

TEST REPORT

Material and component testing
Dumadeck 162 x 26 (hollow)

Project Nr: LI_09_033_02

December 29th, 2009

Dumaplast extrusion
Vliegplein 41
B-9990 Maldegem

Test results are exclusively valid for specimens which are provided by the customer. By changes or supplements occurs a new report with a new revision index. Preceding versions lose their validity.

1 Order

Material testing of WPC-Decking boards according to prCEN/TS 15534.

2 Test methods

Density : EN ISO 1183-1

Equipment: Balance: Sartorius

Density-Kit: Sartorius YDK01

Immersion liquid: water

Temperature: 23 ± 2 °C

Number of samples measured: 4

Sample size: approx. 20 x 10 x 4 mm

The density was calculated according to

$$\rho_{(sample)} = \frac{m_{(air)} \times [\rho_{(water)} - \rho_{(air)}]}{[m_{(air)} - m_{(water)}] \times 0,99983} + \rho_{(air)}$$

Determination of tensile properties: EN ISO 527

Equipment: Universal testing machine, Messphysik, Beta 20-10/4x11

Determination of E-Modulus: extensometer ME45-NG

Pre-load: 3 N

Bearing distance: 110 mm

Testing speed: 1 mm/min

Number of samples measured: 5

Sample size: standard test specimens

Coefficient of linear thermal expansion (30 °C – 80 °C): ISO 11359-2

Equipment: TMA SDTA840, Mettler Toledo

Sample holding device: 20 mm

Measuring sensor: sensing head with ball 3 mm

Sample size: 10 x 10 x 4 mm

Number of samples measured: 3

Sample preparation: samples were cut from larger samples with a circular saw

The samples were measured in direction of extrusion.

Measurement procedure:

30 °C to 80 °C, 5 °C/min, 0,020 N load

☒ Water absorption and swelling in water: EN 317

Equipment: Balance: Kern EG 420/3 NM (accuracy 0,001 g)

Micrometer screw: Atorn

Immersion liquid: water

Water temperature: 20± 2 °C

Sample size: 50 x 50 x 4 mm, brushed surface

Number of samples measured: 3

Immersion time: 1 d, 7 d days and 28 days

After the above mentioned immersion times the samples were taken out of the water, placed on an absorbent paper and the surface water was removed. For an accurate reproducibility the weight of the samples was measured before the determination of the thickness. After the measurement after 24 h and 7 days the samples were replaced in the immersion liquid. The water absorption (WA) was calculated according to

$$WA(\%) = \frac{[m_{(\text{sample after immersion})} - m_{(\text{sample before immersion})}]}{m_{(\text{sample before immersion})}} \times 100$$

The thickness swelling (SW) was calculated according to

$$SW(\%) = \frac{[\text{thickness}_{(\text{sample after immersion})} - \text{thickness}_{(\text{sample before immersion})}]}{\text{thickness}_{(\text{sample before immersion})}} \times 100$$

☒ Bending test according to DIN EN 310

Equipment: Universal testing machine Zwick/Roell Z100

Number of samples measured: 5

Bearing distance: 20 x sample width

Determination of E-Modulus: length variation sensor (+/- 1.5µm), load was less than 10% of F_{max}.

Test speed for determination of the bending strength was chosen, that the break occurs within 90 sec +/- 30 sec.

☒ Hardness test (Brinell hardness) according to EN 1534

Equipment: Universal testing machine, Messphysik, Beta 20-10/4x11

Microscope, Olympus BX 61 with optical evaluation software

Indentation body: hardened steel ball with a diameter of 10 mm

Number of samples measured: 5

Sample size: decking section with 500 mm in length

☒ **Slippery test according to DIN 51131**

Equipment: Elcon Floor Slide Control (FSC 3)

Testing cycle: 3 series of measurements à 5 measurements

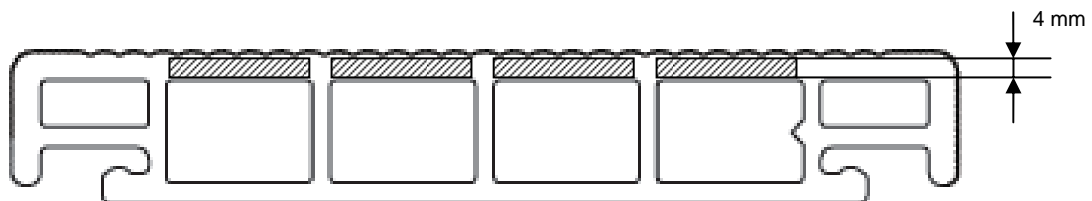
Number of samples measured: 3

Sample size: decking section with 1 m in length



3 Samples

- ☒ **Sample Preparation:** Samples were cut from the extruded Deck-Board supplied by the customer with a circular saw. The grooved surface was milled with a CNC-rotary cultivator. Wall thickness: approx. 4 mm. Sample sizes are defined in the standards.



- ☒ **Conditioning:** Before testing all samples were conditioned at 23°C and 50% rel. H. for at least 72 hours. The samples for the water absorption and swelling in water were pre-treated at 80°C for at least 72 hours in a compartment drier.

4 Results

Dumadeck (hollow)				
Property		Test method	Unit	Value
Material testing	Density	EN ISO 1183-1	g/cm ³	1,41 ± 0,00
	Determination of tensile properties	EN ISO 527		
	Modulus of Elasticity		MPa	6.321 ± 491
	Tensile Strength		MPa	44,06 ± 0,44
	Elongation (at break)		%	1,03 ± 0,10
	Coefficient of linear thermal expansion (30 - 80 °C)	EN ISO 11359-2	ppm/K	12,55 ± 1,11
	Swelling in water	DIN EN 317		
	1 d		%	1,72 ± 0,18
	7 d		%	3,00 ± 0,91
	28 d		%	5,71 ± 1,10
	Water absorption			
	1 d		%	1,43 ± 0,05
	7 d		%	3,49 ± 0,07
	28 d		%	7,49 ± 0,12
Component testing	Brinell hardness	EN 1534		
	Top		N/mm ²	112,51 ± 13,19*
	Bottom		N/mm ²	165,47 ± 6,66
	Milled surface		N/mm ²	182,59 ± 34,97*
	Determination of flexural properties	EN 310		
	Flexural Modulus		MPa	4.001 ± 25
	Flexural Strength		MPa	34,97 ± 0,78
	Coefficient of sliding friction	DIN 51131		0,12

*The results of the Brinell hardness testing showed a high standard deviation on the top of the deck board because of oval indentations due to the surface structure and on the milled surface because of poor resolvable hardness-indentations under the microscope.

5 Measurement reports

5.1 Density (EN ISO 11359-2)

Test standard: Density EN ISO 11359-2
 Test person: JL
 Project: LI09_033
 Sample: LI09_033_01

Balance: Sartorius
 Density-Kit: Sartorius YDK01

Nr.	m_{air} [g]	G [g]	Density [g/cm ³]
1	1,8638	1,3206	1,408
2	1,8610	1,3158	1,411
3	1,8247	1,2905	1,410
4	1,8474	1,3062	1,411
Mean			1,41
Standard Dev.:			0,001

5.2 Tensile Properties (EN ISO 527)

Test standard: Tensile test EN ISO 527
 Test person: JL
 Material: WPC-Decking-Profile
 Project: **LI09_033_01**

Test machine: BETA20-10
 Extensometer: ME46-NG
 Bearing distance: 170 mm

a Sample thickness
 b Sample width
 Et MOE in tension
 Fmax max. Force
 σ_M Tensile strength
 ϵ_B Tensile strain at break

Test.Nr.	a [mm]	b [mm]	Et [MPa]	Fmax [N]	σ_M [MPa]	ϵ_B [%]
1	3,490	9,940	6.987,0	1504,000	43,350	0,999
2	3,590	9,980	6.387,0	1594,000	44,480	1,136
3	3,590	9,950	5.665,0	1572,000	44,010	1,121
4	3,470	10,000	6.081,0	1538,000	44,340	1,013
5	3,560	9,970	6.486,0	1566,000	44,110	0,888
Mean	3,54	9,97	6.321,2	1554,80	44,06	1,031
Standard Dev.:	0,06	0,02	490,7	34,72	0,44	0,101

5.3 Coefficient of linear thermal expansion (11359-2)

sample	1 st threshold [%]	1 st threshold [µm]	2 nd threshold [%]	2 nd threshold [µm]	1 st threshold coefficient of linear thermal expansion [ppm/K]	coefficient of linear thermal expansion [ppm/K]
E558_a	0,069	6,12	-0,015	-1,31	19,31	11,76
E558_c	0,072	6,29	-0,0097	-0,85	19,37	13,33
E558_MW	0,071	6,21	-0,0124	-1,08	19,34	12,55

E558_a = LI_09_033_01/1

E558_c = LI_09_033_01/2

MW = mean

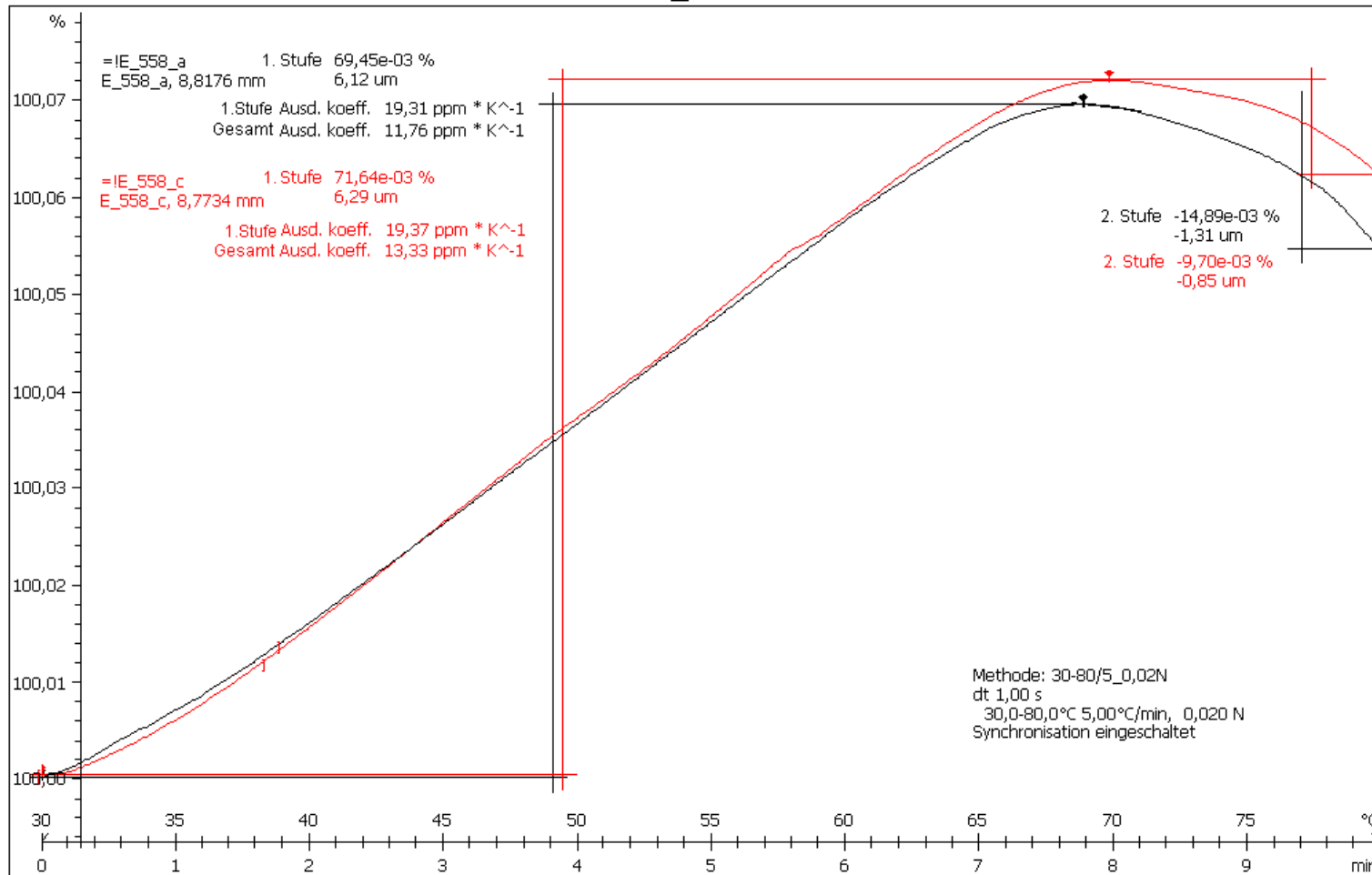
1st threshold = expansion of the sample to the peak of the curve

2nd threshold = contraction of the sample after the peak of the curve

1st threshold coefficient of linear thermal expansion = coefficient of linear thermal expansion to the peak of the curve

Coefficient of linear thermal expansion = coefficient of linear thermal expansion over the entire curve (1st threshold + 2nd threshold)

E_558



Lab: laboraf

STAR^e SW 9.01

5.4 Brinell hardness (EN 1534)

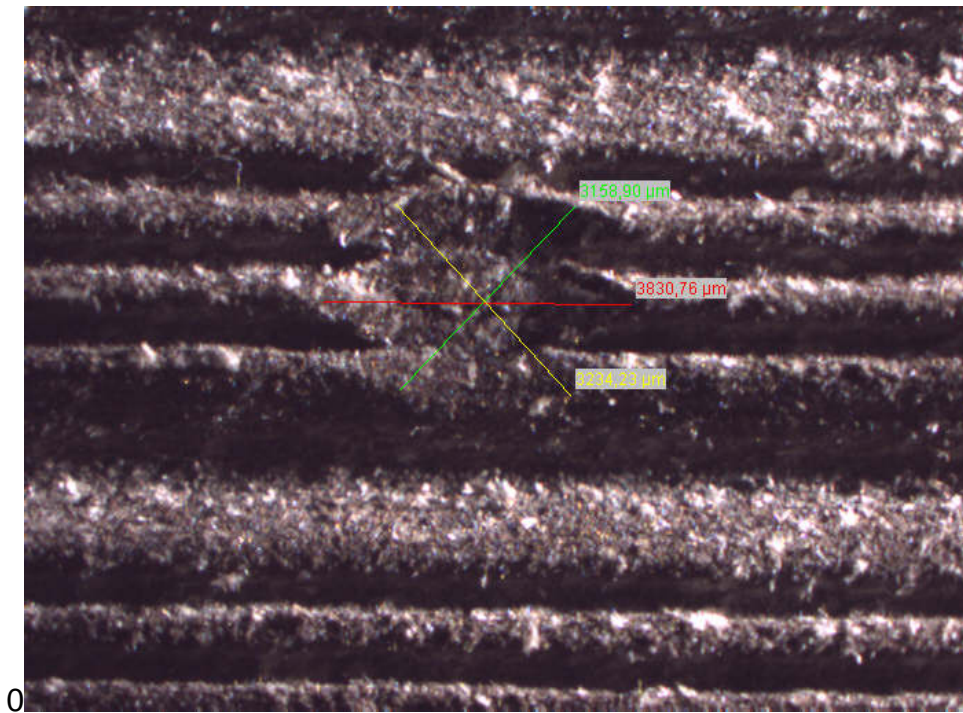


Figure 1: microscope image of the Brinell hardness-indentation on the top

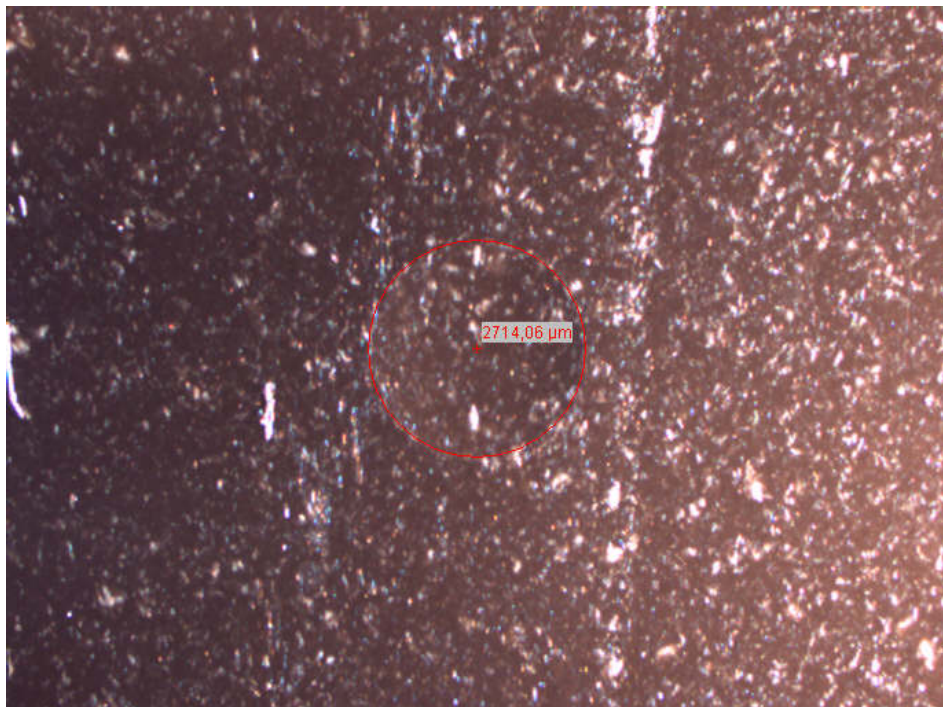


Figure 2: microscope image of the Brinell hardness-indentation on the bottom

The figures above show the analysis of a hardness-indentations under the microscope.

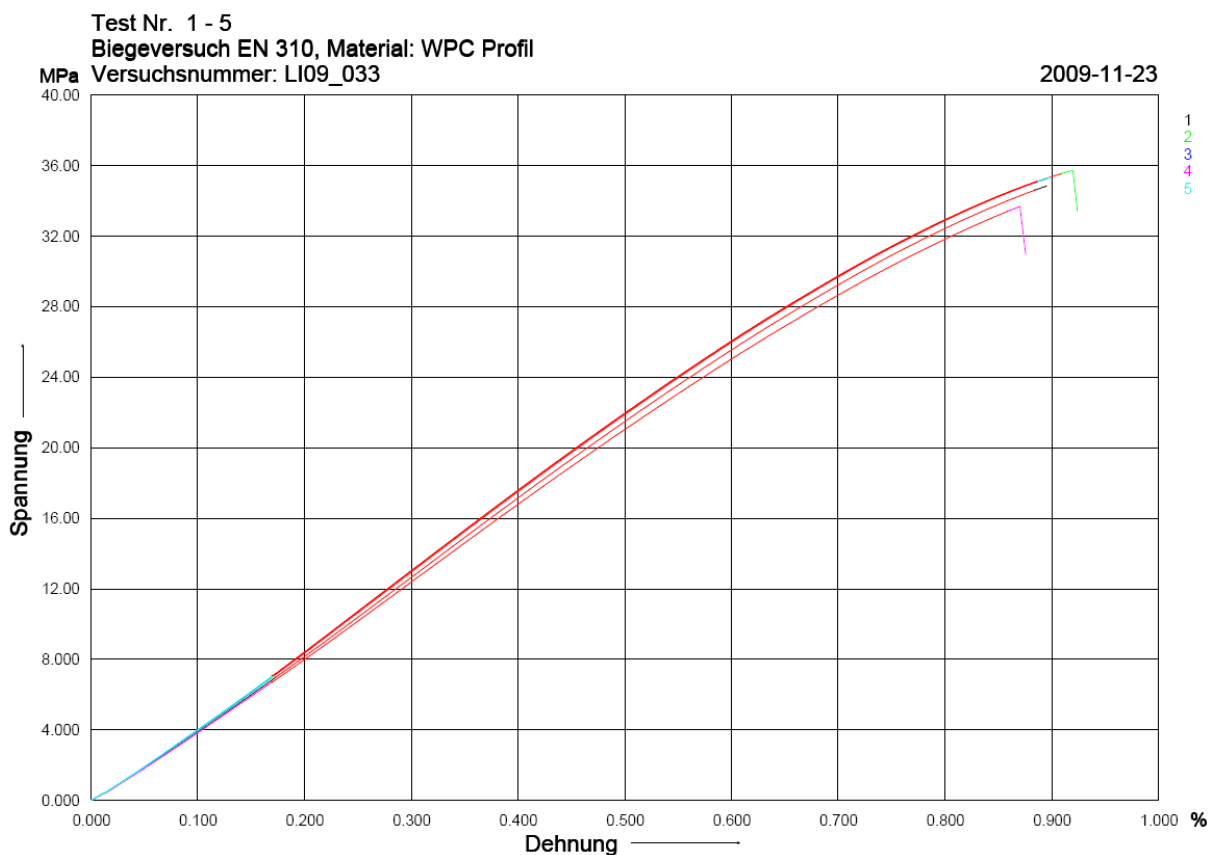
5.5 Bending test (EN 310)

Test standard: Bending test EN 310
 Test person: JL
 Project: LI09_033
 Sample: LI09_033_01

Test machine: Messphysik BETA20-10
 Bearing distance: 20 x sample with

a Sample thickness
 b Sample width
 Ef E-Modulus
 Fmax max. Force
 $\sigma_f M$ Bending strength
 $\epsilon_f B$ Elongation at break

Test.Nr.	a [mm]	b [mm]	Ef [MPa]	Fmax [N]	$\sigma_f M$ [MPa]	$\epsilon_f B$ [%]
1	25,500	162,000	3.997	4798,000	34,840	0,895
2	25,500	162,000	3.982	4917,000	35,710	0,924
3	25,500	162,000	4.026	4857,000	35,270	0,896
4	25,500	162,000	3.973	4638,000	33,680	0,876
5	25,500	162,000	4.026	4866,000	35,340	0,898
Mean	25,50	162,00	4.001	4815,20	34,97	0,898
Standard Dev.:	0,00	0,00	25	107,69	0,78	0,017



5.6 Coefficient of sliding friction (DIN 51131)

Messprotokoll

Gerät: FSC3-3012

Letzte Kalibrierung: Do 25.06.09

Gleiter

Seriennummer: 10008

Beschichtung: SBR 302 Noratest

Hergestellt: Fr 24.04.09

Anzahl Messungen: 49

Strecke gesamt: 49 m

Messung

Methode: DIN51131 manuell

Datum: Mi 18.11.09 16:04:47

Projektnummer: Dumadeck HK (LI09_033)

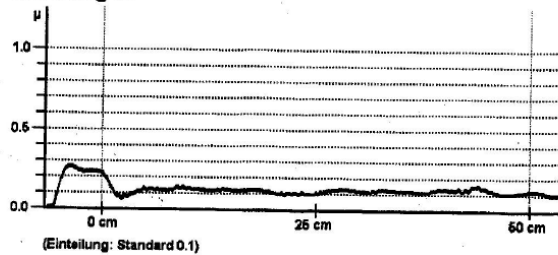
Minimalwert: 0.07

Mittelwert: 0.12

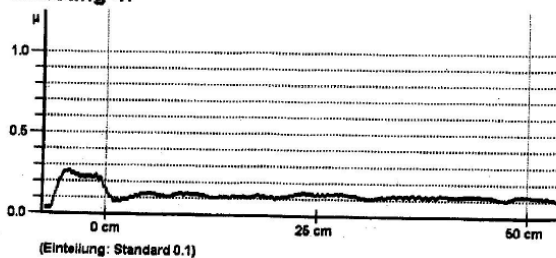
Maximalwert: 0.23

Lfd. Nummer: 147

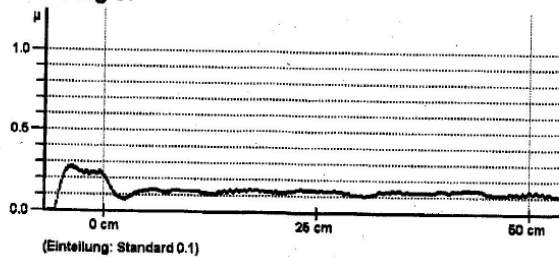
Messung 3:



Messung 4:



Messung 5:



Messort: Technikum Wels

Prüfer: Jürgen Leßlhuber