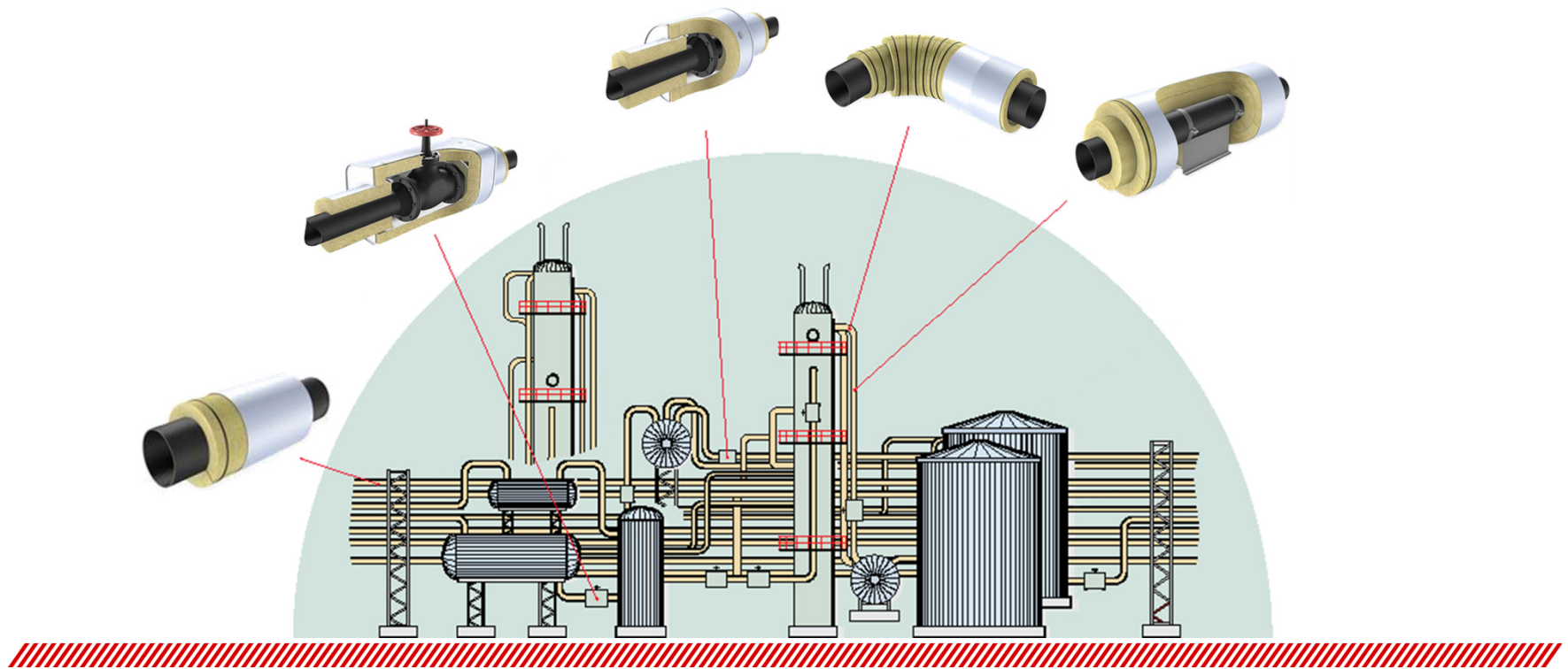




Pipe insulation solutions



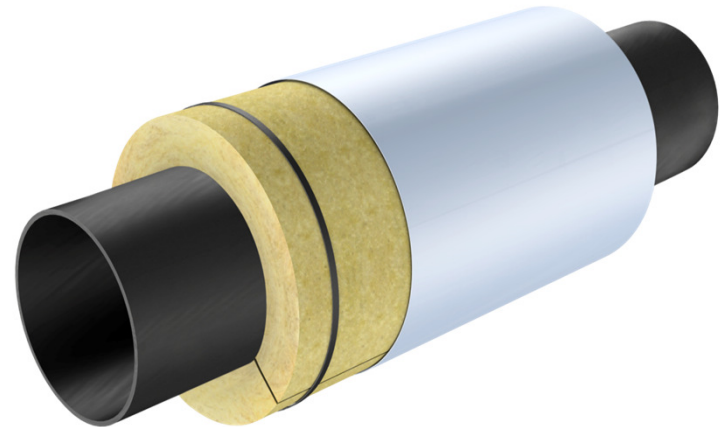
Solutions of pipe insulations



One layer insulation of pipeline

PAROC Pro Section 100

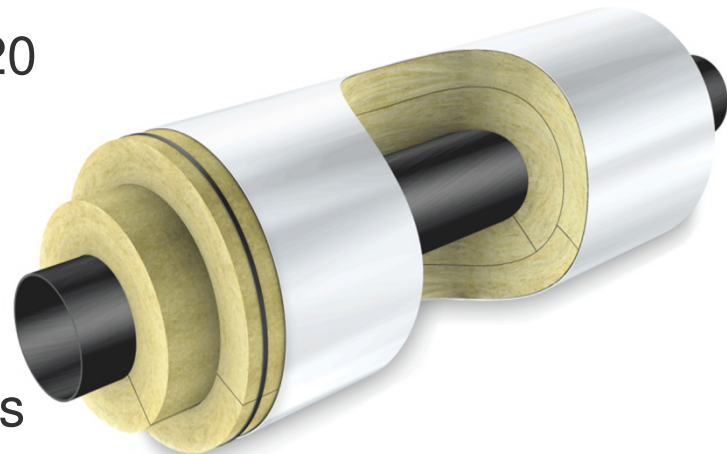
- Solution is suitable for low temperature pipelines up to 250 °C
- Recommended max insulation thickness is 120 mm
- Fixing with metal or plastic bands before cladding



Insulation of high temperature pipeline

PAROC Pro Section DL

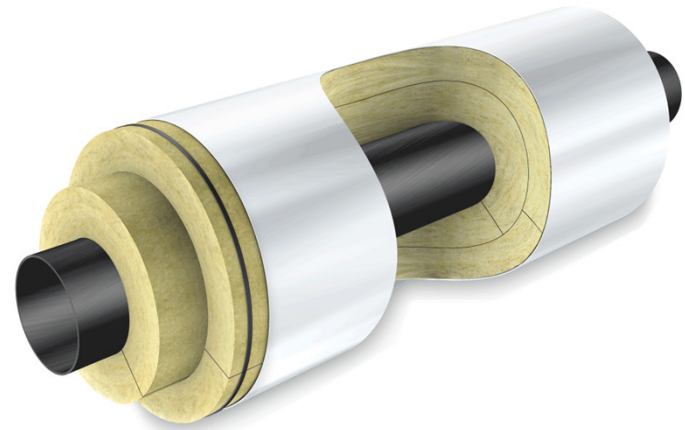
- When total insulation thickness is >120 mm more effective insulation is made with two layers of pipe sections
- Heat expansion of the pipe can open the joints slightly
- The joints should be in different places to prevent direct air gaps
- Alternative product PAROC Pro Lock



Insulation of high temperature pipeline

PAROC Pro Section 140

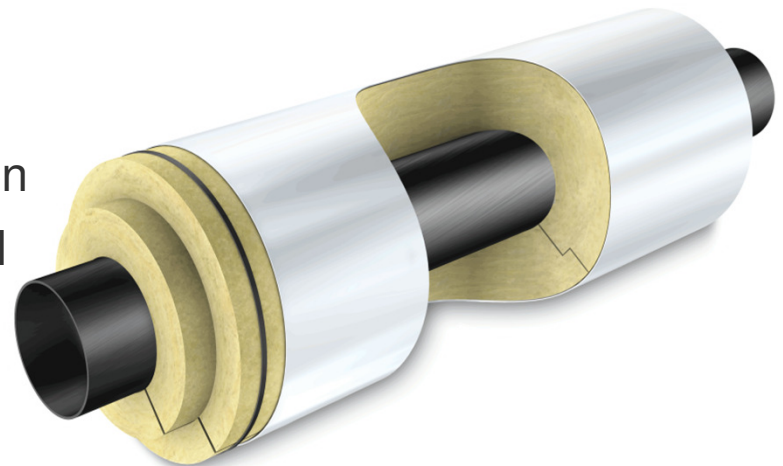
- In temperatures $> 350\text{ }^{\circ}\text{C}$ we recommend high density (140 kg/m^3) pipe sections at least as a first layer
- Thermal conductivity in high mean temperatures is better for high density pipe sections than for normal pipe sections
- The compression strength after heating stays in very good level
- Alternative product PAROC Pro Lock



Insulation of high temperature pipeline

PAROC Pro Lock 100

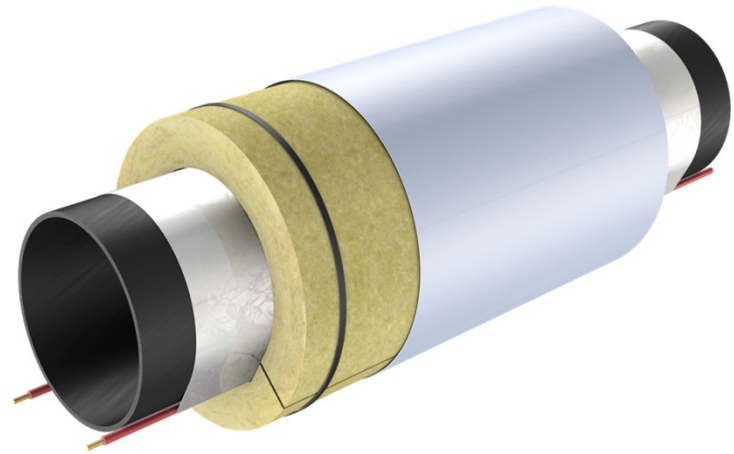
- With one layer PAROC Pro Lock pipe section the same insulation effectiveness can be reached as with two layer insulation
- Z-lock joints in both longitudinal and radial joints
- Less installation work, installation costs and less site down time
- In temperatures $> 350\text{ }^{\circ}\text{C}$ we recommend high density pipe sections like PAROC Pro Lock 140



Insulation of heated pipeline

PAROC Pro Section

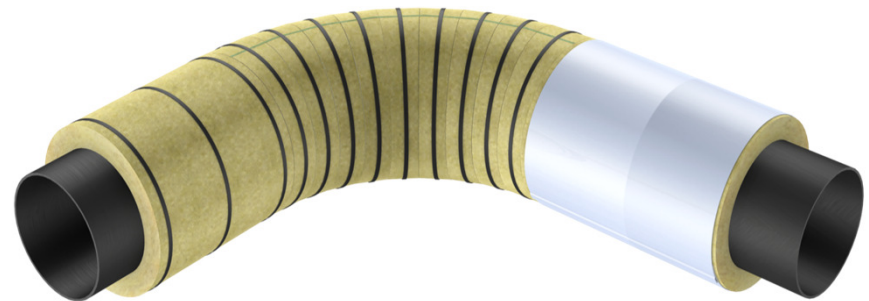
- Long pipelines which are transporting crude oil or other liquids should have heated pipelines to keep exactly right temperature
- It is recommended to cover heating cables or small steam pipes with aluminum foil which expands the heating around the pipe
- After this pipeline can be insulated normally with PAROC Pro pipe sections



Insulation of pipe elbows

PAROC Pro Segment

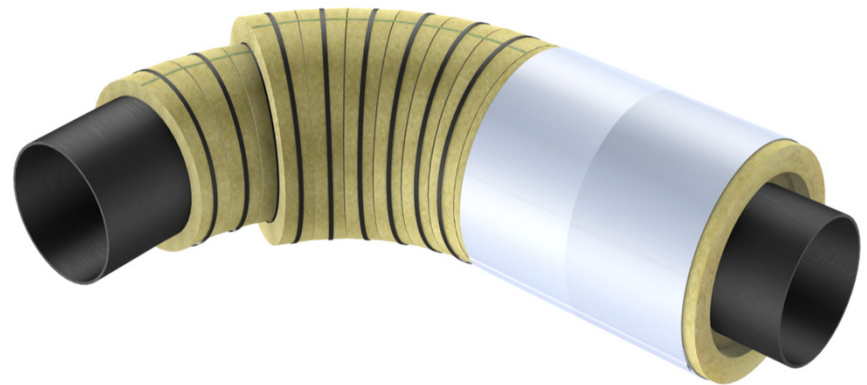
- Prefabricated, dimensionally exact segments fit well on the elbow
- Fixing with metal bands
- Good quality installation work is easy and quick to do
- No support structures needed for the cladding
- No on site clean up due to no need for cut anything



Two layer insulation of elbows

Two layer PAROC Pro Segment

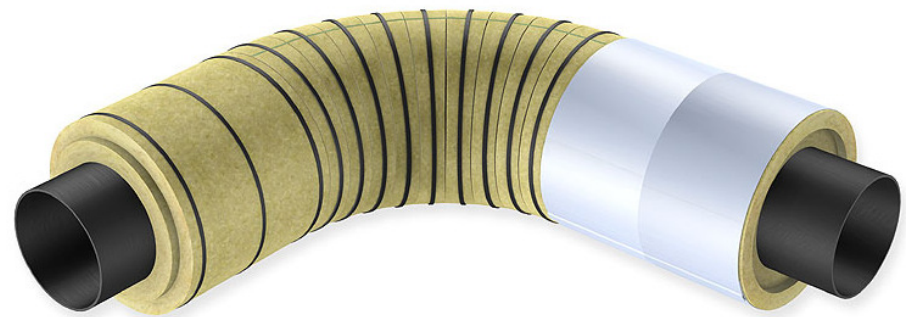
- When using PAROC Pro Lock pipe sections or two layer pipe sections on straight pipelines, the elbows need double layer segments
- Installation of the first layer of segments starts from the male end of PAROC Pro Lock pipe section
- The installation order is shown in a separate slide show
- In temperatures $> 350\text{ }^{\circ}\text{C}$ we recommend PAROC Pro Segment 140 as the first layer



Two layer PAROC segment insulation

PAROC Pro Lock

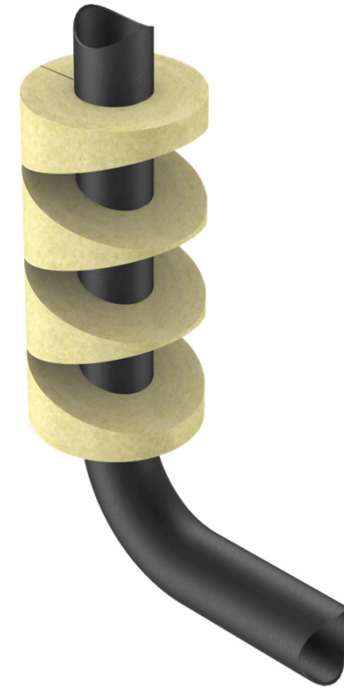
- PAROC Pro Lock segments fit well to elbows due to exact dimensions
- Fixing with metal bands
- Good quality installation work is quick and easy
- Clean installation without cuttings on site
- No support structures needed for the cladding



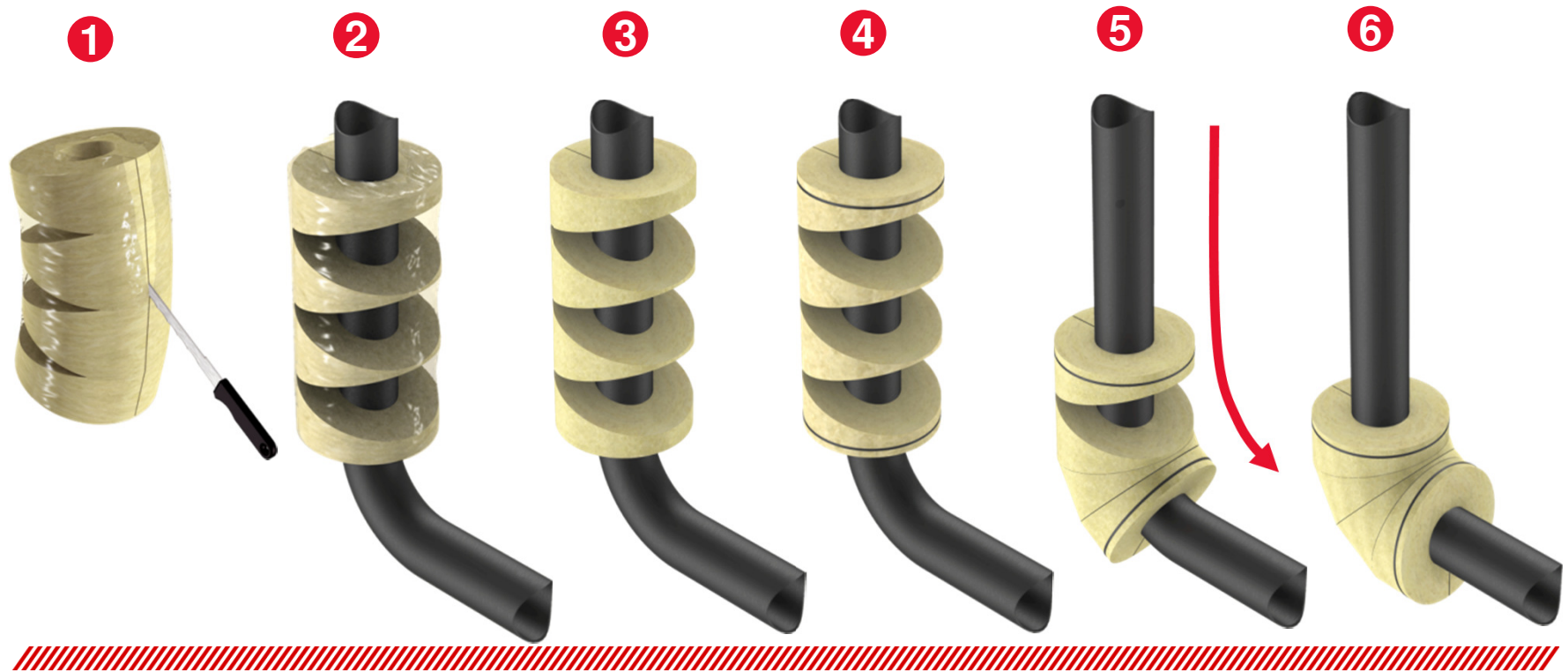
Insulation of small pipe elbows

PAROC Pro Section Bend

- For small pipe elbows we have excellent insulation solution based on preformed components
- The insulation is as effective as pipe section insulation for straight pipes
- It is easy and quick to install in a proper way



Easy installation PAROC Pro Section Bend

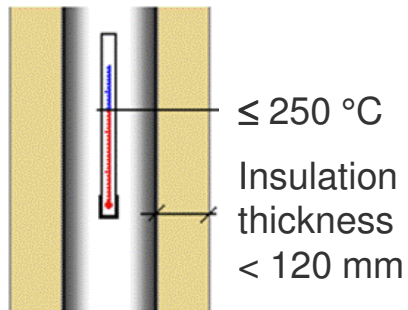


Various insulation solutions for pipelines

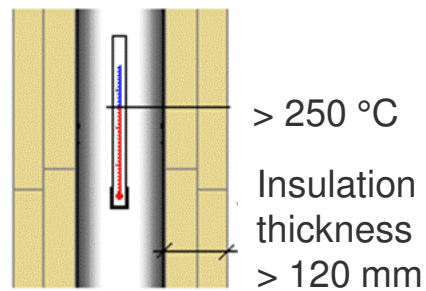
- Two-layer wired mat
 - Needs supporting rings to carry the cladding and maintain the designed space for the insulation
- Two-layer pipe section
 - No supporting structure needed
- One-layer z-lock pipe section
 - No supporting structure needed
 - Thermal expansion of metal pipe does not open the z-lock joints
 - By far the least labour intensive giving a reduction in down-time on the plant

Single and multilayer solutions

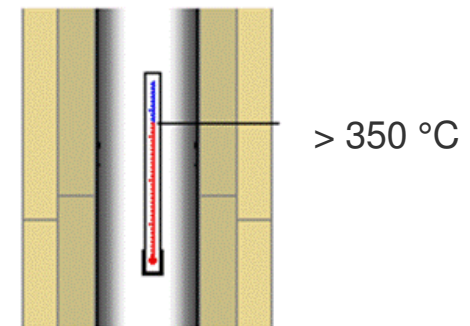
PAROC Pro Section



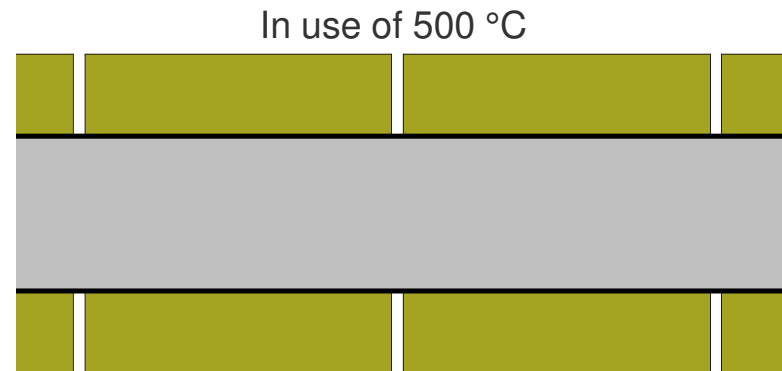
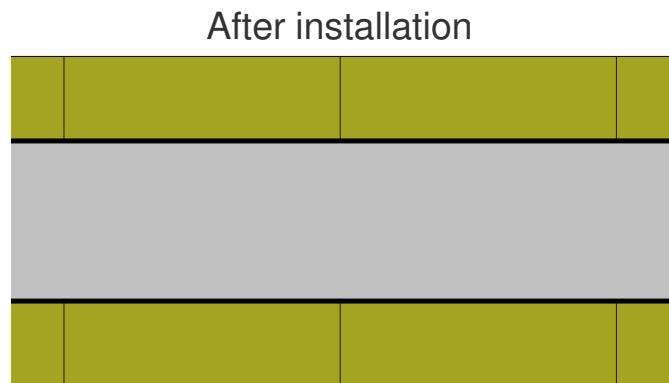
2 x PAROC Pro Section



**PAROC Pro Section 140 +
PAROC Pro Section**



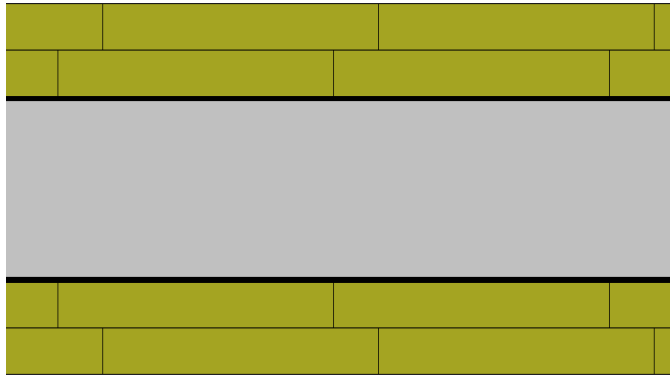
One layer pipe insulation



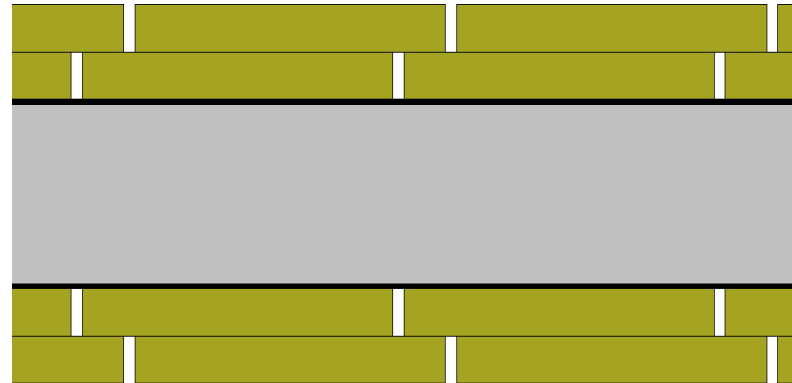
- Pipe sections will be installed in normal outer or inner temperature -20°C - +30 °C
- Heat expansion of metals is about 1mm/100 °C → in 500 °C there can be about 6 mm caps in joints when the length of section is 1,2 m

Double layer pipe insulation

After installation

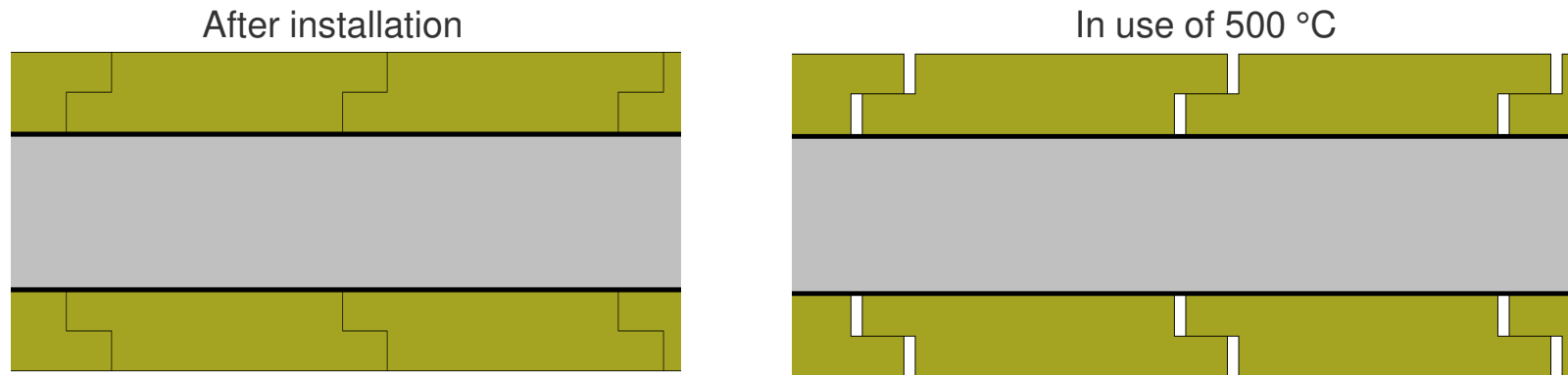


In use of 500 °C



- In two layer solution sections joints are interlaced
- This reduces additional heat loss remarkably

PAROC Pro Lock insulation



- One layer solution with PAROC Pro Lock sections give the same benefit than two layer insulation solution
- Lower installation cost compared to two layer solution

Applications in temperature $>350\text{ }^{\circ}\text{C}$

We recommend high density products with density of 140 kg/m^3 in applications where temperature is $> 350\text{ }^{\circ}\text{C}$

- When the binder has evaporated from the inner part of the wool there has to be enough fibres to keep the insulation thickness and required compression strength
- If the solution is a two or multilayer solution, at least the inner layer should be made using high density product

In one layer solutions and replacing normal two layer solutions we recommend PAROC Pro Lock 140.

PAROC Pro Section 140 for high temperatures

PAROC Pro Section 140
Inner temperature 520 °C after the test



PAROC Pro Lock solution

Two layer pipe section or easier and quicker PAROC Pro Lock solution?

- For high temperature solutions it is required to have double layer insulation
- PAROC Pro Lock can replace two separate layers by having the z-lock in circular and longitudinal joints
- Installation time and costs are the same as for normal one layer insulation - installation of double layer insulation takes about **30 %** more time

Recommended insulation products

Temp. °C	Straight pipes	Pipe elbows
≤ 250	PAROC Pro Section 100	PAROC Pro Segment 100
≤ 250	PAROC Pro Lock 100	PAROC Pro Segment 100 DL ²⁾
> 250	PAROC Pro Section 100 DL ¹⁾	PAROC Pro Segment 100 DL ²⁾
> 250	PAROC Pro Lock 100 + PAROC Pro Section 100	PAROC Pro Segment 100 DL ²⁾ + PAROC Pro Segment 100
> 350	PAROC Pro Lock 140 + PAROC Pro Section 100	PAROC Pro Segment 140 DL ³⁾ + PAROC Pro Segment 100

**In applications where temperature is over 350 °C,
we recommend high density products (140 kg/m³).**



Design values

Operating temperature	530 °C
Average yearly ambient temperature	20 °C
Average mean temperature of the insulating material	290 °C
Wind speed	0 (no wind)
Outer diameter of the pipe	406 mm
Selected insulation thickness	160 mm
Cladding material	Galvanised steel

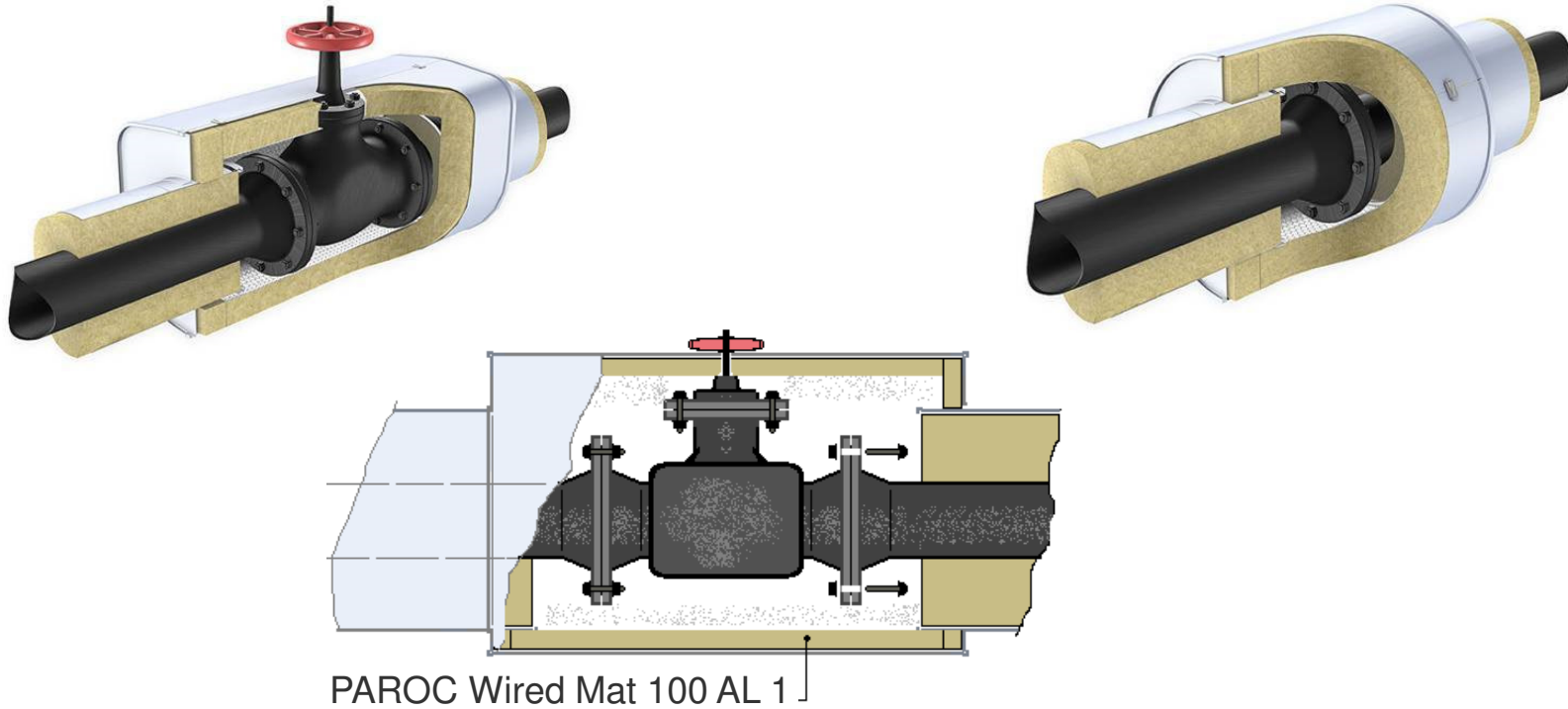
Comparison of heat flows

	1	2	3
Lambda value at mean temperature, W/mK	0,078	0,109/ 0,052	0,075
Theoretical heat loss, W/m	400	382	386
Theoretical surface temperature, °C	52	51	51
Total effect of the increasing factors to the heat loss	30 %	3 %	3 %
Real heat loss, W/m	520	394	398
Real surface temperature, °C	60	52	52

Difference in heat flow 25 %

PAROC Pro Lock 140 (3) / PAROC Pro Wired Mat 100 (1)

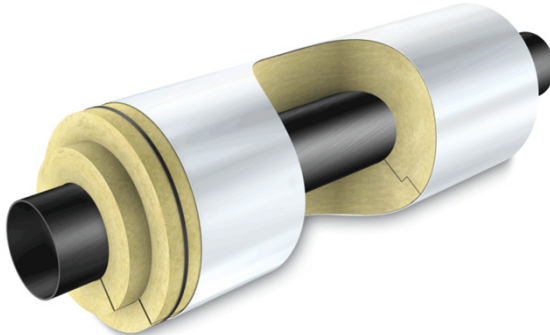
Valve and flange boxes



Benefits, sections compared with mats

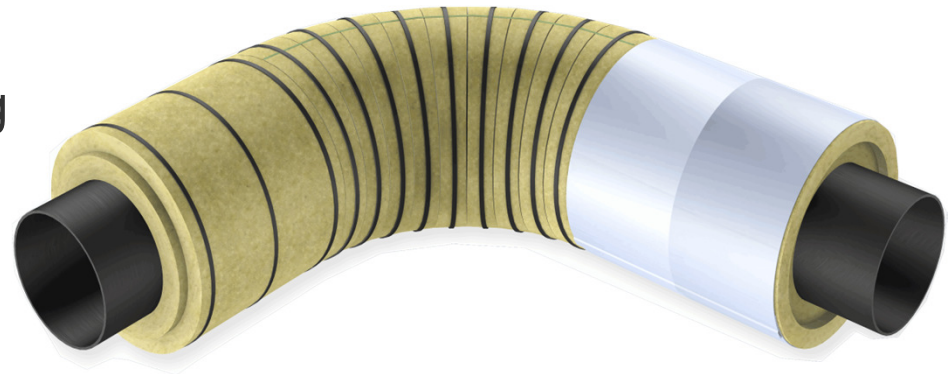
- Technically superior solution without cold bridges
- With the same insulation thickness, 25 % less heat loss compared to wired mat insulation solutions
- With the same heat loss thinner insulation is needed
 - Less surface area and cladding material
 - Takes less space in processes
 - Lower installation costs
 - Total costs about 15 % lower than with wired mats

Benefits, sections compared with mats

- Planning is easy
 - Installation time is shorter
 - Because of consistent outer dimensions the cladding is easy to prefabricate and then install on site on an even insulation surface
 - This means lower general costs of the building site, shorter time for scaffolding, etc.
- 
- No sagging of insulation in long term
 - Same insulation thickness of the insulation is working effectively through the whole lifespan of the pipeline

Benefits, segments compared with mats

- Same insulation capacity for both straight pipes and pipe elbows
- No unnecessary waste resulting from on-site dimensioning
- High mechanical strength, even at high temperatures
- No cutting needed for pipe bends on site, therefore less clean up time



Comparison of installation time

- PAROC Pro Lock pipe section installed as one layer solution saves installation time compared to wired mat installation.
 - Using one layer installation instead of two different layers saves time **at least 30 %**
 - Compared to wired mat installation with support structures needed the difference is **more than 50 %**

