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GREENLAM INDUSTRIES LIMITED
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NALAGARH-174101
INDIEN

Dresden, 12/10/2022
SWEN

Test Report
Order No. 2722242/2

Client: GREENLAM INDUSTRIES LIMITED
Vill-Paterh Bhonku, P.O.-Panjehra,
Tehsil-Nalagarh,
Distt-Solan, Himachal Pradesh
NALAGARH-174101
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Order: Determination of tests according to EN 438-2:2016-02

Contractor: Entwicklungs- und Prueflabor Holztechnologie GmbH
Laboratory Unit Surface Testing
Zellescher Weg 24
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Germany

Engineer in charge: Dipl.-Ing. S. Wenk

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The test report contains 11 pages. Any duplication of extracts requires the written permission of EPH. The test results refer exclusively to the material tested.

1 Task

The accredited Entwicklungs und Prueflabor Holztechnologie GmbH was instructed by GREENLAM INDUSTRIES LIMITED to conduct tests of EN 438-2:2016-02.

This report represents an excerpt from test report 2722242 dated 07/10/2022.

NOTE: All numerical values within this document are given with a comma as decimal.

2 Test material

For testing, the following HPL material was selected by the client and sent to the contractor.
Date of receipt: 22/08/2022.

Sample identification (Sample ID, coded by the client)	**Test pieces / Dimensions [mm]**
HPL-Compact material Grade CGS 12 mm	9/ 100 x 100 x 12 and 14/ 230 x 230 x 12 and 12/ 50 x 50 x 12 and 5 / 200 x 50 x 12 (L;T) and 2/ 250 x 250 x 12 and 4/ 300 x 200 x 12 and 5/ 240 x 20 x 12 (L, T)

3 Test performance

3.1 Determination of the resistance to surface wear

The test of the behaviour under abrasion stress was carried out according to the method described in EN 438-2:2016-02, part 10, using a Taber Abraser Tester 5151 from Taber Industries (test equipment OF-121). The friction wheels had a Shore A of 66 and were fitted with the sanding paper type S42. The loss of mass during calibration of the abrasive paper was 100 mg, which corresponds to the requirement (120±20) mg.

The test was carried out: 30/08/2022

3.2 Determination of the resistance to immersion in boiling water

The test of resistance to immersion in boiling water was carried out according to EN 438-2:2016-02 part 12. The effects of immersion in boiling water for 2 h by means of the increase in mass and thickness of the test specimens and by detecting changes in appearance (surface and edge).

The test was carried out: 15/09/2022

3.3 Determination of the resistance against water vapour

The test of the resistance to water vapour was carried out according to EN 438-2:2016-02, part 14.
A specimen to be tested is held over the neck of a flask of boiling water in such a way that the decorative surface of the specimen is exposed to water vapour. After 1 hour the specimen is removed and stored for 24 hours under normal ambient conditions for recovery before being examined for changes in appearance.

The test was carried out: 29/08/2022 - 30/08/2022

3.4 Determination of the resistance to dry heat

The test of resistance to dry heat was carried out according to EN 438-2:2016-02, part 16.
A block of a standardised aluminium alloy was heated at a specified test temperature of 160 °C was brought into contact with a specimen taken from one of the laminates to be tested, which was glued to a particle board. After a contact period of 20 minutes the block was removed.
Resistance to these test conditions was assessed by visual inspection.

The test was carried out: 29/08/2022 - 30/08/2022

3.5 Determination of the dimension stability at elevated temperature

The test of dimensional stability at elevated temperature was carried out according to EN 438-2:2016-02, part 17.
In this test, the changes in the lateral dimensions of specimens of the laminates to be tested were determined over an extreme range of relative humidity at elevated temperatures.

The test was carried out: 14/09/2022 – 26/09/2022

3.6 Determination of the resistance to wet heat (variants 1 and 2)

The test of resistance to wet heat was carried out according to EN 438-2:2016-02, part 18.
A block of a standardised aluminium alloy was placed on a damp cloth at a specified test temperature of 100 °C in contact with a test specimen taken from the laminate to be tested.
After a contact period of 20 minutes the block was removed.
The resistance to these test conditions was assessed by visual inspection.

The test was carried out: 29/08/2022 - 30/08/2022

3.7 Determination of the resistance to impact by large-diameter ball

The determination of the resistance to impact with a large ball was carried out according to EN 438-2:2016-02, part 21, using the large ball impact device (test equipment - OF 44) described in the standard.

The test was carried out: 31/08/2022

3.8 Determination of resistance to scratching

The determination of the resistance to scratching was carried out according to EN 438-2:2016-02, part 25. A Universal Scratch Tester Model 413 from Erichsen (test equipment OF-45) was used as a testing device. The evaluation of the results was carried out using reference samples according to EN 438-2:2016-02, Figure 22, and the evaluation scale from Table 6, part 25.7.

The test was carried out: 30/08/2022

3.9 Determination of the resistance to staining

The determination of the resistance to staining was carried out with 5 selected staining substances from groups 1 - 3 according to EN 438-2:2016-02, part 26.

The test was carried out: 29/09/2022 - 29/09/2022

3.10 Determination of the light fastness

The light fastness test was carried out according to EN 438-2:2016-02 part 27 with a Xenon Weather Ometer Ci3000+ (KL-84) using the following test parameters according to EN ISO 4892-2:2013-03:

- Synchronous operation (water cooled equipment)
- Global irradiation
- (65 ± 3) °C Black standard temperature
- (50 ± 5) % Relative Humidity
- (60 ± 3) W/m^2 Irradiance at wavelength range of 300 nm - 400 nm
- 36 720 kJ/m^2 Irradiation duration - Radiant exposure dose according to devices with an irradiance of (60 ± 3) W/m^2 with a wavelength range of 300 nm - 400 nm, which means includes an exposure time of 170 h with. (This irradiation dose corresponds to the duration until the contrast between the unexposed area and exposed area of the blue wool light fastness type 6 was equal to the value 4 of grey scale according to ISO 105-A02:1993-09).

The light fastness was determined according to EN 438-2:2016-02 part 27 as the evaluation of the contrast (colour change) between exposed specimen and the control specimen (reference) with respect to the grey scale according to ISO 105-A02 :1993-09.

To avoid an incorrect assessment of colour fastness of the sample due to photochromism, the specimens were stored in the dark at ambient interior conditions prior to the assessment of colour fastness for (24 ± 2) hours.

The test was carried out: 01/09/2022 - 09/09/2022

3.11 Flexural modulus and flexural strength

The determination of bending strength (MOR) and modulus of elasticity in bending (MOE) was carried out according to EN ISO 178:2019 "Plastics – Determination of flexural properties" at three-point bending test.
5 specimens of each variant, sampled parallel with the production direction and 5 specimens of each variant, sampled perpendicular to the production direction were tested at the universal test device Tiratest 28100. The testing rate was 10 mm/min. The bending strength and the modulus of elasticity were calculated according to EN ISO 178:2019.

Performance of the tests: 14/09/2022

3.12 Determination of the density

The density was determined according to EN 323:1993 "Wood based panels – Determination of density". 10 specimens of 50 mm x 50 mm x thickness were tested. The density was calculated by the use of measured values of length, width, thickness and mass of the specimens.

The test was carried out: 14/09/2022

4 Results

4.1 Resistance to surface wear

Number of revolutions until the initial abrasion point (IP) is reached test specimen			Resistance to surface abrasion up to IP (mean value rounded to 50)
1	2	3	
> 400	> 400	> 400	> 400

4.2 Resistance to immersion in boiling water

4.2.1 Increase of mass

Increase of mass after 48 h water storage in % (n = 3)
0,5

4.2.2 Increase of thickness

Increase of thickness after 48 h water storage in % (n = 3)
0,9

4.2.3 Visual Examination (changing the appearance of the surface and edge)

Visual assessment after 48 h water storage in rating	
Surface	Edge
5	5

Evaluation criteria according to to EN 438-2:2016-02 part 12:

Grade 5 no visible change
Grade 4 slight change of gloss and/or colour, only visible at certain viewing angles
Grade 3 moderate change of gloss and/or colour
Grade 2 marked change of gloss and/or colour
Grade 1 blistering and/or delemination

4.3 Resistance against water vapour

Result of the visual examination in rating	Comment
Grade 4	change of gloss

Evaluation criteria according to EN 438-2:2016-02 part 14:

Grade 5 no visible change
Grade 4 slight change of gloss and/or colour, only visible at certain viewing angles
Grade 3 moderate change of gloss and/or colour
Grade 2 marked change of gloss and/or colour
Grade 1 blistering and/or delamination

4.4 Resistance against dry heat

Result of the visual examination in rating by 160 °C	Comment
Grade 5	none

Rating scale according to EN 438-2:2016-02 table 1

Grade 5 *No change*
test area indistinguishable from adjacent surrounding area

Grade 4 *Slight change*
test area distinguishable from adjacent surrounding area, only when the light source is mirrored on the test surface and is reflected towards the observer`s eye, e.g. discoloration, change in gloss and colour

Grade 3 *Moderate change*
test area distinguishable from adjacent surrounding area, visible in several viewing directions, e.g. discoloration, change in gloss and colour, no change in the surface structure, e.g. deformation, cracking, blistering

Grade 2 *Significant change*
test area clearly distinguishable from adjacent surrounding area, visible in all viewing directions, e.g. discoloration, change in gloss and colour and/or the structure of the surface slightly changed, e.g. slight cracking, slight blistering

Grade 1 *Strong change*
The structure of the surface being distingly changed e.g. strong cracking, strong blistering and/or discoloration, change in gloss and colour
and/or the surface material being totally or partially delaminated

4.5 Dimension stability at elevated temperature

Dimension stability at elevated temperature in %	
L (longitudinal)	T (transversal)
0,10	0,30

4.6 Resistance against wet heat

Result of the visual examination in rating by 100 °C	Comment
Grade 5	none

Rating scale according to EN 438-2:2016-02 table 3

Grade 5 *No change*
test area indistinguishable from adjacent surrounding area

Grade 4 *Slight change*
test area distinguishable from adjacent surrounding area, only when the light source is mirrored on the test surface and is reflected towards the observer`s eye, e.g. discoloration, change in gloss and colour

Grade 3 *Moderate change*
test area distinguishable from adjacent surrounding area, visible in several viewing directions, e.g. discoloration, change in gloss and colour, no change in the surface structure, e.g. deformation, cracking, blistering

Grade 2 *Significant change*
test area clearly distinguishable from adjacent surrounding area, visible in all viewing directions, e.g. discoloration, change in gloss and colour and/or the structure of the surface slightly changed, e.g. slight cracking, slight blistering

Grade 1 *Strong change*
The structure of the surface being distingly changed e.g. strong cracking, strong blistering and/or discoloration, change in gloss and colour
and/or the surface material being totally or partially delaminated

4.7 Determination of the resistance to impact by large-diameter ball

Determined impact strength with a large ball in mm drop height					
Single value					Mean value
> 1800	> 1800	> 1800	> 1800	> 1800	> 1800
Indentation diameter at drop height in mm					
5	5	5	5	5	5

4.8 Resistance to scratching

Interrupted scratches, faint polishing marks or no visible traces	Scratching load leading to double rings with ≥ 90 % closeness	Scratch resistance according to EN 438-2 2016-02, Table 6, as rating number
4 N	6 N	Grade 4

Rating scale according to EN 438-2:2016-02 table 6

Rating scale	Interrupted scratches, faint polishing marks or no visible traces	Scratching load leading to double rings with ≥ 90 % closeness
Grade 5	6 N	> 6 N
Grade 4	4 N	6 N
Grade 3	2 N	4 N
Grade 2	1 N	2 N
Grade 1	-	1 N

4.9 Resistance to staining

Visual examination with covering in rating				
Acetone	**Coffee**	**Sodium hydroxide (NaOH)**	**Hydrogen peroxide (H_2O_2,)**	**Carbon black shoe suspension in paraffin oil (shoe polish simulant)**
Group 1	Group 2	Group 3		
16 h	**16 h**	**10 min**	**10 min**	**10 min**
Grade 5	Grade 5	Grade 5	Grade 5	Grade 5

Rating scale according to EN 438-2:2016-02, Table 8 (comparison of the tested area with the surrounding area)

Grade 5 *No change*
test area indistinguishable from adjacent surrounding area

Grade 4 *Slight change (Minor change)*
test area distinguishable from adjacent surrounding area, only when the light source is mirrored on the test surface and is reflected towards the observer`s eye, e.g. discoloration, change in gloss and colour

Grade 3 *Moderate change*
test area distinguishable from adjacent surrounding area, visible in several viewing directions, e.g. discoloration, change in gloss and colour, no change in the surface structure, e.g. deformation, cracking, blistering

Grade 2 *Significant change*
test area clearly distinguishable from adjacent surrounding area, visible in all viewing directions, e.g. discoloration, change in gloss and colour and/or the structure of the surface slightly changed, e.g. slight cracking, slight blistering

Grade 1 *Strong change*
The structure of the surface being distingly changed e.g. strong cracking, strong blistering and/or discoloration, change in gloss and colour

and/or the surface material being totally or partially delaminated

4.10 Light fastness

Contrast (colour change) from test sample to reference by grey scale according to ISO 105-A02:1993-09 Light fastness after 36 720 kJ/m2 radiant exposure dose
4 - 5

Rating scale for the colour change by grey standard evaluation

Grey scale value 5	no change of colour
Grey scale value 4 - 5	very small change of colour
Grey scale value 4	small change of colour
Grey scale value 3 - 4	recognisable change of colour
Grey scale value 3	clearly recognisable change of colour
Grey scale value 2 - 3	very clearly recognisable change of colour
Grey scale value 2	strong change of colour
Grey scale value 1	very strong change of colour

4.11 Modulus of elasticity in bending (MOE) and bending strength (MOR)

Orientation of test specimens	Modulus of Elasticity (MOE) in MPa (n = 5)
parallel to long side of panel	11554
parallel to short side of panel	9686

n = number of samples

Orientation of test specimens	Bending strength (MOR) in MPa (n = 5)
parallel to long side of panel	108,4
parallel to short side of panel	90,7

n = number of samples

4.12 Density according to EN 323:1993

Variant	Density (n = 10) in g/cm³
2	1,36

n = number of samples

5 Evaluation

The tested variant can be evaluated for the several properties according to with EN 438-4:2016-02, Table 3 (General requirements):

Property	Variant	Results	Requirements according to EN 438-4:2016-02 Table 3*	
			Laminate	
			CGS	CGF
Resistance to surface wear (EN 438-2:2016-02, p. 10)		*revolutions until IP (min)*	*≥ 150*	*≥ 150*
	2	**> 400**	**fulfilled**	fulfilled
Resistance to immersion in boiling water (EN 438-2:2016-02, p. 12)		*mass increase: % (max): 2 mm ≤ t < 5 mm*	*5,0*	*7,0*
		t ≥ 5 mm	***2,0***	***3,0***
		thickness increase: % (max): 2 mm ≤ t < 5 mm	*6,0*	*9,0*
		t ≥ 5 mm	***2,0***	***6,0***
		Appearance gloss finish	*≥ Grade 3*	*≥ Grade 3*
		other finishes/	*≥ Grade 4*	*≥ Grade 4*
		edge rating (min):	*≥ Grade 3*	*≥ Grade 3*
	2	**mass increase: 0,5 %** **thickness increase: 0,9 %** **Appearance: Grade 5 / 5**	**fulfilled**	fulfilled
Resistance to water vapour (EN 438-2:2016-02, p. 14)		*Surface gloss finish /*	*≥ Grade 3*	*≥ Grade 3*
		other finishes	*≥ Grade 4*	*≥ Grade 4*
	2	**Grade 4**	**fulfilled**	fulfilled
Resistance to dry heat (160 °C) (EN 438-2:2016-02, p. 16)		*Surface gloss finish/*	*≥ Grade 3*	*≥ Grade 3*
		other finishes	*≥ Grade 4*	*≥ Grade 4*
	2	**Grade 5**	**fulfilled**	fulfilled
Dimensional stability at elevated temperature (EN 438-2:2016-02, p. 17)		*cumulative dimensional change*		
		2 mm ≤ t < 5 mm: longitudinal L: % (max)	*0,40*	*0,40*
		transversal T: % (max)	*0,80*	*0,80*
		t ≥ 5 mm: *longitudinal L: % (max)*	***0,30***	***0,30***
		transversal T: % (max)	***0,60***	***0,60***
	2	**L: 0,10 %**	**fulfilled**	fulfilled
		T: 0,30 %	**fulfilled**	fulfilled
Resistance to wet heat (100 °C) (EN 438-2:2016-02, p. 18)		*Surface gloss finish /*	*≥ Grade 3*	*≥ Grade 3*
		other finishes	*≥ Grade 4*	*≥ Grade 4*
	2	**Grade 5**	**fulfilled**	fulfilled
Resistance to impact with a large diameter ball (EN 438-2:2016-02, p.21)		*Drop height [mm]*		
		2 mm ≤ t < 6 mm	*≥ 1400*	*≥ 1400*
		t ≥ 6 mm	***≥ 1800***	***≥ 1800***
	2	**> 1800**	**fulfilled**	fulfilled
		smooth surface /	*≥ Grade 2*	*≥ Grade 2*
		structured surface	*≥ Grade 3*	*≥ Grade 3*

Property	Variant	Results	Requirements according to EN 438-4:2016-02 Table 3*	
			Laminate	
			CGS	CGF
Resistance to scratching (EN 438-2:2016-02, p. 25)	**2**	**Grade 4**	**fulfilled**	fulfilled
Resistance to staining (EN 438-2:2016-02, p. 26)		*Appearance Group 1 and 2/ Group 3*	*5 and 5 / 4 - 4 - 4*	*5 and 5 / 4 - 4 - 4*
	2	**5 and 5 / 5 - 5 - 5**	**fulfilled**	fulfilled
Light fastness (EN 438-2:2016-02, p. 27)		*Contrast Grey scale*	*4 – 5*	*4 – 5*
	2	**4 - 5**	**fulfilled**	fulfilled
Modulus of elasticity (EN ISO 178:2019)		*MPa (min) parallel to long side of panel parallel to short side of panel*	*≥ 9000/ ≥ 9000*	*≥ 9000/ ≥ 9000*
	2	**11554 MPa / 9686 MPa**	**fulfilled**	fulfilled
Bending strength (EN ISO 178:2019)		*MPa (min) parallel to long side of panel/ parallel to short side of panel*	*≥ 80 / ≥ 80*	*≥ 80 / ≥ 80*
	2	**108,4 MPa / 90,7 MPa**	**fulfilled**	fulfilled
Density (EN 323:1993)		*g/cm3*	*≥ 1,35*	*≥ 1,35*
	2	**1,36**	**fulfilled**	fulfilled

* Statements on conformity assessment/classification were made on the basis of the measurement results obtained. Measurement uncertainties were not included in the assessment (ILAC G8 03/2009 "Guidelines on the Reporting of Compliance with Specification" Section 2.7).

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