Table 1: Primer Lucobridge® Primer 2000P – basic test according to TL/TP Bel-EP Test report P 9526 dated 17/09/2015, KIWA

TL/TP-BEL-EP		STANDARD	CONDITION	UNIT	LUCOBRIDGE® PRIMER 2000P	TL-ING TEIL 7 TL-BEL-EP
3.1	**COMPONENTS – ISOLATED**				3 min / 100 + 2	
3.1.1	Density	ISO 2811	20 °C	g/cm³	0.994	± 2%
3.1.2	Dyn. viscosity	ISO 3219	23 °C, 750 s-1	mPas	110	± 20%
3.1.3	IR spectrum	DIN 51451	ATR-IR, 4000-500 cm-1		o.k.	No deviation from composition
3.1.4	TGA	ISO 11358 ISO 7111	35°C - 900°C, 10K/min		1,5 % residue	No deviation from composition
3.1.5	Bulk density scratch-coating	EN-459-2		g/dm³	N/A	± 0,05 kg/dm³
3.1.6	Grain sizes allowance of scratch-coating				N/A	± 3% abs.
3.2	**COMPONENTS – MIXED**			Primer/hardener ratio	100 + 1 (23°C)	
					100 + 3 (12°C)	
3.2.1	Viscosity	ISO 3219	12°C, 500 s-1	mPas	190	≤ 4000
3.2.2	Ash residue	acc. ISO 3451-1	3 h/ 550°C	%	0	≤ 1 %-Weight
3.2.3	Pot life	TP-BEL-EP 3.2.3	100 cm³, 23°C-40°C	min	17	>10 min, ± 25%
	Max. temperature			°C	162	
	Reaction time			min	24	
3.2.4	Curing time	ISO 2815 Curing grade after Buchholz	7 d – 23°C	a. Final hardness	81	≥ 60
			18 h - 23°C	b. Indentation resistance	76	≥ 60
			40 h – 12°C/85% rF	c. Indentation resistance	72	≥ 60
3.2.5	Moisture sensitivity	TP-BEL-EP 3.2.5	40 h – 12°C/85% rF		o.k.	No white tarnish
3.2.6	Non-volatile ingredients	acc. ISO 3251	3h – 105°C	%	98,7	≥ 98
3.2.7	Extractable ingredients	acc. ISO 6427	16h – n-Hexan	%	2,5 no plasticizer	≤ 11
3.2.8	Water absorption	acc. ISO 62	14d – 23°C	%	1,8	≤ 2,5
3.2.9	Consistency of scratch-coating				N/A	Various
3.3	**TESTING THE COMPOSITE BODIES**					
3.3.1	Manufacture	acc. ZTV-StB 90 - Annex 2				
3.3.2	Free of defects	TP-BEL-EP	silicone - 60 min - 250°C	MΩ	> 10.000	> 10.000
3.3.3	Thermal stress					
3.3.3.1	Silicone oil	TP-BEL-EP	silicone - 60 min - 250°C	MΩ	no complaint	no complaint
3.3.3.2	Welding tensile bond strength	ZTV-SIB Annex 2	100 N/s, 23°C	N/mm²	2,9 100% cohesive break concrete	

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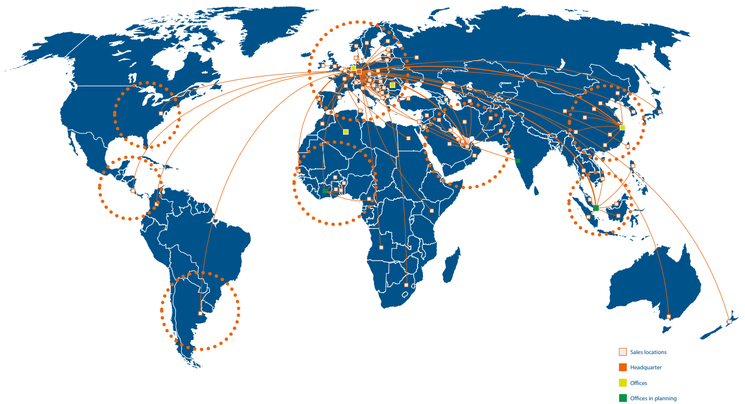
LOCATIONS



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Note
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LUCOBIT
THERMOPLASTIC POLYOLEFINS

LUCOBRIDGE® PV-BIT

WATERPROOFING MEMBRANES FOR STEEL BRIDGES

WATERPROOFING TECHNOLOGY WITH LUCOBRIDGE®

... Waterproofing that lasts

A NEW APPROACH IN STRUCTURAL WATERPROOFING

APPLICATIONS

The Lucobit® PV-BIT membranes in combination with the proprietary adhesive system has been designed to waterproof any Steel Bridge construction. The advantages of using this innovative, new way of sealing steel bridge decks lies in its safe and simplified application.

The non-toxic way of applying the Lucobridge® system using an adhesive prevents damage to the membrane. In addition, resources are saved so that energy consumption has been reduced and thus contributes to saving CO_2 emissions to be released to the environment.

Consequently, the system has an extended lifetime due to its superior stress-crack resistance, resistance to perforation, penetration and impact, low temperature workability, and thus also contributes to savings financial resources.

The hassle-free extended lifetime of the system was proven on steel bridge constructions. In that way it proved superior to the old-fashioned way of flaming membranes for waterproofing onto steel bridge constructions.

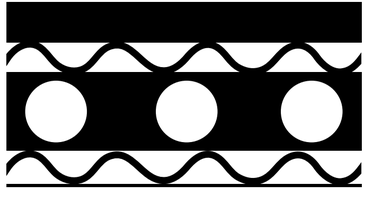
PRODUCT

Lucobridge® PV-BIT for steel bridges in combination with Lucobridge® Primer 2000P (proprietary resin priming coat for steel or concrete bridges) and adhesive Lucobridge® Binder 2010SB (proprietary adhesive) complies with ZTV-ING part 7, Section 1.

External tests showed that the Lucobridge® PV-BIT system exhibits an optimized interlocking system between the basic bridge construction and the top wearing course asphalt layers.

Lucobridge® PV-BIT consists of a 1,6 mm polymer modified bitumen thick ECB (ethylene-copolymer-bitumen) membrane with a glass-fibre mat inlay and polyester mats on both sides. The top of this structure is then covered only by a PmB layer (polymer modified bitumen) that can be heat-activated either by (torch-)flame or hot-air directly onto any bridge deck; a wearing asphalt course can be placed directly on top. This side acts as a heat- and protective shield against to be placed hot asphalt mixes on top while the polyester fleece/mat on the bottom of the membrane is used as interlocking layer between the membrane and the steel construction below. The membranes were flamed in both tested cases into an evenly distributed layer of LUCOBIT AG's proprietary Lucobridge® Binder 2010SB after having primed with Lucobridge® Primer 2000P.

This membrane system warrants an excellent cover for any cracks or breaks due to its superior elasticity even after ageing. The single ply membrane is conceived for the single-ply sealing under stone mastics asphalt, mastic asphalt or concrete.



ADVANTAGES

- Gluing of limits potential heat damage to the waterproofing membrane
- Reduced energy requirements
- Chlorine-free system
- Extremely tear-resistant due to built-in glass mat
- Easy to were flamed in both tested cases as single ply membrane for bridges
- High resistance to static loading due to its elasticity
- High resistance to impact, perforation and penetration
- Excellent behavior in low temperature
- Superior in counteracting cracks and breaks in the basic bridge structure
- Extremely high adherence to pretreated surfaces
- Excellent temperature resistance
- Aging-resistant
- UV-resistant

PROCESSING

The steel surface must be prepared according to regulations and must be pre-treated with Lucobridge® Primer 2000P (ZTV-ING Part 7, clause 1 resp. 4) and adhesive Lucobridge® Binder 2010SB.

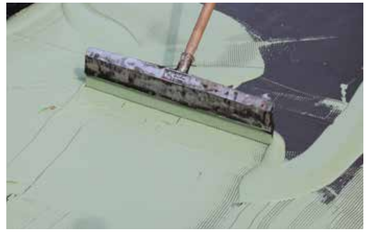
Lucobridge® PV-BIT has to be rolled out, free of voids with overlapping seams. These seams are glued with adhesive Lucobridge® Binder 2010SB according to detailed procedures. These details are found in the handling and laying instructions.

STORAGE

Lucobridge® PV-BIT should be stored upright, protected from moisture and heat.

WASTE DISPOSAL GUIDELINES

Polymeric bitumen- and bitumen membranes as well as other construction material waste acc. to the European Waste Catalogue EWC-No. 17 03 02 ("Bitumen mixtures") can be disposed of in and with thermal combustion disposal processes.



LINTRACK TEST RESULTS AT THE TU DELFT

Research investigations by using the membrane testing methodology developed at Delft University of Technology (TUD) shows that the adhesive strength of the membrane between the surfacing layers and the decks of steel bridges has a strong influence on the structural response of orthotropic steel bridge decks. The role of membrane layers in ensuring the composite action and hence the integrity of the surfacing system is crucial and is one of the most important requirements. In order to characterize the bonding response of the new bonding Lucobridge® technology of gluing the membrane onto the real bridge deck surfacing system, the LINTRACK accelerated pavement testing facility developed at TUD was utilized, see Figure 1a.

The LINTRACK testing facility simulates a heavy vehicle moving on a real bridge deck panel. Depending on the requirement the tire load conditions, tyre type, number of passes and surrounding temperatures can be adjusted for any particular test. This testing facility can be used to evaluate the fatigue life and structural response of the pavement surface system, consisting of different layers of asphalt and membranes over a bridge deck panel, see Figure 1b.

Experiments continued for 12 weeks during which membrane performances under strenuous exposure to tire pressure, various speeds as well as temperature fluctuations were assessed. The Lucobridge® membranes performed well during the testing period and no serious debonding or other damages were observed.

The tests revealed that strains on the steel deck were reduced after the asphalt surfacings were constructed. Although there is some minor difference in relative displacement (slipping) values between the Lucobridge® membrane and asphalt layer, the relative slip remained the same over time. On average, the relative slip between the top membranes remains around 0.7 mm throughout the test and not much difference has been observed with time, see Figure 2. Even after 12 weeks of continuous loading, no appreciable loss in stress carrying capabilities was detected both in transverse as well as in longitudinal directions.

Figure 1a: LINTRACK apparatus at TUD

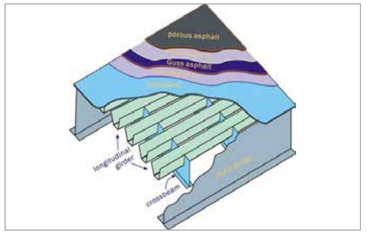
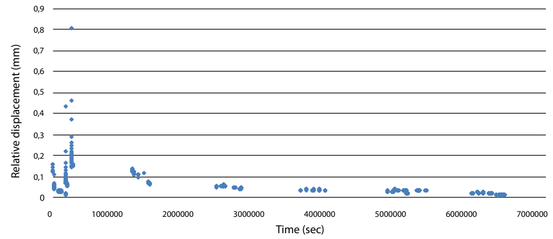


Figure 1b: Layout of the bridge deck surfacing system



Relative Displacement between Bottom Membrane and Guss-Asphalt in longitudinal Direction.

These test results impressively show that the new Lucobridge® Technology of gluing membranes has higher adhesive bonding strength with the surrounding material. Since NO adverse damage to the membrane through flaming can occur, thus, the waterproofing effect for bridge constructions has also been improved.