawn on the leaktightness of the system. The entire installation, as stipulated in the standards, is therefore to be checked for leaktightness by way of a visual inspection.

8. Make sure that the temperature remains as constant as possible during the pressure test.
9. Prepare the pressure test record sheet and note the system data.

Pressure test for systems with RAUTHERMEX or RAUVITHERM pipes

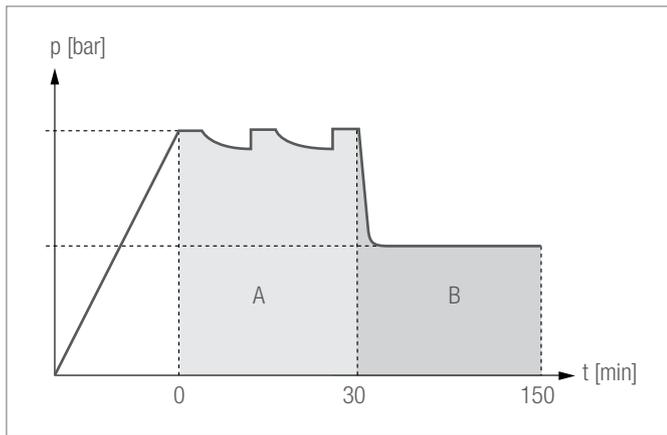


Fig.8-2 Pressure test diagram for RAUTHERMEX and RAUVITHERM pipes according to the ZVSHK code of practice

- A Adaptation time (repressurise where necessary)
- B Pressure test for systems with RAUTHERMEX and RAUVITHERM pipes

1. Build up the test pressure (= 1.1 x max. operating pressure) slowly in the installation.
Example test pressure: 1.1 x 6 bar (at 80 °C) = 6.6 bar
2. Maintain the test pressure for 30 minutes.
Build up the test pressure again where necessary.
3. Note down the test pressure in the pressure test record after 30 minutes.
4. Verify the leaktightness of the entire installation, particularly the connecting points, by means of a visual inspection.
5. Slowly reduce the test pressure to 0.5 x maximum test pressure and note down the test pressure in the pressure test report.
Example reduced test pressure: 0.5 x 6.6 bar = 3.3 bar
6. Read the test pressure after 2 hours and note it down in the pressure test record.
7. Verify the leaktightness of the entire installation, particularly the connecting points, by means of a visual inspection.

If the test pressure drops away:

- Carry out another precise visual inspection of the pipes, draw-off points and connecting points.
- After rectifying the cause of the drop in pressure repeat the pressure test on the system (steps 1-7).

8. If no leaks have been found during the visual inspection the leaktightness test can be concluded.

Concluding the pressure test with water

Following conclusion of the pressure test:

1. The company that performed the test and the client must confirm the pressure test in the pressure test record.
2. Remove the pressure test device.
3. Re-attach the removed safety and metering equipment.

9 STANDARDS AND GUIDELINES



Observe all applicable national and international regulations relating to laying, installation, safety and the prevention of accidents when installing pipe systems, as well as the instructions in this Technical Information.

Also observe the applicable laws, standards, guidelines and regulations (e.g. DIN, EN, ISO, DVGW, TRGI, VDE and VDI) as well as regulations on environmental protection, regulations of the Employer's Liability Insurance Association and specifications of the local public utilities companies.

Areas of application that are not included in this Technical Information (custom applications) require consultation with our technical applications department. Please contact your REHAU sales office for more detailed advice.

The design and assembly instructions relate directly to the REHAU product in each case. Some sections refer to generally applicable standards or regulations.

Please ensure that the guidelines, standards and regulations are the valid issue in each case.

More in-depth standards, regulations and guidelines relating to the design, installation and operation of district heating networks must also be taken into account and do not form part of this Technical Information.

General

AGFW FW420

Fernwärmeleitungen aus flexiblen Rohrsystemen - Systeme aus polymeren Mediumrohren (PMR) [District heating pipes made from flexible pipe systems - Systems made from polymer carrier pipes (PMR)]

ASTM C 1113

Standard Test Method for Thermal Conductivity of Refractories by Hot Wire (Platinum Resistance Thermometer Technique)

BGA KTW

Health assessment of plastics and other non-metallic materials within the framework of the law for foods and commodity goods for potable water applications

DIN 2424 Part 2

Plans for public supplies, for water engineering and for distant heating

DIN 4102

Fire behaviour of building materials and building components

DIN 4726

Warm water surface heating systems and radiator connecting systems - Plastic piping systems and multilayer piping systems

DIN 16892

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

DIN 16893

Crosslinked polyethylene (PE-X) pipes - Dimensions

DIN 53420

Testing of Cellular Materials; Determination of Apparent Density

DIN 53428

Determination of the behaviour of cellular plastics when exposed to fluids, vapours and solids

DIN 53577

Determination of compression stress value and compression stress-strain characteristic for flexible cellular materials

DIN EN 253

District heating pipes - Preinsulated bonded pipe systems for directly buried hot water networks

DIN EN 15632

District heating pipes - Pre-insulated flexible pipe systems

DIN EN ISO 13760

Plastics pipes for the conveyance of fluids under pressure - Miner's rule - Calculation method for cumulative damage

DIN EN ISO 15875

Plastics piping systems for hot and cold water installations - Crosslinked polyethylene (PE-X).

DVGW Worksheet GW 332

Squeezing pipes made from polyethylene in gas and water supply

DVGW Worksheet W 270

Microbial Enhancement on Materials to Come into Contact with Drinking Water
– Testing and Assessment

DVGW Worksheet W 400

Technical rules for water-distribution systems (TRWW)

DVGW Worksheet W 531

Manufacture, quality assurance and testing of pipes made of VPE for drinking-water installation

DVGW Worksheet W534

Pipe connector and pipe connections in drinking water installations

DVGW Worksheet W 544

Plastic pipes in drinking water installation

ISO 1183

Plastics - Methods for determining the density of non-cellular plastics

ISO 11357-3

Plastics - Differential scanning calorimetry (DSC) - Part 3: Determination of temperature and enthalpy of melting and crystallization

ISO 1183

Plastics - Methods for determining the density of non-cellular plastics

Design and installation

DIN 1055

Effects on supporting structures

DIN 4124

Building pits and trenches; slopes, sheeting, working space widths

DIN 8075

Polyethylene (PE) pipes – PE 80, PE 100 – General quality requirements, testing

DIN EN 12831

Heating systems in buildings - Method for calculation of the design heat load

DIN V 4701

Energy efficiency of heating and ventilation systems in buildings

Commissioning

AGFW Worksheet FW 510

Requirements on the recirculated water of industrial and district heating and advice for operation

DIN 1988

Technical regulations for drinking water installations

DIN 18380 (VOB)

VOB General conditions of contract relating to the execution of construction work - Part C: General technical specifications in construction contracts (ATV - Installation of central heating systems and hot water supply systems

DIN EN 806

Specifications for installations inside buildings conveying water for human consumption

DIN EN 1264

Water based surface embedded heating and cooling systems

VDI 2035

Prevention of damage in water heating installations - Scale formation in domestic hot water supply installations and water heating installations

VDI 4708

Pressure maintenance, venting, deaeration

VdTÜV-TCh 1466

Guide values for recirculated water in hot water systems

ZVSHK code of conduct leaktightness testing of drinking water installations with compressed air, inert gas or water

BSRIA BG 50/2013

Water treatment for closed heating and cooling systems

10 REHAU SERVICE



Service via all channels



Advice (technical support)

Already in advance when giving initial consideration to your project we can explain your options on site and, for example, support with presentations and information events.



Personal technical support

We will advise you personally on the telephone and on site. Arrange an appointment with one of our technical specialists.



Sales & technical literature/Internet site

You will obtain detailed information about our product ranges, products and solutions conveniently via the internet (at www.rehau.co.uk/districtheating) but also as a hard copy. We also support the trade with sales promotion tools that are tailored to the target group and professional. Contact us.



Construction site supervision and instruction

Questions about the initial installation of our products? We will be happy to visit you at the site and brief you and your colleagues professionally.



REHAU Academy

The REHAU Academy seminars get to the heart of the most important topics and deliver practical knowledge from the areas of technology, law and sales. Our seminars are held regularly at our training centres, in the REHAU sales offices, but also directly on site with our customers: www.rehau.co.uk

Successful design with REHAU

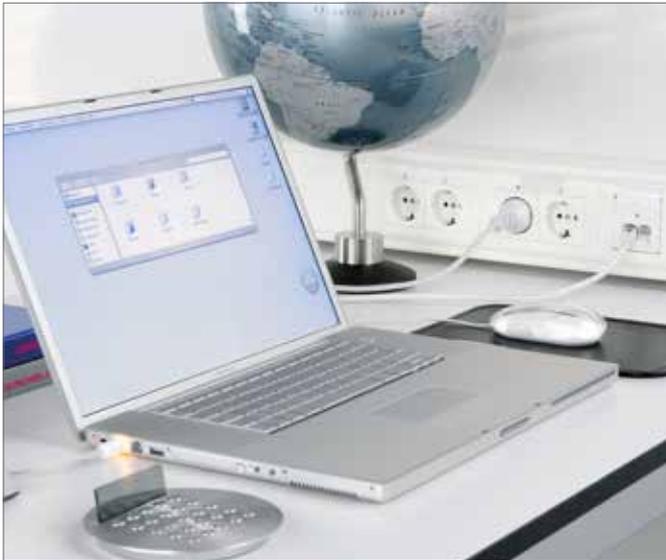
The impressive possibilities of polymer-based solutions provide customers and end consumers with fascinating potential uses. Architects, specifiers and users benefit in the same way as investors and distributors from our system solutions that are aligned ideally to your requirements.

REHAU is an expert partner for ecological and economical future topics such as biogas/wood chip units or district heating supply. As a premium supplier we don't just offer pure product solutions and systems, but also comprehensive service and support.

Already in the design phase REHAU is available to you as a reliable partner from the technical planning through to issuing quotations. Energy efficiency and cost-effectiveness of your construction project are the focus here as well as the technical implementation.

Our design centres in the civil engineering divisions will support you with the preliminary and draft design relating to the project, as well as with the detailed design.

Simply complete the appropriate questionnaire and send it to your local REHAU sales office either online or by fax.



The right partner in an instant

In order to complete your projects to a high standard and on time, you need a reliable, professional partner. We will support you with developing a network, provide you with details of specialist firms that are ideally placed to meet your requirements and will help you to look for bodies to issue energy performance certificates.

For simple requirements the fast online search for specialist firms offers the largest selection on our website. If particular qualifications are required, we will be happy to discuss a recommendation over the telephone and make contact for you.

REHAU partners in your area

We will provide you with:

- REHAU specialist fabricators
- Specialist civil engineering firms in your area
- Engineering offices

Follow REHAU Renewables



Our verbal and written advice relating to technical applications is based on experience and is to the best of our knowledge correct but is given without obligation. The use of REHAU products in conditions that are beyond our control or for applications other than those specified releases us from any obligations in regard to claims made in respect of the products. We recommend that the suitability of any REHAU product for the intended application should be checked. Utilization and processing of our products are beyond our control and are therefore exclusively your responsibility. In the event that a liability is nevertheless considered, then this will be based exclusively on our conditions of sale, which can be seen under www.rehau.de/LZB. This also applies to any warranty claims, whereby the warranty assumes consistent quality of our products in accordance with our specification.

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