



PRIMUS  **LINE**

SAFE.RELIABLE.SUSTAINABLE.

REHABILITATION

PRIMUS LINE® REHABILITATION¹

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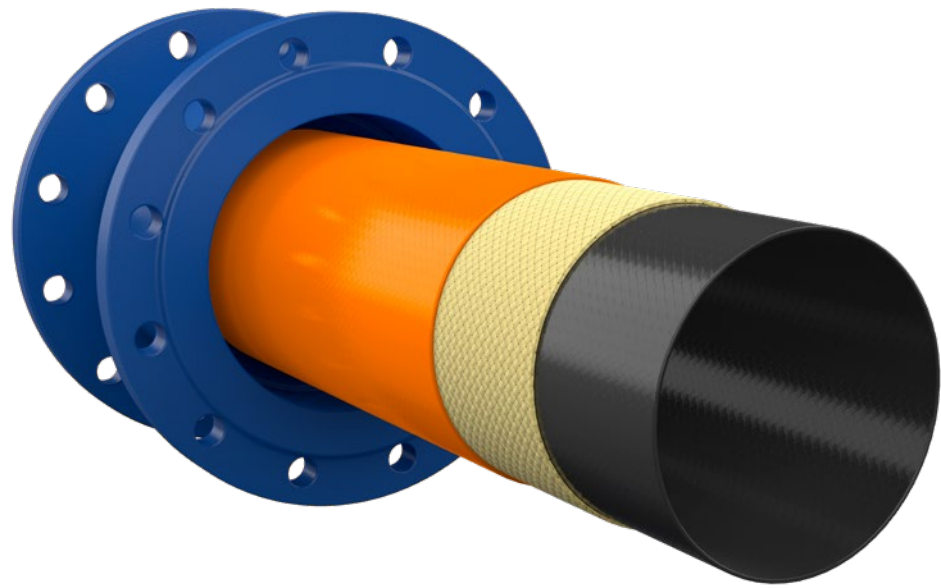
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DESIGNED,
DEVELOPED AND
MADE IN GERMANY

Please note the disclaimer and the technical requirements at the end of the brochure.

STRONG & FLEXIBLE

FLEXIBLE REHAB PIPE = LINER + CONNECTOR



PIPELINE REHABILITATION MADE EASY

Primus Line® Rehab is an innovative technology for the trenchless rehabilitation of pressure pipelines for different media such as water, gas and oil.² The process is based on a flexible high-pressure liner and a connection technology developed specifically for this system.

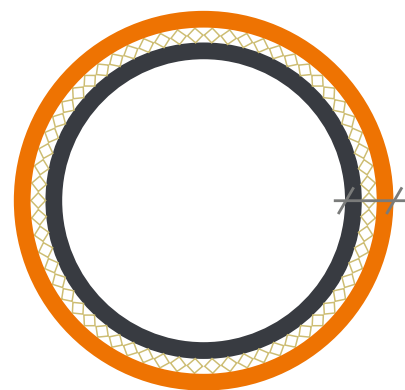
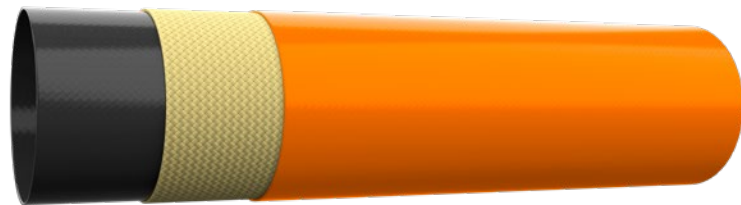
The Primus Line Flexible Rehab Pipe is suitable for the transportation of various liquids and even has drinking water approval in many countries.³

The ideal flow characteristics due to a smooth inner

coating and the optimised systems for high-, medium- and low-pressure requirements make Primus Line® Rehab an economical solution (depending on the individual case) for the rehabilitation of ageing pipelines. In this way, network operators benefit from reliable operation and a sustainable investment in their assets.



COMPOSITE LINER



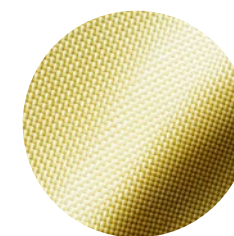
Wall thickness = 6 mm / 0.24 inches



Wall thickness = 8 mm / 0.31 inches



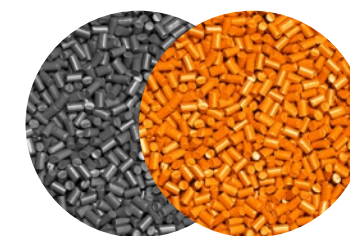
WE EXCLUSIVELY UTILISE TOP-QUALITY RAW MATERIALS



Kevlar®

Kevlar® is a high-strength, lightweight para-aramid synthetic fibre known in the industry for its exceptional tensile strength and durability.

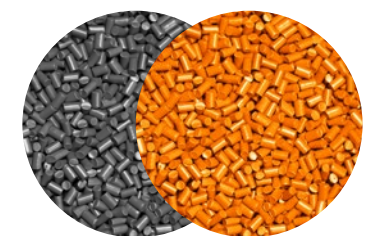
The chemical structure of Kevlar® is comprised of several repeating inter-chain bonds. These chains are cross-linked with hydrogen bonds, providing a tensile strength up to 10 times greater than steel on the same weight basis. For us, it is the perfect reinforcement material for flexible pipes due to its ability to withstand mechanical stress and resist abrasion.



PE

Polyethylene, chosen for its properties, serves as the optimal material for the inner and outer layers of our flexible pipes.

Its flexibility enables easy installation. In addition, the high abrasion resistance of polyethylene contributes significantly to the durability of the pipework. This material ensures long-lasting protection and a secure seal, making it a reliable and robust solution.



TPU

Thermoplastic polyurethane (TPU) is the right polymer for our flexible pipe inner and outer layers. It offers a high level of flexibility, impact strength and chemical resistance, ensuring first-class protection even under extreme conditions.

In addition, TPU has UV and temperature resistance, which is crucial for long-lasting durability and protection of pipework in various applications. The robustness of TPU offers a reliable and durable solution for different industrial and infrastructure requirements.

TECHNICAL DETAILS⁴

- Available in nominal diameters from DN 150 to DN 500 / from 6 inches to 20 inches
- Maximum operating pressure depending on diameter:
82 bar to 12 bar / 1189 psi to 174 psi
- Design values for temperatures greater than 30 °C / 86 °F
and, under certain conditions, up to 60 °C / 140 °F
- Design values for installation around bends
- Friction coefficient: $k = 0.028 \text{ mm}$

Inner layer

Polyethylene (PE) or thermoplastic polyurethane (TPU), depending on the transported medium

- Hygienic
- High abrasion resistance
- High chemical resistance

Reinforcement

One- or two-layered Kevlar® fabric, depending on the required pressure rating

- Accommodates operating pressure by itself
- Up to 10 times stronger than steel of equal weight

Outer layer

Polyethylene (PE) or thermoplastic polyurethane (TPU)

- High abrasion resistance, protecting the fabric during installation and operation

LINER TYPES

Name	Inner layer media-specific based on:	Reinforcement	Outer layer	Wall thickness	Suited for the following media / fields of application. Other media only after detailed review and approval.		
W	PE	Seamless, woven (one- or two-layer) fabric; aramid or aramid-polyester mix	Abrasion-resistant PE sheath	6 mm / 8 mm 0.24 inches / 0.31 inches	 <ul style="list-style-type: none">→ Potable water→ Firefighting water→ Industrial water→ Sea water→ Process water	 <ul style="list-style-type: none">→ Residential wastewater→ Industrial wastewater→ Treated wastewater→ Brine	
O	TPU	Seamless, woven aramid (one- or two-layer) fabric	Abrasion-resistant PE sheath	6 mm / 8 mm 0.24 inches / 0.31 inches	 <ul style="list-style-type: none">→ Crude oil→ Refined petroleum products→ Process water mains→ Diesel	 <ul style="list-style-type: none">→ Jet A1→ Kerosene	
G	TPU	Seamless, woven aramid (one- or two-layer) fabric	Abrasion-resistant PE sheath	6 mm / 8 mm 0.24 inches / 0.31 inches	 <ul style="list-style-type: none">→ Natural gas→ Coke gas→ Methane→ hydrogen (H2ready certified)	 <ul style="list-style-type: none">→ Propane→ Butane→ Oxygen	
F	TPU	Seamless, woven aramid (one-layer) fabric	Thermoplastic polyurethane (TPU)	6 mm / 0.24 inches	  <ul style="list-style-type: none">→ Process water→ Flowback water→ Residential wastewater→ Industrial wastewater→ Firefighting water→ Brine	 <ul style="list-style-type: none">→ Formation water→ Injection water→ Brackish water→ Sea water→ Supply water→ Treated wastewater	

LEAK-FREE CONNECTORS⁵

R-CONNECTOR

- The principle for a pull-proof connection between a liner and an R-Connector is always the same: The bushing has a malleable steel jacket inside. Under high pressure, a two-component resin is pumped through a valve that pushes the steel jacket and the liner into the core profile. This forms a permanently stable unit after the resin has cured.
- Available in nominal diameters from DN 150 to DN 500 / 6 inches to 20 inches – equipped with flanges according to DIN, ANSI and AS4087. Individual solutions for projects are possible as well.
- For wall mounting in chambers, the connector is also available with a mounting plate. It is also offered with a welded connection. That makes it the most flexible type among the Primus Line® connectors.



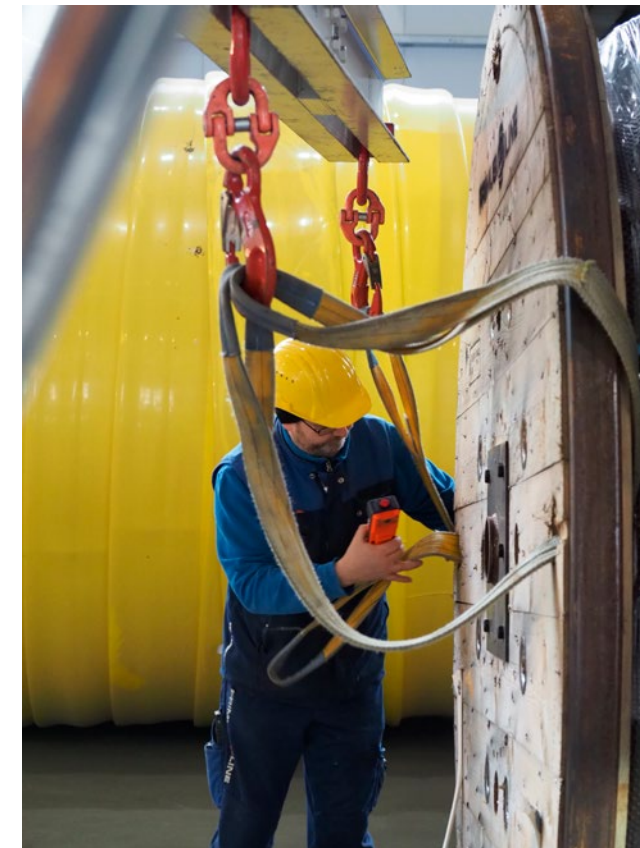
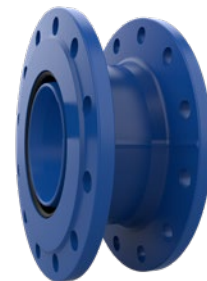
Connection with flange



Welded connection

M-CONNECTOR

- A pull-proof⁶ hold between our flexible pipe and the Primus Line M-Connector is established purely by mechanical forces.
- This is achieved by pressing the core into the bushing with hydraulic equipment that is suitable for on-site use. Not only does this speed up the assembly.
- Available in nominal diameters from DN 150 to DN 350 / from 6 inches to 14 inches with flanges according to DIN, ANSI and AS4087. Project-individual solutions are available on request.



TRANSPORT

The flexible pipe is coiled in U-shape onto specialised transport reels and delivered to the customer. Depending on its diameter, a single reel can accommodate up to 4,000 metres / 13,120 feet of pipeline, efficiently fitting onto a single truck. This approach minimises both logistics costs and the environmental impact associated with transport.⁷

FAST AND EASY DEPLOYMENT

MOST SUITED ENVIRONMENTS

Pipelines often run through environments that are hard to access. Obstacles to an easy and fast rehabilitation of ageing pipes can be of geographical, economical, architectural or environmental nature.

SUITABILITY OF PRIMUS LINE®

Primus Line® is suitable for a quick (depending on the individual case) and reliable rehabilitation of pressure pipes between DN 150 and DN 500 / 6 inches to 20 inches. Thereby, several bends can be traversed while achieving installation lengths of up to 2,500 m / 8,200 feet.



BENEFITS

SAFETY

COST ADVANTAGE

EFFICIENCY

ENVIRONMENTALLY
ORIENTATED



SAFETY

- The core of the Primus Line Rehab pipe is made of seamlessly woven Kevlar® fabric. This synthetic fibre is up to ten times stronger than steel and has twice the strength of glass fibre or nylon. Due to its core, the pipe has a very high factor of safety (FoS). The burst pressure of the flexible pipe is at least 2.5 times the allowable working pressure, depending on the transported medium.
- No work with hazardous materials for curing on site.
- The entire production process is accompanied by in-depth monitoring. Sensors and cameras constantly capture process parameters and are the basis for comprehensive mechanisms for the control of wall thickness and consistency. In addition, every pipe produced is pressure tested in-house before delivery to site.



COST ADVANTAGE⁸

- Installation speeds of up to 10 metres / 32 feet per minute
- Up to 2,500 metres / 8200 feet per pull
- Quick re-commissioning for short downtimes
- Low pre-investment for installers
- 50+ years of service life



EFFICIENCY⁹

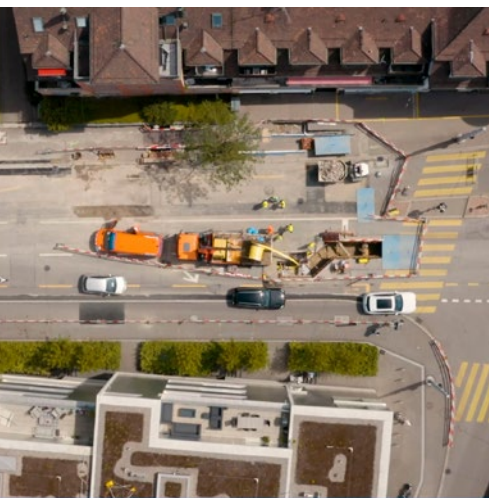
- Installation through multiple bends up to 90°
- Withstands thermal expansion of the host pipe and ground movement
- Burst pressure rates up to 206 bar / 2987 psi
- Operating pressure up to 82 bar / 1189 psi
- Independent of host pipe
- No curing, steaming or adhesion process
- Independent of weather conditions during installation



ENVIRONMENTALLY ORIENTATED¹⁰

- Reduced use of machinery:
The installation can be performed only with a winch. This can result in a significant reduction of the on-site carbon footprint
- Small pits and reduction of road work
- Decreased impact on traffic
- Less disturbance of daily life
- Reduction of the on-site carbon footprint by up to 90% compared to dig and lay

APPLIED WORLDWIDE¹¹



ZURICH

Transported medium: gas
Project length: 414 m / 1,350 feet
Old pipe: steel pipe DN 300 / 12 inches from the year 1970

- Installation time of just under 1.5 hours
- Road traffic was able to continue

"The street has many residents and a lot of traffic - Primus Line® was the best way to organise the construction site."

Primus Line® Rehab user



ESTONIA

Transported medium: wastewater
Project length: 554 m / 1,810 feet
Old pipe: reinforced concrete DN 500 and carbon steel DN 600 / 24 inches and DN 700 / 28 inches

- Various bends: one 45° bend in the first section, three 22.5° bends and one 30° bend in the second section
- Many diameter changes:
Section 1:
DN 600 - DN 500 - DN 700
24 inches - 20 inches - 28 inches
Section 2:
DN 600 - DN 500 - DN 600 - DN 500 - DN 600
24 inches - 20 inches - 24 inches - 20 inches - 24 inches



GERMANY

Transported medium: drinking water
Project length: 580 m / 1,900 feet
Old pipe: Grey cast iron DN 500 / 20 inches from the year 1878

- Rehabilitation with traffic on a main road with tramway operation
- Line route with tram tracks, inaccessible park on a slope and an 80 m / 260 feet long railway subway.

"A space-saving and fast method for the renovation of complicated pipe runs in large dimensions. A problem solver."

Primus Line® Rehab user



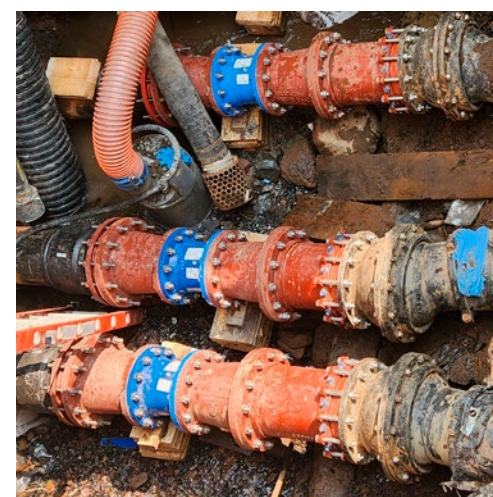
FRANCE

Transported medium: brine
Project length: 455 m / 1,490 feet
Old pipe: steel, unlined DN 450 / 18 inches

- maximum operating pressure is 28 bar / 406 psi and traverses underneath a channel with four 45° bends with $r = 33xD$

"I think we have to move with the times and not close our minds to all the technologies, all the new plastics that exist."

Primus Line® Rehab user



USA

Transported medium: wastewater
Project length: 670 m / 2,200 feet
Old pipe: steel DN 400 / 16 inches

- The seven original steel pipes under the Passaic River were laid more than 100 years ago. Due to fluctuating tides and currents, the water pipes never settled into the riverbed.

"Despite the challenges and the extreme emergency situation, the water main was cleaned, CCTV-inspected, lined, pressure-tested and put back into operation in less than four weeks."

Primus Line® Rehab user



Visit our website for additional references:
<https://www.primusline.com/en/rehabilitation/references>



PRIMUS LINE® FLEXIBLE PIPE PRODUCTION

Multi-layered and many kilometres long:
The Flexible Pipe by Primus Line® requires unique production facilities.

MANUFACTURING TECHNOLOGY

The centrepiece of the flexible pipe production is the patented, self-developed circular loom by Primus Line.

With its high-precision electronic controls, it weaves a seamless and twist-free flexible liner out of Kevlar® or a blend of aramid and polyester fibres.

This is the basis for the extrusion process that applies the inner and outer layers based on polyethylene (PE) or thermoplastic polyurethane (TPU).

The nearly 20-metre high vertical production line combines the three raw materials to create a robust three-layered liner.

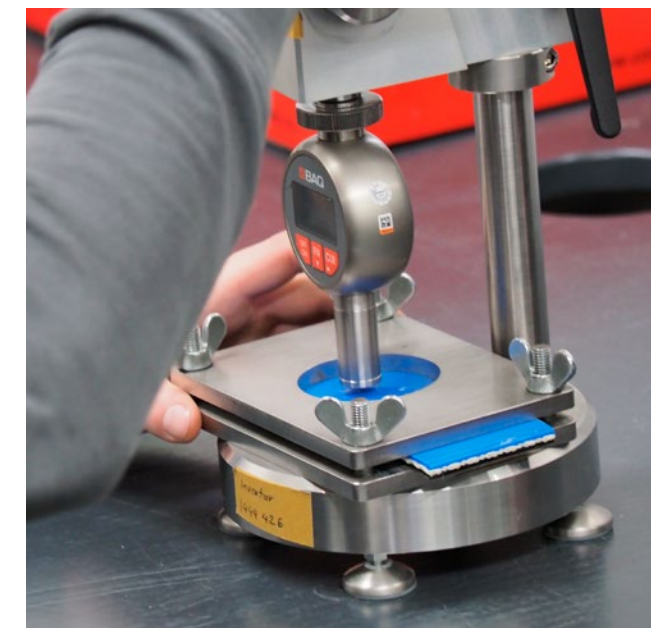
The technology is constantly improving and allows the use of new polymers for the inner and outer layers. This offers the opportunity to further optimise the layers or develop them for entirely new fields of application.

QUALITY

Starting with sourcing raw materials, we set high standards and only work with reputable manufacturers. We carefully check all inbound goods for their quality.

Primus Line® is subject to continuous quality control with optoelectronic measuring instruments. These capture all process parameters and allow a continuous control of the consistency and wall thickness of each layer of the liner. In addition, every production batch receives a batch ID for an unambiguous traceability and undergoes a burst pressure test that reliably confirms the maximum operating pressure.

The connectors are subject to a thorough visual and mechanical inspection. Customers receive technical documentation summarising all results.



Technical rule VP 643, which was developed in cooperation with DVGW (German Technical and Scientific Association for Gas and Water), together with a factory standard set the quality standard for the production of Primus Line®. An independent external test laboratory monitors the adherence to these quality standards with semi-annual controls. They are the prerequisites for the DVGW type examination certificate.

CERTIFIED HIGH QUALITY

Material for pressure pipelines has to meet high quality standards. Within the pipelines, sensitive media like potable water or potentially dangerous media like gas are transported under high pressure.¹² Primus Line® is certified according to the standards for these media in numerous countries.

Primus Line® satisfies the KTW-BWGL established by the German Environment Agency (Umweltbundesamt - UBA) and is certified as a product of gas supply by DVGW (German Technical and Scientific Association for Gas and Water).

CERTIFICATIONS

- ISO 9001:2015 - Quality management system
- ISO 14001:2015 - Environmental management system
- ISO 45001:2018 - Occupational health and safety management system
- ISO 50001:2018 - Energy management system

Test certificate pursuant to KTW-BWGL

For operation in potable water lines, Primus Line® holds numerous additional certifications according to demanding international standards.

- NSF/ANSI/CAN 61
- AS/NZS 4020
- BS 6920
- SS375
- And many more

INTERNATIONAL TEAM AND TRAINED PARTNER NETWORK

Primus Line® is applied in over 55 countries worldwide. In order to better cover the global market and support our partners, three international offices have been established.

At Primus Line's headquarters in Germany and on site, our partners receive a tailored training course. The participants are introduced to the technical details of the system components and trained for the requirements of their construction site.

We also work with local international distributors to be close to the customer.

- Raedlinger Primus Line, Inc. (2013)
in Charlotte, North Carolina, operating in the United States only
- Raedlinger Primus Line Pty Ltd. (2016)
in Sydney, New South Wales, operating in Australia only
- Raedlinger Primus Line CA Inc. (2018)
in Toronto, Ontario, operating in Canada only



RELY ON EXPERIENCE!

The Rädlinger Primus Line Group is part of the Werner Rädlinger Group with about 550 employees. The Werner Rädlinger Group combines most diverse competencies under one roof:

These include construction machinery equipment and steel structures as well as solutions for trenchless pipe rehabilitation, overland piping, electrical installations, photovoltaic systems and inter-company training and education.

The family-managed company manufactures the Primus Line® system, which has been developed in-house, for the trenchless rehabilitation of pressure pipes and overland piping.

In doing so, it relies on the know-how of its employees, which has grown over decades, going back to the beginning of development in 1996 and incorporating many influences from research on the way to market maturity in 2001. This knowledge has also led to the innovative vertical production line for the flexible pipe and the logistics warehouse that is ideally suited to its handling.



LOGISTICS CENTRE

The smooth transport of Primus Line® on reels and in freight containers is prepared by the shipping specialists in the logistics centre in Germany. We stock a range of standard sizes of our flexible pipes, which can be prepared for their journey around the world in a short time using the most suitable handling equipment.

Shipments are sent to international partners or regional offices.



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rädlinger
WERNER RÄDLINGER GROUP

Disclaimer and technical requirements:

The installation of the Primus Line® system has to be performed by an accredited and trained installer. The execution of the work on site is done in accordance with the manufacturer's installation manual. The design guidelines – including but not limited to the maximum allowable operating and testing pressure for the installed system – are documented in the manufacturer's Submittal Support Document. Product specific information available on product datasheet.

The installation company is requested to provide the manufacturer's operating instructions to the network operator. It is the responsibility of the installing company to work with the most current guidelines of the manufacturer which will be made available by the manufacturer upon request or via cloud access. In case of any doubts on the technical properties of the product or the suitability for a certain application, please contact the Primus Line technical experts in your region.

1, 5, 6: Please consider that the following information serves purely informative purposes about the product and does not provide any warranties or guarantees with regard to the product presented. Rather, the following information as well as the conditions for the suitability and usage of the product must be specifically assessed and verified for each individual case. We will be happy to provide you with customised advice for your project. Please note, however, that the ultimate responsibility for operation and compliance with regulatory and, in particular, environmental regulations is with the user of the product.

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