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A Report to

Yushin Melamine Mfg. Co. Ltd.

from

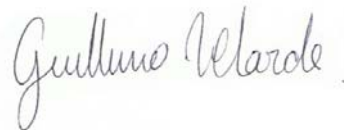
North Carolina State University
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on

NEMA LD3-2005
Laminate Tests

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Principal Investigator



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IMPORTANT

- These tests were conducted according to the procedures described in NEMA standards LD3-2005 except where noted.
- The NEMA LD3-2005 test procedures and standards were designed for high pressure decorative laminates, and their use with other products may produce misleading or irrelevant results.
- We do not certify a manufacturer's laminate. We report only on the results of a given sample of laminate which has been submitted to our laboratory.
- The name of the University is not to be used in any type of advertising or promotional efforts.
- We have undertaken high pressure decorative laminate testing as an independent testing laboratory largely as a service to the laminate manufacturers and the furniture industry. However, our main purpose is that of education and research, which means that we cannot always respond quickly to requests for testing.

Yushin Melamine Mfg. Co. Ltd. submitted three (3) samples for testing according to the test methods in NEMA LD3-2005. The following tests were requested:

LD3-2005

- 3.2 Surface Finish
- 3.3 Light Resistance
- 3.4 Cleanability/Stain Resistance
- 3.5 Boiling Water Resistance
- 3.6 High Temperature Oil Resistance
- 3.7 Glass Scratch Resistance
- 3.7 Diamond Resistance
- 3.8 Ball Impact Resistance
- 3.9 Dart Impact Resistance
- 3.10 Radiant Heat Resistance – coil method
- 3.10 Radiant Heat Resistance – strip method
- 3.11 Dimensional Change
- 3.12 Dimensional Stability
- 3.13 Wear Resistance
- 3.14 Formability (materials 1 and 2)
- 3.15 Blister Resistance (materials 1 and 2)

The materials provide were the following:

Sample 1. Postforming type 1.0mm HGP

Sample 2. Postforming type 0.8mm VGP

Sample 3. General Purpose 0.5mm VGL

Results of the tests follow.

TEST RESULTS

LD 3.2 SURFACE FINISH

TEST RESULTS

sample	60 degree gloss measurement	
	machine direction	cross-machine direction
Sample # 1	12.8	12.6
Sample # 2	12.4	12.1
Sample # 3	12.7	12.4

LD 3.3 LIGHT RESISTANCE

TEST CONDITIONS

black panel temp	70C
wet bulb depression	11C
conditioning water	20C
calibration at	420nm
irradiance rate	1.09 W/m ² (1.10 ± 0.03)
total irradiance	285.1 kJ/m²

TEST RESULTS

	Light Resistance =
Sample # 1	NO EFFECT
Sample # 2	NO EFFECT
Sample # 3	NO EFFECT

No Effect = no change in color or surface finish

LD 3.4 CLEANABILITY/STAIN TEST RESULTS

Sample #	Cleanability	Stain Resistance <i>(reagents not listed = no effect)</i>
Sample # 1	12	no effect – reagents 1-14, severe - 15
Sample # 2	12	no effect – reagents 1-14, severe - 15
Sample # 3	9	no effect – reagents 1-15

reagent #	stain reagent
1	Distilled water
2	50:50 SD-3A ethyl alcohol:water
3	Acetone
4	Household ammonia (non-sudsing)
5	10% Citric acid solution
6	Vegetable cooking oil
7	Freshly prepared coffee
8	Freshly prepared tea
9	Tomato catsup
10	Plain prepared yellow mustard
11	Povidone iodine (10%)
12	Permanent Marker Pen
13	#2 pencil
14	Wax crayon
15	Shoe polish (black paste)

Cleaning steps: *(see NEMA LD3 2000 for full descriptions)*

1. tap water -- removed = (0)
2. BCS + sponge w/ 1 kg weight -- 25 cycles -- rinse w/ tap water -- removed = (1)
3. BCS + baking soda + brush -- 25 cycles -- rinse w/ tap water -- removed = (2).
4. cotton ball + nail polish remover -- rub $\leq$ 2 minutes -- rinse w/ tap water -- removed = (3)
5. cotton ball w/ bleach -- 2 minutes -- rinse w/ tap water -- removed = (4).
6. if reagent remains visible = (5).

Cleanability = sum of reagent cleaning scores

Stain Resistance = No Effect / Moderate Effect / Severe Effect -- (reagents with cleaning score=5)

No Effect = no visible color or surface change under the specified viewing conditions

Moderate effect = difficult to perceive stain visible at all viewing angles or directions

Severe Effect = easily perceived stain, or permanent change/damage to the decorative surface

		sample # 1							sample # 2							sample # 3						
		cleaning steps					cleanability score	stain	cleaning steps					cleanability score	stain	cleaning steps					cleanability score	stain
		0	1	2	3	4			0	1	2	3	4			0	1	2	3	4		
1	water	0					0	N	0					0	N	0					0	N
2	ethanol	0					0	N	0					0	N	0					0	N
3	acetone	0					0	N	0					0	N	0					0	N
4	ammonia	0					0	N	0					0	N	0					0	N
5	citric acid	0					0	N	0					0	N	0					0	N
6	veg. oil	0					0	N	0					0	N	0					0	N
7	coffee	0					0	N	0					0	N	0					0	N
8	tea	0					0	N	0					0	N	0					0	N
9	catsup	0					0	N	0					0	N	0					0	N
10	mustard	0					0	N	0					0	N	0					0	N
11	iodine	0					0	N	0					0	N	0					0	N
12	perm. marker	0	1	1	1		3	N	0	1	1	1		3	N	0	1	1	1		3	N
13	pencil	0	1	1			2	N	0	1	1			2	N	0	1	1			2	N
14	crayon	0	1	1			2	N	0	1	1			2	N	0	1	1			2	N
15	shoe polish	1	1	1	1	1	5	S	1	1	1	1	1	5	S	0	1	1			2	N
Cleanability							12							12							9	

cleaning steps:	0 = removed with water
(cleanability score)	1 = 20 cycles spray cleaner on sponge
	2 = 20 cycles baking soda +spray cleaner on brush
	3 = nail polish remover
	4 = bleach
	5 = not removed -- describe stain as Moderate (M) or Severe (S)
Stain Resistance	N = No Effect (=cleaning scores 0-4)
	M = Moderate Effect -- difficult to perceive stain
	S = Severe Effect -- easily perceived stain, or damaged surface
cleanability =	NEMA LD3 cleanability score = sum cleaning score for reagents 1-15

LD 3.5 BOILING WATER RESISTANCE TEST RESULTS

	Boiling Water Resistance =
Sample # 1	NO EFFECT
Sample # 2	NO EFFECT
Sample # 3	NO EFFECT

No Effect = no visible color or gloss change under the specified viewing conditions

LD 3.6 HIGH TEMPERATURE RESISTANCE (OIL) TEST RESULTS

	High Temperature Resistance =
Sample # 1	NO EFFECT
Sample # 2	NO EFFECT
Sample # 3	NO EFFECT

No Effect = no visible color or gloss change under the specified viewing conditions

LD 3.7 LINEAR GLASS SCRATCH RESISTANCE

Scratches at 20, 50, 100, 200g loading

TEST RESULTS

	Scratch Resistance =
Sample # 1	<20g
Sample # 2	<100g
Sample # 3	<20g

"<20g" = 20g, 50g 100g and 200g scratches visible under specified viewing conditions

"<100g" = 100g and 200g scratches visible under specified viewing conditions

LD 3.7 DIAMOND SCRATCH RESISTANCE

Scratches at 1N, 2N, 4N, 6N loading

TEST RESULTS

	Scratch Resistance =
Sample # 1	3
Sample # 2	3
Sample # 3	3

3 = Scratches at 4N, 6N visible

LD 3.8 BALL IMPACT RESISTANCE

TEST CONDITIONS

224g steel ball – 38.1mm diameter

report drop height with no surface fracture in 3 replicate drops (see LD3 for details)

TEST RESULTS

	Ball Impact Resistance (mm)
Sample # 1	850
Sample # 2	675
Sample # 3	450

LD 3.9 DART IMPACT RESISTANCE

TEST CONDITIONS

25g dart – 5mm diameter spherical tip

report drop height with no surface fracture prior to a series of 3 consecutive fractures (see LD3 for details)

TEST RESULTS

	Dart Impact Resistance (mm)
Sample # 1	< 900
Sample # 2	<700
Sample # 3	<350

LD 3.10 RADIANT HEAT RESISTANCE – COIL METHOD

average time in seconds to failure of 3 test runs

TEST RESULTS

	Average Radiant Heat Resistance (seconds)
Sample # 1	163
Sample # 2	160
Sample # 3	130

TEST DATA

<i>Sample</i>	<i>Rep1</i>	<i>Rep 2</i>	<i>Rep 3</i>
Sample # 1	150	160	180
Sample # 2	170	170	140
Sample # 3	130	140	120

LD 3.10 RADIANT HEAT RESISTANCE – STRIP METHOD

average time in seconds to failure of 3 test runs

TEST RESULTS

	Average Radiant Heat Resistance (seconds)
Sample # 1	214
Sample # 2	232
Sample # 3	187

TEST DATA

<i>Sample</i>	<i>Rep1</i>	<i>Rep 2</i>	<i>Rep 3</i>
Sample # 1	217	210	214
Sample # 2	240	232	223
Sample # 3	198	190	172

3.11 DIMENSIONAL CHANGE

Average of 3 replicates

TEST CONDITIONS

Conditioned at 50% RH 70F

Dry = convection oven at 70C for 24hrs

Wet = 93%RH 40C for 7 days

TEST RESULTS

	Dimensional Change	
	Machine Direction	Cross Machine Direction
Sample # 1	0.36%	0.57%
Sample # 2	0.27%	0.74%
Sample # 3	0.40%	0.66%

3.12 ROOM TEMPERATURE DIMENSIONAL STABILITY

Average of 3 replicate samples

TEST CONDITIONS

Conditioned at 50% RH 70F

Wet = 98%RH 70F for 4 days

Dry = 10% RH at 70F for 4 days

TEST RESULTS

	Room Temperature Dimensional Stability	
	Machine Direction	Cross Machine Direction
Sample # 1	0.20%	0.40%
Sample # 2	0.19%	0.65%
Sample # 3	0.47%	0.65%

LD 3.13 WEAR RESISTANCE

TEST CONDITIONS

Abrasive strip correction factor = 1.227

Wear resistance is the average of initial and final points for 3 samples, adjusted by the abrasive strip correction factor, and rounded to the nearest 50 cycles

TEST RESULTS

Average Corrected WEAR RESISTANCE rounded to nearest 50 cycles

	Average cycles
Sample # 1	850
Sample # 2	850
Sample # 3	950

TEST DATA

Sample	Initial Point (raw cycles)	Final Point (raw cycles)
Sample # 1	525,525,525	950,900,750
Sample # 2	525,550,525	800,900,825
Sample # 3	600,575,575	950,1025,975

3.14 FORMABILITY

postforming grades only

TEST RESULTS

sample	RESULT
Sample # 1	PASSED
Sample # 2	PASSED

3.15 BLISTER RESISTANCE

Average time in seconds to failure of 3 test runs

postforming grades only

TEST RESULTS

	Average Blister Resistance (seconds)
Sample # 1	88
Sample # 2	76