

PT/542/0325 (March 2025)

**Assessment Schedule for the
BRAWOLINER® liner system as
manufactured by Brawo Systems GmbH**



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1 SCOPE

This schedule specifies the requirements for the BRAWOLINER® liner system as manufactured by Brawo Systems GmbH for gravity pipe renovation inside buildings and underground for wastewater applications.

This approval is limited to the following lining sleeve/resin combinations (see Appendix A):

- BRAWO® I resin with all 6 linings.
- BRAWO® III resin with all 6 linings.
- BRAWO® UVPox51 resin with BRAWOLINER 3D® lining.
- BRAWO® LR resin with BRAWOLINER 3D® lining.
- BRAWO® HT resin with BRAWOLINER® HT, BRAWOLINER® HT 3D and BRAWOLINER® HT XT linings.

This approval is not applicable to:

- Leaktightness of end seals.
- Reconnection of laterals.

2 PRODUCT DESCRIPTION

2.1 Introduction

BRAWOLINER® is a cured-in-place pipe liner that lines the inside of the host pipe and corrects any existing damage. Circular, egg-shaped and square profiles can be renovated.

Curing creates a new watertight liner within the old pipe. The BRAWOLINER® process was developed for the rehabilitation of pipes in diameters from DN50 to DN400.

The generic BRAWOLINER® lining sleeve variants being approved include:

- BRAWOLINER® which is the standard lining sleeve used for sewer rehabilitation of pipes from DN50-DN250 with bends up to 90° and up to one dimensional change.
- BRAWOLINER XT® which is a lining sleeve used for pipes under high structural loads from DN100-DN250 with bends up to 90° and up to one dimensional change.
- BRAWOLINER 3D® which is a lining sleeve used for pipes of DN70-DN400 where there are multiple dimensional changes and bends up to 90°.
- BRAWOLINER HT® (and HT XT and HT 3D) which is a lining sleeve with a steam-resistant coating, it can be cured at higher temperatures and used for rehabilitation inside buildings and underground from DN50-DN250 with bends up to 90° and up to two dimensional changes.

The BRAWOLINER® resin variants being approved include:

- BRAWO® I epoxy resin - Steam/hot water/cold curing - fast-curing resin for underground pipes suitable for rehabilitating shorter pipes up to 15 metres in length.
- BRAWO® III epoxy resin - Steam/hot water/cold curing - long processing time resin suitable for rehabilitation of longer pipe sections or larger pipe diameters.
- BRAWO® UVPox51 epoxy resin - Light-curing - pigmented light-curing epoxy resin for efficient light curing

underground and in buildings and properties.

- BRAWO® LR vinyl ester resin - Light-curing - for curing with UV and LED light for the rehabilitation of domestic sewers.
- BRAWO® HT epoxy resin - Steam/hot water/cold curing - for rehabilitation inside buildings. This resin has high thermal dimensional stability ($\geq 93^{\circ}\text{C}$ according to DIN 75-2⁽¹⁾) and fire protection (building material class B2 according to DIN 4102-1⁽²⁾).

2.2 Applicable standards

The following product standard is applicable to this product:

- BS EN ISO 11296-4:2018+A1:2021⁽³⁾.

2.3 Approval History

This is the first WRc Approved certification for the BRAWOLINER® liner system.

3 REQUIREMENTS AND TESTING

3.1 Product Design

For the Brawoliner® liner system, providing the host pipe is in good condition and the liner stiffness, $\text{SN} > 500 \text{ N/m}^2$ then design is not required. If required then the liner is designed in accordance with DWA-A 143-2⁽⁴⁾ (circular) and DWA-M 144-3⁽⁵⁾ (egg-shaped).

The HT resin system is used within buildings and is therefore not designed.

3.2 Materials and Components

The BRAWOLINER® resins shall comply with the requirements of BS EN ISO 11296-

4:2018+A1:2021 Clause 5.3, requiring the following test:

- Temperature of deflection under load.

3.3 Type Testing

The BRAWOLINER® liner system shall comply with the mechanical characteristic testing requirements within BS EN ISO 11296-4 listed in Table 1. Declared values for the lining sleeve/resin combinations within the scope of this approval are presented within Appendix B.

**Table 1 Brawoliner® liner system
mechanical characteristics**

Test	Standard/Clause
Short-term flexural modulus	BS EN ISO 11296-4:2018+A1:2021 §8.5.2 Table 5
Long-term flexural modulus	BS EN ISO 11296-4:2018+A1:2021 §8.5.2 Table 6
Short-term flexural stress at first break	BS EN ISO 11296-4:2018+A1:2021 §8.5.2 Table 5
Short-term flexural strain at first break	BS EN ISO 11296-4:2018+A1:2021 §8.5.2 Table 5
Long-term flexural strength	BS EN ISO 11296-4:2018+A1:2021 §8.5.2 Table 6
Long-term creep factor	BS EN ISO 11296-4:2018+A1:2021 §8.5.2 Table 6
Poisson's ratio	ASTM D638 ⁽⁶⁾

PT/542/0325 (March 2025)

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3.4 Marking

The BRAWOLINER® liner system shall comply with the requirements of BS EN ISO 11296-4:2018+A1:2021 Clause 5.8 and Clause 6.8.

3.5 Manufacture

To ensure the quality and performance of the BRAWOLINER® liner system the manufacturing process shall include appropriate systems for the:

- Specification of component materials;
- Verification component materials received are to specification;
- Handling and storage of all component materials and finished lining sleeves and resin;
- Detailed drawing / schedule for the lining manufacture;
- Manufacture of the BRAWOLINER® linings, and;
- Fabrication and quality control of workmanship.

The production of the BRAWOLINER® liner system and related quality control procedures shall comply with requirements to ensure the stated performance of the product is reliably achieved.

3.6 Installation

When installed in accordance with the installation documentation^(7, 8), the BRAWOLINER® liner system shall be reasonably expected to perform as described.

4 APPROVAL

The BRAWOLINER® liner system has been audited and successfully met all the requirements stated within this assessment schedule.

Signed:

A handwritten signature in black ink, appearing to be 'G.L.' followed by a horizontal line and a dot.

Valid until 30th March 2030

5 REFERENCES

1. DIN 75-2 Determination of temperature of deflection under load, Part 2 Plastics and ebonite, 2004.
2. DIN 4102-1, Fire behaviour of building materials and elements - Classification of building materials - Requirements and testing, 1998.
3. BS EN ISO 11296-4:2018+A1:2021 Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks. Lining with cured-in-place pipes.
4. DWA-A 143-2 Rehabilitation of drainage systems outside buildings - Part 2: Static calculation for the rehabilitation of wastewater pipes and pipes with lining and assembly methods (July 2015).
5. DWA-M 144-3 - Additional Technical Contract Conditions (ZTV) for the Rehabilitation of Drainage Systems Outside Buildings, November 2012.

PT/542/0325 (March 2025)

**Assessment Schedule for the
BRAWOLINER® liner system as
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independent certification of your products & services

6. ASTM D638 – 22 Standard Test Method for Tensile Properties of Plastics.
7. Process Instructions - BRAWOLINER® Rehabilitation Process - 01/2022.
8. Process Instructions - Rehabilitation Process BRAWOLINER® - Light Curing - 05/2023.

PT/542/0325 (March 2025)

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Appendix A

The table below illustrates the lining sleeve/resin combinations that are included within the scope of this approval.

Table 2 Brawoliner® Resin/Liner Combinations Scope

	Liner						
	BRAWOLINER	BRAWOLINER XT	BRAWOLINER 3D	BRAWOLINER HT	BRAWOLINER HT XT	BRAWOLINER HT 3D	
Resin	BRAWO I	Included	Included	Included	Included	Included	Included
	BRAWO III	Included	Included	Included	Included	Included	Included
	BRAWO UVPox51	X	X	Included	X	X	X
	BRAWO LR	X	X	Included	X	X	X
	BRAWO HT	X	X	X	Included	Included	Included

Appendix B

The table below indicates the declared values.

Table 3 Brawoliner Declared Values

Resin	Test	Declared Value
BRAWO I & III	Short-term flexural modulus	2,200 MPa
	Long-term flexural modulus	1,520 MPa
	Short-term flexural stress at first break	44.29 MPa
	Short-term flexural strain at first break	1.8%
	Long-term flexural strength	31 MPa
	Long-term creep factor	1.44
	Poisson's ratio	0.20
	BRAWO UVPox51	Short-term flexural modulus
Long-term flexural modulus		580 MPa
Short-term flexural stress at first break		30 MPa
Short-term flexural strain at first break		1.1%
Long-term flexural strength		8 MPa

	Long-term creep factor	3.62
	Poisson's ratio	0.356
BRAWO LR	Short-term flexural modulus	2,000 MPa
	Long-term flexural modulus	533 MPa
	Short-term flexural stress at first break	28 MPa
	Short-term flexural strain at first break	1.7%
	Long-term flexural strength	7.4 MPa
	Long-term creep factor	3.75
	Poisson's ratio	0.36
	BRAWO HT	Short-term flexural modulus
Short-term flexural stress at first break		52.5 MPa
Short-term flexural strain at first break		1.3%