PIPE SYSTEMS FOR SUPPLY NETWORKS
FOR RENOVATION AND NEW INSTALLATION

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Subject to technical modifications
www.rehau.com
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Due to a system conversion to SAP in 2012, our article numbers have changed to material numbers.

The previous article numbers have become material numbers with 2 extra digits:
old: 123456-789  (article number)
new: 11234561789  (material number)
To illustrate this, we have visually identified the additional digits: 1  = 1, e.g.: 11234561789

Please note that in the system all quotations, order confirmations, dispatch notes and invoices will largely only be issued with the 11-digit number.
PIPE SYSTEMS FOR SUPPLY NETWORKS
CUSTOMISED FOR ANY APPLICATION

Universal: Pressure Pipes in Polymer Materials
Polymer materials are increasingly superseding the traditional materials of cast iron and steel in the production of pipes. Modern synthetic pressure pipes offer the best requirements for use in the supply of drinking water and gas in local and district heating grids, heating systems and compressed air lines through to wastewater pipes, in private households and local administration areas as well as in the industrial environment. With pressure pipes, the specific advantages of polymer materials are manifested equally in their simple, economical processing and in their reliable everyday operation.

Customised for Any Application
Whether high-density crosslinked PE-Xa for maximum reliability even at increased operating temperatures or robust PE 100-RC for cost-effective installation with no sand filling, the material used can be optimally adjusted for the respective application – so drinking water can be transported to the consumer with no contamination and gas pipes remain absolutely sealed even under extreme conditions. Polymer pipes from REHAU are designed for maximum efficiency and resilience in all installation situations.

Robust, Economical and Safe from the Outset
REHAU pressure pipes in durable polymers guarantee maximum operating reliability over decades. They do not corrode and they display different advantages depending on the pipe material chosen, e.g. such as high notched impact strength, outstanding temperature resistance or the avoidance of stress cracking in the case of point loads. Many REHAU pressure pipe systems are therefore ideally suited to quick, cost-effective, trenchless installation with no sand filling.

REHAU: Pressure Pipes from the Polymer Specialist
As a leading polymer processor with its own research and development, REHAU has decades of experience with polymer materials. The versatile pressure pipe systems from REHAU offer economical and future-proof solutions in certified quality, which are suitable for construction sites for all applications. All components are optimally matched to each other. Customers benefit from comprehensive advice in the planning phase and expert support in the project implementation.
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ADDITIONAL RELIABILITY – PRESSURE
Experience Provides Security

Wherever reliable, efficient and cost-effective pipelines are needed, RAU-PE-Xa pipes are the first choice.

Since 1971, over 750 million metres of RAU-PE-Xa pipes from REHAU have been successfully used in the broadest range of areas worldwide.

To be sure: RAU-PE-Xa pressure pipes for gas, wastewater and drinking water.
Applications:

**For All Current Installation Methods**
- Installation with no sand filling
- Trenchless installation and renovation, e.g.:
  - Ploughing-in
  - Cutting-in
  - Horizontal directional drilling
  - Relining
  - Burst lining

**Extreme Installation Conditions**
- Use in areas of mining subsidence

**Connection Options**
- Electrofusion jointing
- Mechanical connection with off-the-shelf clamp, screw and push fittings

**Water Management**
- For domestic connection or supply/disposal routes that are kilometres long
- Suitable for use in drinking water protection areas
- Suitable for drinking water protection areas 2 and 3

Benefits:

**Cost Saving**
- Ideally suited to quick and cost-advantageous installation techniques with no open trench
- Compactable material of any desired grain size and shape can be used
- Large stock lengths as coils or on drums
- Small bending radii possible due to high flexibility
- Long service life. Long, guaranteed depreciation times

**Very High Operating Reliability**
- Notch depths of up to 20% of the pipe wall thickness permitted
- Coloured identification coating as a visual check of the flaking in the context of welding preparation and as additional UV protection
- Excellent resistance to stress cracking/point loads
- Outstanding chemical resistance

**Convincing Quality**
- German gas and water association (DVGW) certified system
- Constant internal/external checking, incl. external monitoring by SKZ (southern German polymer centre)
- Many years of REHAU experience with respect to reliability
- 10-year guarantee on all integrated PE-Xa pipes possible on request (Germany)
Properties:

- Resistance to notches
- Resistance to point loads
- Stress cracking resistance
- No rapid crack propagation
- High resistance to abrasion
- High notched impact strength at extremely low temperatures
- High flexibility at low temperatures
- Can be used up to a constant temperature of 95 °C
- High recovery capacity (memory effect)
**Resistance to Point Loads**

In the case of pipes in conventional thermoplastics that are not crosslinked, point loads from outside, e.g. due to stones, can cause hairline cracking in the structure. This so-called stress cracking corrosion can cause premature failure of the pipes. As a result of the crosslinking of the molecule chains with RAU-PE-Xa, resistance to the formation of stress cracks is considerably improved by comparison with a pipe in conventional PE 80 or PE 100. PE-Xa pipes therefore offer the greatest reliability in the case of installation with no sand filling.

**Recovery Capacity**

RAU-PE-Xa pipes have excellent recovery capacity. This property, which is also called the memory effect, has a particularly positive impact on the manufacture of mechanical pipe joints. Shape recovery of kinks can be achieved by heating.

**Long-Term Hydrostatic Pressure Resistance**

With polymer materials that are subject to mechanical loads, the creep behaviour must be taken into account. Based on laboratory and practical experience with pipes in crosslinked polyethylene, parameters have been identified, which allow extrapolation of the long-term hydrostatic strength to 100 years. Allowing for a safety factor of 1.5, wastewater pressure pipes with a positive operating pressure of 12.5 bar (SDR 11) are reliable for at least 100 years at 20 °C. With a safety factor of 1.25, SDR 11 wastewater pressure pipes can be pressurised up to 15 bar.
Notch Behaviour
During the underground installation of pipes and possibly also during subsequent operation, notches can form on the pipe surface. These notches grow under mechanical load, whether from internal pressure or soil load, over the service life of the pipes.

The notch depth and the speed at which the notches grow are critical for the life expectancy of such a pipeline. RAU-PE-Xa has significantly greater resistance to the formation of notches and crack propagation than pipes in conventional polyethylene that is not crosslinked.

Long-term internal pressure tests have demonstrated that the minimum service life required by DIN 16892 is significantly exceeded even in the case of notch depths of up to 20% of the pipe wall thickness.

In the FNCT (Full Notch Creep Test), whereby a test piece notched all around is subjected to a constant tensile load of 4 N/mm² in a 2% wetting solution at a temperature of 95 °C, a service life of over 6000 hours was achieved. RAU-PE-Xa pipes are therefore especially suited to trenchless installation techniques, with which damage to the pipe surface is virtually unavoidable.

Rapid Crack Propagation
Rapid crack propagation refers to the tendency of pipes to develop rapidly extending cracks of great length at high pressures, with compressible media and at low temperatures in the case of pipe damage in longitudinal direction.

Even at temperatures down to −50 °C and pressures up to 16 bar, RAU-PE-Xa pipes display no crack propagation. In the case of incomplete ventilation and if there is air in the water, the air present in a RAU-PE-Xa pipeline system cannot cause rapid crack propagation. RAU-PE-Xa pipes are therefore especially suitable for networks with higher operating pressures.

Advantages at a Glance

<table>
<thead>
<tr>
<th></th>
<th>PE-Xa</th>
<th>PE 100</th>
<th>PE 100-RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance to slow and rapid crack propagation</td>
<td>+++</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Resistance to notch formation</td>
<td>+++</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Resistance to point loads</td>
<td>+++</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Flexibility and ease of installation</td>
<td>+++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Thermal resistance</td>
<td>+++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Installation with sand filling</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Trenchless installation</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Shape recovery of kinks</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Low linear expansion</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Long durability even at notch depths of 20%.

High flexibility even on winter construction sites.
High Flexibility  
The high flexibility of PE-Xa pipes, whether cut lengths or coils, allows easy and quick installation. As such, smaller obstacles can be avoided by bending the pipes and changes of direction within the trench are possible without the need to use fittings. Smaller bending radii are possible with RAU-PE-Xa pipes compared with PE 80 or PE 100 pipes.

Coloured Identification Coating  
According to the intended purpose, the colourless RAU-PE-Xa pipes are coated with a coloured identification coating according to the application. This serves both as additional UV protection and as a visual check of the flaking in the context of welding preparation.
Construction projects are frequently associated with high financial outlay and numerous unexpected events. It is good to be able to depend on reliable, hard-wearing systems such as the REHAU pressure pipes in RAU-PE-Xa: one less worry.

REHAU pressure pipes in RAU-PE-Xa are compliant with DIN 16892/16893 and approved under DVGW GW 335 – part A3.
RAU-PE-Xa** Drinking Water Pipes
are the most widely installed REHAU pressure pipes in RAU-PE-Xa.
Uncompromising quality for one of our basic foodstuffs, which must meet the highest demands: our drinking water

<table>
<thead>
<tr>
<th>Operating pressure (bar)</th>
<th>Safety factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDR 11</td>
<td>12.5</td>
</tr>
<tr>
<td>SDR 7.4*</td>
<td>20.0</td>
</tr>
</tbody>
</table>

RAU-PE-Xa** Wastewater Pressure Pipes
complement your water management. Even when laid in sensitive ecological areas, e.g. such as drinking water protection areas, RAU-PE-Xa wastewater pressure pipes give you the necessary reliability that you can trust.

<table>
<thead>
<tr>
<th>Operating pressure (bar)</th>
<th>Safety factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDR 11</td>
<td>15</td>
</tr>
<tr>
<td>SDR 7.4*</td>
<td>24</td>
</tr>
</tbody>
</table>

RAU-PE-Xa** Gas Pipes
Gas supply systems from REHAU stand for safety, reliability and economy. As supply lines for underground installation, the systems are suitable both for conventional trench installation and for trenchless installation. Maximum allowable operating pressure in accordance with DVGW rule G472: 8 bar.

* On request

**Reference:
Compaction guidelines plus product, planning and installation information for RAU-PE-Xa wastewater, gas and drinking water pipes can be found in the section on installation.
RAU-PE-Xa Pressure Pipes

PE-Xa pipes compliant with DIN 16892/DIN 16893 with DVGW registration number

Carrier pipe
Material: RAU-PE-Xa
Colour: Natural (no colouring)
Identification coating
Material: PE-HD
Colour: RAL 5012 light blue

### SDR 11 to 12.5 bar operating pressure (safety factor C = 1.5)

<table>
<thead>
<tr>
<th>Mat. No. 100 m coils</th>
<th>Mat. No. 6 m cut lengths</th>
<th>d mm</th>
<th>s mm</th>
<th>Weight kg/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>136471 100</td>
<td>136471 006</td>
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<td>136481 006</td>
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<tr>
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<td>136491 010</td>
<td>40</td>
<td>3.7</td>
<td>0.425</td>
</tr>
<tr>
<td>136501 100</td>
<td>136501 006</td>
<td>50</td>
<td>4.6</td>
<td>0.658</td>
</tr>
<tr>
<td>136511 100</td>
<td>136511 006</td>
<td>63</td>
<td>5.8</td>
<td>1.040</td>
</tr>
<tr>
<td>136661 100</td>
<td>136661 006</td>
<td>75</td>
<td>6.8</td>
<td>1.450</td>
</tr>
<tr>
<td>136671 100</td>
<td>136671 006</td>
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<td>2.100</td>
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<tr>
<td>136681 102</td>
<td>136681 004</td>
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<td>10.0</td>
<td>3.110</td>
</tr>
<tr>
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<td>136424 006</td>
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<td>136472 006</td>
<td>160</td>
<td>14.6</td>
<td>6.590</td>
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### SDR 7.4 to 20 bar operating pressure (safety factor C = 1.5)

<table>
<thead>
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<th>d mm</th>
<th>s mm</th>
<th>Weight kg/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>On request</td>
<td>On request</td>
<td>40</td>
<td>5.5</td>
<td>0.594</td>
</tr>
<tr>
<td>On request</td>
<td>On request</td>
<td>50</td>
<td>6.9</td>
<td>0.926</td>
</tr>
<tr>
<td>On request</td>
<td>On request</td>
<td>63</td>
<td>8.6</td>
<td>1.450</td>
</tr>
</tbody>
</table>

1) Weights in accordance with DIN 16893/Other sizes on request
**RAU-PE-Xa Wastewater Pressure Pipes**

PE-Xa pipes compliant with DIN 16892/DIN 16893

Quality assurance and inspection on the basis of DVGW rule GW 335-A3

Carrier pipe
Material: RAU-PE-Xa
Colour: Natural (no colouring)
Identification coating
Material: PE-HD
Colour: RAL 8023 orange brown

<table>
<thead>
<tr>
<th>Mat. No.</th>
<th>Mat. No.</th>
<th>d (mm)</th>
<th>s (mm)</th>
<th>Weight (kg/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11136413101</td>
<td>111364131006</td>
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<tr>
<td>11136262101</td>
<td>On request</td>
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<td>6.8</td>
<td>1.450</td>
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<tr>
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<td>111364821006</td>
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<td>2.100</td>
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<td>111360991006</td>
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<td>4.020</td>
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<tr>
<td>11136016101</td>
<td>On request</td>
<td>160</td>
<td>14.6</td>
<td>6.590</td>
</tr>
</tbody>
</table>

1) Weights in accordance with DIN 16893/Other sizes on request

**RAU-PE-Xa Gas Pipes**

Carrier pipe
Material: RAU-PE-Xa
Colour: Natural (no colouring)
Identification coating
Material: PE-HD
Colour: RAL 1018 zinc yellow

Compliant with DIN 16892/DIN 16893 with DVGW registration number

<table>
<thead>
<tr>
<th>Mat. No.</th>
<th>Mat. No.</th>
<th>d (mm)</th>
<th>s (mm)</th>
<th>Weight (kg/m)</th>
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<td>0.269</td>
</tr>
<tr>
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<td>111804911006</td>
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<td>1.040</td>
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<td>125</td>
<td>11.4</td>
<td>4.020</td>
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<tr>
<td>111800011100</td>
<td>111800011006</td>
<td>160</td>
<td>14.6</td>
<td>6.590</td>
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</tbody>
</table>
**PACKAGING TYPES**

**Coils**

<table>
<thead>
<tr>
<th>Standard length 100 m</th>
<th>Internal Ø Approx. m</th>
<th>External Ø Approx. m</th>
<th>Width Approx. m</th>
<th>Weight Approx. kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0.65</td>
<td>1.10</td>
<td>0.16</td>
<td>17</td>
</tr>
<tr>
<td>32</td>
<td>0.80</td>
<td>1.10</td>
<td>0.19</td>
<td>27</td>
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<td>40</td>
<td>0.80</td>
<td>1.20</td>
<td>0.28</td>
<td>43</td>
</tr>
<tr>
<td>50</td>
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<td>1.55</td>
<td>0.25</td>
<td>66</td>
</tr>
<tr>
<td>63</td>
<td>1.20</td>
<td>1.90</td>
<td>0.26</td>
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</tr>
<tr>
<td>75</td>
<td>1.50</td>
<td>2.05</td>
<td>0.40</td>
<td>145</td>
</tr>
<tr>
<td>90</td>
<td>1.75</td>
<td>2.50</td>
<td>0.37</td>
<td>210</td>
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<tr>
<td>110</td>
<td>2.00</td>
<td>2.80</td>
<td>0.45</td>
<td>311</td>
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<tr>
<td>125</td>
<td>2.30</td>
<td>3.00</td>
<td>0.66</td>
<td>402</td>
</tr>
<tr>
<td>160</td>
<td>2.35</td>
<td>3.00</td>
<td>1.12</td>
<td>659</td>
</tr>
</tbody>
</table>

**Timber Frame Crates**

Sizes and weight as required.

**Other Packaging Types**

On request. We are available to advise.

The pipe ends are sealed with end caps.
INSTALLATION WITH NO SAND FILLING – RAU
The solid-walled pipe structure of RAUPROTECT using raw materials from the top quality, non crosslinked material generation PE 100-RC with excellent stress cracking resistance ensures that no crack initiation occurs even in the case of point loads on the inside of the pipe.

Particularly in rural areas where traditional pipe installation is generally associated with high costs, trenchless installation of RAUPROTECT is an ideal, cost-effective alternative. With the use of REHAU drinking water and pressure drainage systems, significant cost savings can be achieved in conjunction with a high level of reliability.
Applications:

Excellently Suited to Modern Installation Techniques:
- Cutting-in
- Ploughing-in
- Steered pipe jacking
- Long-section relining
- Burst lining
- Installation in an open pipe trench with no sand filling
- Suitable for all soil classes
- Areas of mining subsidence
- In water protection areas II and III

Benefits:

Time and Cost Saving:
- Trenchless installation
- Can be laid without cost-intensive soil replacement (trenchless installation)
- The acquisition of bedding material and disposal of excess excavation material are no longer necessary

Reliability:
- High operating reliability
- Quality management
- Material monitored on the basis of drinking water standards
- DVGW approvals
- 10-year guarantee on all integrated RAUPROTECT PE 100-RC pipes possible on request (Germany)
Properties:

Every metre of pipe is quality assured thanks to RQS and traceable due to plain text lettering including traceability barcode that is applied by laser, hard-wearing and durable.

**Scratch Resistant**
Notches in PE 100-RC RAUPROTECT are permitted up to a depth of 20% of the wall thickness with no significant reduction of the service life.

**Heavy-Duty**
RAUPROTECT in PE 100-RC with material resistance that is huge for PE offers short-term ring stiffness of at least 20 kN/m². SDR 11 pipes are even well above this.

**Compatible**
RAUPROTECT pressure pipes can be connected with all off-the-shelf heater coil and clamp fittings or by butt welding.

**Chemically Resistant**
RAUPROTECT pipes in PE 100-RC are particularly resistant when transporting chemically aggressive waste liquids. If the waste liquids carry lyes, acids, saline solutions and alcohols then RAUPROTECT is resistant even at higher temperatures.

Notch depths of up to 20% of the wall thickness permitted.
Service life over 100 years.

Every metre of pipe is quality assured.

**PRODUCT ADVANTAGES**

**Resistance to Stress Cracking**
The solid-walled RAUPROTECT available in PE 100-RC with excellent resistance to stress cracking ensures that no crack initiation occurs even in the case of point loads on the inside of the pipe. This is confirmed by TÜV Süd in its approval of RAUPROTECT in PE 100-RC in accordance with PAS 1075.

**Resistant**
RAUPROTECT in PE 100-RC is particularly resistant to:
- Surface damage from transport and installation
- Point loads from sharp-edged stones/bedding material up to soil class 7
- Stresses in the pipe wall due to external forced loads (soil settlements, route crossings, moving loads)
RAUPROTECT in PE 100-RC Drinking Water

Sizes as per DIN 8074 and DIN EN 12201
Weights as per table KRV, status March 2008
With DVGW registration number
Pipe colour: RAL 9004 deep black
Stripe colour: RAL 5005 signal blue

<table>
<thead>
<tr>
<th>Mat. No.</th>
<th>Mat. No.</th>
<th>d (mm)</th>
<th>s (mm)</th>
<th>Weight (kg/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>131189</td>
<td>131189</td>
<td>63</td>
<td>5.8</td>
<td>1.06</td>
</tr>
<tr>
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SDR 11
Operating pressure 16 bar where $C^{(1)} = 1.25$ / Operating pressure 12.3 bar where $C^{(1)} = 1.6$

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SDR 17
Operating pressure 10 bar where $C^{(1)} = 1.25$ / Operating pressure 7.8 bar where $C^{(1)} = 1.6$

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<th>Weight (kg/m)</th>
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$^{(1)} C$ = Safety factor
Other lengths/sizes on request
RAUPROTECT in PE 100-RC Wastewater

Sizes as per DIN 8074 and DIN EN 13244
Weights as per table KRV, status March 2008
Quality assurance and inspections on the basis of DVGW rule GW 335-A2
Pipe colour: RAL 9004 deep black
Stripe colour: Green

### SDR 11
Operating pressure 16 bar where $C^{(1)} = 1.25$ / Operating pressure 12.3 bar where $C^{(1)} = 1.6$

<table>
<thead>
<tr>
<th>Mat. No. 100 m coils</th>
<th>Mat. No. 12 m cut lengths</th>
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<th>s mm</th>
<th>Weight kg/m</th>
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$^{(1)} C =$ Safety factor
Other lengths/sizes on request

### SDR 17
Operating pressure 10 bar where $C^{(1)} = 1.25$ / Operating pressure 7.8 bar where $C^{(1)} = 1.6$

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$^{(1)} C =$ Safety factor
Other lengths/sizes on request
Coils
Standard length: 100 m
All pipe ends are sealed with end caps.

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Timber Frame Crates  
Standard length: 12 m  
All pipe ends are sealed with end caps.

### RAUPROTECT in PE 100-RC WASTEWATER

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Other Packaging Types  
On request
Under the brand name U-Liner, REHAU supplies the practice-approved close-fit liner for trenchless renovation of pressure lines for drinking water and wastewater as well as unpressurised sewers.

After installation, the liners sit in the old line with no significant annular clearance and autonomously meet the requirements for statics and operating pressures up to max. 10 bar in the same way as new pipes. In the case of greater operating pressures, the U-Liners protect the pipe from internal corrosion and incrustation.
Applications:

Trenchless Renovation of Drinking Water, Municipal and Industrial Wastewater Pipes and Sewers

In Case of Pipe Inaccessibility
- Pipes covered e.g. with concrete slabs
- High pipe density in the ground
- High groundwater levels
- Greater sewer depths

In Areas Sensitive to Construction
- High moving load
- In historic city centres for the protection of the structure
- In water protection zones II and III

To Extend the Operating Life of the Pipe
- Increasing static resilience
- Minimising pipe joints
- Increasing the chemical resistance of the pipe

Benefits:

Economy:
- Significant cost saving potentials of up to 30 \% compared with open installation depending on installation conditions
- Long depreciation periods
- Low maintenance cost
- Maintaining traffic flow
- Using the existing pipe route
- Accessibility of neighbouring properties remains largely preserved
- Tree population, traffic spaces and historic building stock are preserved
Properties:

Product:
- Solid-walled pipe in high quality PE 80 and PE 100 material
- Quality of new pipes with a life expectancy of at least 50 years
- Quality produced and inspected in the plant
- Best hydraulic properties due to smooth internal surfaces
- Guaranteed high static resilience
- Uniform pipe run to minimise pipe joints

U-Liner for Wastewater Pressure Lines:
- SKZ inspected and monitored reliability with operating pressures of up to 10 bar
- Protection of the old pipe against corrosion

U-Liner AC:
- DIBT-approved
- Connection of side junctions with all approved cap seal and compression techniques
- Seal compliant with DIN EN 1610, IKT confirmed
- Resistance to high-pressure rinsing of the pipe system in accordance with DIN 19523, method 2, IKT confirmed

U-Liner AW:
- DIBT-approved
- Chemically and thermally resistant
- Can be high-pressure flushed
- Inner layer that is easy for a camera to inspect

U-Liner RAUSISTO
- Outstandingly high resistance to abrasion
- Increased chemical and thermal resistance
- DIBT-approved

Cost saving potential of up to 30%

Average abrasion values of sewer pipes in various materials in the Darmstadt method

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<th>Material</th>
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<th>Range of measurements on PVC pipes</th>
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<td>RAULINER SEWER</td>
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<tr>
<td>with RAUSISTO</td>
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</tr>
</tbody>
</table>

Load cycles × 100,000

0 2 4 6
PRODUCT ADVANTAGES

Smooth Outside and Inside
With wall roughness of 0.01 mm, U-Liner drinking water and wastewater pipes are considerably smoother than steel, cast iron or concrete pipes and largely compensate for the minimal loss of cross section. If deposits occur in the line due to the media then standard flushing of the pipe is sufficient and the pipes are as good as new.

Chemically Resistant
U-Liners display their strengths particularly in the transport of chemically aggressive waste liquids. If the waste liquids carry lyes, acids, saline solutions and alcohols then U-Liners in PE 100 are resistant even at higher temperatures.
**Unending**
U-Liners are wound unendingly onto a drum up to the largest size of DN 400. This allows a significant saving of storage area on the construction site and a reduction of traffic disruption. The pipe lengths can be laid and removed in one piece. The pipe joints in the line are reduced to a minimum.

**Weldable**
The U-Liners in PE 80 and PE 100 are unconditionally weldable in accordance with DVS. Off-the-shelf fittings are available for the close-fit external diameter after removal. Removed U-Liner pipes can be connected by electrofusion fittings. Domestic connections to removed U-Liners can be created by welding on tapping clamps.

**Minimal environmental and traffic disruption.**

**Reliable pipe branches.**
All variants approved for DIBT sewers.

Greater reliability: pipe quality assurance in the plant.

U-Liner for High-Pressure Water Pipe

**Reliable**
The basic pipes are produced solid-walled in a PE 100 material that is suitable for the application. The material and pipe properties such as ring stiffness, material resistances and dimensions are already set, checked and monitored in the plant during production. In the course of installation, the pipe diameter is adapted to the existing line.

**Professional**
Installation is undertaken by specialist companies with many years of experience, so high installation quality is guaranteed in accordance with the relevant regulations.

**Resilient**
U-Liners for drinking water and high-pressure sewer applications are manufactured in the high-strength material PE 100 and offer pressure capacity of up to 10 bar at 20 °C, as do comparable new pipes.
If there are particularly high demands on the pipes in terms of point load resistance due to fragments in the existing pipe or in the construction trench, we recommend the use of PE 100-RC U-Liners with outstanding resistance to stress cracking.

**Approved**
U-Liners for the area of drinking water are approved by DVGW and their quality is constantly monitored. For the area of high-pressure sewers, the U-Liners are inspected on the basis of the DVGW standards.
U-Liner for Gravity Pipelines

Adhesive
The permanent, coextruded, adhesive inner layer of the U-Liner AC allows the economic use of cap seal and compression techniques for connecting side junctions. Complex, expensive and moreover unreliable weld solutions with the robot have therefore finally been consigned to history.

Securely Stuck
Extensive test results are available to REHAU with respect to the adhesive strength of the inner layer on the base pipe material in accordance with DIN EN 1542. With strength of 3 N/mm², the adhesive strengths are at least twice those of comparable adhesive joints on concrete surfaces.

Abrasion Resistant
If abrasive materials such as stones or grit are transported in the wastewater, the highly abrasion resistant RAUSISTO inner layer ensures a longer service life of the wastewater pipe, particularly in the case of direction changes in the pipe run. Ideal for transporting abrasive substances.

Approved
U-Liners AC and AW are approved by the German Institute for Structural Engineering with effect from 5th February 2010 as a renovation process for underground wastewater pipes in the nominal bore range from DN 150 to DN 400. The approval confirms the high quality of the liners used and the reliability in proper and professional installation of the pipes.

Up to 600 m can be installed per day.
PRODUCT VARIANTS

U-LINER AC
The adhesive, trenchless and economic solution for joining domestic connections. U-Liner AC (adhesive connection) consists of a PE 80 base pipe, which guarantees the load resistance under the static requirements. The permanent, coextruded, adhesive inner layer on the inside of the pipe allows the use of all cap seal and compression techniques for connecting side junctions. Ideal for the renovation of municipal sewers.

U-LINER AW
In addition to the static load resistance, the base pipe in PE 80 material ensures the high chemical resistance of the newly laid pipe. The translucent inner layer allows optimal viewing conditions in the case of sewer inspection and cleaning. Ideal for the renovation of industrial sewers.

U-LINER RAUSISTO
On the inside, the U-Liner displays an inner layer in the material RAUSISTO that is coextruded with the PE 80 base pipe. Whilst the base pipe provides the static load resistance, the RAUSISTO inner layer optimally ensures abrasion resistance to abrasive substances and increases the chemical resistance.

U-Liner for Pressure Lines
In the area of drinking water and wastewater pressure, only materials that are nationally approved and authorised for the respective use are employed. The drinking water U-Liner is approved by DVGW in accordance with GW 335 A2.

U-Liners is a registered trademark of PRS Rohrsanierung GmbH.
### U-LINER for pressure pipes in PE 100**

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<th>SDR</th>
<th>Size</th>
<th>Authorised Op. pressure bar</th>
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<th>External drum diameter m</th>
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* The full material number is defined individually as required according to the packaging.

** Price on request

### U-LINER for gravity pipelines in PE 80**

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<th>SDR</th>
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</table>

Special lengths on request.

* The full material number is defined individually as required according to the packaging.

** Price on request
With maximum reliability due to the innovative jointing technique, REHAU offers a solution for trenchless new installation of sewers both in existing and in new pipe routes.
Applications:

- Increasing static resilience
- Increasing chemical resistance
- Can be laid even on winter construction sites
- Pipes covered e.g. with concrete slabs
- With high moving loads
- Usable even with a high groundwater level

Installation Method

Renovation Method

RELINING
- Use of the existing route without complex approvals
- Easy installation

CALIBRE BURST LINING
- Use of the existing pipe route without complex approvals
- Increasing the static resilience of the pipe
- Reducing location deviations, pipe socket misalignments

New Installation

SOIL DISPLACEMENT
- No soil excavation
- Preservation of the surfaces
- No traffic congestion
- Quick installation
Benefits:

**Time and Cost Saving**
- Space-saving installation method with no disruption to traffic flow
- Significant cost saving potentials of up to 30% compared with open installation
- Long depreciation periods as with new pipes
- Low maintenance cost

**Permanent Function**
- Guaranteed new pipe quality

**Conservation of the Environment**
- Accessibility of neighbouring properties remains largely preserved
- Traffic spaces and historic building stock are preserved and harmful emissions are avoided

**Reliability**
- Quality management
- Inspected pipe quality

Easy, quick installation with screw thread.

Cost saving of up to 30%.
High static resilience with SN >20.

Properties:

High Impact Strength
- Minimising damage from transport and storage
- Can be high-pressure flushed up to 340 bar

Quick Installation
- Due to smooth external surfaces
- No protruding socket joints

Permanently Leak-Free Even in the Case of Deformations and Angles
- Double seal with lip seal as primary seal and Q-TE-C as secondary seal
- Leak-free up to at least 2.5 bar test pressure

High Ring Stiffness > SN 20
- Absorption of all static loads
Stretch and Shear Resistant Jointing Technique
(with Trapezoidal Thread)
- Absorption of high tensile and compression forces in the joint confirmed by SKZ

High Chemical and Thermal Resistance
- Use of filler-free polypropylene compliant with DIN EN 1852
- Operating temperature range from −20 °C to +90 °C (short-term)

Leak-free up to 2.5 bar.
PRODUCT ADVANTAGES

Environmental advantage.

Huge resistance to scratches and grooves.

High Ring Stiffness
AWADUKT PP TL stands out for a high level of stiffness of at least 20 kN/m² (SN20). It therefore has a large reserve compared with standard sewer pipes and significantly exceeds the set requirements with respect to static resilience. Subsequent soil settlement due to construction works near the pipe, location deviations or increased moving loads in the area of the pipe are no longer an issue.

Short installation times
Even with rough or broken pipe walls in the old sewer, the pipes can be continuously pushed or inserted into the sewer pipe without becoming stuck. With two people, the metre-long DN 200 pipes are screwed together in a few minutes and can be pushed up to 80 metres into the sewer with no further aids. Quicker installation can be achieved due to the minimised friction of the pipes on the internal walling of the sewer.

Economical and Environmentally Friendly
Because of the trenchless installation of AWADUKT PP TL, significant cost saving potentials of up to 30 % can be achieved compared with conventional open installation, depending on the conditions on site.
Noise and odour nuisances are limited to a minimum. The accessibility for neighbours is preserved.
If there is already a pipe in place then the pipe route can be used for the new pipeline.
Suitable for winter construction sites.

**Versatile Use**
The tensile and compression forces of the screw connections as confirmed by accredited institutions are particularly advantageous. They allow the pipes to be pushed into the sewer as well as providing support by inserting the pipes if necessary. The sewer pipe system is therefore ideally suited not only to relining by also to boring and bursting processes.

**Leak-Free**
The pipe connections are secured with a double seal: whilst a lip seal provides the seal under standard installation conditions up to 2.5 bar, a secondary Q-TEC-C seal ensures additional reliability under extreme conditions, for example such as greater angles.

**Huge Impact Strength**
In addition to the stiffness, the huge strength and resistance to impact stresses must be mentioned, which allow installation of the pipes even in the cold part of the year.

**Robust and Flexible**
In storage and on the construction site, during transport or handling in the construction trench, when connecting or pushing/pulling the pipes in fragile sewers, AWADUKT PP TL demonstrates its high reserves with respect to mechanical strength, flexibility and scratch resistance. Because of the material flexibility, even jamming of the pipe ends when connecting and corresponding counterpressures do not necessarily result in breaking of the pipe ends.
PRODUCT RANGE

AWADUKT PP TL
Pipes with longitudinally force-locked threaded joint
Material: RAU-PP 2300
Colour: Orange

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<th>BL (mm)</th>
<th>d1 (mm)</th>
<th>e (mm)</th>
<th>Weight (kg/m)</th>
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Thrust plate/jacking heads on request

AWADUKT PP TL Strap Wrench

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The strap wrench must always be ordered in pairs
FLEXIBLE ROUTE USE – RAUJET IN PVC-
RAUJET ducts in PVC-U offer maximum security for your gas, drinking water, telecommunication and power lines to prevent mechanical damage when installing. The RAUJET ducts are laid cost-effectively and simply as jacking pipes using the burst lining and soil displacement methods. The specially moulded, internal socket guarantees a smooth external surface of the pipe to minimise sheath friction.
**Applications:**

Large-scale diversions, temporary traffic lights, traffic jams and superfluous environmental pollution are finally consigned to history due to trenchless installation techniques.

RAUJET ducts from REHAU offer security for your carrier line when installing using the burst lining and soil displacement methods.

With these trenchless installation techniques, the RAUJET ducts can be laid for telecommunication lines, power cables, gas and water pipes with no significant underground construction work.

The specially moulded, internal RAUJET socket produces a smooth external pipe surface on pipes that are pushed together, so the sheath friction affecting the ducts during installation is minimised.

The use of the impact mole technique requires soil that can be displaced in the zone of the pipe as well as sufficient coverage. With recommended minimum coverage of 10 × Ø DR (external diameter of the displacing body), resilience of SLW 60 (100 kN/m²) is guaranteed over the entire RAUJET size range in accordance with ATV-A 127.

**Benefits and Product Advantages**

- Cost-effective protection of the carrier line
- Greatest possible free cross section due to optimised pipe wall thickness
- Static resilience up to SLW 60 (100 kN/m²)
- Specific colour coding depending on application
- Minimisation of sheath friction by internal RAUJET socket and therefore smooth external pipe surface
- Strong and leak-free RAUJET connections due to the use of Tangit adhesive
- Tree population, traffic spaces and historic building stock are preserved
- Reusable route
- Low traffic obstruction and disruption due to smallest construction sites
PRODUCT RANGE AND PACKAGING TYPES

Plant Standard
RAUJET (PVC-U)
Material: RAU-PVC 1109
Installation length: 1000 mm
Other installation lengths on request

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<th>s (mm)</th>
<th>te (mm)</th>
<th>dmax (mm)</th>
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<th>Unit</th>
<th>Unit/ HRV*</th>
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*HRV = timber frame crate

Colour Coding/Warning Notice
RAUJET pipes – with the exception of black – are colour coded for the specific application of the carrier pipe/cable.
The lettering also gives the corresponding warning notice.

Lettering: Colour:
“Caution! Gas line”  Yellow
“Caution! High voltage”  Red
“Caution! Water line”  Blue

*HRV = timber frame crate
PLANNING AND INSTALLING THE
Notes on Planning

Professional Requirements for the Personnel
For planning, construction, building execution, pressure testing and initial operation, the requirements of the current directives, e.g. G472, W400, DWA-A 116 and KRV installation guide, must be observed. The pipeline construction companies to be commissioned to carry out the installation work must hold and have proven the necessary qualifications for this. The qualifications are considered to have been proven if the pipeline construction companies hold the relevant DVGW certification in accordance with DVGW GW 301 and GW 330/GW 331. Particular attention must be paid to observance of EC directive 96/57/EEC and of the construction site ordinance.

Transport
Before loading the pipes onto the lorry, the loading area must be cleaned. There must be no nails, screws or other sharp objects protruding from the loading area. All pipes should be supported over their entire length if possible and not project beyond the loading area. Secure the pipes against slipping! Do not draw the pipes over sharp edges when loading/unloading! Do not drag the pipes over the ground!

Storage
The storage area should be level and allow support over the entire pipe length. Do not store the pipes with stones or sharp-edged objects! RAU-PE-Xa pressure pipes with a yellow, blue or brown identification coating in PE-HD can be stored outside in central Europe for up to 1 year with no effect on the service life of the pipe. From experience, RAUPROTECT pipes can be stored outdoors in central Europe for up to 2 years with no effect on the strength properties. In the case of longer periods of outdoor storage or in areas of strong sunshine, e.g. by the sea, in southern countries or at heights over 1500 m, storage must provide protection from the sun. When covering with tarpaulins, good ventilation of the pipes and fittings must be ensured in order to prevent a heat build-up and therefore deformations. Transparent sheets or tarpaulins are not suitable for covering the pipes. There are no restrictions on storage time in the case of storage with protection from light. Sealing elements should essentially be stored out of the sun and in a cool place.
The height of the pipe stack should be max. 1 m. Secure the pipes from rolling away to the side (risk of accident)!

Coils should be stored flat and not on top of one another.

If the coils are stored standing up, they must be secured at the side to prevent falling over (risk of accident).

Pipes and parts of pipelines must be stored such that they do not become dirty inside. The sealing caps should therefore be removed only on installation. Avoid contact with harmful media (see DIN 8075 supplementary sheet 1)!

After cutting coils or cut lengths, the end caps must be replaced on the pipes remaining in storage.
NOTES ON INSTALLATION

Earthworks
The requirements of DVGW rules G 472/W 400 and DWA-A 116-2 must essentially be followed for earthworks and installation work.

It is not necessary to create a specific bed for installation when excavating the pipe trench.

Checking the Pipes and Pipe Components
The pipes and pipe components must be checked for damage from transport and storage before being placed in the pipe trench. Pipes with grooves, scratches or extensive deposits of over 20% of the wall thickness are not to be installed.

Specific Features in the Processing of Coils

When unwinding the pipes from drums or coils, it must be noted that the pipe ends can spin away when the bindings are released. As significant forces are released particularly in the case of larger diameters, proceed accordingly with caution (risk of accident!)

When unwinding, ensure that the pipe does not twist, otherwise kinks can form.

Minimum Bending Radii
The high flexibility of the pipes, whether cut lengths or coils, allows easy and quick installation. As such, smaller obstacles can be avoided by bending the pipes and changes of direction within the trench are possible without the need to use fittings. The minimum bending radii dependent on pipe temperature must be observed here. Smaller bending radii are possible with RAU-PE-Xa pipes compared with pipes in PE that is not crosslinked.

<table>
<thead>
<tr>
<th>Installation temperature</th>
<th>RAU-PE-Xa</th>
<th>RAUPROTECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 °C</td>
<td>10 × d</td>
<td>20 × d</td>
</tr>
<tr>
<td>10 °C</td>
<td>15 × d</td>
<td>35 × d</td>
</tr>
<tr>
<td>0 °C</td>
<td>20 × d</td>
<td>50 × d</td>
</tr>
</tbody>
</table>

The decrease in flexibility at low temperatures means that the pipes are less easy to unwind/install at installation temperatures around freezing point. In this case, interim storage of the coils in a heated hall or heated tent over a period of a few hours immediately before installation will help with processing. Alternatively, the pipes can be heated by passing warm air or steam through them. When doing this, it must be ensured that the pipes are not made dirty inside.
Squeeze-off Technique
According to DVGW rule GW 332, shutting off the medium flow using the squeeze-off technique is permitted for PE pressure pipes for integration and repair measures – however, practical experience to date is available only for diameters up to 160 mm and wall thicknesses up to 10 mm. The specifications from the datasheet must be observed. The squeeze point must be at least \( 5 \times \) the external diameter away from the next pipe connection. The distance from a previous squeeze point must be at least \( 6 \times \) the external diameter.

Creating Fitting Lengths
The pipes are cut to length either with a pipe cutter or with a fine-toothed saw.

When cutting to length, ensure that the pipes are free of tension! If necessary, apply a fixing to both pipe sections to be separated, otherwise they could spring away (risk of accident!)

Ensure that the cuts are perpendicular to the pipe axis. When sawing, use a cutting jig. Remove burrs and irregularities from the joint faces using a scraper, rasp or similarly suitable tool. When cutting to length and installing, observe the variation in pipe length due to temperature (see initial operation/retrofitting/length variation). If the pipes are laid outdoors, e.g. in a duct, high tensile forces occur at the fixed points as a result of the lengthening or shortening of the pipe due to temperature. The total length of the pipeline must therefore be planned in relation to temperature.
THE FOLLOWING JOINTING TECHNIQUES ARE POSSIBLE:
- Electrofusion jointing (HM)
- Mechanical connection with off-the-shelf clamp, screw and push fittings
- Butt fusion jointing (HS) (RAUROTECT only)

WELDED JOINTS

The pipes can be welded by electrofusion jointing (please observe directive DVS 2207-1 supplementary sheet 1). Both RAUROTECT pipes and standard pipes in PE 100 can be welded. Butt fusion jointing is not yet possible for RAU-PE-Xa pipes at present.

ELECTROFUSION JOINTING (HM)

RAUROTECT and RAU-PE-Xa pipes can be welded with off-the-shelf electrofusion fittings. For installation of the joints, follow the fitting instructions of the fitting manufacturers.

PREPARATION FOR ELECTROFUSION JOINTING

Weld preparation is very important for the weld quality. It is therefore essential to follow the fitting manufacturer’s installation instructions.

Immediately before welding, the machined point on the pipe must be cleaned with a suitable cleaning cloth. Ensure here that no dirt particles from the sections of pipe that have not been cleaned previously are introduced to the weld area with the cleaning cloth.

The external pipe surface must then be removed to a thickness of approx. 0.2 mm by scraping once with a suitable rotary scraper.

The specific structure of RAU-PE-Xa pipes allows simple checking of the scraping process:

If the coloured identification coating is not completely removed after one-off rotary scraping then this is an indication of uneven and possibly inadequate cutting removal. In such cases, it is recommended to remove the rest of the coloured identification coating with a hand scraper. Do not repeat scraping with a rotary scraper, so the external pipe diameter is not reduced to below the minimum size required for proper welding.

Any remains of the coloured identification coating on the RAU-PE-Xa pipe will have no lasting effect on the weld quality.

In cases where use of a rotary scraper is not possible, e.g. in confined spaces in the pipe trench, the use of a hand scraper is permitted. For such exceptional cases, it is recommended to fully remove the coloured identification coating from the RAU-PE-Xa pipes in the area to be worked on. This guarantees that enough material has been removed in order to be able to create a proper weld.

The coloured identification coating of the RAU-PE-Xa pipes thus offers a visual option for checking in order to ensure optimum welding.

Unlike conventional pressure pipes in PE 80 or PE 100, RAUROTECT in PE 100-RC displays a permanently applied label strip on the outside of the pipe, which carries both plain text lettering in accordance with the standard and the traceability barcode for complete traceability.

The current rotary scrapers generally follow the external contour of the pipe to be processed. In the area of the label strip on a RAUROTECT pipe, a slight discontinuity may remain, which nevertheless represents no problem for the durability of the joint. After one-off scraping with a functional rotary scraper, any remains of the strip still present should be fully removed using an ordinary scraper.

The coloured identification coating of the RAU-PE-Xa pipes thus offers a visual option for checking in order to ensure optimum welding.

Butt fusion jointing (HS)

With this method, RAUROTECT in PE 100-RC can be welded to standard pipes in PE-HD. To do this, the pipe ends are heated on a heated plate and butt jointed by pressing together.
Planning and Installing the Pressure Pipes
Pressure Test
Initial operation of the line may take place only once the pressure test processes in accordance with DVGW worksheet G 472/G 469 have been conducted faultlessly in observance of the specifications in DIN EN 12327 for gas, W 400-2 for water and DWA-A 139 for wastewater.

To keep the cost as low as possible for finding and eliminating any leaks, the length of the pipe section to be tested should not exceed a reasonable size. Moreover, the line should be covered only sufficiently for the effects of temperature on the result of the pressure test to be largely eliminated. The connection points should remain accessible as far as possible.

Corrosion Protection of Metallic Accessories
Corrosion protection compounds that are hot or that contain solvents must not come into contact with the pipe. If sealants and lubricants containing fat are used then the pipes must be protected from direct contact by means of sheaths that are impermeable to fat.

The processing instructions, particularly concerning the compatibility of the intended corrosion protection agent with PE 100 pipes, are to be obtained from the respective manufacturer. The corrosion protection may be applied only after the pressure test.

Backfilling of the Pipe Trench
When installing, compactable material of any grain size and shape may be used to backfill the pipe trench in the area of the pipeline.

If the pipe temperature is significantly higher than the temperature of the pipe trench due to direct solar radiation, the pipe should be lightly covered before final backfilling of the pipe trench. The remaining backfilling of the pipe trench should be carried out in accordance with the current civil engineering regulations.

Exposed areas of the pipe must be protected with a cover that is impermeable to light or with pipe insulation. For exposed emergency supply lines, RAUPROTECT drinking water pipes can be used as an alternative.
Initial Operation
The stipulations according to DVGW W 291 (A) apply for drinking water pipelines. The pipelines must be cleaned and flushed before initial operation.

Subsequent Installation of Pipe Sections
For the creation of mechanical or electrofusion joints, the line must be tension and pressure free on separation. The latter can be achieved by setting shut-off bladders or squeezing-off the pipeline.
To avoid electrostatic charges, the pipe surface must be kept wet at the work point in the case of mechanical processing of polyethylene pipes carrying gas, e.g. when separating. Use an air purge system (e.g. tapping clamp), to guarantee that no internal pressure from gases can build up during the connection work.

Length Variation in the Case of Temperature Fluctuations
The length variation caused by temperature fluctuations is significantly greater than with metallic pipes.

The following must be taken into account when calculating length variation $\Delta L$:
- Prevalent temperature at the time of installation ($T_1$)
- Lowest and highest expected pipe wall temperature during operation of the system ($T_2$)
- Coefficient of linear thermal expansion
  - For RAU-PE-Xa $\alpha = 1.5 \times 10^{-4} \text{ K}^{-1}$
  - For RAUPROTECT $\alpha = 2.0 \times 10^{-4} \text{ K}^{-1}$

Calculation examples:

<table>
<thead>
<tr>
<th>Pipe length</th>
<th>10 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation temperature</td>
<td>+15 °C</td>
</tr>
<tr>
<td>Lowest expected pipe wall temperature</td>
<td>+5 °C</td>
</tr>
<tr>
<td>Greatest expected contraction</td>
<td>$\Delta L_1 = 10 \times 10 \times 1.5 \times 10^{-4} \text{ K}^{-1} = 15 \text{ mm}$</td>
</tr>
<tr>
<td>Highest expected pipe wall temperature</td>
<td>+20 °C</td>
</tr>
<tr>
<td>Greatest expected extension</td>
<td>$\Delta L_2 = 10 \times 5 \times 5 \times 1.5 \times 10^{-4} \text{ K}^{-1} = 7.5 \text{ mm}$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature Difference from Installation Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAU-PE-Xa</td>
</tr>
<tr>
<td>RAUPROTECT</td>
</tr>
<tr>
<td>$\Delta L_1$ = $10 \times 10 \times 1.5 \times 10^{-4} \text{ K}^{-1} = 15 \text{ mm}$</td>
</tr>
<tr>
<td>$\Delta L_1$ = $10 \times 10 \times 2.0 \times 10^{-4} \text{ K}^{-1} = 20 \text{ mm}$</td>
</tr>
<tr>
<td>$\Delta L_2$ = $10 \times 5 \times 2.0 \times 10^{-4} \text{ K}^{-1} = 10 \text{ mm}$</td>
</tr>
</tbody>
</table>
PLANNING AND INSTALLING THE
U-LINER

Planning and Installing the U-Liner
Applications

The method is used for the trenchless renovation of:

- Steel or cast iron pressure pipes
- Concrete, reinforced concrete, stoneware, fibre cement, cast iron, GRP, PVC-U and PE-HD sewer pipes

The method is suitable if the old pipeline is no longer able to cope with the demands from a hydraulic and static perspective, there are leaks to be mended, the pipeline needs protecting from dirt, and the operating life of the pipe is to be extended.

The method is particularly advantageous in the case of inaccessible holders, a heavy volume of traffic or complex building structures.

In addition to the pipe material, the economic analysis must also take into account all other factors of the construction measure including traffic regulations and environmental constraints, e.g.:

- Protecting the surfaces with minor construction measures
- Protecting the tree population and historic building stock
- Unimpeded traffic flow during the construction measure
- Minimising nuisance to residents
- Avoiding harmful emissions in the atmosphere or groundwater
Planning

Based on the internal diameter of the existing pipeline, the external diameter of the U-Liner is selected to be at least 1.5% smaller than the smallest internal diameter of the old pipeline. Using gauges, the critical points can be localised and removed with the aid of appropriate equipment. The wall thicknesses are measured on the basis of DIN 8074. The minimal reduction of pipe cross section due to the wall thickness of the U-Liner is compensated by eliminating hindrances to the flow, e.g., such as ingrown roots and incrustation and by improving the inner surface of the pipe (k value of the PE pipe is 0.01 mm).

In most cases, the renovation even results in improvement of the hydraulic flow capacity and in a self-cleaning effect. Compared with pipes that are laid using the cut-and-cover method, the loads affecting a liner are lower, as the installation of the liner does not disrupt the balance between the old pipe and the surrounding soil.

The planning is conducted using suitable calculation methods, as described in ATV (general technical regulations) datasheet M 127 “Static calculation for the renovation of sewer channels and pipes with lining and assembly processes”, part 2 as a supplement to worksheet ATV-DVWK-A 127.

The different loads are discussed in detail as examples here: e.g. soil and moving loads, groundwater pressure, support from the old pipe (depending on the CLOSE-FIT result).

The U-Liners can be used both as self-supporting liners, which withstand all loads alone, and as liners that provide additional support with reduced wall thickness, e.g., which absorb only any groundwater load present.

The planning is the responsibility of the planner or installer and must therefore be carried out by professionals trained for such. REHAU accepts no responsibility for improper and incorrect planning services or for damages due to deficient planning.
Installation

Installation is carried out by specialist companies with over 15 years of experience, so high installation quality in observance of the relevant regulations is guaranteed.

The accessibility of the line and the presence of spaces for the steam system, drum lorry, winch and compressor are critical to whether the U-Liners can be laid.

The preparatory work is limited to the creation of starting and target excavations and the cleaning of the line, such that the required free pipe cross section exists for inserting the U-Liners.

In the case of sewer pipes, the existing shafts are used. The U-Liners are inserted from the drum directly into the line to be renovated. There is no need to lay out the pipe run in advance or for butt welding in the case of pipe diameters from DN 200. **This produces space and time savings compared with other pipe run methods.**

The maximum permitted tensile forces in accordance with GW 320-2 must not be exceeded during insertion. With the controlled and documented installation process, up to 600 m can be laid per day. The method therefore guarantees extremely low installation times.
Planning and Installing the U-Liner
Planning and Installing AWADUKT PP TL
Transport and Storage

Proper transport and correct storage must be ensured in order to guarantee the function of the AWADUKT PP TL pipes. The pipes are supplied packaged in skeleton containers or on pallets. Suitable transport equipment must be used for loading and unloading. Tipping and throwing are not permitted. Avoid sagging and impact loads! Grooves and scratches particularly in the area of joints can cause leaks in the screw connection. Pipes, fittings and other joint accessories must be checked on delivery in order to ensure that they are compliant with the planning requirements and display no damage.

All materials must be stored appropriately in order to prevent dirt and damage. This particularly concerns the seals of the AWADUKT PP TL. The secondary seals are supplied in a sealed, watertight bag and must be protected from moisture for the duration of storage until installation. The pipes are to be protected from the sun, e.g. with bright tarpaulins. Provide good ventilation in order to prevent heat build-up under the tarpaulins!

Lowering into the Pipe Trenches

For safety reasons and to avoid damage, appropriate equipment and methods must be used to lower the components into the pipe trenches. The pipes are principally lowered into the pipe trenches by hand due to the light weight of smaller diameters. The pipes must not be thrown into the pipe trenches. When using lowering equipment, ensure that the pipes do not become damaged.
Jointing Technique

For connecting side inlets, we recommend the use of AWADOCK POLYMER CONNECT, AWADOCK T-FLEX or saddle pieces. Connect to concrete shafts with AWADUKT KGF shaft linings. In the case of scratches on the outside of the pipe from the pipe end to be pushed in, we recommend replacing the pipe concerned with a new one that has no surface damage in order to ensure the seal of the shaft joint. To do this, the pipe end can be separated from the laid pipe run at the screw connection. The new pipe must be protected from damage in the planned area of the shaft lining during assembly on the pipe run and when pushing into the shaft lining.

Notes on Installation

The regulations of DWA datasheets ATV-DVWK-A 125 (pipe jacking and related procedures) and ATV-DVWK-A-161 (static calculation of jacking pipes) must be observed. In the case of annular clearances of >5 mm between the external pipe wall and the soil present and in the case of geologically unfavourable conditions, we recommend filling the gap with load-bearing insulating material. In the case of greater tensile forces during installation (e.g. over longer lines), we recommend appropriate tensioning of the pipes. If AWADUKT PP TL is used in steered auger boring, then strong screw joints must be ensured so the thread is not loosened by material movement. Use thrust plates for preliminary pressing of the pipe without damaging the pipe. Insert the plates into the end of the pipe that is connected last and tension with the expander head ahead of the first pipe.

If the AWADUKT PP TL are laid in relining, we recommend the use of a jacking head instead of the expander head in the case of elbows, angles or for example with offset sockets. The jacking head allows support for insertion of the pipes into the existing line by means of tensile force.
Pipes, pipes components and sealants must be checked for damage before being lowered into the pipe trench.

Screw Connection from AWADUKT PP TL

AWADUKT PP TL pipes must be checked for damage to the thread and seal before forming the screw connection. If necessary, clean dirt from the internal and external threads in order to ensure a proper connection. To guarantee a leak-free joint, there must be no dirt on the sealing surfaces (see picture 1).

A grey secondary seal (swelling seal) supplied must be removed from the bag without stretching the seal. Reseal the bag to protect the remaining seals from moisture. To place the secondary seal in the groove provided for this, the seal must be carefully rolled over the external thread up to the groove and with minimal stretch (see picture 2).

The secondary seal must be inserted such that it lies evenly in the groove provided, over the entire circumference of the pipe (see picture 3).
For the screw process, the black lip seal and the inside of the socket ahead of the internal thread must be coated with standard lubricant for plastic pipes (no silicone lubricant). It must be ensured here that the seals are sitting correctly. Do not coat the threads with lubricant (see picture 4).

Now push the pipes together and tighten the screw joints by hand (see picture 5); with two strap wrenches, screw the pipes as far as resistance (see picture 6).
PLANNING AND INSTALLING RAUJET
Planning and Installing RAUJET
1. Soil displacement method
Using an impact mole powered by compressed air, heavily frequented roads, railway embankments, gardens and other surfaces deserving preservation can be underpassed with no trench accurately over a length of 25 m and more.

2. Burst lining method
Gas and water supply pipes can be renovated using the burst lining method with RAUJET pipes. The dynamic impacts of the impact mole destroy the old pipe and displace the fragments into the surrounding earth. In the same operation, the RAUJET pipes, which are tensioned in the soil by means of a chain, are inserted into the soil channel with almost no friction. After a certain time, the relaxation of the compacted soil in the area of the pipe results in good filling of the duct run.

3. Installing the carrier pipe
After installing the RAUJET duct, the carrier pipe or cable can be drawn in with the aid of a conical back-pulling head or sock. For shorter holding lengths, the carrier pipe can also be pushed in. It is recommended to insert the new pipe in the direction of the socket.
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