



Technical Data Sheet

Brandenburger Liner BB Rail

Version 1.1/26 WVO
Replaces Version 1.0/26 WVO

1. Technical Data/Basis for Verification

The following technical specifications for the Brandenburger Liner BB Rail are based on the material properties of the Brandenburger Liner BB2.5 base system in accordance with General Building Approval DIBt Z-42.3-490 dated September 15, 2022, as well as on supplementary verifications for use in the context of railway traffic loads. For applications under railway facilities, the tested standard structural analysis and the verification of fatigue strength behavior are particularly decisive.

Material Properties	Standard	DN 150 – DN 875	*DN 875 – DN 1000
Circumferential modulus of elasticity (short-term)	EN 1228	14,200 N/mm ²	16,875 N/mm ²
Circumferential modulus of elasticity (short-term)	EN 1228	11,180 N/mm ²	13,288 N/mm ²
Short-term flexural modulus of elasticity	ISO 178	11,800 N/mm ²	13,600 N/mm ²
Long-term flexural modulus of elasticity	ISO 178	9,290 N/mm ²	10,708 N/mm ²
Material classification	DWA-M 144-3	22	26
Density	ISO 1183	1.54 g/cm ³	1.54 g/cm ³
Short-term bending stress	ISO 178 ISO 11296-4	200 N/mm ²	200 N/mm ²
Long-term bending stress	ISO 178 ISO 11296-4	157 N/mm ²	157 N/mm ²
Long-term reduction factor (50 years)	EN 761	1.27	1.27
Fatigue strength (N = 10 ⁸)	BD-220182 ISO 11296-4:2021-11 ISO 13003:2003-12	59.4 N/mm ²	59.4 N/mm ²

Testing Basis BB Rail

For use in the internal pressure zone of railway traffic loads, the following test and design specifications are particularly relevant in addition to the material-specific properties: DIN EN ISO 11296-4, ISO 13003, BD-220182, ATV-DVWK-A 127, DWA-A 161, and the verified standard structural analysis for BB Rail.

2. Diameter/Wall Thickness e

Pipe size: DN 150 – DN 1000

Applications

Scope of application

The Brandenburger Liner BB Rail is manufactured based on verified standard structural analysis and/or a site-specific structural design. The average wall thickness produced at the factory complies with the structural requirements of the approved application. The specified wall thicknesses refer to the cured state without additional wear layers.

The Brandenburger Liner BB Rail is intended for the rehabilitation of non-pressurized sewer lines and culverts within the internal pressure range of railway traffic loads.

The basic scope of application according to DB regulations is limited to cross-sections up to ID 1000, circular or elliptical profiles, ovalization $\leq 1\%$, and overhangs ≥ 1.10 m – 5.50 m. Only rehabilitation cases in old pipe conditions AZ I and AZ II according to DWA-A 143-2 are permitted.

The tested standard range of BB Rail presented in this data sheet covers only circular profiles from DN 150 to DN 1000. For elliptical profiles, other profiles, other nominal diameters, or applications deviating from these boundary conditions, a project-specific static design is required.

Tested standard range (circular profile, cover depth 1.1 m to 5.5 m above the crown)

Regelstatiken Brandenburger Liner GmbH & Co. KG für DB AG												
Material: BB ^{2.5}												
Schwingbreite =		59,4 MPa										
E-Modul (kurzzeitig) =		14200 MPa (16875*)										
Poissonzahl =		0,16 -										
zul. Verformung =		6%										
gem. geprüfter Regelstatik / DIN EN ISO 11296-4 / DWA-A 143-2 / ATV-DVWK-A 127 / DWA-A 161 / DB-Planungshilfe Teil 1												
Achtung! Die angegebenen Wandstärken der jeweiligen DN, gelten in allen Einbautiefen. Diese Bereiche sind:											Einbautiefe	
BB RAIL		Linersteifigkeit [kN/m ²]	SDR [-]	Wandstärke							[m]	
				4,2mm	4,9 mm	6,3 mm	7,7mm	9,1mm	10,5mm	11,9mm	14,0mm	
Nennweiten Kreisprofil	DN 150	25,0	37,5	X								1,1
	DN 200	10,3	50	X								1,5
	DN 300	4,0	68,2		X							2,0
	DN 400	4,1	67,8			X						2,5
	DN 500	4,1	67,6				X					3,0
	DN 600	4,0	68,2					X				3,5
	DN 700	4,0	68						X			4,0
	DN 800	4,0	68,4							X		4,5
	DN 1000*	4,0	71,9								X	5,0
											5,5	

The standard application range shown applies exclusively to circular profiles in existing pipe conditions AZ I and AZ II, for cover depths of 1.10 m to 5.50 m and without confining groundwater.

Deviating boundary conditions as well as elliptical profiles require a project-specific static design.

(The standard range marked with an asterisk (*) is based on the increased modulus of elasticity values specified in the "Material Properties" table for the range DN 875 to DN 1000.)

Note on the curing system for large wall thicknesses:

For wall thicknesses of 13.3 mm or greater, the use of a thermally activated peroxide system is recommended from a technical standpoint to ensure complete curing even in deep laminate layers.

In the range from 13.3 mm up to and including 15.4 mm, the selection of the curing system must be determined on a project-specific basis, taking into account the installation situation, ambient temperature, pipe geometry, and technical approval.

Should the client, contrary to our technical recommendation, choose not to use the peroxide system in this range, this is done expressly at their own risk and excludes any liability or warranty on the part of the manufacturer.
For wall thicknesses of >15.4 mm, the use of a peroxide system is mandatory.

3. Material Certificates

The GRP liner is produced as a continuous, ready-to-install product, protected inside and out by special airtight and watertight films, and packaged in a UV-resistant film.

The use of individual materials complies with DIN 16869, Part 2 "Pipes made of glass-fiber-reinforced polyester resin (UP-GF)."

4. Material certification for resin

Unsaturated polyester resin (UP), equipped with a UV light initiator that triggers curing. The reaction resin mixture is produced using a processing method developed by Brandenburger specifically for this purpose to ensure exceptionally uniform impregnation.

UV-curing resins

(selected resin properties):

Resin	UP resin
Type per DIN 16946	1140
Group	
according to DIN 18820 Part 1	3
according to EN 13121	4
Density	1.1 g/cm ³
Glass transition temperature DIN 53445	140°C
Resin modulus of elasticity DIN 53457	4000 N/mm ²

Optional: Thermally initiatable peroxide system (combination curing) for accelerated curing under controlled heat exposure.

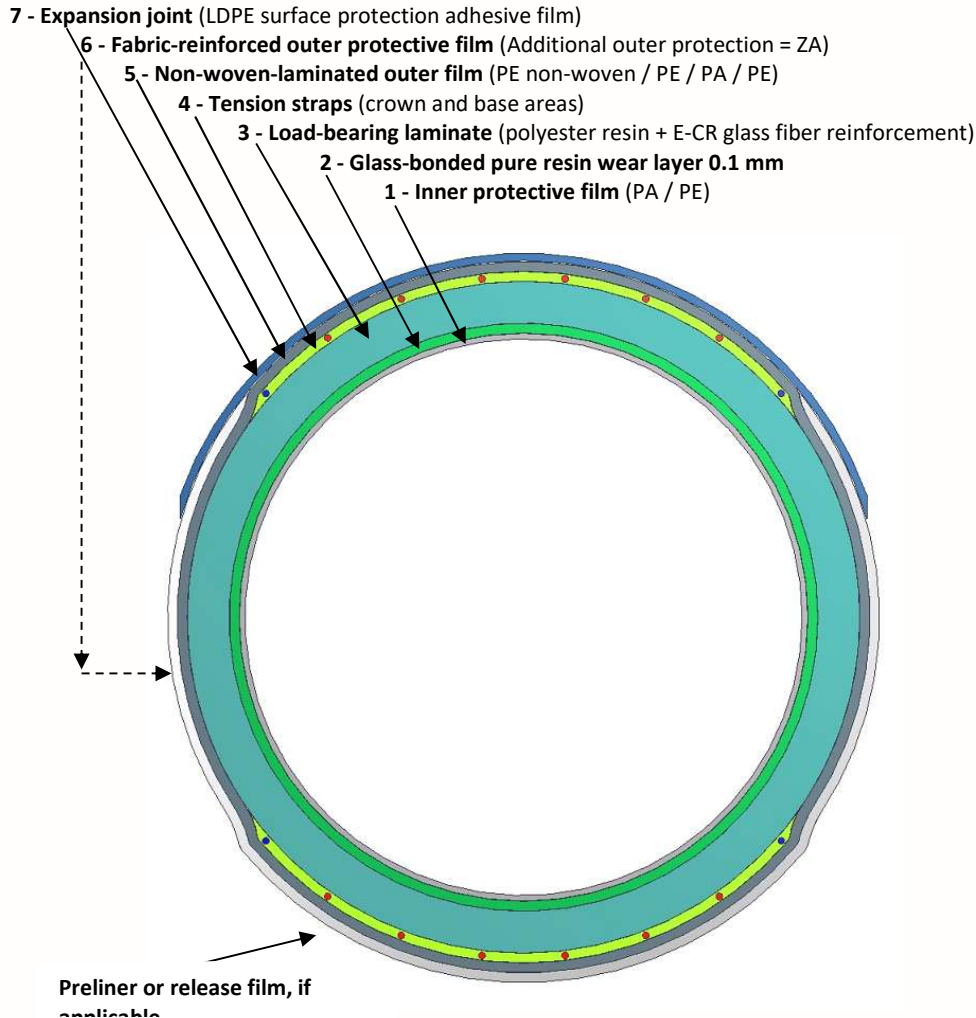
5. Material certification for reinforcement material

A laminate made of a glass fiber complex specially developed for this purpose is used, which features a glass-bonded pure resin wear layer of 0.1 mm and an exceptional glass structure component. In accordance with EN 14020, the chemically high-quality Advantex® textile glass fiber with a basis weight of approx. 730 g/m² is used. The Brandenburger Liner **BB RAIL** has no seams whatsoever, as it is seamlessly wound with the glass composite laminates using a specially developed, patented process.

6. Load-bearing performance

The Brandenburger Liner **BB Rail** works in conjunction with the existing old pipe. For applications subject to internal pressure from railway traffic loads, structural analyses must be performed taking cyclic stresses into account. The decisive factors here are the verified standard structural analysis or a project-specific structural design, as well as the verification of fatigue strength.

FRP liner construction: seamless design with additional external protection



The Brandenburger Liner **BB RAIL** is supplied as standard with additional external protection for every nominal diameter. Depending on the condition of the old pipe to be rehabilitated, this additional external protection can serve as an integrated release liner.

7. Protective films

The Brandenburger Liner **BB RAIL** is manufactured with both outer and inner protective liners:

- The styrene-resistant inner film/calibration tube (polyamide (PA)/polyethylene (PE) composite film) is removed after curing.
- The non-woven-laminated outer film is a flat film welded at the sides and is UV- and styrene-resistant. The outer film protects the liner against water ingress from the sewer.

- The fabric-reinforced outer protective film serves as additional protection against mechanical damage to the non-woven-laminated outer film.

8. Resistance to chemical attack and high (sewage) temperatures (according to DWA-M 144-3; DIN 18820-1)

An UP resin (Type 1140, DIN 16946 and Group 3, DIN 18820) is used to impregnate the Brandenburger **BB RAIL** liner, which meets the high resistance requirements for municipal wastewater as specified in DIN 19550.

9. Mechanical abrasion resistance

The tested specimen demonstrated resistance to stress caused by high-pressure flushing cycles (according to *test report 1347671 dated May 14, 2013, Siebert + Knipschild GmbH Oststeinbek*):

Abrasion behavior according to DIN EN 295-3 (Darmstadt tilting trough) followed by testing of high-pressure flushing resistance according to DIN 19523 Method 1 (material testing).

- Results according to DIN EN 295-3 with 100,000 load cycles, abrasion depth of 0.07 mm
- Result according to DIN 19523, Method 1
- (material testing), inner resin-rich layer present – high-pressure flushing resistance passed.
- For cleaning and flushing of rehabilitated pipes, DWA-M 197, DWA-M 144-3, and RSV Information Sheet 12.1 must be observed.

10. Leak Test

The leak test is performed after curing in accordance with DIN EN 1610. It can be performed using either air or water as the test medium.

To ensure a permanently functional seal of the liner ends in the transition area to the existing pipeline or manhole structure, we recommend the use of a suitable liner end sleeve.

11. Transport and Storage of Liners

The liners are supplied as standard in sturdy wooden packaging and are UV-protected. If necessary, intermediate packing layers are used. They can be shipped by ground freight via a freight forwarder as well as by air or sea freight. The liner is approved for transport by the IATA.

The UP resin liner can be stored for up to 12 weeks at temperatures between +5°C and +30°C and for up to 26 weeks at storage temperatures between +12°C and +20°C from the date of manufacture.

It is essential to note that the storage period begins as soon as the liner is completed. It is generally recommended to store the liners in their wooden crates in temperature-controlled warehouses until installation, as they must not be exposed to direct weather conditions (sun, moisture, frost) and, if possible, should not be subjected to temperature fluctuations. Mechanical damage must be avoided under all circumstances. Deviations from the prescribed storage and transport conditions may impair or prevent the durability of the liners and proper installation. In the event of any warranty claims, the storage conditions must be strictly and verifiably adhered to.

It should also be noted that storage temperatures do not correspond to the recommended installation temperatures. The minimum installation temperature, measured at the laminate, starts at +15°C. Before installation, the liners must be brought to the recommended minimum installation temperature.

12. Installation Advantages

- The GRP liner is pre-assembled and ready for installation
- The liners are shipped worldwide by air, sea, or truck
- The inner surface of the liner is exceptionally homogeneous/smooth and visually appealing, resulting in a high flow velocity of the wastewater
- The glass mat composite has excellent radial elasticity.
- High strength allows for the use of thinner wall thicknesses compared to conventional hose liners, resulting in a lighter weight for the GRP liner. This significantly improves handling on the construction site.
- Thanks to a specially developed and optimized resin system, curing is controlled and extremely fast

Combination curing with peroxide:

- – Transport: Refrigerated (<15°C), ideally temperature-controlled. Max. 48 hours at max. 20°C prior to installation.
- – Storage: Dry, protected from light, constant ≤ 15°C. Max. 6 weeks from production.
- – Laminate must reach at least +15°C before installation.
- – Rapid curing in hybrid resin systems due to an additional thermal reaction

Before installation, ensure that the liner laminate has reached a minimum temperature of +15°C. This temperature is required to ensure the complete activation of the thermal initiator (peroxide) contained in the resin system.

13. Quality Assurance

Handling of Temperature Loggers

Thermal loggers are supplied with every peroxide liner to record the temperature profile during transport and storage. The thermal loggers must not be removed from the transport crate until immediately before installation. Once the work is complete, they must be returned to us immediately for data backup.

Please note: Claims related to potentially elevated storage or transport temperatures cannot be accepted without the corresponding thermologger data.

General

The Brandenburger Group owes its international competitiveness to its innovative strength and its own high standards for the products it manufactures. This is reflected in a commitment to quality and successful certification in accordance with DIN EN ISO 9001:2015. At the heart of all processes is product safety for our customers, as well as the safety of our employees and the environment.

The products of the Brandenburger Group are manufactured under the supervision of the quality management system implemented in 1994, which is certified by TÜV Rheinland in accordance with DIN EN ISO 9001:2015 and is internationally recognized. The Brandenburger Liner **BB RAIL** is also manufactured under strict adherence to these guidelines to meet the high quality standards of our customers.

We reserve the right to make changes in the context of technical advancements. The reference values listed in this data sheet are not contractual data.

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